Mt Todd Gold Project

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Volume VI

June 2013

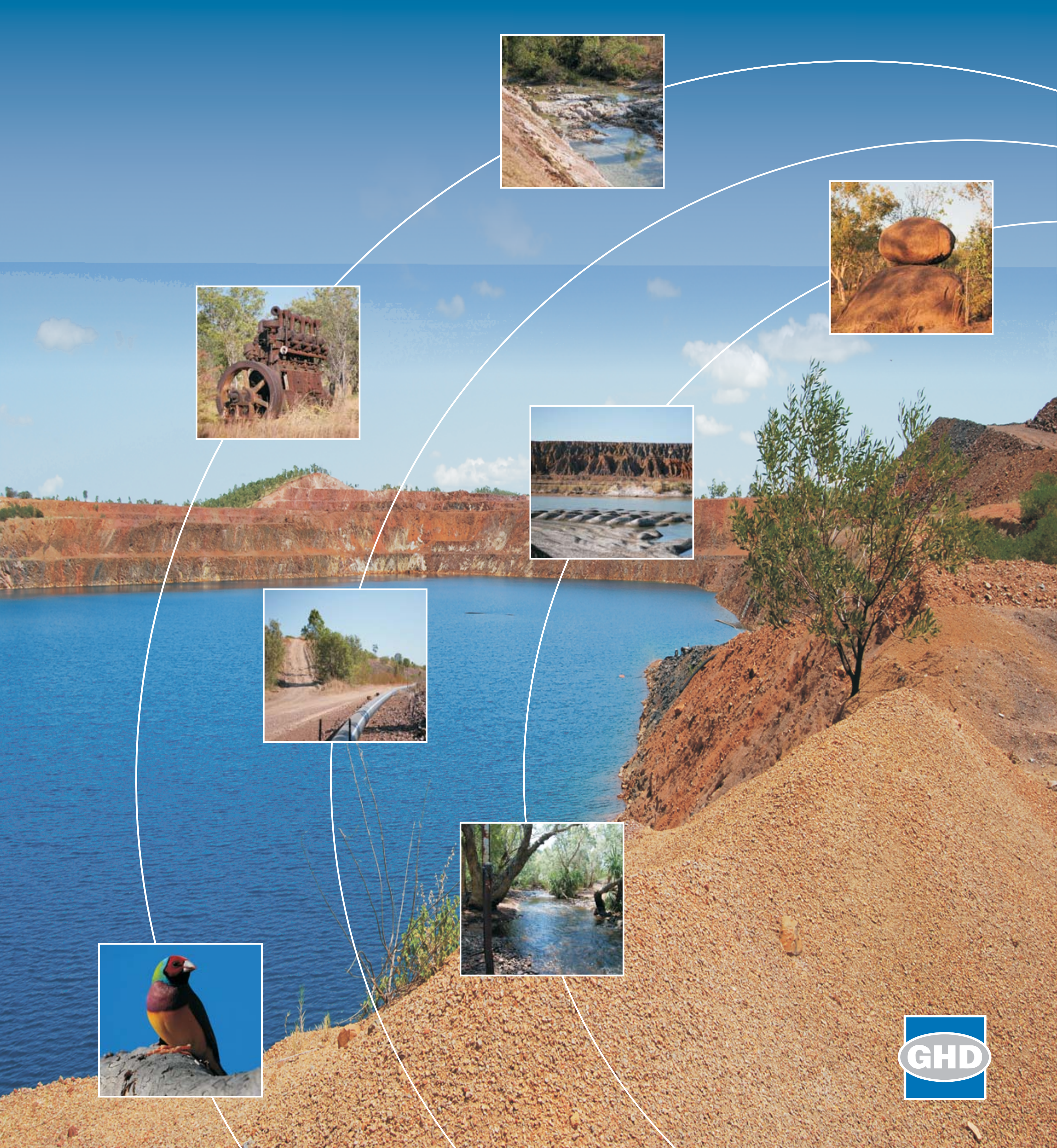
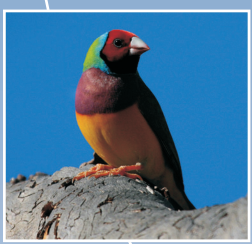


Table of Contents - Volume VI

Appendices

APPENDIX S

Jawoyn Ecological Knowledge



CLIENTS | PEOPLE | PERFORMANCE

Vista Gold Australia Pty Ltd

Mt Todd Gold Project

Jawoyn Ecological Knowledge

June 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

This Jawoyn Ecological Knowledge Report ("Report"):

1. *has been prepared by GHD Pty Ltd ("GHD") for Vista Gold Australia Pty Ltd (Vista Gold);*
2. *may only be used and relied on by Vista Gold and ;*
3. *must not be copied to, used by, or relied on by any person other than Vista Gold without the prior written consent of GHD;*
4. *may only be used for the purpose of Environmental Impact Assessment (and must not be used for any other purpose).*

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Vista Gold arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- *were limited to those specifically detailed in section 4 of this Report;*

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report ("Assumptions"), including (but not limited to):

- *The Jawoyn people identified by the Jawoyn Association as the true traditional owners of the areas investigated are the correct people to speak for that country.*

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and may be relied on for 6 months, after which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

This report is not intended to be used as a foraging guide. Knowledge regarding plants and animals as food or medicine should not be taken verbatim.

Contents

Table Index

Figure Index

1. Summary and Conclusions

Vista Gold Australia Pty Ltd (Vista Gold) is proposing to re-establish and operate the Mt Todd Gold Mine, located approximately 55km north-west of Katherine, Northern Territory (NT).

The Mt Todd Gold Project (Project) will include the mining of gold from the existing Mt Todd Gold Mine - Batman Pit (previously mined and now in care and maintenance).

This report satisfies the requirements of the EIS Guidelines relating to discussion and recording of plants and animals of Aboriginal cultural significance.

A total of 126 plant, animal and fungi taxa were identified and discussed with accompanying Jawoyn knowledge recorded. These comprised:

- Sixty two animal taxa;
- Sixty three plant taxa from 31 families; and
- One fungus.

In contemporary times hunting and foraging methods have changed somewhat such that nowadays people hunt with guns and fishing lines rather than spears, throwing sticks and hand weaved line. Similarly there are many bush foods and medicines that are no longer eaten or administered. Despite this, the knowledge on how to gather and prepare these foods and medicines is still disseminated by those who hold this information.

Amongst the Jawoyn traditional owners, the mine site is not considered a notably productive environment. It was expressed by these people that the plants and animals encountered and discussed during this ecological knowledge consultation are widespread and not unique to the mine site.

2. Introduction

Vista Gold Australia Pty Ltd (Vista Gold) proposes to re-establish and operate the Mt Todd Gold Mine, located approximately 55km north-west of Katherine, Northern Territory (NT). The mine and proposed associated infrastructure are known as the Mt Todd Gold Project (Project).

The then Northern Territory Minister for Natural Resources, Environment and Heritage determined that a Draft Environmental Impact Statement (EIS) is required for the Project. The Northern Territory Environment Protection Authority (NT EPA) (formerly Department of Natural Resources, Environment, The Arts and Sport (NRETAS)) subsequently issued '*Guidelines for the Preparation of an Environmental Impact Statement – Mt Todd Gold Project Katherine Region NT, Vista Gold Australia Pty Ltd, September 2011*'. The EIS is being assessed under an accredited arrangement between the Commonwealth and Northern Territory governments.

This report addresses the point from Section 6.3 of the EIS Guidelines:

> *Identify and discuss species of traditional Aboriginal cultural significance (particularly aquatic and terrestrial fauna species), based upon consultation with traditional owners and surveys of the Project area.*

The Traditional Owners of the Mt Todd mine site are Jawoyn aboriginal people. Jawoyn traditional lands extend from Katherine, south-east to the township of Mataranka, eastward past Barunga and Beswick, then north east from Bulman in Arnhem land to the southern part of Kakadu National Park and south west Arnhem (Jawoyn AAC 2012).

The term Jawoyn is used to encompass the language, culture, and territory of the Jawoyn people. Jawoyn heritage and traditional ownership of country is passed down from a Jawoyn father and in some cases, through a Jawoyn mother. It is these kinship relationships as well as a deep understanding of all aspects of country that connect Jawoyn people to their land (Jawoyn AAC 2012).

The people who generously shared their knowledge for this report are individuals who the Jawoyn Association (JA) identified as having a kinship connection to the mine site area.

This report provides a brief overview of some of the traditional ecological knowledge the Jawoyn Traditional Owners have of the plants and animals on the mine site and surrounding area. This document is not intended to be a comprehensive ethnoecological account of the area.

3. Project Description and Study Area

3.1 Proposed Works

The Project area is in a historical mining district, and was mined for gold in the 1990s (by previous proponents). Design capacity was never achieved due to inadequacies in the crushing circuit reducing recoveries of gold. Underperformance and higher operating costs led to the mine being closed and placed in care and maintenance in 1997.

General Gold formed a joint venture with Multiplex Resources and Pegasus Gold to own, operate and explore the mine in 1999. Operations ceased in July 2000, with administrators appointed. Mining infrastructure such as tailing dams, waste rock dumps and remains of processing facilities remain on site. The mine has been in care and maintenance for the past 10 years.

Vista Gold Australia Pty Ltd (Vista Gold) proposes to re-establish and operate the Mt Todd Gold Mine (Figure 3-1). The mine and proposed associated infrastructure are known as the Mt Todd Gold Project (the Project).

The Project will expand the Batman Pit, re-establish and refurbish existing facilities, expand the existing waste rock dump and develop new associated infrastructure such as a processing plant, power station, and a second Tailings Storage Facility (TSF2) (Figure 3-2).

The proposed development will occur both within the existing disturbance footprint of the Batman Mine and in surrounding areas.

Mining will be an open-pit truck and shovel operation, using large haul trucks, hydraulic shovels and front end loaders to transport materials to the crusher, stockpiles, Run of Mine (ROM) pad and waste dump. Extracted ore, will be processed in an ore processing plant where it will be crushed, milled and then carbon in leach (CIL) leached followed by adsorption, desorption and recovery leading to gold dore (unrefined gold).

Approximately 17.8 million tonnes per annum (Mtpa) of ore will be processed. Gold dore will be transported for onward secure shipment to a refinery.

The Project, based on current known data, will have a life of around 19 years inclusive of construction, operations and closure. Construction is anticipated to commence in the first quarter of 2014 and take two years, including 6 months pre-production. The mine is scheduled to operate for a further 13 years. Closure and rehabilitation of the mine is expected to take four years.

3.2 Study Area

The Mt Todd Gold mine site is located approximately 55km north west of Katherine and 250km south of Darwin, NT, Australia (Figure 3-1). The topographical feature named Mt Todd is in the mineral leases. The mine site is accessed via Jatbula Road (restricted mine access road), approximately 10km west of the Stuart Highway (the main highway between Darwin and Adelaide).

Mining and associated operations will occur on predominantly on mineral leases MLN 1070, MLN 1071 and MLN 1127 covering approximately 5,403ha (Figure 3-3). Vista Gold also controls exploration leases EL 25576, EL 25668, EL 25669 and EL 25670 covering 117,632ha.

For the purposes of this assessment the following definitions apply:

- Mine site – areas of previous or proposed disturbance within the mineral leases;
- Mineral leases – the broader area defined by MLN 1070, MLN 1071 and MLN 1127.

Surrounding land uses immediately adjacent to the mine site include:

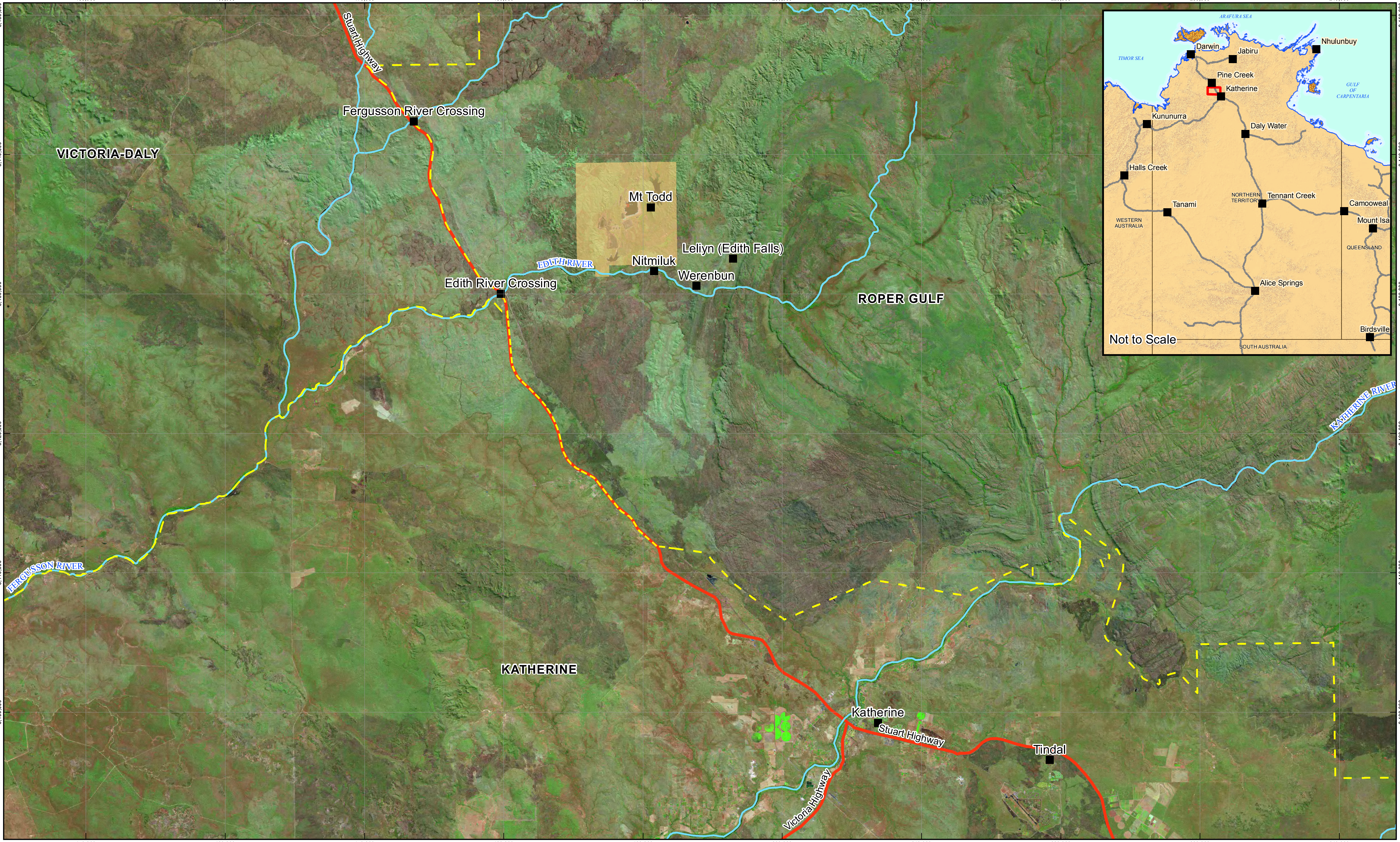
- North – Horseshoe Tin Field (no longer operational);
- East – Nitmiluk National Park;
- South – Edith River and Edith Falls Road;
- West – Yinberrie Hills (identified on the NT Government list of Sites of Conservation Significance).

The Mt Todd mine site contains a variety of landforms including hills and strike ridges on persistent Burrell Creek Greywacke, sandstone and siltstone, and undulating hills on lower Proterozoic sediments (Burrell Creek Formation). There are major creek and river drainage floors and a regular distribution of levees, back plains and depressions, dissected by erosion gullies.

Soils vary from sandy and loamy red and yellow earths to lateritic and yellow podsolic soils on the gently undulating land, often over compact clay sub-soils. Heavier textured grey soils are found on the floodplains and levees of the Daly River system while stony and skeletal soils occur in the rocky outcrops.

Key environmental feature of the site and its surrounds include:

- Mt Todd which lies in the Project area and has an elevation of 230m;
- The Yinberrie Hills located to the west of Batman Pit. The Yinberrie Hills are on an Interim List for the Register of the National Estate. They are not listed under the *Environment Protection and Biodiversity Conservation Act 1999*. The Yinberrie Hills is one of a few known major breeding sites for the nationally endangered Gouldian finch and is listed on the NT Government list of Sites of Conservation Significance; and
- The Edith River located immediately south of the mine site. The mine site is downstream of Edith Falls.



1:250,000 (at A3)

0 2.5 5 7.5 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

LEGEND

- Place Names
- Major Roads
- Rivers
- LGA Boundaries
- Mt Todd Mineral Leases

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	30 May 2013

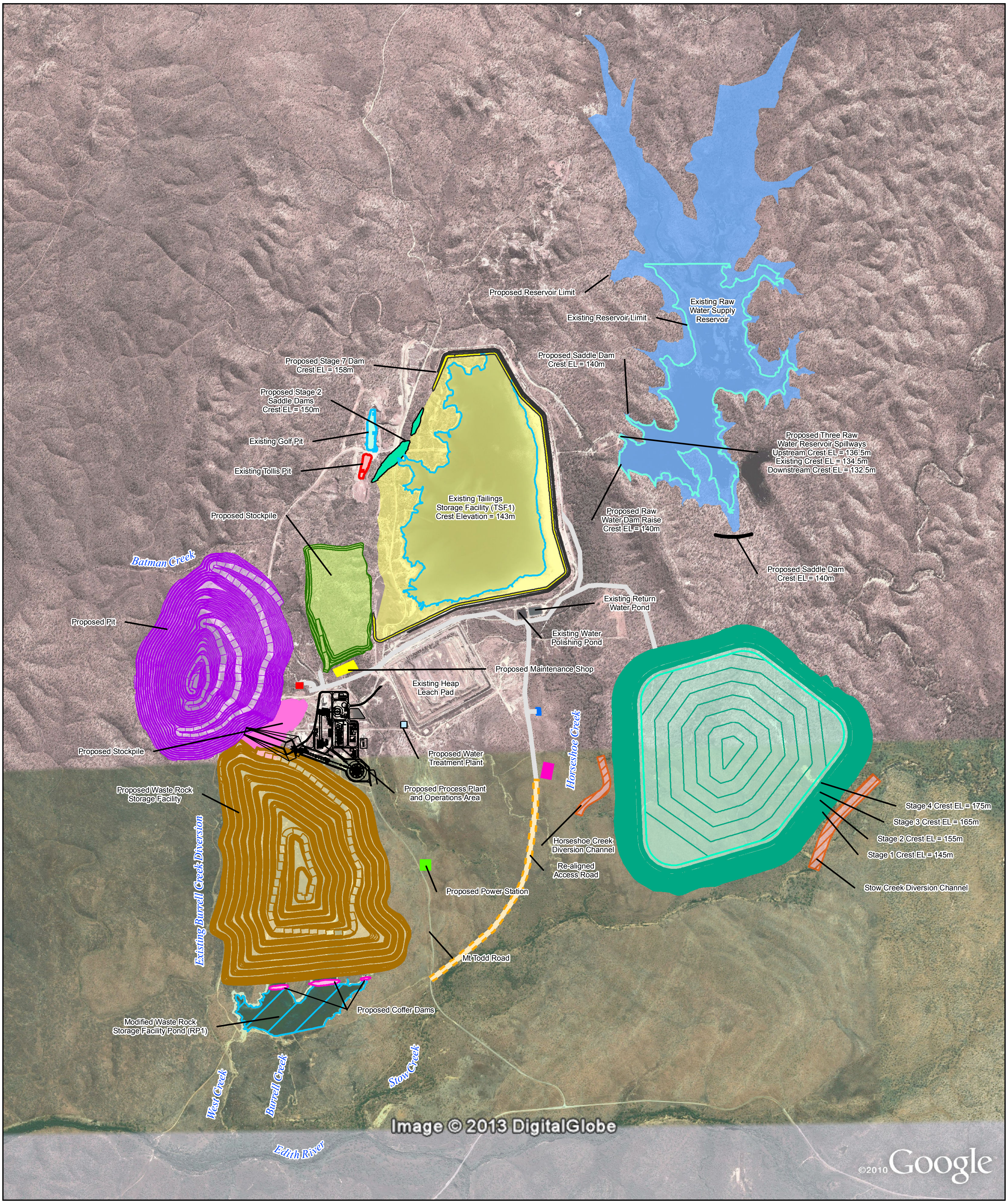
Project Location

Figure 3-1

G:\43\21801\GIS\Maps 30000 TPA\JawoynEcologicalKnowledge\4321801_2001.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: NRETAS - Drainage (2011). Vista Gold - Mt Todd Mineral Lease (2011). Geoscience Australia - Landsat Imagery (2007), Place Names, LGA Boundaries, Roads, State Boundaries, Shoreline (2008). Created by: CM



LEGEND

- Process Plant
- Golf Pit
- Tollis Pit
- Fuel Bays
- Proposed Maintenance Shop
- Power Plant
- Proposed Haul Road
- Re-aligned Access Road
- Coffer Dams
- ANFO Facility
- Explosives Magazine
- Diversion Channels
- Raw Water Dam Existing Water Body
- Indicative Raw Water Dam
- TSF1 Contours
- TSF1 Existing Water Body
- Proposed Saddle Dam
- TSF1
- Low Grade Ore Stockpile Contours
- Low Grade Ore Stockpile
- TSF2 Impounded Surface Area (Year 12)
- TSF2 Contours (Year 12)
- TSF2 Footprint (Year 12)
- Water Treatment Plant
- Batman Pit Contours (Year 12)
- Proposed Saddle Dam (Raw Water Dam)
- Retention Pond 1
- Batman Pit Footprint (Year 12)
- Waste Rock Dump Contours (Year 10)
- Waste Rock Dump Footprint (Year 10)
- Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	0
Date	05 Jun 2013

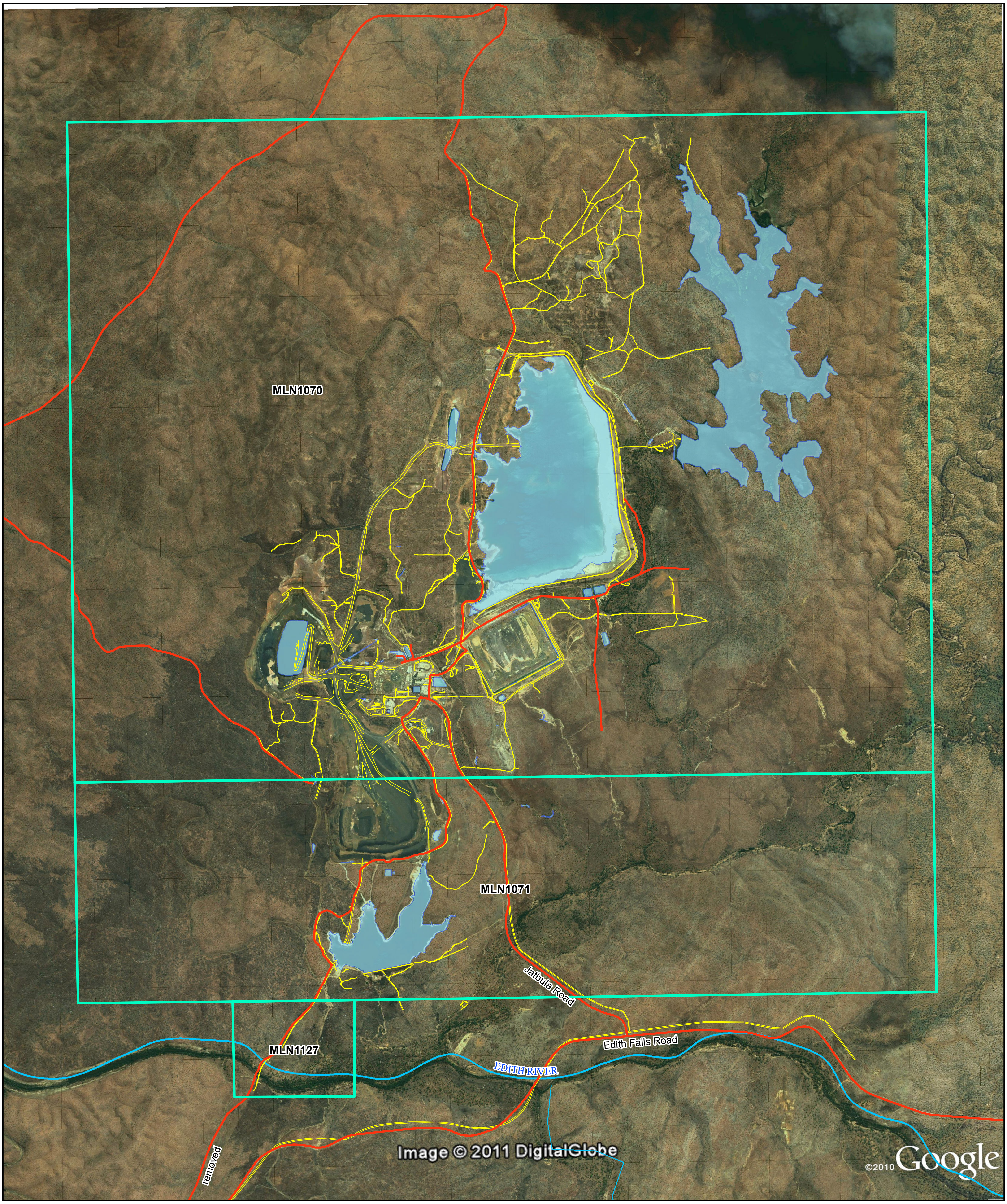
Mt Todd General Facilities Arrangement

Figure 3-2

G:\43\21801\GIS\Maps 30000 TPA\JawoynEcologicalKnowledge\4321801_2002.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013).
GHD - Creek Names (2011). Created by: CM



LEGEND

Mineral Lease Boundarys
Water bodies
Existing Mine Layout
Waterways
Access Roads

1:30,000 @ A3

0 0.3 0.6 0.9 1.2 1.5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Mineral Leases

Job Number	43-21801
Revision	0
Date	30 May 2013

Figure 3-3

G:\43\21801\GIS\Maps 30000 TPA\JawoynEcologicalKnowledge\4321801_2003.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: NRETAS - Waterways (2011). Vista Gold - Mineral Leases, Water Bodies, Mine Layout (2011). Google Earth Pro - Imagery (Date Extracted: 28/03/2011). GHD - Access Roads (2011). Created by: CM

4. Method

4.1 Background Review

Background information on the Jawoyn people, their history, ecological knowledge and society was reviewed from available sources in the public domain.

4.2 Consultation

The Jawoyn Association (JA) was consulted to identify the appropriate people who hold traditional ecological knowledge of the Project area. The JA identified the following people as the appropriate Traditional Owners for the country on which the Project area is situated:

- Bessie Coleman;
- Bianca Balmana;
- Roy Anderson; and
- Wesley Wilika.

With the assistance of a cultural heritage specialist (Karen Martin-Stone from EarthSea Consultants) these traditional owners were contacted and agreed to accompany two GHD ecologists on a visit to the Project area with the intention of discussing plants and animals that occur in the area. It was determined to use EarthSea Consultants in the consultation group as the cultural heritage specialist (Karen Martin-Stone) had an existing relationship with the Jawoyn group on which this project could be built. This assisted in familiarisation of the consultation team to the Jawoyn people.

Fieldwork consisted of a combination of on-country walk overs and discussion sessions on the mine site over a two day period (21 and 22 February, 2012). The fieldwork participants are identified in Table 4-1.

Consultations on site were conducted in culturally appropriate, separate male and female groups.

Table 4-1 Fieldwork Days

Day	21 February	22 February
Researchers	Matthew Flower (GHD)	Matthew Flower
	Arien Quin (GHD)	Arien Quin
	Karen Martin-Stone (EarthSea)	Karen Martin-Stone
Jawoyn Participants	Bessie Coleman	Bessie Coleman
	Bianca Balmana	Bianca Balmana
	Roy Anderson	Roy Anderson
		Wesley Wilika

The GHD ecologists explained the purpose of the fieldwork at the beginning of the fieldwork. This included explaining that information provided by the participants would be presented in a report that will be on public display. The participants were informed that if information was of a personally or culturally sensitive nature it should not be shared. The briefing was repeated on the second day when an additional person joined the group.

Plants and animals were discussed in the field as they were encountered. Information was recorded and photos taken where appropriate. Discussions about plants and animals contained in the Jawoyn Plants and Animals Book (Wiynjorrotj *et al.* 2005) were also conducted in the mine site office.

Plant and animal knowledge was categorised. The categories used were:

- Ecology: Knowledge of the animal or plant's ecology i.e. behaviour, habitat, predator/prey or other relationship to other taxa (relationships between animals and plants could possibly be spiritual);
- Food: The plant or animal provided sustenance to people;
- Medicine: The plant or animal was used as a medicine for people;
- Spiritual: The plant or animal was used in ceremonies or in other spiritual ways; and
- Tool: The plant or animal was used to make tools, equipment (canoes, mattresses, etc.), dyes and other such items.

4.3 Limitations

The knowledge that has been shared in this report includes public or secular information. There is a large amount of information considered to be sacred that can only be passed on to people who have achieved a certain level of cultural status and position in Jawoyn society through their participation in various ritual and ceremonial obligations. The information contained in this report is constrained by the limited time spent on country as well as the time of year when the survey was undertaken. In this respect it is not intended to provide a comprehensive account of all plants and animals that occur in the project area but rather an overview of the types of resources that may be used.

Other factors that influenced the detail contained in this report include:

- The unfamiliarity of the GHD people to the Jawoyn people (alleviated in part by building on the existing relationship between EarthSea Consultants and the Jawoyn people);
- The cultural background of the researchers i.e. none were Jawoyn people;
- Culturally appropriate levels of public knowledge dissemination;
- Fieldwork was conducted over two days (the Jawoyn participants hold a lifetime of acquired knowledge and it is unrealistic to expect all this knowledge to be shared over the course of two days);
- Fieldwork was only conducted during the Wet season (which in 2012 was anecdotally a dry Wet season): some plants and animals of the Project area may have not been apparent or present;

- Fieldwork was not conducted during the night and did not involve animal trapping. Fauna discussion was therefore limited to incidental, physical encounter and discussion using photos and data from the Jawoyn Plants and Animals Book (Wiynjorrotj et al. 2005);
- No linguist was present and no linguistic data were collected. Plant and animal names were provided and discussed in English. This could lead to the decontextualisation of knowledge and some knowledge may be lost in translation.

5. Results

5.1 Seasonality

The Jawoyn observe an annual cycle comprised of five major seasons with minor seasons recognised in each. The timing and duration of each season is not the same each year. A different variety of plants and animals can be relied on during each season. Environmental indicators signal the transition between seasons and can include plants flowering or certain animal behaviour (Wiynjorrotj *et al.* 2005).

The Gregorian calendar months and the generalised, approximate Jawoyn equivalent are provided in Table 5-1 (Wiynjorrotj *et al.* 2005).

Table 5-1 Jawoyn Seasons and Approximate Gregorian Equivalent

Jawoyn Season	Seasonal Characteristics	Gregorian Months
Jiyowk	Heavy rain	January - February
Pangkarrang	Rain ceases; dry begins	March - May
Malapparr	Cold weather time	June - August
Jungalk	Hot time (build-up)	September - November
Kuran	First rains	December

5.2 Summary of Plant and Animal Knowledge

A total of 126 plant, animal and fungal taxa were identified, discussed and associated Jawoyn knowledge recorded.

Sixty two animal taxa were identified and discussed. A breakdown of the animal knowledge type by category and the animal groups for which knowledge was discussed is provided in Table 5-2 and Table 5-3. Some species are listed in more than one category.

Table 5-2 Animal Knowledge Type by Category

Knowledge Type	Count
Ecology	31
Food	34
Medicine	1
Spiritual	1
Tool	4

Table 5-3 Numbers of Animals Discussed by Group

Animal Type	No. Discussed
Amphibian	1
Bird	20
Fish	6
Invertebrate	8
Mammal	10
Reptile	17
Total	62

Sixty-three plant taxa from 31 families were identified and discussed. A breakdown of the knowledge type by category and the plant families discussed is provided in Table 5-4 and Table 5-5 respectively.

Table 5-4 Plant Knowledge Type by Category

Knowledge Type	Count
Ecology	16
Food	40
Medicine	4
Spiritual	2
Tool	29

Table 5-5 Numbers of Plant Taxa Discussed by Family

Plant Family	Taxa Discussed
Anacardiaceae	1
Araceae	1
Asclepiadaceae	3
Asteraceae	1
Bixaceae	1
Combretaceae	3
Commelinaceae	1
Cucurbitaceae	1
Cuppresaceae	1

Plant Family	Taxa Discussed
Cyperaceae	1
Dioscoreaceae	2
Erythroxylaceae	1
Fabaceae	5
Haemodoraceae	1
Lecythidaceae	1
Malvaceae	2
Menyanthaceae	1
Moraceae	3
Myrtaceae	7
Orchidaceae	1
Pandanaceae	2
Passifloraceae	1
Phyllanthaceae	2
Picrodendraceae	2
Poaceae	6
Rubiaceae	3
Solanaceae	2
Taccaceae	1
Tiliaceae	1
Verbenaceae	1
Vitaceae	3

5.3 Jawoyn Plant and Animal Knowledge

Scientific and common names of and knowledge about each taxon are detailed below. Animal knowledge is ordered alphabetically in English by the animal group then animal common name. Plant knowledge is ordered alphabetically in English by the plant scientific name.

5.3.1 Jawoyn Animal Knowledge

Common Name	Scientific Name	Knowledge
Amphibian		
Sand frog	*Limnodynastes ornatus*	This frog is eaten and can be used for fish bait.
Bird		
Azure kingfisher	*Alcedo azurea*	This bird fishes to catch fish to eat.
Black cockatoo	*Calyptorhynchus banksii macrorhynchus*	The presence of this bird indicates the right time to burn the country.
Brolga	*Grus rubicunda*	This bird is a good dancer.
Bush turkey	*Ardeotis australis*	This bird is good to eat around the hot time (October/November). It is widespread on the floodplains and associated woodlands. This animal feeds on the gum from the ironwood tree.
Collared sparrowhawk	*Accipiter cirrhocephalus*	This bird hunts other birds.
Common koel	*Eudynamys scolopaceae*	This bird sings out after the first rains of the year.
Crimson finch	*Neochmia phaeton*	This bird nests in pandanus trees.
Darter	*Anhinga melanogaster*	This bird is a fishing bird and eats fish. It catches fish by spearing them with its beak.
Emu	*Dromaius novaehollandiae*	This bird is cooked in a ground oven and is good eating. It used to be speared through the heart but now is shot from a car. This animal likes to live in quiet, peaceful places. It is deterred by towns. This bird is not found around the Mt Todd area.

Common Name	Scientific Name	Knowledge
Ibis	*Threskiornis spp.; Plegadis falcinellus*	This bird can be eaten after boiling it a few times. It is caught with a spear or with a short throwing stick.
Jabiru	*Ephippiorhyncus asiaticus*	This bird was eaten in a past era.
Little corella	*Cacatua sanguinea*	This bird eats grass seeds.
Little pied cormorant	*Phalacrocorax sulcirostris*	This bird fishes to catch fish to eat.
Nankeen night heron	*Nicticorax caledonicus*	This bird has excellent vision which helps it hunt at night.
Owls		Children get scared when they hear the owl calling at night. Mentioning the owls call encourages children to go to sleep early.
Pelican	*Pelecanus conspicillatus*	This bird can be eaten after boiling it a few times. It is caught with a spear or with a short throwing stick.
Peregrine falcon	*Falco peregrinus*	This bird hunts other birds.
Sulphur-crested cockatoo	*Cacatua galerita*	The presence of this bird indicates that it is not the right time to burn the country.
White-bellied sea eagle	*Haliaeetus leucogaster*	This bird eats turtles. To crack the shell open they will grab the turtle then fly to a great height and drop the shell to the ground. The turtle is then taken to the nest and fed to young eagles.
Fish		
Archerfish	*Toxotes chatareus*	This fish shoots at insects by spitting water at them. It can even shoot a spider out of its web and then eat the spider.

Common Name	Scientific Name	Knowledge
Barramundi	*Lates calcarifer*	This fish can be caught on a line from creeks like Horseshoe Creek.
Big black catfish	*Arius leptasis*	This fish is eaten. It is caught using worms or sand frogs. When caught people check their guts to identify if this fish has been eating cane toads.
Black bream	*Hephaestus fuliginosus*	This fish can be caught on a line from creeks like Horseshoe Creek. In a past era it was caught using a net.
Blue catfish	*Arius graeffei*	This fish is eaten. It is caught using worms or sand frogs.
Jewfish	*Scientific name unknown*	This fish can be caught on a line from creeks like Horseshoe Creek.
Invertebrate		
Bush cockroach	*NA*	This insect will spray liquid when threatened. It has very good aim with this liquid.
Freshwater crabs	*Holthuisana transversa*	In a past era this animal was eaten by people. This animal is food for the water rat.
Freshwater mussels	*Velesunio wilsonii*	This animal is food for the water rat. In a past era this animal was eaten by people.
Grasshopper	*NA*	This insect is used as fish bait.
Green ant	*Oecophylla smaragdina*	The queen ants can be eaten like witchetty grubs[1]. The nests are crushed and the juice of the ants can be drunk to treat coughs and colds.

[1] Information could possibly refer to the pupae and larvae.

Common Name	Scientific Name	Knowledge	
Native bees	*Trigona spp.*	There are several types of native bee that produce honey or 'sugar bag'. They can be found in a variety of trees and are highly sort after. The wax from sugarbag is used to fill holes in coolamons and to fix heads to spears and stone axe handles. They keep an edible hive which can be found in tree hollows or in the ground in the hilly country.	
Worms	*NA*	These worms live in burrows near rivers and were collected by women for use as fish bait. Pigs hunt for these worms.	
Yabbies	*Macrobrachium spp.; Caridina spp.*	This animal lives in creeks like Horseshoe Creek. It is caught by throwing in a hollow log as refuge. Yabbies crawl into the log and then the log is later pulled out of the creek.	
Mammal			
Bats	*NA*	These animals live in caves, flies at night and eat insects.	
Black wallaroo	*Macropus bernardus*	This animal has excellent camouflage.	

Common Name	Scientific Name	Knowledge
Echidna	*Tachyglossus aculeatus*	This animal lives in the hilly country in a burrow. It is caught by digging it out of its burrow and then is delivered a swift blow to the head. The spines are burned off in the coals and then scraped off. It is cooked in a ground oven and ready to eat when soft.
Little red flying-fox	*Pteropus scapulatus*	This animal was eaten in a past era but now is thought to be a carrier of disease.
Macropods	*NA*	All macropods are good eating. In a past era they were speared through the heart but now are shot from a car.
Northern brown bandicoot	*Isoodon macrourus*	This mammal nests on the ground or in a big hollow log. They are flushed out by starting a fire and then struck when they run out.
Northern brushtail possum	*Trichosurus vulpecula*	This mammal nests in a hollow log on the ground or in a hollow tree branch. They are flushed out by starting a fire and then struck when they run out.
Red-cheeked dunnart	*Smithopsis virginiae*	This small mammal lives in the hilly country.
Sugar glider	*Petaurus breviceps*	This animal nests in leaf lined hollows in stringybark trees.
Reptiles		
Black-headed python	*Aspidites melanocephalus*	This snake is considered food for the elders.
Death adder	*Acanthopsis praelongus*	This animal is very deadly. It has learnt not to touch cane toads.

Common Name	Scientific Name	Knowledge	
Emu snake	*Delma tincta*	This small, quick snake is poisonous. It bites the legs of emus and is capable of killing them[2].	
File snake	*Acrochordus arafurae*	This animal is cooked in the ground oven and is good eating.	
Freshwater crocodile	*Crocodylus johnstonii*	Some people eat this animal. They first check the guts of the animal to see if it has been eating cane toads.	
Frill-necked lizard	*Chlamydosaurus kingii*	This animal is good food.	
Geckos	*NA*	These animals have excellent camouflage.	
Green tree snake	*Dendrelaphis punctulata*	This snake has good camouflage for climbing trees and does so to kill and eat birds.	

[2] Snake could possibly have been misidentified in the field as *Delma tincta* rather than a poisonous brown snake (*Pseudonaja sp.*).

Common Name	Scientific Name	Knowledge	
King brown	*Pseudechis australis*	This animal is very deadly. It has learnt not to touch cane toads.	
Oenpelli python	*Morelia oenpelliensis*	This snake is capable of killing and eating a kangaroo.	
Olive python	*Liasis olivaceus*	This snake is considered food for the elders.	
Sand goanna	*Varanus panoptes*	This animal is good food.	
Shaky paw lizard	*Diporiphora albilabris*	This lizard can change colour based on the rock colour of its environment.	
Turtle (long neck)	*Chelodina sp.*	These animals can be caught on a line and are cooked on their back in the fire. Long neck turtles inhabit billabongs and larger rivers downstream of the mine site.	
Turtle (saw shell)	*Elseya latistrenum*	These animals can be caught on a line and are cooked on their back in the fire.	
Turtle (short neck)	*Emydura sp.*	These animals can be caught on a line and are cooked on their back in the fire. Short neck turtles would inhabit environments such as Horseshoe Creek. Short neck turtles can be caught when the river levels are low by spearing them. They are good to eat.	
Water goanna	*Varanus sp.*	This animal is good food.	

5.3.2 Jawoyn Plant Knowledge

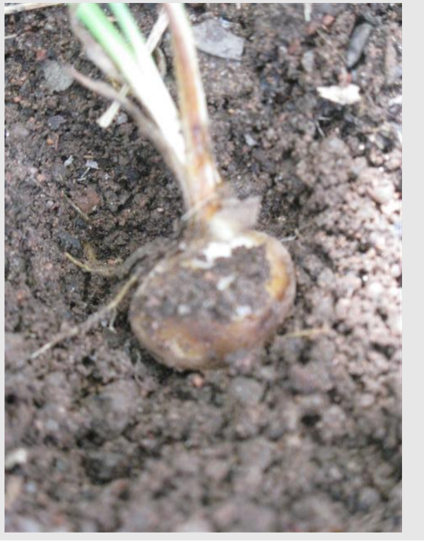
Common Name	Scientific Name	Knowledge	
	Acacia sericoflora	This plant is used as soap.	

Common Name	Scientific Name	Knowledge	
Cockatoo grass	*Alloteropsis semialata*	This grass is picked and rubbed between the hands then used as a tool to extract sugarbag.	
Bush pumpkin	*Amorphophallus paeoniifolius*	This plant has a bulbous yam which is dug up and roasted. The outer skin is removed then the yam is cut up and placed in a string bag in flowing water over night. It is then roasted and eaten.	
Wild grape	*Ampelocissus acetosa*	The fruit of this shrub/vine is eaten when black (late Wet season). The fruit of this shrub/vine is eaten by the bush turkey.	

Common Name	Scientific Name	Knowledge	
Wild grape	*Ampelocissus frutescens*	The fruit of this shrub/vine is eaten when black (late Wet season). The fruit of this shrub/vine is eaten by the bush turkey.	
Black currant	*Antidesma ghesaembilla*	The fruit from this shrub are eaten raw. When ripe they turn a dark purple, this occurs during the Wet season.	
Bamboo	*Bambusa arnhemica*	The long, hard, straight stems of bamboo are used to make spear shafts. The spears are/were used to kill buffalo, cattle, kangaroos and other mammals as well as during tribal conflict. This plant grows near the river.	

Common Name	Scientific Name	Knowledge	
Kurrajong	*Brachychiton diversifolius*	The bark from young saplings can be also used to make string for bags. When young this tree has a big yam which can be eaten.	 

Common Name	Scientific Name	Knowledge	
Kurrajong	*Brachychiton megaphyllus*	The bark from young saplings can be also used to make string for bags. The dry, strait stems and branches are used to make fire sticks. When young this tree has a big yam which can be dug up and eaten raw or roasted.	
Bush potato	*Brachystelma glabriflorum*	This vine has an edible yam which is eaten raw. The flowers point towards the other plants of this species in the area.	
Green plum	*Buchanania obovata*	This tree has a green plum which is edible. The bark of this tree is stripped and rolled in the hands to make string which is then used to fix spear heads to shafts in combination with sugarbag wax. The string is fireproof and used to bind the limbs of animals being cooked.	

Common Name	Scientific Name	Knowledge	
Cypress pine	*Callitris intratropica*	The wood of this tree was used to make digging sticks. It is considered one of the strongest woods for tools.	
Small bush yam	*Cartonema spicatum*	This small plant has an edible yam.	

Common Name	Scientific Name	Knowledge	
			

Common Name	Scientific Name	Knowledge	
NA	*Cayratia trifolia*	The fruit of this vine is ground and used as a black coloured dye for dyeing fibre for weaving.	 

Common Name	Scientific Name	Knowledge	
Kapok bush	*Cochlospermum fraseri*	This plant is a calendar plant, its flowering indicating one of the Jawoyn seasons. The taproots of young plants are roasted on hot coals, peeled and then eaten. Very young green fruit can also be eaten.	 
Bush cucumber	*Cucumis melo*	The fruit of this vine is eaten once it turns yellow.	

Common Name	Scientific Name	Knowledge	
			 
NA	*Cyclophyllum schultzii*	This tree grows in the river country and has an edible fruit.	

Common Name	Scientific Name	Knowledge	
Tree orchid	*Cymbidium canaliculatum*	The green sap that is produced from the green leaves of this orchid is used as a glue to fix spear heads and axe heads to shafts and handles. It is also rubbed on bark to stop it from cracking before being painted on.	

Common Name	Scientific Name	Knowledge	
NA	*Cymbopogon sp.*	This aromatic grass is used as a flavour to cook with fish. The aromatic leaves of this grass are used as a medicine for colds. It is also used as a medicine for babies.	
NA	*Cynanchum pedunculatum*	This plant has an edible fruit that is like the bush banana.	
Sedge	*Cyperus sp.*	The stem of this sedge is chewed and then used by men as a paint brush.	

Common Name	Scientific Name	Knowledge	
			
NA	*Dioscorea sp.*	This vine has an edible yam which is boiled, the skin scaped off and then squeezed to get the juice out.	

Common Name	Scientific Name	Knowledge	
			
Long yam	*Dioscorea transversa*	This plant has an edible tuber which is cooked. The yam is scraped using bone from Kangaroo shoulder it is then cut up, put in a dilly bag which is then placed in running water overnight before roasting.	
NA	*Eriachne ciliata*	This grass is used to start a fire. It is placed at the junction of two sticks being rubbed together.	
Bats wing coral	*Erythrina vespertilio*	The seeds from this tree are collected to make necklaces.	

Common Name	Scientific Name	Knowledge	
Ironwood	*Erythrophleum chlorostachys*	The leaves are placed on a fire green and the smoke is used for spiritual purposes to cleanse people and houses of people who have passed away. The wood of this tree was used to make digging sticks. It is considered one of the strongest woods for tools. The wood of this tree makes really good cooking coals. Children eat the gum from the ironwood as a sweet.	
Kerosene wood	*Erythroxylum ellipticum*	The wood of this tree is reliable firewood in the wet season as it is always dry. The red fruits are eaten by birds.	
Woollybutt	*Eucalyptus miniata*	Cockatoos eat the seeds and nuts of this tree.	
Stringybark	*Eucalyptus tetrodonta*	The bark of this tree is cut off in large sections then straightened and flattened on a fire and used to make	

Common Name	Scientific Name	Knowledge	
		shelter.	
Bloodwood	*Eucalyptus/Corymbia spp.*	The wood of this tree was used to make digging sticks. It is considered one of the strongest woods for tools. Big old hollow trees (esp. big salmon gums) are used for burial sites. Hollow lengths of branches are removed from the tree (or gathered from the ground) and one end sealed up with wax from the native beehive. This is then used as a water carrier. The wood of this tree makes really good cooking coals. All gums provide good firewood.	
NA	*Ficus aculeata*	This plant has a rough leaf which can be used as a woodworking tool (i.e. to smooth wood). The fruit is animal food.	

Common Name	Scientific Name	Knowledge	
River fig	*Ficus coronulata*	The fruits of this plant are eaten by turtles. The leaves of this shrub are used as a medicine for colds.	 

Common Name	Scientific Name	Knowledge	
Cluster fig	*Ficus racemosa*	The fruit of this tree are eaten once they turn yellow/brown.	
NA	*Flueggea virosa*	This shrub produces plentiful white fruit which is eaten by the handful. It grows on limestone.	

Common Name	Scientific Name	Knowledge	
			
NA	*Gardenia megasperma*	The fruit of this tree is eaten. This is more of a food of a past era.	

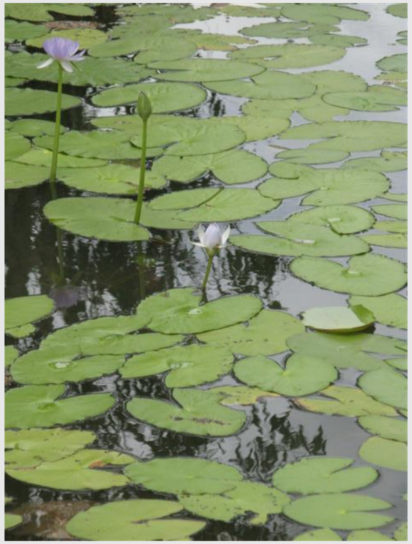
Common Name	Scientific Name	Knowledge	
NA	*Grewia retusifolia*	The fruit of this shrub is ripe in the cold weather time when it turns red. It tastes like apricot. It is eaten by bush turkeys.	
Red root	*Haemodorum coccineum*	The roots of this lily are dug up and boiled in water to produce a red/brown dye. The seeds when boiled make a red dye.	
NA	*Helicteres sp. Darwin*	The black fruits are eaten by the blue tongue lizard.	

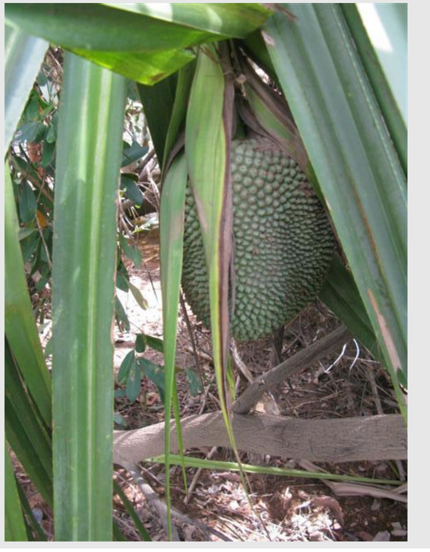
Common Name	Scientific Name	Knowledge	
Giant speargrass	*Heteropogon triticeus*	After the Wet season the stems of this grass are chewed to extract sweet water.	 

Common Name	Scientific Name	Knowledge	
NA	*Galactia mulleri*	This plant can be used as a tool to extract sugarbag.	 
Bush banana	*Marsdenia australis*	This fruit is eaten in the cold weather time after removing the seeds.	

Common Name	Scientific Name	Knowledge	
NA	*Melaleuca minutifolia*	The flowers of this tree are food for flying foxes.	
Paperbarks	*Melaleuca spp.*	This tree has large bumps on the trunk which can be knocked off to obtain water after wet periods. The bark can be used for wrapping food to be cooked and the leaves can be used for flavour. The bark of this tree can be used to make bedding to sleep on.	

Common Name	Scientific Name	Knowledge	
Leichhardt Tree	*Nauclea orientalis*	The fruit from this tree can be eaten. The stems from this tree can be made into dug-out canoes.	

Common Name	Scientific Name	Knowledge	
Water lily	*Nymphoides crenata*	This plant produces tubers which can be roasted on coals then eaten. The flower stalks can be eaten raw "like a salad".	

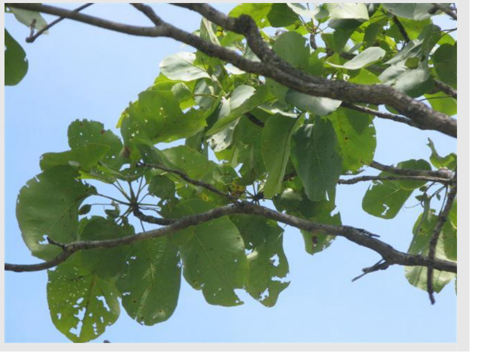
Common Name	Scientific Name	Knowledge	
Pandanus	*Pandanus aquaticus*	The large fruit of this tree contains nuts that are extracted after cutting the fruit in half. The fruit of this tree is eaten by turtles and fishes.	

Common Name	Scientific Name	Knowledge	
Pandanus	*Pandanus spiralis*	The fruit of this tree is roasted and eaten. The leaves of these trees are woven into mats and baskets.	
Stinking passionfruit	*Passiflora foetida*	The fruit of this vine is eaten by black and white cockatoos.	
Quinine tree	*Petalostigma pubescens*	The fruits of this tree are eaten by birds (especially emus).	

Common Name	Scientific Name	Knowledge	
NA	*Petalostigma quadriloculare*	This little shrub is not eaten. It is related to the quinine tree.	
Gooseberry	*Physalis minima*	The fruit of this shrub was eaten.	
Cocky apple	*Planchonia careya*	In a past era this tree was used for fibre out of which string bags were made.	
Cocky apple	*Planchonia careya*	The fruits of this tree are eaten by kangaroos.	

Common Name	Scientific Name	Knowledge	
NA	*Pterocaulon serrulatum*	The leaves of this aromatic plant can be dried and smoked. The leaves of this plant can be crushed and then boiled and used as a skin wash.	
Bush tomato	*Solanum echinatum*	This plant has a fruit which is eaten after removing the spikey parts on the fruit.	
Bush apple	*Syzygium sp.*	This tree has edible white fruit.	
Red bush apple	*Syzygium suborbiculare*	This tree has edible red fruit.	

Common Name	Scientific Name	Knowledge	
Tacca	*Tacca leontopetaloides*	The fruit of this shrub is eaten when ripe (yellow).	

Common Name	Scientific Name	Knowledge	
			
Billy goat plum	*Terminalia ferdinandiana*	The fruits of this tree are eaten.	

Common Name	Scientific Name	Knowledge	
Nut tree	*Terminalia grandiflora*	Once the fruit of this tree is dry the seeds are eaten. It is similar to a peanut is size and taste. The timber may be used to make digging sticks.	 
NA	*Terminalia sp.*	These trees have edible fruit.	

Common Name	Scientific Name	Knowledge	
Spinifex	*Triodia bitextura*	Resin from this grass is used to attach spear heads. It is heated to soften then moulded, when it cools it sets very hard.	
NA	*Vigna vexillata*	This twining vine has an edible yam.	
Black plum	*Vitex glabrata*	The black fruits of this tree are eaten during the cold weather time.	

5.3.3 Jawoyn Fungi Knowledge

The growth on the bark of the ironwood tree is picked off, heated and applied to the knees of young babies to make them walk strong.

6. Discussion

Australian indigenous culture is recognised as one of the cultures of the world that remained isolated and relatively unchanged for an exceptionally long time, with evidence of occupation of the continent dating back over 60,000 years.

To the Jawoyn people their presence on the land extends back to a time called Buwurr or Burr. Simplified, Buwurr is what is often referred to as the Dreamtime, a time during which the features of the earth (the hills, rocks, trees, gorges and rivers) were formed. The Buwurr is also the time when the Jawoyn people and all living creatures came into being. During the time of Buwurr the ‘Law’ was given to the Jawoyn. This Law is central to all aspects of Jawoyn life and culture as it sets out the rules for proper behaviour, kinship relations, relationships to country and relations to neighbouring and often distant language groups (NRETAS 2012).

The land to the Jawoyn encompasses all aspects of life, it is a supermarket, a hospital, a hardware, a map and a church. It is important to recognise when aiming to understand the connection that Jawoyn people have to their land that its components cannot be separated into individual elements and that the plants, animals, gullies, ridges, rocks, rivers, water holes and the past, present and future are all intrinsically intertwined through the Buwurr (Jawoyn AAC 2012).

All Jawoyn people have cultural responsibilities to look after their land. This includes continuing traditional cultural practices such as hunting, gathering and performing ceremony to manage country (Jawoyn AAC 2012).

Cultural knowledge is traditionally passed down orally. Young people are educated through the course of their everyday lives by talking about country and being actively involved in cultural activities such as hunting, painting, collecting plant materials, weaving and ceremonies (NRETAS 2012).

When Europeans arrived in the Katherine region in the late 19th century life for Jawoyn was significantly disrupted. Pastoral and mining leases were established which forced Jawoyn people from their lands. This has an impact on the local subsistence economy as people were excluded from traditional hunting and fishing areas. This era also brought about regional destruction of bush foods due to the introduction of cattle and buffalo whose hard hooves cause significant amounts of environmental damage (NRETAS 2012).

By the late 1950s many Jawoyn people were forced from their traditional homes and instead lived in bush camps scattered around the edges of Katherine. Many people were forced into government settlements. It was from this time that government control over people’s lives increased and as a consequence use of ‘bush tucker’ began to diminish due to the inability to access traditional land coupled with increased dependence on European foods such as flour, sugar and tinned meats.

Despite these significant disruptions to Jawoyn life, Jawoyn culture has remained strong and traditional ecological knowledge is still held and passed on through the generations. The *Lands Right Act 1976* which allowed for some traditional lands to be returned to the Jawoyn has helped with the passing on of knowledge as people have been able to spend time on country, a vital element of being able to pass on traditional ecological knowledge.

6.1 Landscape Ecology

Three broad landscape units were identified in the mine site area during consultation: woodlands, hills and riparian (including aquatic) environments. Their characteristics and the Jawoyn knowledge about the environments are described below. Additional environments of Jawoyn country are mentioned but as they are not represented in the mineral leases. These are not discussed in detail.

This section documents the resources known from the various landscape groups.

Woodlands

These environments are widespread across the mineral leases and cover the majority of the area. They are mostly low, open eucalyptus forests with a sparse shrub layer and a ground layer dominated by annual grasses and herbs during the Wet season. During the Pangkarrang, Malapparr and Jungalk (Dry season) the ground layer of the woodland becomes dry and the plants senescent. Widespread fires burn across the woodlands, reducing the ground layer to bare ground.

Animal food resources of importance in the woodland environments include the frill-necked lizard. Some foods are eaten by the elders or are considered food for the 'old people'. It is unclear if this means they were foods of a past era and young people don't eat them or are foods that are reserved for the elders. This includes the black-headed python.

Plant food resources of importance in the woodland environments include wild grape (*Ampelocissus acetosa* and *A. frutescens*), black currant (*Antidesma ghesaembilla*), *Gardenia megasperma*, bush banana (*Marsdenia australis*), pandanus (*Pandanus spiralis*), tacca (*Tacca leontopetaloides*) and nut tree (*Terminalia grandiflora*).

Useful plants of importance in the woodland environments include, *Acacia spp,* tree orchid (*Cymbidium canaliculatum*), bats wing coral tree (*Erythrina vespertilio*) and pandanus (P*andanus spiralis*).

Hills

These environments occur on Mt Todd and the hills in the eastern and western parts of the mineral leases. Like the woodlands they are characterised by eucalyptus forests with a sparse shrub layer and a ground layer dominated by annual grasses and herbs during the Wet season. During the Pangkarrang, Malapparr and Jungalk (Dry season) the ground layer of the hills becomes dry and the plants senescent. Widespread fires burn across the hills, reducing the ground layer to bare ground. The ground surface is notably rocky, separating this landscape type from the woodlands.

The hilly environments were used by people during the Wet season as they were environments free from flooding. People also knew that several animal resources moved to the hilly country in the wet season to escape the flooding. It was recognised that hunting was easier on the hills in the Wet season due to the greater visibility afforded by shorter speargrasses compared to the woodlands of the lower country where the speargrasses often grew to well above head height.

Animal food resources of significance include the echidna, northern brown bandicoot and the northern brushtail possum.

Plants with utility value from these environments include *Ficus aculeata*.

Riparian

These environments occur across the mineral leases as taller eucalyptus woodlands in drainage lines and riparian forests of paperbarks and pandanus. Included in this landscape group are the resources that may be available in the waters of the streams, creeks and pools. Across the mineral leases they exist along and in the Edith River and its tributaries (Stow Creek, Horseshoe Creek, Batman Creek, Burrel Creek and West Creek) and ephemeral drainage lines. Some of these aquatic environments are ephemeral, occurring only during the Wet season as a response to the surface water runoff from monsoonal rain before receding to chains of pools and drying out late in the Wet season and others have sufficient base flow to remain as flowing watercourses throughout the Dry season.

Based on the Jawoyn ecological information recorded during this study, they contain the most resources of all the landscape groups in the mineral leases. These environments are particularly significant as fishing is still practiced by a large number of people.

Animal food resources of importance include the sand frog, bush turkey (associated with riparian environments as it is found in the open floodplains), ibis, pelican, barramundi, big black catfish, black bream, blue catfish, jewfish, file snake, turtle (long neck), turtle (saw shell), turtle (short neck) and water goanna.

Food resources eaten in a former time and no longer eaten by people include the jabiru, freshwater crabs, freshwater mussels, black flying-fox, little red flying-fox and freshwater crocodile. Some foods are eaten by the elders or are considered food for the ‘old people’ (it is unclear if this means they were foods of a past era and young people don’t eat them or are foods that are reserved for the elders). This includes the olive python.

Plant food resources of these environments include bush potato (*Brachystelma glabriflorum*), bush cucumber (*Cucumis melo*), *Cyclophyllum schultzii*, *Dioscorea* sp., long yam (*Dioscorea transversa*), cluster fig (*Ficus racemosa*), paperbarks (*Melaleuca* spp.), Leichhardt Tree (*Nauclea orientalis*), water lily (*Nymphoides crenata*), pandanus (*Pandanus aquaticus*), gooseberry (*Physalis minima*), bush tomato (*Solanum echinatum*), bush apple (*Syzygium* sp.), red bush apple (*Syzygium suborbiculare*) and black plum (*Vitex glabrata*).

Plant medicine resources of importance include the river fig (*Ficus coronulata*).

Useful plants of importance include bamboo (*Bambusa arnhemica*), sedges (*Cyperus* sp.), kerosene wood (*Erythroxylum ellipticum*), Paperbarks (*Melaleuca* spp.) and Leichhardt Tree (*Nauclea orientalis*).

Widespread

Many plants and animals do not specifically occur in any one vegetation type.

Animal food resources of importance and of widespread occurrence include the emu, green ant, native bees, macropods and sand goanna.

Animal medicine resources of importance include the green ant nest.

Plant food resources of importance include kurrajong (*Brachychiton diversifolius* and *B. megaphyllus*), green plum (*Buchanania obovata*), *Cartonema spicatum*, kapok bush (*Cochlospermum fraseri*), *Cymbopogon* sp., ironwood (*Erythrophleum chlorostachys*), *Grewia retusifolia*, giant speargrass (*Heteropogon triticeus*), billy goat plum (*Terminalia ferdinandiana*), *Terminalia* sp. and *Vigna vexillata*.

Useful plants of importance include cockatoo grass (*Alloteropsis semialata*), kurrajong (*Brachychiton diversifolius* and *B. megaphyllus*), green plum (*Buchanania obovata*), Cypress pine (*Callitris intratropica*), *Cayratia trifolia*, *Eriachne ciliata*, ironwood (*Erythrophleum chlorostachys*), stringybark (*Eucalyptus tetrodonta*), bloodwood (*Eucalyptus/Corymbia* spp.), purple pea (*Galactia muelleri*), red root (*Haemodorum coccineum*), cocky apple (*Planchonia careya*), *Pterocaulon serrulatum* and spinifex (*Triodia bitextura*).

Two widespread trees have spiritual importance for ceremonial uses: large, hollow gums (such as the salmon gums) and the ironwood (*Erythrophleum chlorostachys*).

Escarpment and Outcrop

These environments occur in Jawoyn country along in the Arnhem Escarpment and its outliers but not within the mineral leases. The knowledge shared of animals inhabiting these environments was ecological in nature and not regarding resources of utility.

Plant food resources of importance include *Cynanchum pedunculatum* and *Flueggea virosa*.

Monsoon Vine Forest

These environments are within Jawoyn country but not within the mineral leases. The only plant knowledge shared relating to these environments was that of one edible plant: bush pumpkin (*Amorphophallus paeoniifolius*).

7. Conclusion

In contemporary times hunting and foraging methods have changed somewhat such that nowadays people hunt with guns and fishing lines rather than spears, throwing sticks and hand weaved line. Similarly there are many bush foods and medicines that are no longer eaten or administered. Despite this the knowledge on how to gather and prepare these foods and medicines is still disseminated by those who hold this information.

Amongst the Jawoyn traditional owners, the mine site is not considered a notably productive environment. It was expressed by these people that the plants and animals encountered and discussed during this ecological knowledge consultation are widespread and not unique to the mine site.

8. References

Fisher I. (2000). Jawoyn People, Land and Country. People's Health Assembly – December 2000. People's Health Movement.

http://www.jawoyn.org/jawoyn-land Accessed: 19 March 2012; Updated: unknown.

http://www.phmovement.org/pha2000/stories/jawoyn.html Accessed: 23 April 2012

Jawoyn Association Aboriginal Corporation (AAC) (2012). Jawoyn Land.

NRETAS (2012) *Nitmiluk National Park Tour Guide Handbook, Section 3 Jawoyn Culture.*

http://www.nretas.nt.gov.au/national-parks-and-reserves/manage/tour/nnpguide Accessed: 19 March 2012; Updated: 2007.

Wiynjorrotj P, Flora S (dec.), Brown ND (dec.), Jatbula P (dec.), Galmur J, Katherine M, Merlan F and Wightman G. Jawoyn Plants and Animals: Aboriginal flora and fauna knowledge from Nitmiluk National Park and the Katherine area, northern Australia. Northern Territory Botanical Bulletin No. 29. Ethnobiology Project (NRETA) and Jawoyn Association, Darwin.

GHD

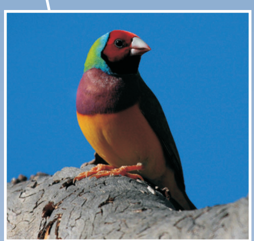
Level 5, 66 Smith Street. Darwin NT 0800
T: (08) 8982 0100 F: (08) 8981 1075 E: drwmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	A Quin	K Fitzpatrick		I McCardle		15/5/13

APPENDIX T

Air Quality Assessment



Vista Gold Australia Pty

Mt Todd Gold Project

Air Quality Assessment

June 2013

Executive summary

GHD was commissioned by Vista Gold Australia Pty Ltd (Vista Gold) to undertake an air quality impact assessment for the proposed Mt Todd Gold Mine and Power Station located approximately 55 km northwest of Katherine in the Northern Territory (NT).

This report addresses the EIS guideline requirements of assessment against the *National Environment Protection Measures (Implementation) Act 1998* which includes the assessment of impacts to air quality. This report must be read in conjunction with the limitations set out in section 14 and the assumptions and qualifications contained throughout.

The Mt Todd Gold Mine is a brownfield/disturbed site located in a historical mining district, and was most recently mined for gold in the 1990s. Mining infrastructure such as tailing dams, waste rock dump and the remains of processing facilities are present on site. Vista Gold is proposing to:

- re-establish and operate the Mt Todd Gold Mine; and
- commission a grid connected on-site gas-fired power station.

The assessment has considered the:

- air quality impact assessment criteria applicable in the Northern Territory;
- existing background air quality;
- local meteorological conditions;
- location of sensitive receptors in the study area;
- estimated emissions to air generated by construction and operational activities associated with the:
  - mining operations;
  - power station at the mine site;
- potential for impacts to air quality due to dust and other gaseous emissions associated with the project through an assessment using the AUSPLUME dispersion model and Environmental Risk Assessment process; and
- application of appropriate mitigation measures through the development of a Dust Management Plan (DMP) for the ongoing minimisation of dust emissions.

Particulate emissions, as crustal dust, in three main particle size fractions, were considered to be the primary source of air pollutants released from the combined mine and power station project. The size fractions are based on total suspended particles (TSP), PM_{10} and $PM_{2.5}$ (i.e. particles less than 50 µm, 10 µm and 2.5 µm, respectively). The proposed mine plan was evaluated to determine the key dust generating sources and the worst case dust emissions due to the quantity of material to be excavated, transferred, processed and stored on the site. Year 3 of the mine plan was found to represent the worst case in terms of material volumes moved and dust emissions generated, and consequently, this year was used in the assessment. The volumes of material used to develop the dust emissions inventory were:

- 102 Mtpa of material extracted; and
- 17.8 Mtpa of ore processed.

The estimated total annual dust emissions by size fraction, based on Year 3 activity rates, with dust emission controls applied were calculated to be:

- 5,469 tonnes of TSP;
- 2,569 tonnes of PM_{10}; and
- 1,030 tonnes of $PM_{2.5}$.

The secondary sources of air emissions were considered to be associated with the power station. Particulate emissions from gas-fired engines at the power plant and diesel equipment on site mainly comprise $PM_{2.5}$ and are considered negligible by comparison to mining related dust. Emissions of volatile organic compounds (VOC) released from stationary and mobile combustion sources including earthmoving equipment, haul trucks, site vehicles and the power generating gas-fired turbine and reciprocating engines are also considered to be in trace quantities by comparison with the principle products of combustion, oxides of nitrogen (NO_X) and carbon monoxide (CO). Consequently, NO_X and CO emissions associated with the power station have also been assessed.

Background dust levels in the region are primarily associated with natural sources such as scrub fires and wind generated dust storms during the dry season. There are few significant anthropogenic sources of dust, NO_X and CO in the region. For the cumulative dust assessment, measurements collected at Casuarina, Northern Territory were applied. The background concentrations were:

- 21.8 µg/m³ for the 24-hour average of PM_{10};
- 11.2 µg/m³ for the 24-hour average of $PM_{2.5}$; and
- 42 µg/m³ for the annual average of total suspended particulates (TSP).

The Mt Todd mine is located in a remote region of the Northern Territory where routine meteorological monitoring is not conducted. Consequently, a one-year meteorological dataset for the 12-month period between September 2007 to August 2008, representative of the project area and suitable for input to the AUSPLUME dispersion model was simulated using the CSIRO's TAPM (The Air Pollution Model).

In the absence of Northern Territory published guidance on the assessment of air quality, the standards promulgated in the National Environment Protection (Ambient Air Quality) Measure (Air NEPM) were used to assess the potential for impacts of PM_{10}, $PM_{2.5}$, NO_2 and CO. Where the Air NEPM and state environmental regulator has not developed published air quality assessment criteria for a substance, it is accepted practice that an assessment criterion may be adopted from another national or international jurisdiction. For this assessment, the NSW Office of Environment and Heritage (OEH) impact assessment criteria for TSP and deposited dust have been used.

The impact assessment found that the Air NEPM standards of NO_2 and CO and the OEH impact assessment criteria of TSP and deposited dust are predicted to be met at all identified sensitive receptor locations. However, the assessment also found that the Air NEPM standards of PM_{10} and $PM_{2.5}$, for the protection of human health, have the potential to be exceeded at the Werenbun community between two and seven times per year, depending on the assumptions made. The assessment findings were found to be extremely sensitive to a variety of important assumptions made for the estimation of emissions, dispersion model configuration and the application of existing background concentrations.

In accordance with NEPM guidance (which is a monitoring protocol rather than dispersion model goal setting), conservative assumptions have been applied at each step of the process in order to assess the maximum ground level concentration under worst case conditions. Due to the predicted exceedences of the PM_{10} and $PM_{2.5}$ standards, an Environmental Risk Assessment was undertaken to investigate the frequency of exceedence of the standards and the conditions under which they occur. The risk assessment found that exceedences were predicted to occur under north-westerly winds during the wet season, and that changing the assumptions used in the emission estimation, dispersion modelling and background concentration calculation to more adequately represent wet season conditions, would be expected to significantly reduce predicted ground level dust concentrations at the Werenbun community and comply with the standards.

While unpopulated areas beyond the mining lease boundary are not considered to be within the assessment jurisdiction of the Air NEPM, dust emissions will be managed and mitigated through the implementation of a Dust Management Plan for the mine site in order to minimise the dust impacts in protected and remote areas. Through the management of mining processes, implementation of a dust mitigation strategy and monitoring program, interactive dust management, and minimisation of dust emission generation during worst case meteorological conditions, the Mt Todd Gold Project is expected to comply with air quality standards.

Abbreviations

Project Specific Terminology	
Abbreviation	**Term**
the EIS	Vista Gold Mount Todd Environmental Impact Statement - refers to the particular document that GHD is preparing to facilitate approval of the Project
the Proponent	Vista Gold Australia Pty Ltd
the Project	Mount Todd Gold Project

Generic Terminology	
Abbreviation	**Term**
AP-42	US EPA Database on Air Pollutant Emission Factors
AWS	Automatic Weather Station
AUSPLUME	Gaussian plume modelling system for the simulation of atmospheric pollution dispersion distributed by EPA Victoria
BoM	Bureau of Meteorology
CSIRO	Australian Government agency Commonwealth Scientific and Industrial Research Organisation
DERM	Queensland Department of Environment and Resource Management
DMP	Dust Management Plan
E_i	Emission rate of pollutant i (kg per activity)
EAD	Equivalent aerodynamic diameter
EETM	Emissions Estimation Technique Manual
EFi	Uncontrolled emissions factor for pollutant i (kg per activity)
EMF	Environmental Management Framework
EPA	Northern Territory Environment Protection Authority
EPP	Environment Protection Policy
ERA	Environmental Risk Assessment
GHD	GHD Pty Ltd
GLC	Ground Level Concentration
ha	hectare
k	Proportional constant to maintain total annual emissions as constant
kg	kilogram
LGO	Low Grade Ore
M	Soil moisture content
MW	Megawatt
NCAR	National Centre for Atmospheric Research
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NOx	Oxides of nitrogen
NPI	National Pollutant Inventory
OCM	Open Cut Mine
OH&S	Occupation Health and Safety
$PM_{2.5}$	Particulate Matter less than 2.5 µm EAD
PM_{10}	Particulate Matter less than 10 µm EAD
ROM	Run-Of-Mine
SO_2	Sulphur dioxide
TAPM	The Air Pollution Model (TAPM) developed and supplied by CSIRO

Generic Terminology	
Abbreviation	**Term**
tpa	tonnes per annum
TSP	Total Suspended Particulates
U	Wind speed at the reference height of 10 m
US EPA	United States Environment Protection Agency
veh	Vehicle
VKT	Vehicle Kilometres Travelled
VOC	Volatile Organic Compound

Table of Contents

Table index

Figure index

Appendices

1. Introduction

GHD was commissioned by Vista Gold Australia Pty Ltd (Vista Gold) to undertake an air quality impact assessment for the proposed Mt Todd Gold Mine and Power Station located approximately 55 km north west of Katherine in the Northern Territory (NT). The Mt Todd Gold Mine is a brownfield/disturbed site located in a historical mining district. The site was most recently mined for gold in the 1990s. Mining infrastructure such as tailing dams, waste rock dump and the remains of processing facilities are present on site. Vista Gold is proposing to:

- Re-establish and operate the Mt Todd Gold Mine; and
- Commission a grid connected on-site gas-fired power station.

The assessment was subject to the limitations outlined in Section 14 of this report, and has considered the:

- Air quality impact assessment criteria applicable in the Northern Territory;
- Existing background air quality;
- Existing meteorological conditions;
- Location of sensitive receptors in and around the study area;
- Estimated emissions to air generated by construction and operational activities associated with the:
  - mining operations.
  - power station at the mine site
- Impact to air quality of dust and other gaseous emissions associated with the project through an assessment using a regulatory dispersion model; and
- Application of appropriate mitigation measures through the development of a Dust Management Plan (DMP) for the ongoing minimisation of dust emissions.

1.1 Guidelines Addressed

The Northern Territory Government has not published air quality standards or guidance documents for the assessment of air quality impacts from industrial developments in the Territory. Consequently, this report does not address any specific NT guidelines regarding air quality (EPA (formerly NRETAS) 2011). Notwithstanding this, in accordance with the requirements of the *National Environment Protection Measure (Implementation) Act 1998*, an assessment of air quality is required. The requirements of this Act are discussed in section 2.2.

2. Legislative Framework

2.1 Commonwealth Legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), any development requires assessment if it has the potential to affect one or more of eight matters of National Environmental Significance (NES). The matters of NES include:

- World Heritage properties;
- National Heritage places;
- wetlands of international importance (listed under the Ramsar Convention);
- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Commonwealth marine areas;
- The Great Barrier Reef Marine Park; and
- nuclear actions (including uranium mines).

The environment under the EPBC Act includes:

1. ecosystems and their constituents;
2. natural and physical resources;
3. qualities and characteristics of locations, places and areas;
4. heritage values of places; and
5. the social, economic and cultural aspects.

Mt Todd Gold Project falls within a Site of Conservation Significance (Yinberrie Hills), a key site recognised for EPBC listed 'Endangered' species. A habitat and baseline flora and fauna survey, and assessment were undertaken as part of the Draft EIS to consider potential impacts and mitigation associated with land clearing and mining activities.

2.2 National Environment Protection Measures (Implementation) Act 1998

Under the *National Environment Protection Measures (Implementation) Act 1998*, the National Environmental Protection Council (NEPC) was established to set national environmental goals and standards for Australia through the development of National Environment Protection Measures (NEPMs). The NEPC is part of the Environment Protection and Heritage Council (EPHC). Section 14(1) of the NEPC Act prescribes that NEPMs may relate to any one or more of the following:

- ambient air quality;
- ambient marine, estuarine and fresh water quality;
- the protection of amenity in relation to noise;
- general guidelines for the assessment of site contamination;
- environmental impacts associated with hazardous wastes; and
- the re-use and recycling of used materials.

2.3 Northern Territory Legislation

2.3.1 Mining Management Act 2001

The *Mining Management Act 2001* provides for authorisation of mining activities, management of mining sites, preparation of the environment on mining sites and related purposes. The Act is administered by the Department of Mines and Energy (DME). The objectives of the Act are:

- ensure the development of the Territory's mineral resources in accordance with environmental standards consistent with best practice in the mining industry;
- protect the environment by:
  - the authorisation and monitoring of mining activities;
  - requiring appropriate management of mining sites;
  - facilitating consultation and cooperation between management and workers in implementing environment protection management systems;
  - implementing audits, inspections, investigations, monitoring and reporting to ensure compliance with agreed standards and criteria; and
  - specifying the obligations of all persons on mining sites with respect to protection of the environment.
- assist the mining industry to introduce programs of continuous improvement to achieve best practice environmental management; and
- enable persons connected with the mining industry to participate in the implementation of this Act through the establishment of a Mining Board to advise the Minister on:
  - guidelines for the industry;
  - specification of competencies required by persons involved in the industry;
  - best practice in mining activities; and
  - minimise the liability of the Territory by requiring the payment of security to provide for the rehabilitation of mining sites or to rectify environmental harm caused by mining activities.

2.3.2 Environmental Assessment Act 1982 and Environmental Assessment Administrative Procedures Act 1984

The *Environmental Assessment Act 1982* and the *Environmental Assessment Administrative Procedures Act 1984* ensure, to the greatest extent practicable, that each matter affecting the environment which is, in the opinion of the NT Minister, a matter which could reasonably be considered to be capable of having a significant effect on the environment, is fully examined and taken into account in, and in relation to:

- formulation of proposals;
- carrying out of works and other projects;
- negotiation, operation and enforcement of agreements and arrangements (including agreements and arrangements with authorities of the Commonwealth, the States and other Territories);
- making of, or the participation in the making of, decisions and recommendations; and
- incurring of expenditure.

2.3.3 Waste Management and Pollution Control Act 2009

The purpose of the *Waste Management and Pollution Control Act 2009* is to protect the environment through objectives and approvals, encouraging effective and responsible waste management and reduction and response to pollution. This Act facilitates the implementation of national environment protection measures made under the *National Environment Protection Council (Northern Territory) Act 1999*, and incorporates environmental compliance plans and audits.

Section 14 of the Act establishes a process for notifying the EPA (the administrating agency for the Act) about incidents causing, or threatening to cause pollution. Schedule 2 of the Act requires environment protection/licensing for certain activities.

Protection of the environment through encouragement of effective waste management and pollution prevention and control practices were developed in accordance with the Act.

3. Project Location

3.1 Mine

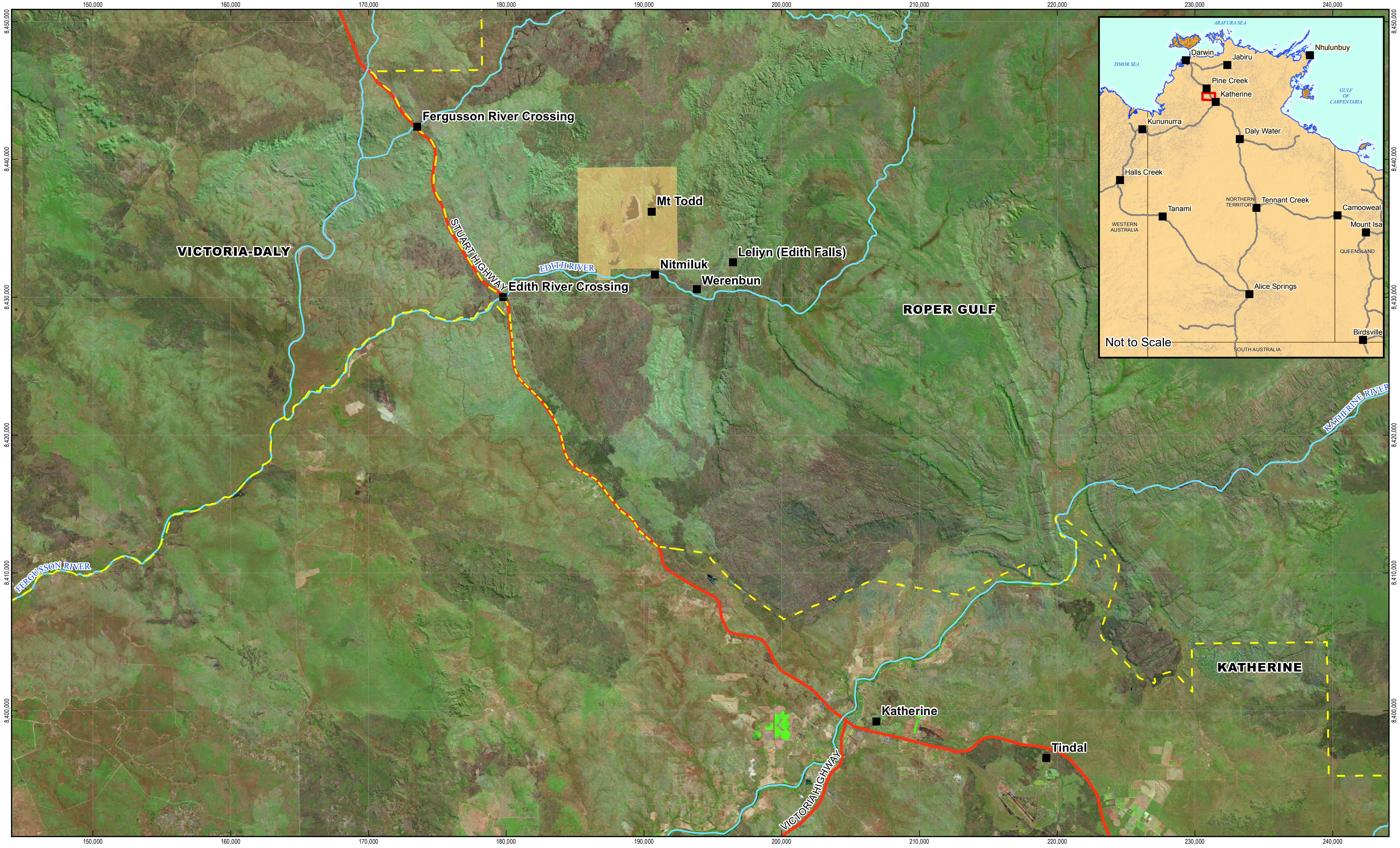
The Mt Todd Gold Mine site is located approximately 55 km north-west of Katherine and 250 km south of Darwin in the Northern Territory (NT) (Figure 1).

Surrounding landmarks immediately adjacent to the mine site include:

- North – Historic Horseshoe Tin Field;
- East – Nitmiluk National Park;
- South – Edith River and Edith Falls Road; and
- West – Yinberrie Hills.

3.2 Power Station

The gas-fired power station will be situated on-site along the south west side of the main entrance road. Power generation will consist of a single Rolls Royce Trent 60 Wet Low Emissions gas turbine generator and two reciprocating MAN engines with a combined installed power generation capacity of approximately 76 MW. For the purposes of this assessment, it has been assumed that the combined emissions from the gas turbine and reciprocating engines will be released from a single exhaust stack.



1:250,000 (at A3)

0 2.5 5 7.5 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

LEGEND

- Place Names
- LGA Boundaries
- Major Roads
- Mt Todd Mineral Leases
- Rivers

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	05 Jun 2013

Project Location

Figure 1

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

G:\43\21801\GIS\Maps 30000 TPA\Air\4321801_1105.mxd

Data source: NRETAS - Drainage (2011). Vista Gold - Mt Todd Mineral Lease (2011). Geoscience Australia - Landsat Imagery (2007), Place Names, LGA Boundaries, Roads, State Boundaries, Shoreline (2008). Created by: CM

4. Project Operations

4.1 Overview of Construction Activities

Subject to statutory approvals, construction activities are planned to commence during the first quarter of 2014.

Construction works will take place largely between 6 am to 6 pm, with construction workers operating on 12 hour rotating shifts. Administration and management personnel will work a standard 5 x 2 day roster. Occasional night works may be required, for example for concrete pours during hotter months, or to catch up on schedule delays.

Construction works will include the following:

- demolition and disposal of existing process plant and other facilities such as the gate house;
- construction of temporary facilities (i.e. lay down areas, offices, workshops, etc.);
- construction camp (located within 25 km of the mine site and subject to separate approval);
- on site concrete batch plant/s;
- administration and plant site buildings including:
  - mine and plant workshops, warehouses and maintenance facilities;
  - offices, medical facilities and training facilities;
  - security gate house, weighbridge etc.;
  - crib room and ablutions;
  - laboratory.
- ore processing plant;
- power station;
- water treatment plant (WTP);
- sludge disposal cell and equalisation pond;
- site roads;
- pumps and pipelines; and
- new sumps, decant towers, decant ponds, collection ditches and diversions.

In addition, the following activities associated with ongoing operations will progressively occur:

- raising of TSF1 from 16 m in height to approximately 34 m in height in six phases;
- construction of TSF2 to 60 m in height over four stages
- increase in the height of the existing waste rock dump from 24 m to approximately 350 m;
- development of a clay borrow area(s) ;
- construction of LGO stockpile, collection ditch and lined sump;
- construction of water treatment wetlands; and
- potential construction of a re-aligned access road.

The Project will use standard construction machinery, general trade equipment and specialised equipment as required. The indicative number and type of construction equipment required is shown in Table 1.

Table 1 Indicative construction equipment

Equipment	Indicative Number
Scraper/Roller 11T	4
Excavator	4
Front-end loader	6
Grader	2
Crane	6
Water tanker	2
Concrete trucks / pumps	6
Concrete batch plant	1
Dozer D8	2
Dozer D7	1
Rear Dumps or Highway Trucks	10

4.2 Mining and Ore Processing

4.2.1 Overview

Mining operations (Figure 2) will be conducted by conventional open-pit truck and shovel methods, using large haul trucks, hydraulic shovels and front-end loaders to transport material to the crusher, ore stockpiles and waste dumps. Extracted ore will be transported to an ore processing plant where it will be crushed, pre-treated and subjected to carbon in leach (CIL) leaching followed by adsorption, desorption and recovery to produce gold dore (unrefined gold). Gold dore will be transported for onward secure shipment to a refinery.

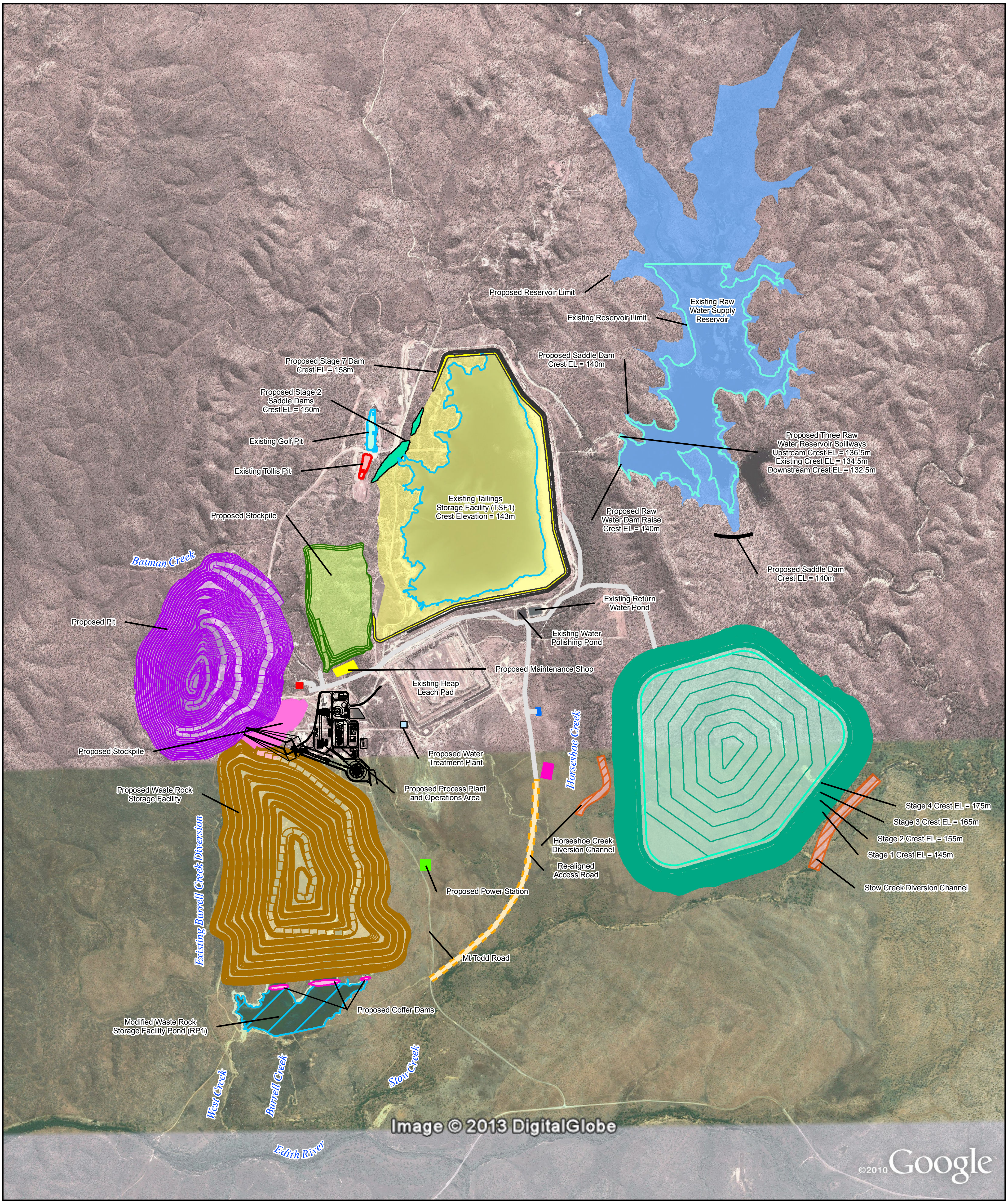
Mining and associated operations will primarily occur on Mineral Leases MLN 1070, MLN 1071 and MLN 1127, covering 5,365 ha.

4.2.2 Production Schedule

Proven and Probable Reserves have been used to schedule mine production. The production schedule of over 222 Mt of processed ore will occur over a 13 year period (Table 2). This does not include pre-production mining during the construction phase.

Based on a review of geological data and current bench slopes, a detailed pit design has been completed. The ultimate pit is achieved by mining in four separate phases or cut backs, as outlined below:

- phase one – mining during pre-production starts from the current pit pushback limit that was started by previous operators and mines it to RL -188 m.
- phase 2 – during year 1 mines around the phase 1 pit and deepens the pit to RL -246 m.
- phase 3 – during year 3 continues to mine around the south end of the phase 2 pit and achieves a RL of -336 m.
- the final phase – during year 5 completes mining in the north and below phase 3 to a RL of -396 m.



LEGEND

Process Plant	Power Plant	Explosives Magazine	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Proposed Saddle Dam (Raw Water Dam)	Stockpile
Golf Pit	Proposed Haul Road	Diversion Channels	Proposed Saddle Dam	TSF2 Contours (Year 12)	Retention Pond 1	
Tollis Pit	Re-aligned Access Road	Raw Water Dam Existing Water Body	TSF1	TSF2 Footprint (Year 12)	Batman Pit Footprint (Year 12)	
Fuel Bays	Coffer Dams	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Water Treatment Plant	Waste Rock Dump Contours (Year 10)	
Proposed Maintenance Shop	ANFO Facility	TSF1 Contours	Low Grade Ore Stockpile	Batman Pit Contours (Year 12)	Waste Rock Dump Footprint (Year 10)	

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	05 Jun 2013

Mt Todd General Facilities Arrangement

Figure 2

G:\43\21801\GIS\Maps 30000 TPA\Air\4321801_1106.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names (2011). Created by: CM

Based on the supplied annual mine production schedule (Table 2), year 3 is estimated to have the greatest amount of material excavated from the pit.

Table 2 Annual mine production schedule ('000 tonnes)

Mining year	Total ore mined	Total waste mined	Total tonnes mined	Strip ratio	Total rehandle	Total ore processed
Pre-production	11,764	24,761	36,525	2.10	-	-
1	28,101	33,803	61,905	1.20	316	17,799
2	20,983	55,290	76,273	2.64	5,085	17,750
3	**23,941**	**78,227**	**102,169**	**3.27**	**1,108**	**17,750**
4	18,285	71,608	89,893	3.92	6,061	17,750
5	29,066	58,329	87,395	2.01	-	17,799
6	7,561	71,279	78,840	9.43	10,770	17,750
7	4,777	54,405	59,182	11.39	12,973	17,750
8	7,078	45,482	52,560	6.43	10,672	17,750
9	10,700	38,710	49,410	3.62	7,099	17,799
10	24,331	27,864	52,195	1.15	-	17,750
11	22,861	2,592	25,454	0.11	-	17,750
12	Heap Leach & Stockpile			-	17,750	17,750
13	Heap Leach Only			-	9,505	9,505
Total	209,451	562,349	771,800	2.68	81,339	222,651

Note: Rehandle includes 13,200 t from the existing Heap Leach Pad

4.2.3 Mining

Mine operations will be 24 hour, split across two shifts (6:00 am to 6:00 pm and 6:00 pm to 6:00 am).

Drilling and blasting, to loosen rock ahead of mining, will be undertaken in order to produce rock sizes that conform to processing requirements. Blasted ore will be loaded into haul trucks for transportation either directly to the primary crusher, ROM pad or Low Grade Ore (LGO) stockpile. Ore will be reclaimed from the ROM pad and LGO stockpile by front-end loader and fed to the primary crusher.

The Batman Pit will be significantly deepened and enlarged from its current depth of 114 m to a proposed depth of 588 m (RL - 396). The surface area of the pit will be increased from approximately 40 ha to 137 ha.

Rock will be blasted and extracted by conventional truck and shovel methods. Walls will be scaled during the mining operation in order to maintain a safe work place. Safety berms will be utilised as required to maintain safe working areas. In some cases, primarily on the east wall, these safety berms will be incorporated into haul roads. Where this is done, a berm along the road will be built to contain any sloughing material. The pit will incorporate 6 m benches for mining. In areas where the material is consistently ore or waste, benches may be mined in 12 m heights.

Water will be sprayed onto roads to suppress dust using a water cart. Environmentally benign surfactants will also be used on road surfaces to reduce the water demand for dust suppression where practical.

4.2.4 Ore Processing

A new ore processing facility will be constructed on the site of the previous process plant.

The processing plant has been designed to treat free milling ore using conventional technology to recover cyanide leachable gold using a carbon in leach (CIL) process. The processing plant will consist of the following components:

- gyrator crusher;
- secondary crushers;
- coarse screening;
- coarse ore stockpile;
- high pressure grinding rolls (HPGR);
- fine screening;
- classification;
- ball mills;
- pre-leach thickener;
- CIL circuit;
- elution circuit
- gold room
- cyanide detoxification; and
- tailings pumps.

Support services include reagent mixing and dosing facilities, and a centralised control room.

A simplified process flow sheet is shown in Figure 3.

The following are key components of the Ore Processing Plant:

- Comminution (crushing and grinding of ore);
- Adsorption and detoxification; and
- Gold extraction.

Comminution

Ore will be fed into a primary gyratory crusher, either directly by haul truck from the pit or by front-end loader from the ROM pad and LGO stockpile. Ore contained within the existing LGO stockpile and scats from the scats stockpile will also be reprocessed. Primary crusher product will be reclaimed from the discharge vault by the apron feeder and discharged onto a conveyor.

Primary crushed ore will be secondary crushed using cone crushers. Crusher product will be screened on banana screens with oversized material transferred back to the secondary crusher feed conveyor. Screened undersized material will be transferred onto a coarse ore stockpile where ore will be reclaimed by a feeder, onto a conveyor to the High Pressure Grinding Rolls (HPGR). HPGR product will be conveyed by belt conveyors to a fine ore splitter where it will be transferred across a fine ore screen by two belt conveyors operating in parallel. Screened oversize material will be conveyed back to the HPGR feed conveyor with the undersized material gravitating to a hydrocyclone feed sump. Slurry from the feed sump will be pumped into a hydrocyclone cluster. The hydrocyclone underflow will then gravitate to two ball mills where it will undergo further size reduction. The hydrocyclone overflow slurry will flow by gravity onto three trash removal screens. Screened undersize slurry will gravitate into a pre-leach thickener, after which thickened slurry will be pumped to the CIL circuit.

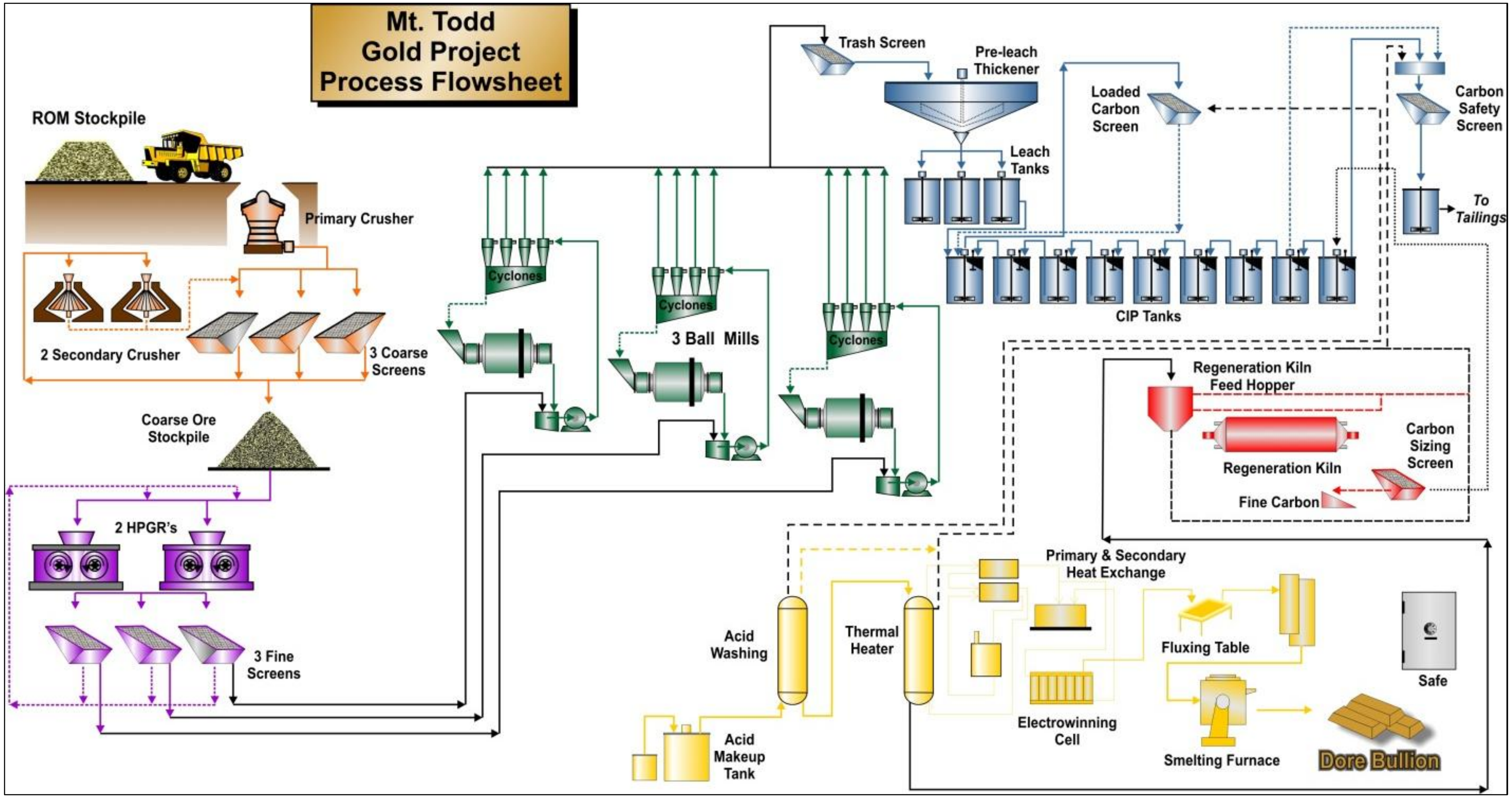


Figure 3 Simplified Process Flowsheet

Adsorption and Detoxification

The CIL circuit will consist of a pre-leach thickening stage followed by conventional leaching and adsorption. Pre-aeration reduces cyanide consumption during leaching. Cyanide will be added to the slurry to dissolve the gold after which carbon is added to adsorb the solubilised gold. Reactivated carbon, supplemented with fresh carbon as necessary, will be added to the final tank in the circuit.

CIL process tailings will be directed to a cyanide detoxification circuit, whereby the cyanide will be reduced and / or eliminated. The slurry exiting the detoxification tanks will gravitate into a tailings pump hopper. From here the slurry will be pumped to tailings storage.

Gold Extraction

Loaded carbon will be separated by screen from the CIL tank located immediately after the leach tanks and transferred to a carbon strip vessel. Prior to gold stripping, copper will be stripped from the loaded carbon via a cold cyanide strip.

Gold will be removed from the loaded carbon using a modified Anglo American Research Laboratories carbon strip. Pregnant solution will be stored in a pregnant solution tank in preparation for electrowinning. Electrowinning will commence once the solution level in the pregnant solution tank is sufficient to cover the electrowinning feed pump intakes. Pregnant solution will be circulated from the pregnant solution tank through electrowinning cells wherein gold will be electrochemically plated onto stainless steel wool. Recirculation of pregnant solution will occur until gold grades are below economic levels. The barren solution will be reintroduced into the CIL circuit to recover any residual gold that was not electrowon.

Gold adhering to the stainless steel cathodes in the electrowinning cells will be washed under high pressure from the cathodes into the bottom of the cell and transferred into a vacuum pan filter. Solids from the filter will be transferred into a drying oven. The dried gold sludge will then be transferred into an induction furnace, fluxed, smelted and poured into dore bars.

4.2.5 Cyanide detoxification circuit

Cyanide will be treated in a detoxification circuit through a reaction with sulphur dioxide (SO_2) in a solution of Sodium Metabisuplhite (SMBS). Information supplied by Vista Gold[1] indicates that gaseous SO_2 emissions from the process are expected to be negligible. Consequently, no emissions to air have been assessed from the cyanide detoxification circuit.

Vista Gold proposes to accept delivery of SMBS as a 95 per cent pure solid powder in shipping containers. A container tipper and solids handling equipment will transfer the powder from the storage containers to the mixing tank. SMBS will be mixed to 20 % (w/v) in solution and dosed to the detoxification tanks via duty/standby dosing pumps. SMBS will be consumed at a rate of 0.73 kg/t of ore treated. This amounts to approximately 12,958 tonnes per year for processing 50 ktpd of ore. The mixing and storage tanks will be enclosed with a roof to minimise the release of air emissions. The SMBS reacts with the cyanide in the detoxification process to produce sulphuric acid that is in-turn neutralised. Dust emissions generated through the handling and transfer of bulk material will be mitigated using source appropriate methods. Dusty areas where site personnel are operating will be well ventilated.

---

[1] Email from Andrew Sawicki (Vista Gold Mt Todd) to Nikki Conroy (GHD) 21 May 2013 at 2:19 pm. Subject: FW: SO_2 in cyanide detox.

4.2.6 Transport and Ancillary Operations

The gold bars will be stored in a secured area at the project site and transported by secure shipment to a refinery.

The leaching efficiency of the carbon in the CIL process is reduced over time through the build-up of carbonates. Carbon will be regenerated through regular washing in a mild, cold hydrochloric acid wash to remove the carbonates before reactivation in a kiln after carbon stripping. The reactivated carbon will then be screened to remove carbon fines before being reintroduced to the CIL circuit.

GHD understands that power generated on site will be used to heat the kiln and consequently, emissions associated with the kiln have not been assessed.

4.2.7 Site Vehicles

A broad range of vehicles will operate at the mine to undertake a variety of functions including mining, stockpile management, plant feeding, road maintenance, dust suppression, and general personnel movement. The proposed vehicle fleet includes the following:

- 8 Atlas Copco Pit Vider 235 blast-hole drills;
- 1 Atlas Copco 45K rotary drill rig;
- 2 ammonium nitrate / fuel oil truck;
- 1 skid loader;
- 4 Hitachi EX5500 hydraulic shovels;
- 2 Cat 994 loader;
- up to 38 Cat 793C trucks during the mine life;
- 1 Cat D8 track dozer;
- 2 Cat D9 track dozers;
- 2 Cat 16H motor grader;
- 2 Cat 777B with a 70 kL water truck;
- 2 Cat 834H rubber tire dozer;
- 1 36 tonne capacity crane;
- 1 Cat 321DL excavator;
- 1 low-boy trailer with 60 tonne haul truck;
- 1 flatbed truck;
- 1 rock breaker attached to the 321DL excavator;
- 4 light plants;
- 1 fuel / lube truck;
- 16 4WD utes; and
- 2 passenger vans.

Fuel consumption for vehicles operating at the mine is estimated at 90,000 litres per day.

4.3 Infrastructure

4.3.1 Power Supply

During operations, site electrical normal demand (steady state) is 86MW and the peak demand is approximately 95MW

Electrical demand will be met by the installation of a single Rolls Royce Trent 60 Wet Low Emissions gas turbine generator (Figure 4, right) and two reciprocating engines (Figure 4, left) located along the south side of the main entrance road.

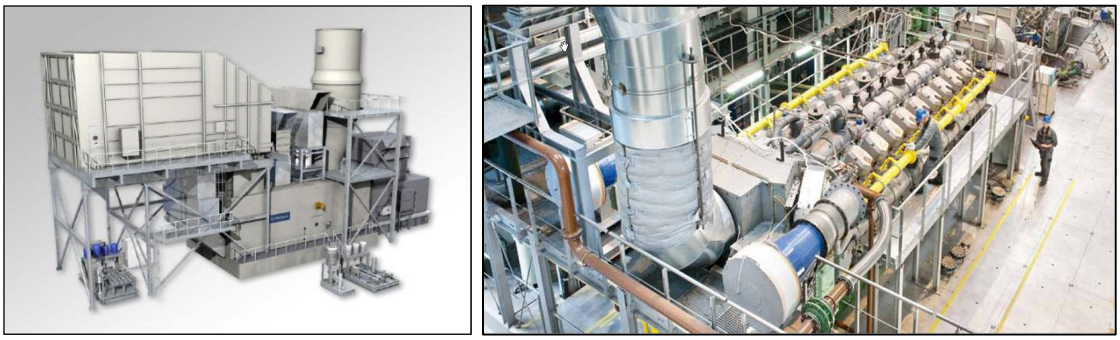


Figure 4 Rolls Royce Trent 60 Gas Turbine (left) and MAN 20V35/44 SG Reciprocating Engine (right)

Total power generation capacity (installed) will be approximately 76 MW. Some power may be obtained from the existing transmission lines if a temporary shortfall occurs. The peak electrical demand will be met by a combination of gas turbine generated power and grid supply.

Water consumption in the power plant is primarily for compressor interstate cooling, control of oxide of nitrogen (NO_X) emissions through injection into the combustor and periodic cleaning of the turbine compressor section. The raw water dam will supply the required 290,000 m³ per annum for power plant operation.

The proposed exhaust stack configuration for the combined emissions will be a single 21.3 m high stack with a 3 m diameter.

Key specifications of the proposed power plant are provided in Table 3.

Table 3 Power Plant Specifications

Specification	Measurement
Gas Consumption	8.9 Peta Joules per year
Electricity produced	18,000 GWh over Project life
Estimated Emissions (1)	
Oxides of Nitrogen	50.0 mg/Nm³
Carbon monoxide	54.5 mg/Nm³
Particulate Matter (as TSP)	5.1 mg/Nm³
Volatile Organic Compounds (VOC)	2.5 mg/Nm³

[1] Dry at 15 % O_2.

4.3.2 Chemical and Hydrocarbon Storage

Diesel will be stored on-site for mining equipment and some vehicles. The current API 650 tank (600 kl storage capacity) will be used to store diesel fuel with fuel distributed as required basis through a combination of pipelines and, fuel trucks. It is planned to have a single diesel storage area close to the heavy equipment workshop. Refuelling facilities will be provided in the heavy vehicle workshop area for the vehicles belonging to the operation. It is anticipated that up to 90,000 L of diesel will be used daily (31.5 MLpa). Storage capacity of up to 820,000 L will be maintained on-site.

Various reagents for mixing and processing in the ore processing plant will also be stored on-site and include the following:

- cyanide will be predominantly delivered in bulk isotainer for sparge mixing; however due to the lack of on-site liquid storage, a backup dry solids mixing system will be required that will necessitate the storage of a suitable amount of dry cyanide in boxed form. Liquid cyanide storage is in the order of 2.5 days, which provides an insufficient operational buffer.
- sodium hydroxide will be delivered in one tonne bags with storage capacity of approximately is 12 m^3;
- flocculant will be transported as a solid, stored in a silo and made up into two 180 m^3 tanks;
- loose bulk SMBS will be delivered in 20 foot containers with container liner. Mixed solution will be stored in a 325.4 m^3 tank;
- hydrochloric acid will be delivered in 1,150 kg Intermediate Bulk Containers (IBC);
- activated carbon will be delivered onsite in 500 kg bulk bags;
- fluxes will be delivered to site on approximately one tonne pallets;
- lead nitrate will be delivered in powder form in one tonne bags with 20% solution and stored in a 102 m^3 tank; and
- quick lime will be delivered to site in loose bulk in 20 foot containers.

Lubricating oil will be stored in bulk containers inside a bunded area with spill protection.

Waste oil will be stored in a tank within a bunded area to be held for collection by a contractor for reprocessing and recycling.

All chemicals, fuels and oils will be stored and contained according to Australian Standards.

4.3.3 Explosive Magazines / Depot

The project will require an explosive storage and handling facility for ANFO. Ammonium nitrate will be stored in sea containers and will be emptied into the hopper/bin for discharge into the explosives mixing truck. The emulsion, in gel form, will be stored in the self-contained bullet tank and will be pumped into the mixing truck powder magazines and a cap magazine, which will be built and operated in accordance with Dangerous Goods regulations. Applications for a Magazine Licence or a licence to store dangerous goods will be submitted to the relevant authority before commencing construction of the explosive storage facilities. On average, 3,000 t of explosive will be used each year. Peak year consumption is about 4,100 tonnes of explosive.

4.4 Construction Workforce and Accommodation

4.4.1 Workforce

The construction workforce is expected to peak at about 450. This workforce would be the responsibility of a construction contractor.

The mine workforce, including operations, maintenance, engineering, geological and support personnel, is expected to peak at about 350. It is expected that up to 40 personnel would be required for the decommissioning and closure phases.

4.4.2 Accommodation

The Construction Workforce will be housed in a purpose built camp. The location of this camp is still to be determined but it is likely to be located within 25 km of the mine.

The operations workforce of 350 is expected to comprise 60 personnel drawn from the region with the remaining 290 personnel being new. Initial work has indicated that these personnel could be accommodated as follows:

- 70 workers at the construction camp. This would accommodate mainly FIFO[2] / DIDO[3] personnel and provide an ability to quickly increase capacity and house overflow peak period personnel to meet mining needs or maintenance shut downs;
- 120 workers (family households with or without children) in a mixture of:
  - new three and four bedroom houses located on existing vacant Katherine and regional land;
  - existing (renovated if required) houses located in Katherine and regionally; and
  - subject to real estate availability at the time of the arrangement, a small contained development on Katherine land.
- 100 workers located in a Katherine based single person accommodation facility.

The ultimate accommodation strategy adopted will be developed following further discussions with local and territory government agencies.

For the decommissioning and closure phase, the 40 required workers would be housed in either the previous FIFO / DIDO accommodation or in the Katherine based single person accommodation.

4.5 Waste Management

4.5.1 Waste Rock Dump (WRD)

The existing WRD, located to the southeast of Batman Pit, will be extended. The WRD will be created in stages. To facilitate this ultimate plan, coffer dams will be constructed upstream of RP1.

The existing WRD comprises approximately 16 Mt of waste rock. The ultimate WRD dump will contain around 510 Mt of waste rock material, an addition of approximately 494 Mt. From its current area of 69 ha, the WRD will expand to around 217 ha. The current WRD is around 24 m high. The ultimate WRD design will be approximately 350 m high.

---

[2] FIFO: Fly In, Fly Out

[3] Drive In, Drive Out

The WRD will be constructed:

- to avoid grading of waste rock at the end of the mine-life;
- at an effective angle of 30^{o} (with interbench slopes of 34^{o});
- with eight metre wide benches constructed in lifts resulting in 30 m vertical intervals on the exterior faces; and
- with geosynthetic clay liner (GCL) covers spanning approximately 52 m on top of each lift, covering the eight metre bench and running below the subsequent lift.

A Waste Rock Management Plan (WRMP) will be developed that specifies how waste rock will be handled in order to maximise its beneficial use. The WRMP will include, but not limited to, the following provision for dust minimisation:

- vehicular speed limits on areas of unconsolidated or unsealed soil associated with the WRD;
- water spraying onto roads to suppress dust using a water cart;
- application of environmentally benign surfactants may be used on road surfaces to reduce the water demand for dust suppression;
- prompt mitigation of visible dust emissions from operations;
- sequential closure of inactive dump areas and faces as mining progresses.

The WRMP will also emphasise the implementation of operational techniques and dump designs that encourage clean water diversion, rapid internal surface runoff, and seepage control during operations and at closure.

In addition to the primary dump, additional waste will be placed to level out an area to the northeast of the waste dump and extend north around the crushing area. This area will be built to provide truck access to the crushing facility.

4.5.2 Tailings Storage Facility (TSF)

Thickened tailings will be generated from the ore processing plant. Over the estimated 15 year mine life, the Project will require a total of approximately 223 Mt of new tailings storage. Vista Gold proposes to store tailings in two facilities; the existing TSF1 to the northeast of the existing ore processing plant pad and a proposed new TSF2 in the valley southeast of TSF1 (Figure 2).

It is proposed to dispose approximately 62 Mt of tailings at the existing TSF1 in the first five to six years of production. TSF1 will be raised from 16 m above ground level to approximately 34 m. The embankment will be raised in six stages:

- Stage 1 – The design will involve a centreline raise type of construction. The thickened tailings will be discharged by spigots from the embankment crest to form a beach behind the embankment wall. The embankment crest will be composed of either fill or waste rock, and raised vertically; and
- Stages 2 to 6 – These will require upstream raise construction methods. The thickened tailings will again be discharged by spigots from the embankment crest to form a beach behind the embankment wall, driving the water pool to the west. The embankment crest will be raised upstream as material (fill or waste rock) for the embankment is placed on the tailings beach. Water will be removed from the water pool using the existing decant towers, which will be raised along with the embankment stages. The existing toe drain and under-drains will convey seepage water to the return water pond, where it will be pumped back to the impoundment.

Approximately four million tonnes of material is required for the construction of TSF1. This will be acquired through the mining of non acid forming waste rock from open pit mining operations.

On the west side of TSF1, two saddle dams (Saddle Dam North and Saddle Dam South) will be constructed concurrently with the Stage 2 embankment raise. These dams will be constructed using non acid forming waste rock. The design crest width for both the saddle dams is eight metres, with a final design crest elevation of 152.5 m.

The remaining 161 Mt of tailings will be disposed of in the new TSF2. TSF2 will be constructed over four stages commencing in year 4/5 of production. Stage 1 will be constructed entirely on native ground using bulldozers for clearing and grubbing. Soil will be salvaged from the footprint of TSF2 and temporarily stockpiled prior to construction commencing. Stages 2 through 4 will be constructed using embankment raise construction methods in order to contain the tailings deposited in the facility. Approximately 45 Mt of material is required for the construction of TSF2. This will be acquired through the mining of waste rock from open pit mining operations.

The ultimate height of TSF2 is approximately 60 m above ground level (RL175 m).

Thickened tailings will be pumped via a pipeline to the crest of the embankment and sub-aerial tailings deposition from spigot points along the crest. The tailings will form a consolidated beach along the crest, creating a water pool towards the centre of the facility. Water will be removed from the water pool using a floating barge with pumps and pipes to convey the reclaimed water back to the processing facilities.

TSF2 has been designed to operate as a zero-discharge facility, so all seepage from the underdrain, toe drain, and overdrain systems will be collected and pumped back to the impoundment during operations.

5. Existing Environment

Two key factors are important in the assessment of air quality impacts in the project region. These are the region's existing air quality and meteorology. Background concentrations of important air pollutants are required to carry out a cumulative impact assessment, while a good understanding of the region's meteorology is required to simulate emission plume transport and assess their ground level impact. Data used in the assessment is described in this section.

5.1 Climate Classification

The project area is situated between the Inter-Tropical Convergence Zone (ITCZ) and the Subtropical pressure ridge. There is a distinct wet and dry season with little variation in temperature throughout the year. Inland regions experience hot and dry air outside the wet season. Consequently, the region is classified as a Tropical Savannah climate.

5.2 Local Meteorology used in the Assessment

The project is located in a remote region of the Northern Territory and meteorological monitoring is not conducted in the immediate region. Consequently, site-representative meteorological observations suitable for use in dispersion modelling were unavailable and to provide data for the assessment, the prognostic meteorological model TAPM (The Air Pollution Model) was used to simulate regional and local flows.

5.2.1 Meteorological Modelling

A one-year meteorological dataset representative of the project area and suitable for input to the AUSPLUME dispersion model was simulated using TAPM.

TAPM (version 4) was developed by the CSIRO Marine and Atmospheric Research Division and is a desktop computer based prognostic meteorological modelling system that can predict regional-scale three-dimensional meteorology. It is suitable for use with complex geographical sites and/or when the available site representative meteorological data are not adequate for use in air quality assessment.

The model can be used with no local surface meteorological data and, instead, can be initiated with synoptic weather analyses from the United States Global Forecasting System (GFS) that is regularly used in Numerical Weather Prediction to provide global weather forecasts. TAPM provides the link between the synoptic large-scale flows and the local meteorology, which in this case includes such phenomena as broader scale terrain wind channelling. Any surface observations can optionally be partially assimilated into the predicted flow field.

The performance of TAPM to simulate regional meteorology was evaluated against Bureau of Meteorology (BoM) observations at the Tindal and Pine Creek monitoring stations. This evaluation found that the distribution of modelled wind speed and direction are generally in agreement with the observations. These sites were selected for comparison as an assessment of the BoM data found that they were more regionally representative and suitable for evaluating the performance of TAPM than the monitoring sites located closer to the Mt Todd site.

5.2.2 Model Configuration

Synoptic data for the 12-month period between September 2007 to August 2008 was used to initiate TAPM. This year was chosen as it experienced near average regional rainfall and captured one full representative wet season. TAPM was initially configured with a nested model grid coverage designed to capture:

- broad scale synoptic flows;
- regional and broader scale land breezes;
- regional and broader wind channeling around terrain features; and
- the influence of land use.

The nested grids were then configured with the surface characteristics, such as terrain elevation; surface roughness/vegetation type; soil type and monthly varying (initial) deep soil moisture content.

The terrain elevation data, at a 9-second (300m) resolution, was obtained from Geoscience Australia. The characterised vegetation and land use was determined from the use of aerial photographs in conjunction with the datasets provided within the model. Soil type information was derived from the default US Geological Survey dataset provided with the model.

Deep soil moisture content was varied to reflect actual rainfall during the year (Table 4). The wet season, based on meteorological records for the region, was determined by an experienced meteorologist to have begun on 1 December 2007 and to have finished on 11 March 2008. In this period the region experienced persistent rainfall events. As a result, the initial deep soil moisture content was increased for the months December to March to take into account the persistent intake of moisture. It should be noted that when modelled, the wet season conditions were applied to the whole of March as the extensive rainfall in the preceding three months would result in wet soils for some time after the rain stopped. The build-up to the wet season for the examined period was found to occur during November, when rainfall events were present, but not consistent. Similarly, in April the soil holds some residual moisture from the wet season. The initial deep soil moisture content is increased slightly in these months to reflect this.

Table 4 Initial Deep Soil Moisture Content – Input into TAPM

Month	Initial Deep Soil Moisture Content, m^3/m^3 (volume of water per volume of soil)	Modelled Season
September	0.15	Dry
October	0.15	Dry
November	0.2	Onset Wet
December	0.4	Wet
January	0.4	Wet
February	0.4	Wet
March	0.4	Wet – transition
April	0.2	Dry
May	0.15	Dry
June	0.15	Dry
July	0.15	Dry
August	0.15	Dry

Other specific model settings were as follows:

- 4 nested grids at 1000 m, 2000 m, 6000 m and 18,000 m resolution;
- 25 vertical levels, ranging up to 8000 m;

- 60 x 60 grid points;
- surface vegetation and precipitation processes included (snow processes and non-hydrostatic processes were excluded).

At the completion of the TAPM run, hourly varying surface winds, temperatures and atmospheric stability were extracted at the mine site. For the purpose of validation, the same information was also extracted for the locations of RAAF Base Tindal AWS and Pine Creek, where there is comparable meteorological data recorded by the BoM. BoM station data, as opposed to other sites, is of sufficient quality and known to be measured to the appropriate Australian Standards for an accurate assessment to be completed.

5.2.3 Meteorological Model Evaluation

Overall, the TAPM model provided a good representation of the meteorology in the project region. Wind directions and speeds are generally in agreement with both the Tindal (AWS site 014932) and Pine Creek (AWS site 014960) observations obtained from the BoM. This can be seen in Figure 5 and Figure 6.

Some subtle differences between the modelled data exist but these are not likely to influence the findings of the impact assessment that is based on the highest ground level concentrations under worst case meteorological conditions. As shown in Table 5, the predicted wind speed at Tindal AWS varies from the corresponding BoM measured values by less than three per cent.

At Pine Creek, wind speed and direction is measured once daily at 3pm. Notwithstanding the single spot reading each day, TAPM overpredicts wind speed at Pine Creek by ~ 65 per cent.

Table 5 Mean Wind Speed Comparison

Site	BoM Observations	TAPM Modelled
Tindal	2.84 m/s	2.76 m/s
Pine Creek (3 pm)	2.12 m/s	3.52 m/s

The frequency of observed winds from the east-southeast is higher than in the TAPM data where the winds are of higher frequency from the southeast.

During the wet season, the wind direction is more varied in the observations compared to TAPM at Tindal. However, the wind direction is confined to the same quadrant (the northwest).

5.2.4 Wind Climate and Atmospheric Stability

The predicted annual distribution of winds at the mine site based on the TAPM simulation is illustrated in Figure 7. This wind rose shows the prevailing wind to be from the southeast quadrant. Winds from the southeast comprise 20 per cent of annual winds, followed in frequency by winds from the east-southeast (19 per cent). This pattern reflects the easterly trade winds experienced at this latitude of the southern tropical belt.

The incidence of light winds, which give rise to poor dispersion of emissions released at ground level, is also highest from the southeast. These winds comprise 19.5 per cent of winds in the less than 2.1 m/s category. The average wind speed, based on the TAPM modelling at the mine site was 2.46 m/s.

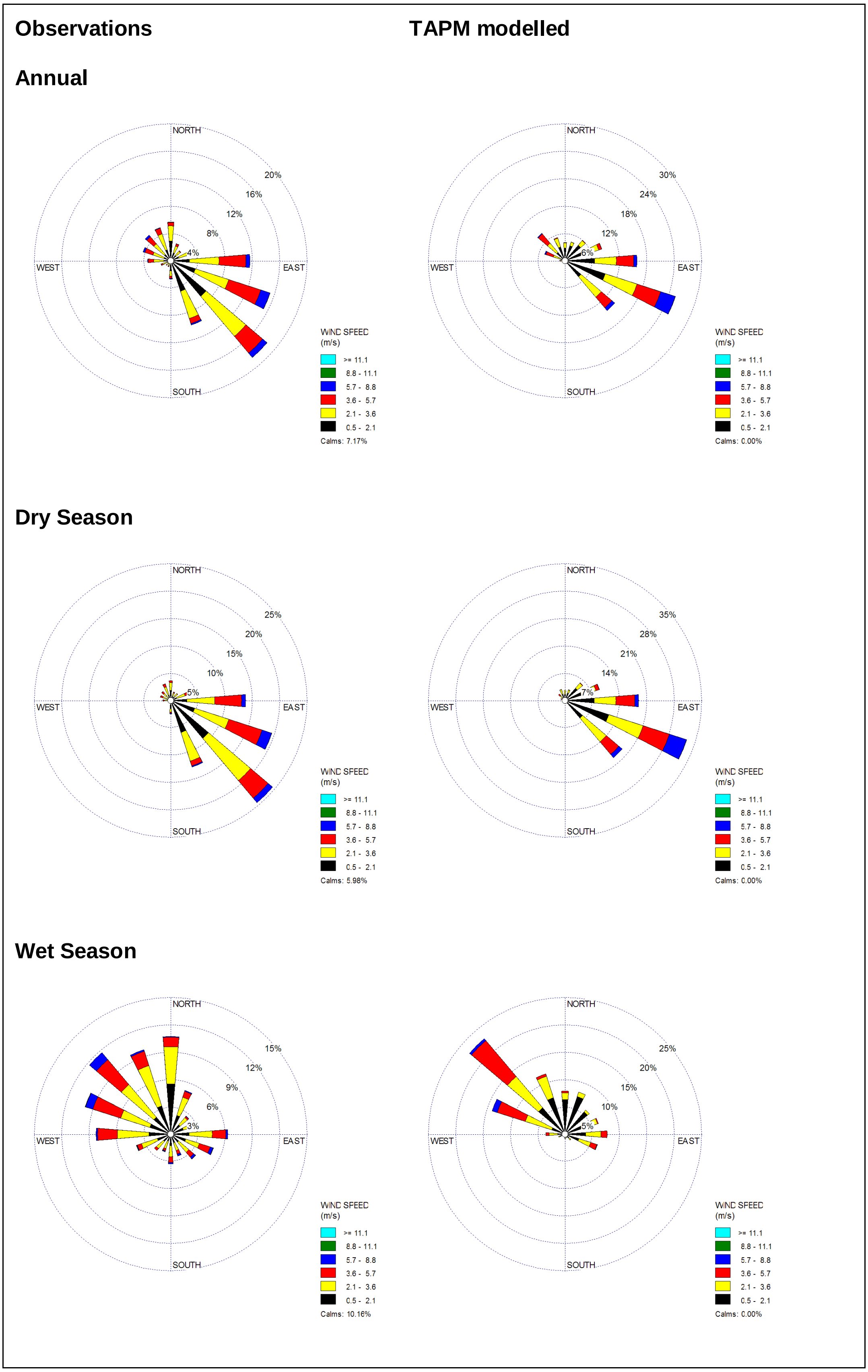
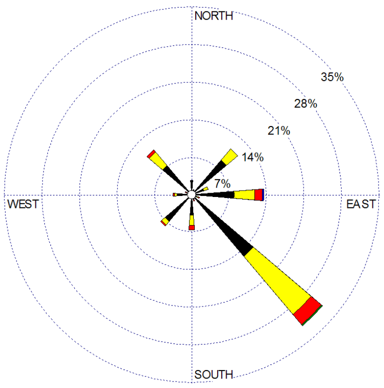


Figure 5 Comparisons of Predicted and Observed Distributions of Wind at Tindal

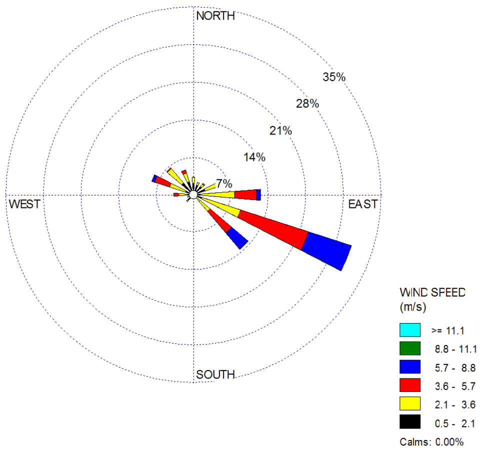
Observations
(8-pt compass only)

TAPM modelled
(16-pt compass)

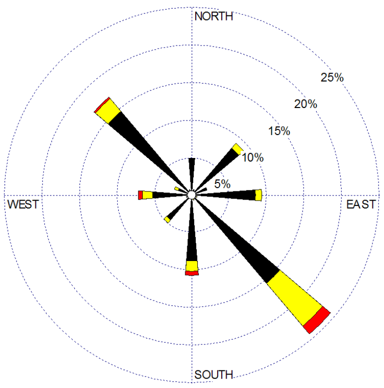
Annual 3 pm



Annual 3 pm



Annual 9 am



Annual 9 am

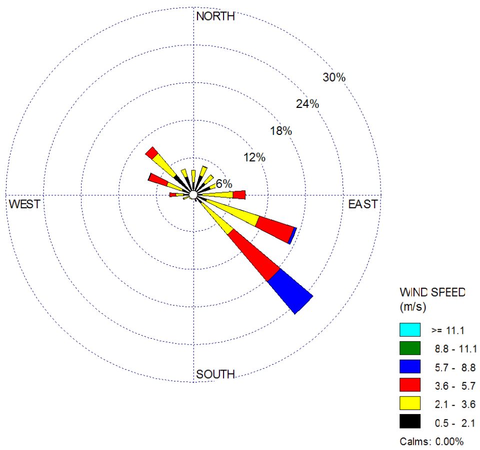


*Figure continued on next page.

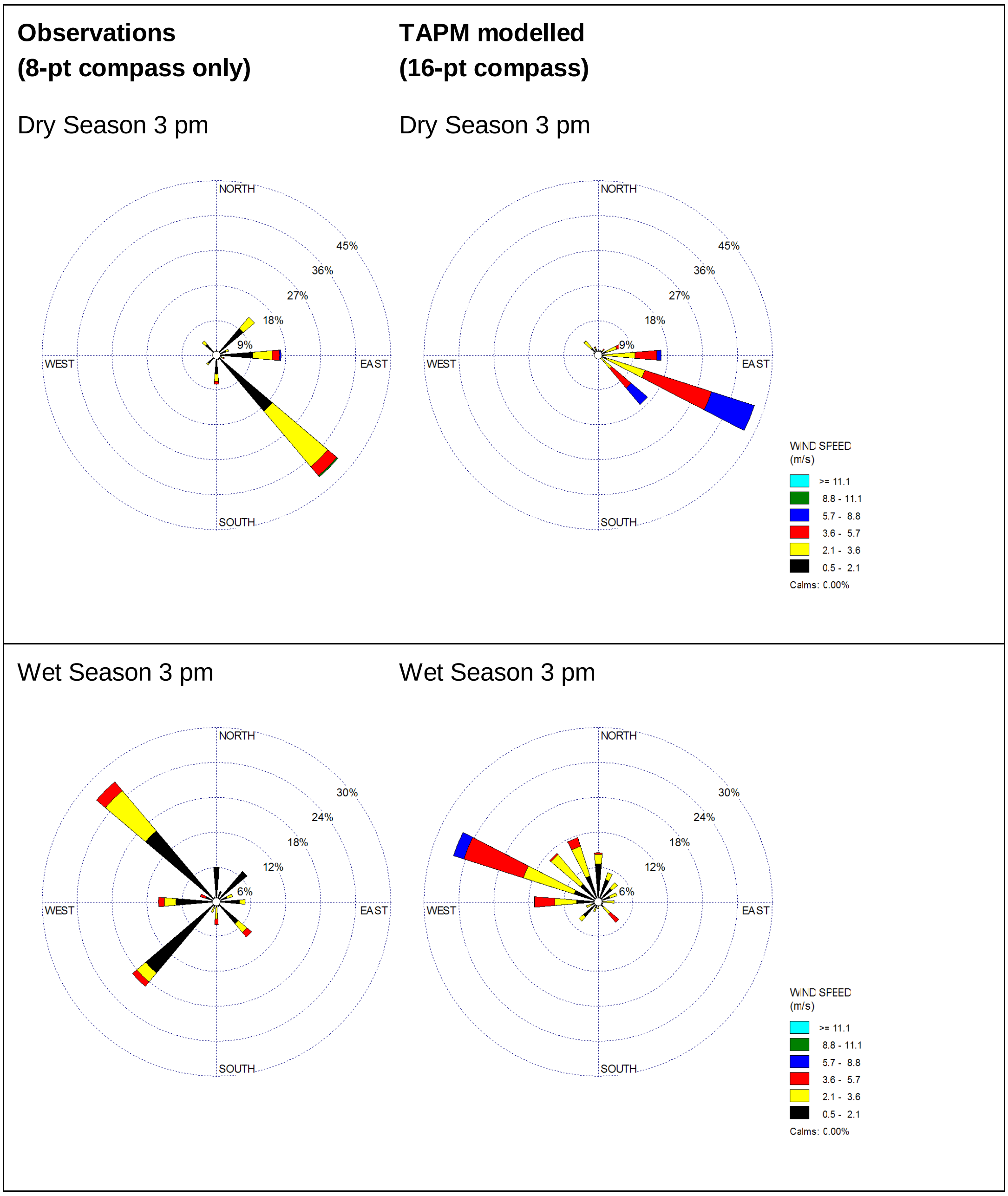


Figure 6 Comparisons of Predicted and Observed Distributions of Wind at Pine Creek

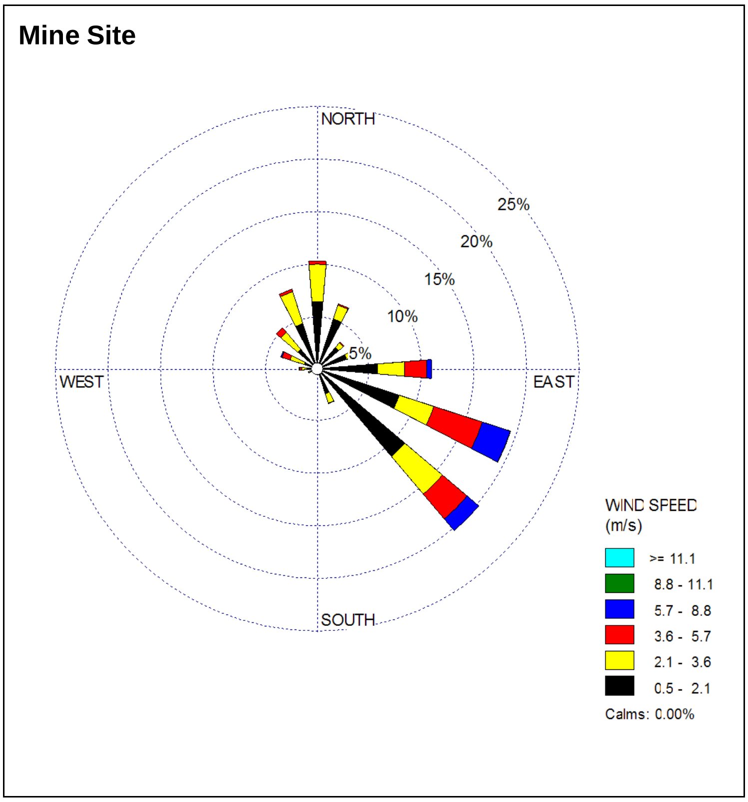


Figure 7 Predicted Annual Distribution of Winds at the mine site (TAPM simulation September 2007 to August 2008)

Seasonal Variation in Wind Climate

There is a clear distinction in incident wind direction between the wet and dry season shown in Figure 8. During the wet season the Australian Monsoon dominates synoptic flows altering the prevailing wind to be from the northwest. Synoptic flows during the dry season are characterised by the east to southeasterly Trade Winds.

Atmospheric Stability

Atmospheric stability dictates how effectively and efficiently a plume will disperse. The Pasquill/Gifford scale of atmospheric stability consists of six stability classes. Classes A, B and C represent strongly, moderately and slightly unstable atmospheres, respectively. These conditions only occur during daylight hours and are normally associated with increasing levels of solar radiation combined with decreasing wind speeds. For example, strongly unstable atmospheric conditions (A Class) will typically occur around midday when solar radiation levels are high, with no or little cloud cover. They will also occur during high solar radiation conditions with light wind speeds. Should the wind speed increase during A class conditions, the stability class is likely to transition from A through to C with wind speed increases. Under unstable conditions the dispersion of ground level emissions is efficient due to convective turbulent vertical mixing; thereby lowering predicted ground level impacts. However, elevated plumes from stack emissions are also vertically mixed by atmospheric convection and as such, high ground level impacts can result.

Category D classifies a neutral atmosphere where there is minimal solar induced convective mixing. These conditions typically occur during overcast daylight and night time hours or when wind speeds are high. Dispersion of both stack and ground based emissions are dominated by mechanical mixing of the Earth’s atmosphere.

Stability classes E and F represent slightly and moderately stable atmospheres respectively. Stable conditions will generally develop at night, under clear skies and with light to moderate wind speeds. Such conditions are often coupled with ground based, radiation forced temperature inversions (where the air at ground level is cooler than that above it), sometimes with mist or fog events. In a stable atmosphere (categories E and F), dispersion is poorest for ground based sources as vertical mixing of air is suppressed. This can result in higher downwind plume concentrations to that compared to similar emissions under unstable conditions. Conversely, elevated plumes from stack sources released above an inversion layer or with sufficient vertical momentum to penetrate an inversion layer are very unlikely to reach ground level unless they encounter rare events such as rain or showers producing wind downdraughts. It is commonly stable conditions that result in off-site impacts at a maximum range.

The modelled annual distribution of atmospheric stability for the data set is depicted in Figure 9. The following features are evident:

- Stability class D (neutral) is the most frequently experienced atmospheric condition and occurs for 38 per cent of the time;
- Stable classes E and F combined comprise 34 per cent of atmospheric condition; and
- The highest incidence of E and F conditions occur during winds from the southeast.

A seasonal analysis of atmospheric stability and wind direction indicates that the highest incidence of stable conditions corresponds to the change in prevailing wind (Figure 10) due to the wet season.

Dry Season

Wet Season

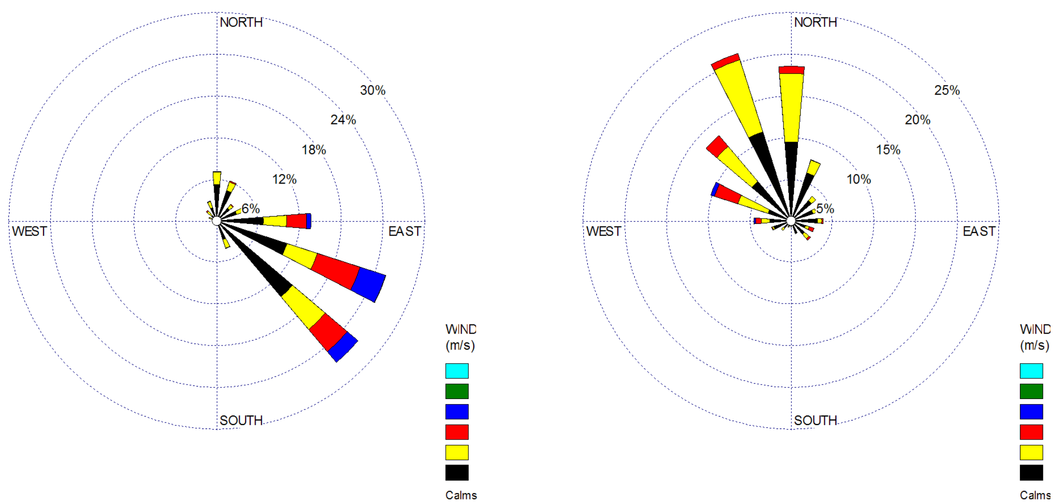


Figure 8   Predicted Seasonal Distribution of Winds at the mine site

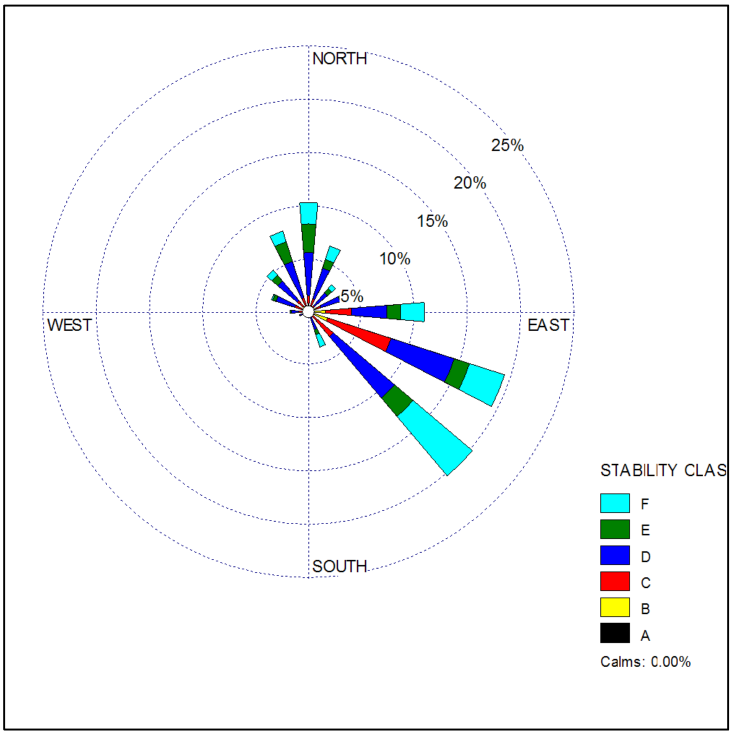


Figure 9 Predicted Annual Distribution of Atmospheric Stability by Wind Direction at the Mine site

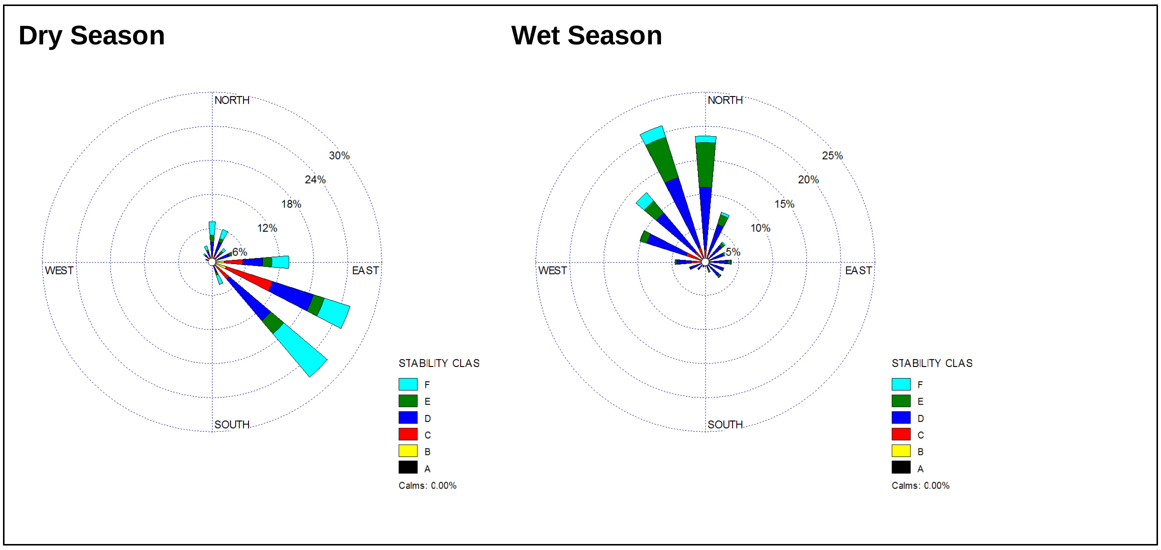


Figure 10 Predicted Seasonal Distribution of Atmospheric Stability by Wind Direction at the Mine site

5.3 Existing Ambient Air Quality

The assessment of criteria air pollutants, such as particulate matter, is made by comparison of ground level concentrations of emissions associated with the project combined with existing pollutant background concentrations against the air quality standards. Consequently, it is important to understand the background air quality at the mine and the location of sensitive receptors. This provides for the assessment of the potential total exposure of receptors to air pollutants as well as the incremental increase above background levels generated by the project.

The project is situated in a sparsely populated rural area primarily consisting of scrubby vegetation with the nearest urbanised areas, Katherine and Pine Creek, located more than 50 km to the south-southeast and northwest, respectively. The main naturally occurring sources of dust in the region are smoke from low temperature scrub fires, wind erosion of large areas of sparsely vegetated exposed ground and sealed and unsealed roads. Other dust sources in the project area include the wind erosion of existing non-operational facilities such as the heap leach, waste rock dump and tailings pond. Ambient concentrations of other air contaminants including combustion products, that are generally associated with urban development, motor vehicles and industry, are expected to be very low.

The most important air contaminant associated with the construction and operation of open-cut mining projects is particulate matter (as dust), generated through the extraction, handling, transfer, storage and processing of bulk material such as overburden, ore, waste rock, tailings and soil. Dust is assessed in various size fractions and applies to all dust generated. The dust is assessed against human health protection criteria as airborne ground level concentrations (i.e. within the human breathing zone between the ground surface and approximately two metres above the ground) and amenity criteria as dust deposited on surfaces.

A power plant comprising a gas turbine and two gas-fired reciprocating engines is also proposed for development. Combustion emissions from the plant will contribute to a relatively small local increase in ambient concentrations of NO_2 and CO and trace quantities of $PM_{2.5}$ and VOCs. Notwithstanding this, the location of the plant is remote and well separated from other similar sources of pollutants and regional ambient air quality is not expected to be altered from that of the existing rural setting.

Particulates are commonly monitored in three size ranges:

- less than 2.5 micron fraction ($PM_{2.5}$);
- less than 10 micron fraction (PM_{10}); and
- Total Suspended Particles (TSP).

All particle size ranges are capable of being suspended in ambient wind. TSP is generally considered to describe a particle size of less than 50 µm. Larger particles contribute most to potential nuisance, while the finer particles (PM_{10} and $PM_{2.5}$) can present a health issue. The most important size fraction of the particulate load generated in both the ambient environment and by the project is PM_{10} and $PM_{2.5}$.

Dust levels in the ambient environment are expected to be variable due to a range of factors from climatic conditions (wet and dry seasons, wind speed and direction to and from sources to receptors), and the movement of people in the region including tourists (270,000 in 2007) during the dry season. Vehicle movement along the sealed Stuart Highway will generate some wheel dust and vehicle exhaust emissions in the area and contribute a small amount to background levels of particulate matter. Furthermore, some minor wheel generated dust is likely to be produced by tourists travelling along the Edith Falls Road during the dry season.

5.4 Background Dust Concentrations used in the Cumulative Impact Assessment

Ambient air quality performance monitoring in accordance with the requirements of the *National Environment Protection Council Act 1994* is not required in the Mt Todd region as the population is less than 25 000 people. In addition to this, regional ambient air quality has not been monitored by the Northern Territory environmental regulator or by the previous mine operator.

The *National Environment Protection (Ambient Air Quality) Measure 2003* (Air NEPM) provides guidance on the monitoring and assessment of criteria air pollutants, including the promulgation of national air quality standards but stops short of providing guidance on the determination of representative background air quality for use in cumulative impact assessment and in instances where no regionally-specific data are available. Notwithstanding this, the *Victorian State Environment Protection Policy (Air Quality Management*) (SEPP(AQM), 2001 does provide such guidance. It states that the 70th percentile of one year's observed hourly concentrations may be used as a constant value to represent background in numerical modelling.

PM_{10} and $PM_{2.5}$ levels at Casuarina in the Northern Territory are monitored annually. The average of the 75th percentile for years 2004 to 2009 is given in Table 6. As these levels will be marginally higher than the 70$^{\mathbf{th}}$ percentile values, they are used here to infer background particulate levels for Mt Todd. While the Casuarina monitoring location is situated nearer to the Darwin urban area, it is considered to be a suitable, though conservative, representation of ambient background levels of particulate matter for use in the impact assessment. In the absence of monitoring data for TSP, a value of 42 $\mu g/m^3$ has been adopted. This concentration is based on measurements in other Australian airsheds where the ratio of ambient concentrations of TSP to PM_{10} is 2:1.

Table 6 Ambient Background Concentrations used in the Assessment

TSP	PM_{10}	$PM_{2.5}$
42	20.8	11.2

Units are in $\mu g/m^3$.
Data sourced from Charles Darwin University Casuarina and calculated from Northern Territory Air Monitoring Report 2009.
Average 75th Percentile Daily Peak Concentration Particulate Levels

5.5 Sensitive Receptors and Surrounding Land Uses

The areas surrounding the mine site are rural and sparsely populated, with the nearest identified community residing as Werenbun. The Stuart Highway (the main arterial road in the region), is located west of the mine site. Figure 1 depicts the current land use around the mine site.

A sensitive receptor may be defined as any location where people reside or are present for an extended period of time. This may include any of the following:

- A dwelling, mobile home or caravan park or other residential premises;
- a motel, hotel or hostel;
- a kindergarten, school, university or other educational institution;
- a medical centre or hospital;
- a place of worship;
- a protected area;
- a public park or gardens;
- a commercial place or part of the place potentially affected.

The nearest sensitive receptor to the project area is the Werenbun Community situated approximately 6 km to the southeast (upstream of the Edith River located to the immediate south of the mine site). The location of an accommodation camp has not yet been selected. However, it is likely to be situated up to 25 km from the project area.

In addition to sensitive human receptors, a population of the endangered Gouldian Finch has been identified as an inhabitant of the Yinberrie Hills area to the west of the Batman Pit (NSR, 1992, p.81-84). While no specific impact assessment criteria for particulate matter has been developed for this species, the impact of dust emissions associated with the project on this species has been considered.

6. Air Quality Assessment Criteria

The Northern Territory government has not published any guidance or objectives for the assessment of air quality in the territory. In the absence of state or territory-specific environmental protection regulations, suitable air quality assessment criteria and guidance have been sought from other national and state legislation. In this case, and in accordance with the requirements of the Commonwealth *National Environment Protection Measures (Implementation) Act 1998*, air quality standards for criteria air pollutants promulgated under the Air NEPM (2003) have been adopted for the assessment.

The Air NEPM standards have been used to assess the potential for impacts of PM_{10}, $PM_{2.5}$, NO_2 and CO. In addition to the lack of state and territory-specific air quality criteria, where the Air NEPM has not published air quality assessment criteria for a substance, assessment criterion may be adopted from another national or international jurisdiction. For this assessment, the NSW Office of Environment and Heritage (OEH) impact assessment criteria for TSP and deposited dust have been used. The EPA Victoria *Mining and Extractive Industries Protocol for Environmental Management 2007* (EPA Victoria, 2007) assessment criteria for $PM_{2.5}$ and PM_{10} have also been referenced.

The air quality assessment criteria used in the dust impact assessment have been determined and promulgated to protect human health and well-being, and to minimise the loss of amenity and the causation of nuisance affects. Objectives for protecting terrestrial flora and fauna and aquatic environments have not been specifically derived and published. Consequently, the air quality criteria identified for use in this impact assessment apply specifically to the protection of human receptors. Air quality criteria appropriate for use in the protection of the Gouldian finch and its identified area of habitat, for example, have not been identified in this assessment. Issues regarding Gouldian finch habitat are addressed in more detail in the flora and fauna chapters of the EIS.

The air quality standards and impact assessment criteria used in the assessment are presented in Table 7.

Table 7 Air Quality Standards and Impact Assessment Criteria used in the Assessment

Indicator	Air Quality Standard [a]	Impact Assessment Criterion [b]	Intervention Level [c]	Averaging Time
PM_{10}	50 µg/m³	50 µg/m³	60 µg/m³	24-hour
$PM_{2.5}$	25 µg/m³		36 µg/m³	24-hour
TSP	N/A	90 µg/m³	N/A	Annual
Deposited dust	N/A	Total: 4 g/m²/month Incremental: 2 g/m²/month	N/A	Annual
NO_2	226 µg/m³ 56 µg/m³	N/A	N/A	1-hour Annual
CO	10,260 µg/m³	N/A	N/A	8-hour

a. Ambient Air Quality NEPM

b. NSW DECCW criterion

c. EPA Vic. Mining PEM

N/A: Not applicable

7. Air Emissions

The generation of dust emissions is dependent on the intensity of mine construction and operations and the volume of material to be extracted, handled and processed. For this reason it is necessary to define the expected construction and the ongoing mining operations at the site, which include, but are not limited to:

- details of project activities including sequencing and timelines;
- vehicle and plant type;
- patterns of movement and shift timing; and
- power station emissions.

Given the evolving nature of mine planning, this assessment is based on a selected mine stage that represents the worst potential impact due to estimated maximum emissions.

7.1 Emission Sources and Pollutants

7.1.1 Construction Emissions

As discussed in section 5.3, the most important air pollutant emitted during mine construction, including the mine pit, ore processing plant and conveyor system, is anticipated to be dust (TSP, PM_{10}, and $PM_{2.5}$) due to the disturbance and clearing of land. Refer to section 4.1 for more detail regarding construction activities.

In addition to particulate matter, minor quantities of vehicle, mobile and fixed plant exhaust emissions during the construction phase, such as NO_X, CO and trace quantities of VOCs, are expected to have a negligible impact on regional air quality. This is due to the several factors including the short-term, transient and spatially variable location of emission sources, the paucity of sensitive receptors in the region, the separation of sensitive receptors from the emissions sources and the low background concentrations of gaseous pollutants.

Activities which will generate emissions during construction of the Mt Todd mine include, but are not limited to:

- hazard or ‘fuel’ reduction burning;
- excavating and levelling of disturbed surfaces;
- handling and localised stockpiling of soil and overburden;
- localised welding, cutting and grinding (includes fumes);
- vehicles driving on unsealed roads and unconsolidated soil surfaces including delivery of materials;
- blasting;
- wind erosion of exposed unstable soil and stockpiles; and
- power plant emissions (particulates and fumes).

7.1.2 Operational Emissions

Mining Operations

In a similar manner to that of construction emissions, the most important emissions associated with the mine's operation will be dust generated by many different processes. These include, but are not limited to:

- wind erosion of unconsolidated exposed and open surfaces, including stockpiles;
- hazard or 'fuel' reduction burning;
- overburden removal;
- loading ore onto haul trucks;
- wheel generated dust from vehicles on unpaved roads (mine haul roads);
- wheel generated dust from vehicles on paved roads (access roads and ore processing area);
- dumping of ore at ROM (run of mine) pad stockpile;
- primary and secondary crushing;
- screening;
- conveyor transfer points between different process stages;
- motor vehicle exhaust; and
- heating and power generation.

Tailings Storage (TSF)

During operation, the moisture content of the mine tailings in storage facilities TSF1 and TSF2, as detailed in section 4.5.2, is expected to result in negligible dust emissions. While the drying of the TSF material may produce a hard crust on the surface by the end of the dry season, dust emissions from these areas are expected to remain very low as the surface will not be mechanically disturbed.

Dust emissions during the construction and/or modification of the TSFs are assumed to be caused by bulldozer operations. Dust emissions generated through wind erosion of exposed surfaces will be minimised using dust management practices to be outlined in the site Dust Management Plan. Dust management techniques may comprise the use of water sprays and the re-vegetation of exposed surfaces, as discussed further in section 12.

Based on supplied information and site drawings, the construction of an expanded TSF1 and a second TSF (TSF2) is to be undertaken in stages by increasing the height of the earth dam wall as additional capacity is required. Dust emissions associated with this process were estimated based on a bulldozer operating during daytime hours (i.e. 6 am to 6 pm) and the unloading of waste rock from the pit to build up the TSF walls.

Power Generation

On site power will be generated from a single gas-fired turbine and two gas-fired reciprocating gas engines (section 4.3.1). The key combustion related air pollutants emitted from the power plant are NO_X (as NO_2) and CO. Emissions of fine particles ($PM_{2.5}$) and VOCs are expected to be negligible and contribute only a very small fraction to the ambient environment. Consequently, the assessment of potential air quality impacts associated with the power station has focussed on emission of NO_2 and CO.

7.2 Conditions for Worst Case Dust Emission Generation

The assessment of potential impact to air quality associated with the project has been based on emissions estimated under worst case dust generation conditions. Air quality criteria are designed to assess impacts of the maximum allowable emissions.

Worst-case dust generation and impact is most likely to occur under the following conditions:

- when rainfall is at a minimum (dry season);
- construction or operational activities are at a peak; with
- additional particles from vegetation burning (higher regional background levels); and
- when winds are light and stable, leading to poor dispersion of dust emissions from operational activities; or
- when winds are stronger and hence able to both:
  - generate higher emissions through dust lift-off; and
  - transport larger particles for a greater distance before settling.

When two or more of these conditions coincide there is potential for dust emissions to cause an impact beyond the boundary.

7.3 Considerations and Assumptions in Emission Inventory Development

An air emissions inventory of dust and other gaseous constituents for the Mt Todd mine and power plant was developed for the first 10 years of production with the year of maximum production and worst case potential for dust generation determined to be year 3 of the mine plan. This inventory is summarised in Table 8. For the mine during the operational phase, total dust emissions were estimated according to the mining process and activity rates outlined in Section 4, published emission factors for mining and based on a nominal total quantity of earth moved of 102.169 Mt. Emissions factors were sourced from the following documents:

- NPI Emission Estimation Technique Manual for Gold Ore Processing Version 2.0 EETM NPI, Dec 2006;
- NPI Emission Estimation Technique Manual for Mining Version 3.1 EETM NPI Jan, 2012;
- US EPA AP-42, Heavy Construction Operation Guideline[4] (Section, 13.2.3, AP-42); and
- NPI Emission Estimation Technique Manual for Combustion Engines Version 3.0 EETM NPI Jun, 2008.

$PM_{2.5}$ emissions are not calculated directly from the NPI Emission Estimation Techniques Manuals (EETM). Alternatively they are calculated from the particle size distribution ratios for three identified distinct dust generation sources. The $PM_{2.5}$ distributions are detailed in section 8.5, and indicate that the ratio of $PM_{2.5}$ to TSP size fractions varies from 0.16 to 0.08 depending on the source.

Calculations for the emissions inventory are detailed in Appendix A.

Estimated dust emissions are directly proportional to the total amount of material extracted and moved through the process. The inventory indicated that total annual emissions of PM_{10}, accounting for the application of dust emission controls, was highest in year 3 and at least seven per cent higher than the second highest year. This estimate is based on a static nominal

[4] AP 42, Heavy construction operation guideline. www.epa.gov/ttnchie1/ap42/ch13/final/c13s02-3.pdf

mine plan and does not take into account the year-to-year variations based on the different stages of construction of the Tailing Storage Facilities and other augmentations of the mine plan. In addition, the overall project footprint including waste rock dump is likely to have a similar size footprint to the year modelled, with the exception of the mine pit.

Minor dust emission sources and sources that can be minimised using standard practice emission controls that were considered to contribute only a negligible proportion of total emissions were omitted from the inventory for assessment. Sources that were omitted included the construction of temporary facilities, permanent workshops, offices and pipelines. Drilling emissions were considered negligible due to the high level of dust mitigation that has become standard practice in the industry. Emissions associated with the HPGR were found to be minor as the belt feeds directly into the HPGR rather than entering via a transfer point[5] and dust emissions generated from paved roads were also omitted as the amount generated is negligible by comparison to emissions from unpaved roads and other mining operations.

Table 8 Estimated PM_{10} annual emissions for the first ten years

Production Year	Total Mined Earth Mined (Mtpa)	Total Ore Processed (Mtpa)	Estimated Annual PM_{10} Emissions (tonnes per year)
1	61.9	17.80	1,893
2	76.3	17.75	2,144
3	102.2	17.75	2,569
4	89.9	17.75	2,376
5	87.4	17.80	2,315
6	78.8	17.75	2,212
7	59.2	17.75	1,891
8	52.6	17.75	1,776
9	49.4	17.80	1,718
10	52.2	17.75	1,738
Average	71.0	17.76	2,063

The distribution of material moved around the mine site during Year 3, and used in the development of the emissions inventory, is summarised in Table 9.

Table 9 Year 3 Mining Schedule

Material Component	Year 3 (Mt)
Total Earth Moved	102.169
Total Ore Mined	23.971
Total to Processing Plant	17.750
Total To Ore Stockpile	6.191
Total to Waste or TSF construction	78.227

The emission inventory and dispersion model configuration was based on the following assumptions. These assumptions have been developed from process information supplied by Vista Gold and described in Chapter 2 of the EIS.

- Wind erosion of exposed areas and stockpiles was only considered for the dry season;
- Wind erosion was assumed to be wind speed dependent based on a total annual emission rate re-distributed as a function of the wind speed;

[5] Mt Todd Gold Project Engineering and Cost Study pg 8 AUSENCO Appendix E

- Water spray controls were applied to the loading, unloading and wind erosion of stockpiles. A control factor of 50 per cent was applied to the uncontrolled emissions of these sources as per the NPI Mining EET (2012, p.21) guidance;
- Blasting frequency, area and depth were developed in reference to assumptions made in previous projects. Emissions were calculated from a worst case assumption of blasts occurring everyday covering an area of 2,000 m^2 and a depth of 10 m. This allows the determination of predicted maximum daily impacts to be made accurately, without missing days. Blasting was assumed to be undertaken daily at 8 am, however, this will be confirmed during detailed mine plan development. Furthermore, any differences in predicted 24-hour average ground level concentrations of dust are expected to be negligible if blasting was to occur at other times of the day. An hourly variable emissions file was used to model blast emissions with the dust emissions for all hours except for the blast hour (hour 9 each day) set to zero;
- The assessment does not take into account any emissions from processing beyond the fine screening stage just prior to grinding and classification;
- It was assumed that all ore will be processed by the primary crusher, with 20 per cent of ore undergoing secondary crushing and coarse screening twice. Similarly, 20 per cent of HPGR ore was assumed to undergo screening for a second time[6];
- A dust emission control efficiency of 70 per cent was applied to the primary crushing, secondary crushing, screening and conveyor transfer operations. This was considered to be a conservative value as Vista Gold has not yet indicated whether water spraying or dust collection to a wet scrubber or fabric filter (i.e. a control efficiency of 99.5 per cent) would be used as the control method;
- The NPI (2012, p.62) dust emission estimation equation for primary ore crushing assumes an ore moisture content of at least four (4) per cent. The moisture content of the Mt Todd ore entering the primary crusher was considered to be relatively high at approximately 10 per cent. It is assumed that this will be achieved in the process by the application of water sprays should the ore moisture at any particular time fall below this level. During the wet season, it is expected that the ore moisture content would be higher than during dry season periods;
- The HPGR will operate without air conveying or classification. It is assumed that adequate controls will be applied to suppress at least 99 per cent of the potential dust;
- Pit retention factors of 5 per cent for PM_{10} and 50 per cent for TSP were applied to all processes which will occur in the mine pit as per the NPI (2012) guidance. Affected processes include blasting, loading mined material, wind erosion and haul road dust. The NPI (2012) equations do not have variable pit retention factors based on pit depth. It is conservatively (and simply) assumed that pits of 5 or 500 m deep will have the same retained amount of dust;
- Due to a lack of site-specific information, haul road dust emissions were calculated using the default surface silt content of 10 per cent and surface moisture content of 2 per cent (NPI, 2012). These assumptions, particularly for silt content and moisture content during the wet season, are considered to be conservative and provide an overestimation of haul road dust emissions;
- Emission mass rates from area sources were determined based on the appropriate emissions inventory data;

[6] Revision B Vista Gold Corp- Mt Todd Gold Project, Engineering and cost study – 11Mt/y option study 17 December 2010, Pg 8

- ROM, LGO stockpile and WRD areas were assumed fixed and at a maximum size estimated from the corresponding areas designated for year 12 operations. The specific emission rate (in $g/s/m^2$) was changed based on the emission inventory specific for that year of operations;
- Haul routes were conservatively calculated from the proposed works with details provided in Appendix A;
- Dust emissions from light vehicles were considered negligible and were not modelled;
- Dust from sealed road surfaces was not modelled as the application of the NPI (2012, p.21) emission control factors for the mitigation of dust emissions on sealed haul roads provides a control factor of 100 per cent;
- Emissions for screening and transfer points within the ore crushing circuit were modelled as individual units as each of the units are connected by long conveyors – greater than 100 m. However, unloading the crusher or screen unit to a conveyor was included in that unit's emission factor in accordance with NPI (2012, p.62);
- Operational wind erosion emissions from the TSF were considered as negligible;
- A maximum dust emission control efficiency factor of 90 per cent was assumed for the unpaved haul roads. This emission control efficiency is based on the work of Kinsey and Cowherd (Buonicore and Davis, 1992, p.144) that showed that dust emissions from unpaved roads can be reduced by greater than 90 per cent by using chemical stabilisation. The chemicals generally have a petroleum resin basis, and need to be regularly re-applied. These generally do not have any adverse effects on the local environments; however, the specifics of each chemical should be assessed on a case-by-case basis prior to application;
- Loading of the re-claim stockpile was assumed to be undertaken with the application water spray controls to provide a nominal 50 per cent dust emission control efficiency. Dust emissions associated with a greater level of control, such as that achieved using a telescopic chute and variable height stacker were not modelled but will be considered during the detailed design phase;
- Water spray controls were assumed for truck unloading at the ROM and LGO stockpile. This gives a nominal 50 per cent reduction (NPI, p.21); and
- No dust controls were applied to the unloading of haul tracks at the WRD and TSF1 construction areas. As the areas of these sites are large, it is unreasonable to assume that water sprays can be applied to every variable location that a truck unloads.

Estimated maximum dust emission rates for mine operations in Year 3 are presented in Table 10. The calculation of the emission rates is detailed in Appendix A. The inventory indicates that during peak production periods, wheel generated dust comprises approximately 50 per cent of total annual PM_{10} emissions. The only other single source to exceed 10 per cent of the total inventory was unloading waste rock to the waste rock dump (11 per cent).

Construction of TSF1 will be undertaken during year 3 and therefore dust emissions have been estimated and assessed. The TSF2 is not scheduled to have construction commenced until year 5 of operations and consequently, it has not been included in the assessment of year 3 emissions. Emissions from the operation of one continuous bulldozer and the corresponding unloading of waste rock from the pit for its construction have been modelled. Unpaved haul road emissions associated with the movement of haul trucks transferring waste rock from the pit to TSF1 for construction have also been modelled.

Modelling assumed that the TSF1 operational area would remain wet and those constructed areas would have the exposed soil stabilised as quickly as practicable.

Table 10 Estimated Maximum Annual Controlled Dust Emissions for Mt Todd Mine Site Operations

Location of dust source	Dust emitting process	Estimated Emissions (tonnes/year)		
		$PM_{2.5}$	PM_{10}	TSP
Mine Pit	Blasting	1.0	3.5	3.6
	Loading mined material to trucks	19.9	62.5	69.9
	Wind erosion from mine pit	22.4	149.1	157.0
ROM pad	Loading Stockpile (50% water sprays)	16.0	37.3	106.5
	Wind erosion of ROM stockpile (50% reduction)	0.7	4.9	9.9
LGO Stockpile	Loading LGO Stockpile (50% water sprays)	5.6	13.0	37.1
	Wind Erosion Of LGO stockpile (50% reduction)	3.8	25.5	51.0
Waste Rock Dump	Wind Erosion of WRD (30% reduction – rock armour)	26.1	174.3	348.5
	Loading WRD	120.5	281.2	803.5
Haul Roads	Wheel Generated Dust (90% reduction chemical stabilisation)	649.3	1,277.7	2,706.9
	Wind Erosion of Haul Roads (50% reduction)	0.4	2.8	5.6
Processing Plant	Loading Primary Crusher (70% reduction as enclosed)	1.1	3.4	7.3
	Conveyor transfer points(1) (70% reduction for enclosure)	7.5	20.4	47.1
	Primary Crusher (75% reduction due to scrubbers)	7.1	17.8	44.4
	Secondary Crusher (1) (75% reduction due to scrubbers)	25.6	63.9	159.8
	Screening (75% reduction due to scrubbers)	70.9	332.3	443.0
	Wind Erosion of Coarse Ore Stockpile	0.2	1.2	2.3
	HPGR(1) (99% reduction as enclosed)	40.9	33.2	255.6
Tailings Storage Facility 1	Bulldozer Operation	11.2	17.9	74.5
	Waste Rock Unloading for Construction	20.3	47.3	135.3
Total		**1,030**	**2,569**	**5,469**

(1) Includes total values for material which is oversized and reprocessed.

7.3.1 Emissions from Power Generation

Emissions associated with power generating equipment were calculated from vendor supplied data provided by Vista Gold. Power generation will be provided by:

- A single Rolls-Royce Trent 60 Wet Low Emissions gas turbine generator; and
- Two MAN 20V35/44 gas-fired reciprocating engines.

Emissions were calculated assuming that all equipment is operating at full capacity, i.e. a total of 76 MW electricity generation, 24 hours per day, 365 days per year.

The Trent 60 Wet Low Emissions single gas turbine generator does include capacity to reduce NOx emissions.

Nominal flue gas stack exit conditions are summarised in Table 11.

Table 11 Stack Source Characteristics used in the Modelling Assessment

Parameter	Units	Gas turbine	Reciprocating engines
Model	--	Rolls-Royce Trent 60	MAN 20V35/44
Number of units assessed	--	1	2
Number of discharge points	--	1	1
Stack height	m	21.3	21.3
Stack exit plane diameter	m	3.05	1.83
Stack exhaust exit plane velocity	m/s	48.3	12.5
Stack exhaust temperature	^{o}C	422	298
Mass flow rate	kg/s	166	N/A
Emission controls	--	NO_X – Wet Low Emissions Technology	None

N/A: Not available

Modelled power plant emission rates of NO_2 and CO are presented in Table 12. An NO_2 to NOx ratio of 30 per cent was assumed for the modelling.

Table 12 Stack Emission Rates used in the Modelling Assessment

Pollutant	Gas turbine	Reciprocating engines
Nitrogen dioxide [a.] (g/s)	1.84	2.32
Carbon monoxide (g/s)	6.69	4.66

[a] NO_2 was calculated from vendor supplied NOx, assuming an NO_2 : NO_x ratio of 30 per cent for a conservative approach.

8. Modelling Methodology

The impact assessment was conducted using EPA Victoria's AUSPLUME (Version 6.0) dispersion model to simulate plume transport and predict ground level pollutant concentrations and dust deposition for the estimated worst case operational emissions. AUSPLUME was used to model the dispersion of fugitive dust emissions from the mine and stack emissions of fuel combustion products from the power plant.

8.1 Model Configuration for Assessment of Mine Fugitive Dust Emissions

The AUSPLUME model configuration is summarised below. Further detail is given in the sample AUSPLUME output text file, shown in Appendix C.

Model:	AUSPLUME Version 6.0
Meteorology:	Representative of the mine site (see section 5) for the period September 2007 to August 2008
Emission rates:	Time varying
Receptor Grid:	15 km x 15 km, grid interval 300 m (N/A for deposition – discrete receptors only)
Nearest Sensitive Receptor:	Werenbun Community (193,545 mE, 8,430,319 mN);
Surface Roughness:	Zo = 0.1 m flat rural
Terrain:	Not required – relatively flat terrain. Note: surface and volume sources in AUSPLUME ignore terrain.
Dry Plume Depletion:	No depletion options applied.
Particle Size Distribution:	See Section 8.5.

8.2 Model Configuration for Assessment of Power Station Stack Emissions

The AUSPLUME model configuration to assess the impact associated with three stacks combined is summarised below.

Meteorology:	Representative of the mine site (see section 5) for the period September 2007 to August 2008
Receptor Grids:	1 km x 1 km Cartesian gridded receptors with 25 metres increments; and 19.6 km x 27.44 km Cartesian gridded receptors with 280 m increments
Surface Roughness:	Zo = 0.1 m flat rural
Terrain:	Not required – relatively flat terrain in the near-field
Emission Rate:	See Section 7.3.1 and Appendix B.
Stack Source Characteristics:	See Section 7.3.1 and Appendix B.

8.3 Model Limitations

AUSPLUME model predictions are subject to the inherent limitations of a Gaussian dispersion model. Dispersion and predicted ground level pollutant concentrations from one hour do not contribute to the predicted concentrations of subsequent hours. Furthermore, the effect of potential alterations to the landscape by the construction of both the open cut mine pit and the WRD on the local wind effects is not modelled.

8.4 Source Characterisation

Emissions rates for area and volume sources are detailed in Appendix B. All source initial dispersion characteristics were modelled based on the AUSPLUME model guidance. This equated to volume initial source emission dispersion being equal to one quarter of the relevant dimension. Modelled areas, not the actual mine surface areas, are provided for area sources in Appendix B.

A variable emissions file was created to model emissions associated with blasting once per day, wind speed dependent wind erosion during dry months and no wind erosion during wet season months for the years 2007-08. The wet season was determined to extend over the period 1 December 2007 to 31 March 2008 inclusive.

8.5 Particle Size Distribution

In order to model dust deposition, which is based on emission rates of TSP, the particle size distribution must be specified. The model algorithms then simulate the fall velocities, with the coarser particles settling out from the dust plume at shorter distances and under higher wind speeds than the finer fractions. There are nominally three sources of dust from the site. These sources are from unprocessed/stockpiled ore, process ores and wind erosion from exposed surface areas.

To give a representative pattern of dust deposition from the site, particle size distributions for TSP were applied across the three sources (Table 13). These distributions are based on US EPA references.

TSP was only modelled up to a size of 50 µm. This is based on two factors, 1) large particles fall out close to the source and are therefore unlikely to cause an impact beyond the mine site boundary; and 2) TSP is defined under Queensland air quality regulations for the purpose of assessing air quality as having a mean EAD of *not more than 50 microns* (Air EPP 2008, p.11).

Table 13 Particle Size Distributions of Modelled TSP

Range (µm)	Mean Size (µm)	Unprocessed Ore [(a)] Mass Fraction	Processed Ore [(b)] Mass Fraction	Wind Erosion [(c)] Mass Fraction
0 to 2.5	1.25	0.15	0.16	0.08
2.5 to 6.0	4.25	0.19	0.21	0.27*
6.0 to 10	8.0	0.17	0.25	0.16*
10 to 50	30	0.49	0.38	0.50
Total		1.00	1.00	1.00

(a) US EPA Document EPA-450/4-86-013 July 1986, Table 3-2, p.22.

(b) US EPA Document EPA-450/4-86-013 July 1986, p.A-7.

(c) US EPA AP-42 Industrial Wind Erosion, Chapter 13.2.5, Equation 2.

***** Distribution derived from unprocessed ore distribution.

9. Air Quality Assessment

9.1 Predicted Maximum Ground Level Dust Concentrations

The predicted maximum incremental and cumulative ground level concentrations of TSP, PM_{10} and $PM_{2.5}$ for year 3 of mine operations are presented in Table 14

Table 14 Summary of Maximum Predicted Dust GLCs for Operational Year 3

Air Quality Indicator	$PM_{2.5}$		PM_{10}	TSP
Averaging Period	24 hours	Annual	24 hours	Annual
EPA Victoria Mining Criterion (µg/m³)	36	-	-	-
NEPM Criterion (µg/m³)	25	8	50	90
Background (µg/m³)	11.2	11.2	20.8	42
Compliant at Site Boundary	N/A*	N/A	N/A	N/A
Incremental @ Werenbun Community GLC (µg/m³)	21.6	1.4	49.7	6.9
Total @ Werenbun Community GLC (µg/m³)	32.8	12.6	70.5	48.9
% of Criterion at Werenbun Community	131	157	141	54
Incremental @ Katherine (µg/m³)	5.6	0.3	12.6	1.4
Incremental @ Pine Creek (µg/m³)	7.4	0.8	17.4	3.9

*N/A – the NEPM criteria for dust to be met at the site boundary may not be applicable in the Northern Territory. This must be determined by the appropriate regulator in NT.

The assessment found that maximum cumulative ground level dust concentrations are predicted to comply with air quality criteria at sensitive human receptor locations for the annual average of TSP only. The cumulative annual average ground level concentration of TSP at Werenbun is predicted to be about 54% of impact assessment criteria, while the incremental impact is predicted to be very low at 16% of the assumed background concentration and less than 8% of the criteria.

The maximum cumulative 24-hour average ground level concentrations of PM_{10} and $PM_{2.5}$ are predicted to exceed the Air NEPM standards of 50 µg/m³ and 25 µg/m³, respectively at the Werenbun community centre due to high estimated dust emissions at the mine. While PM_{10} and $PM_{2.5}$ ground level concentrations are predicted to be relatively high at Werenbun the highest concentrations associated with mine emissions in isolation are expected to meet the air quality standards. The frequency of exceedences has been examined in detail in an Environmental Risk Assessment (ERA), detailed in section 10.

Notwithstanding the predicted exceedence of the Air NEPM standard of $PM_{2.5}$ for the maximum 24-hour average ground level concentration, the annual average ground level $PM_{2.5}$ concentration at Werenbun is predicted to exceed the Air NEPM advisory standard due to a very high background concentration of 11.2 µg/m³ that is 140% of the standard of 8 µg/m³. It should be noted that the predicted incremental annual average ground level concentration of $PM_{2.5}$ is very low at less than 18% of the standard and less than 13% of the background.

Predicted maximum 24-hour average ground level concentrations of PM_{10} at the site boundary and across the local area are illustrated as a concentration contour isopleth in Figure 11. This figure indicates that the predicted highest concentrations of PM_{10} occur to the northwest of the mine emission sources due to the dominant southeast trade winds.

The assessment has also found that the Gouldian Finch habitat at the Yinberrie Hills (to the west of the Batman Pit) has the potential to be exposed to predicted maximum 24-hour ground level concentrations of PM_{10} of greater than 200 µg/m³, including background of 20.8 µg/m³.

As detailed in the assessment methodology, the dispersion modelling assessment is based on a complex series of assumptions. As the mine footprint is mobile, dust emission sources are temporally and spatially variable and meteorological conditions are also highly variable, a direct assessment of ground level concentrations at fixed locations such as the mining lease boundary and sensitive receptors over the life of the mine is difficult to achieve. The potential risk of environmental impacts is discussed in section 10, while mitigation measure and dust emissions management is detailed in section 11.

9.2 Predicted Maximum Dust Deposition Rates

In the absence of measured regional dust deposition rate information, the assessment of deposited dust has been made against the incremental annual average impact assessment criterion of 2 g/m^2/month. The assessment found that the incremental dust deposition rate was predicted to meet the impact assessment criterion at the sensitive human receptors, as shown in Figure 12. This is based on model predictions that ignore the dry depletion of particles and consequently, can be considered to be a conservative estimate. The inclusion of the dry depletion option in the model is expected to further reduce predicted deposition rates beyond the lease boundary. Furthermore, wet removal of process generated dust, i.e. ore loading and crushing operations, during the four wet season months has also not been modelled. It is highly likely that the inclusion of wet depletion will significantly reduce the annual average deposition rates in key sensitive areas as illustrated in Table 12.

At the nearest sensitive receptor, the Werenbun community, the incremental deposition rate was predicted to be 0.4 g/m^2/month, without the inclusion of dry and wet depletion. This value is expected to be a conservative upper limit as dust depletion through wet removal mechanisms is expected to be large during the wet season.

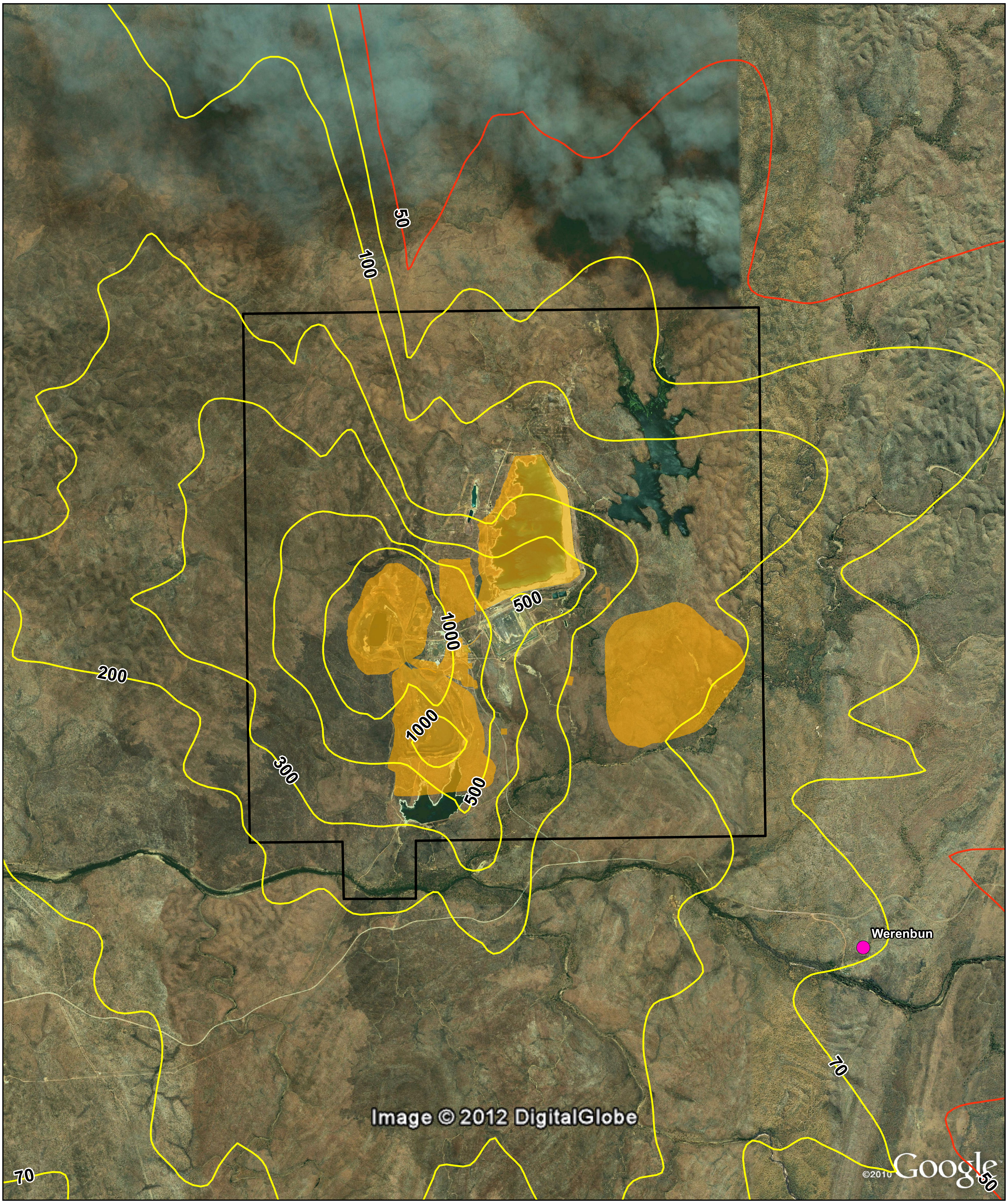
The Gouldian Finch habitat in the Yinberrie Hills area to the west of the Batman Pit is predicted to have the highest deposition rates due to the prevailing southeast trade winds. Dust impacts at sensitive places can be managed through the implementation of a Dust Management Plan.

9.3 Predicted Maximum Ground Level Concentrations of Nitrogen Dioxide and Carbon Monoxide

The predicted maximum 1-hour (Figure 13) and annual average ground level concentration of NO_2 and 8-hour average ground level concentration of CO at any location beyond the mine site boundary is presented in Table 15. The predicted maximum ground level concentrations at the nearest sensitive receptor, the Werenbun community, are well below the Air NEPM standards.

Table 15 Predicted Maximum Ground Level Concentrations of NO_2 and CO in the region

Constituent	Averaging Time	Predicted Peak GLCs (µg/m³)	NEPM Air Quality Criteria (µg/m³)	Percentage of Criterion (%)
CO	8 hours	15.7	10,260	0.2
NO_2	1 hour	11.8	226	5.2
	1 year	0.8	56	1.4



LEGEND

- Sensitive Receptors
- Concentration ug/mg^3 (Criterion 50 ug/m^3
- Criterion 50 ug/m^3
- Mineral Lease
- Emission Sources

0 0.5 1 1.5 2
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	05 Jun 2013

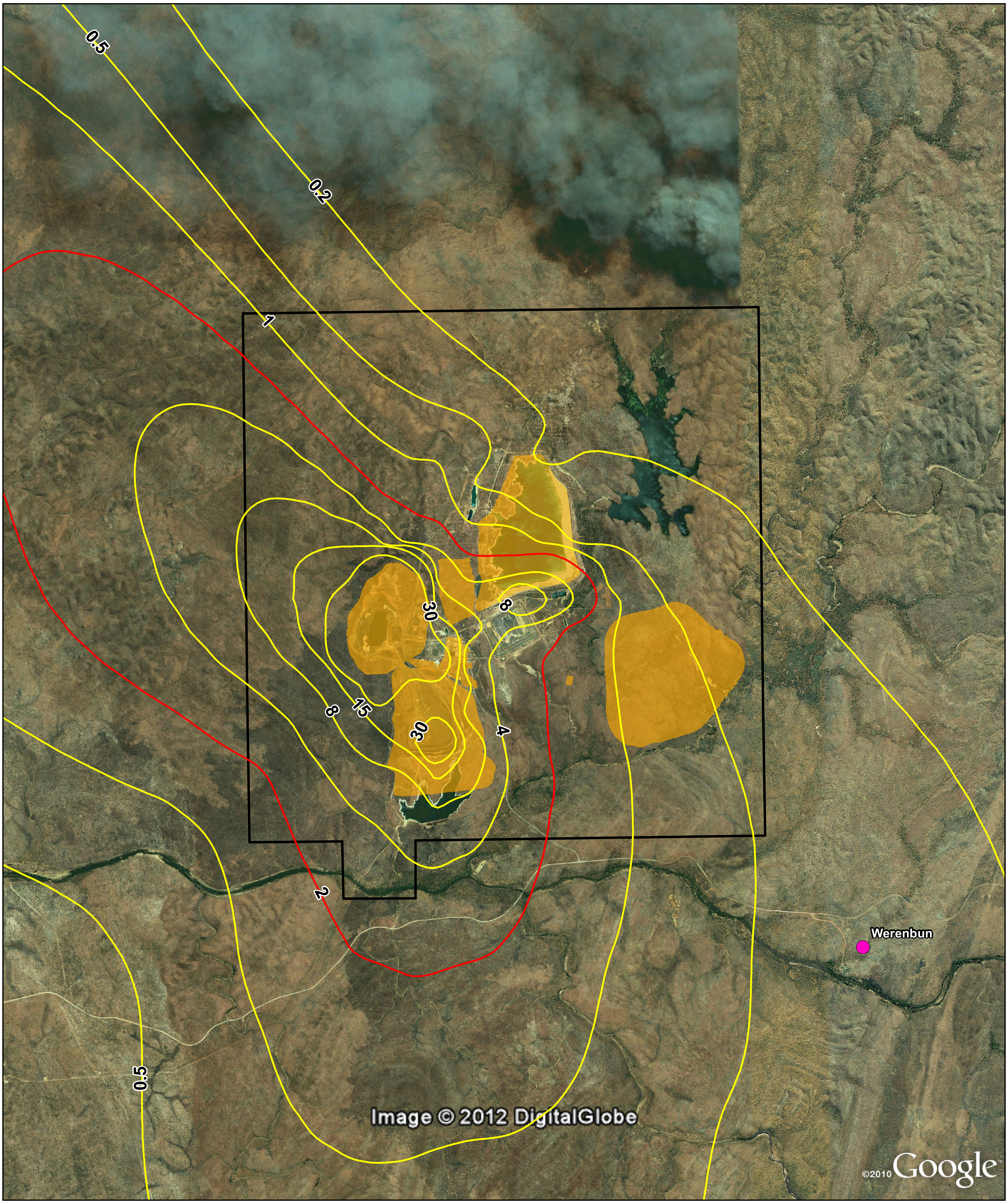
Predicted GLC for the 24-hour PM10 - With Background (20.8 ug/m^3)

Figure 11

G:\43\21801\GIS\Maps 30000 TPA\Air\4321801_1101.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: NRETAS - Mineral Lease (2011). Tetra Tech - Emission Sources (2013). Google Earth Pro - Imagery (Date extracted: 11/05/2012). GHD - Ground Level Concentration (2012). Created by: CM



LEGEND

- Sensitive Receptors
- Mineral Lease
- Deposition g/m^2/month
- Emission Sources
- Criterion 2 g/m^2/month

0 0.5 1 1.5 2
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	05 Jun 2013

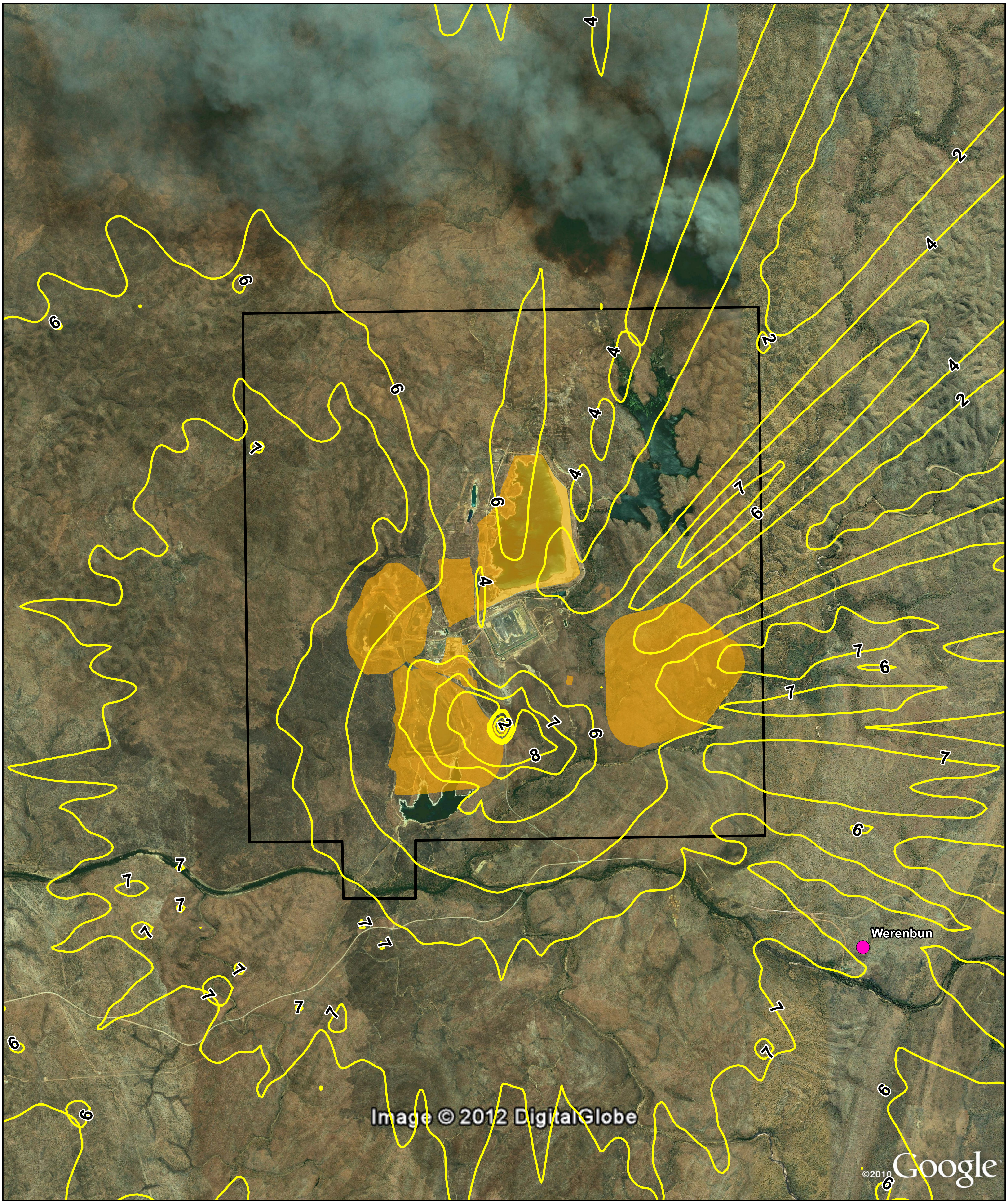
Predicted Incremental Annual TSP Deposition Rate (g/m^2/month)

Figure 12

G:\43\21801\GIS\Maps 30000 TPA\Air\4321801_1102.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: NRETAS - Mineral Lease (2011). Tetra Tech - Emission Sources (2013). Google Earth Pro - Imagery (Date extracted: 11/05/2012). GHD - Deposition Rate (2012). Created by: CM



LEGEND

- Sensitive Receptors
- Concentration ug/m^3 (Criterion = 226 ug/m^3)
- Mineral Lease
- Emission Sources

0 0.5 1 1.5 2
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	05 Jun 2013

Predicted Maximum 1-Hour Average
NO2 GLC Contours. Criterion = 226 ug/m^3

Figure 13

G:\43\21801\GIS\Maps 30000 TPA\Air\4321801_1103.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: NRETAS - Mineral Lease (2011). Tetra Tech - Emission Sources (2013). Google Earth Pro - Imagery (Date extracted: 11/05/2012). GHD - NO2 Concentration (2012). Created by: CM

10. Environmental Risk Assessment

An environmental risk assessment (ERA) was undertaken to investigate the frequency and magnitude of predicted exceedences of the Air NEPM standards of PM_{10} and $PM_{2.5}$ at the Werenbun community receptor. The use of the ERA approach is prescribed in both the NSW and Victorian air quality regulations. Through an examination of the causes of, and the degree of, exceedences of the assessment criteria, an ERA assesses and assigns a level of risk to the overall impact of the project in regard to air emissions. The approach and methodology of the ERA are detailed in Appendix D.

10.1 PM_{10} Impact at Werenbun

The air quality assessment found that the air pollutant of most concern due to exceedences of the Air NEPM standard is PM_{10}. While the Air NEPM standards are designed to be applied to average ambient concentrations monitored across a regional network that covers an urban airshed with a population of greater than 25,000 people, the PM_{10} criteria of 50 µg/m³ has been adopted as an air quality objective in the Queensland *Environmental Protection (Air) Policy* and an impact assessment criterion in the NSW *Approved Methods for the Modelling and Assessment of Air Pollutants*. Consequently, the application of the Air NEPM standard of PM_{10} in this assessment is considered to be able to provide guidance on environmental impact despite the standard really being for a monitoring assessment rather than a modelling assessment.

Notwithstanding the suitability of the Air NEPM standard for PM_{10}, the assessment criterion of $PM_{2.5}$ is promulgated in the Air NEPM as an advisory standard, and consequently, it is not considered appropriate that it be used with equal weighting to assess the impact to air quality. This is particularly relevant as the annual average background level of $PM_{2.5}$ used in the cumulative impact assessment already exceeds the Air NEPM advisory standard. Furthermore, $PM_{2.5}$ impacts are mostly concerned with particulate matter generated from combustion processes, i.e. diesel engines, as opposed to mechanically generated crustal dust.

The Air NEPM standard of PM_{10} has an allowance of 5 days exceedence per year. These five days are to take into account extreme events such as bush fires and dust storms. They are not an allowance for an operation to design a management plan to have five exceedences of the criterion. Best practice environmental management must still be undertaken by the mine operators.

Further AUSPLUME modelling was carried out to assess the sensitivity of dry particle depletion on ground level concentrations of PM_{10} at the Werenbun receptor. Particle depletion is also commonly known as dust settling or fallout. Large particle size fractions fall out of the plume closer to the source, and therefore will not travel the distance from the mine to the Werenbun community.

The initial assessment presented in section 9 provided maximum ground level concentrations without dry depletion configured in the model due to the prohibitive computational times for the calculation of particle depletion for a large number of gridded receptors. For this assessment, only a single receptor has been modelled at Werenbun and consequently, dry particle depletion could be easily included. The 20 highest ranked 24-hour average ground level concentrations of PM_{10} are presented in Table 16 for the modelling with and without dry depletion. The results for the without depletion option are included here for consistency with the results presented in Table 14.

The assessment indicates (Table 16) that five exceedences of the Air NEPM standard of PM_{10} are predicted at Werenbun when dry depletion is taken into account. By comparison, seven exceedences of the Air NEPM standard of PM_{10} are predicted at Werenbun when dry depletion is ignored.

Table 16 Ranked GLC of 24 hour averaged PM_{10} at Werenbun

Rank	With Particle Depletion			Without Particle Depletion		
	Incremental Impact (µg/m³)	Total Impact (µg/m³)	Date	Incremental Impact (µg/m³)	Total Impact (µg/m³)	Date
1	44.2	**65.0**	17 Feb 2008	49.7	**70.5**	17 Feb 2008
2	43.8	**64.6**	18 Feb 2008	49.6	**70.4**	18 Feb 2008
3	33.1	**53.9**	15 Jan 2008	36.5	**57.3**	15 Jan 2008
4	31.1	**51.9**	23 Feb 2008	35.3	**56.1**	23 Feb 2008
5	29.7	**50.5**	16 Jan 2008	32.9	**53.7**	24 Jan 2008
6	26.6	47.4	24 Feb 2008	32.0	**52.8**	16 Jan 2008
7	26.5	47.3	17 Jan 2008	31.2	**52.0**	30 Dec 2007
8	26.2	47.0	30 Dec 2007	29.1	49.9	24 Feb 2008
9	25.8	46.6	24 Jan 2008	28.5	49.3	17 Jan 2008
10	24.4	45.2	31 Dec 2007	28.1	48.9	31 Dec 2007
11	22.5	43.3	6 Feb 2008	26.6	47.4	28 Dec 2007
12	21.2	42.0	3 Feb 2008	24.9	45.7	6 Feb 2008
13	21.1	41.9	28 Dec 2007	24.0	44.8	28 Oct 2007
14	20.8	41.6	28 Oct 2007	24.0	44.8	3 Feb 2008
15	18.1	38.9	14 Feb 2008	20.6	41.4	25 Nov 2007
16	18.0	38.8	25 Nov 2007	20.4	41.2	14 Feb 2008
17	17.0	37.8	2 Jan 2008	19.6	40.4	2 Jan 2008
18	16.8	37.6	7 Oct 2007	19.4	40.2	7 Oct 2007
19	16.3	37.1	22 Feb 2008	18.1	38.9	23 Jan 2008
20	15.9	36.7	23 Jan 2008	18.0	38.8	1 Feb 2008

Background = 20.8 µg/m³

NEPM Criterion = 50 µg/m³

10.2 PM_{10} Exceedence Times

The 12 highest ranked 24-hour average ground level concentrations of PM_{10} at the Werenbun community are all predicted to occur during the months of December, January or February. This coincides with a shift in the prevailing southeast wind to the northwest due to the wet season monsoon. Also associated with these months is a significant amount of rainfall. Rainfall has not been accounted for in the modelling assessment except in the removal of dust emissions associated with wind erosion of exposed surfaces during the wet season months. Mechanically generated dust from crushers and haul truck movement has not taken into consideration rainfall and moisture conditions during the wet season. Notwithstanding the general changes in meteorological conditions during the wet season, worst case assumptions have been applied, as it cannot be assumed that a northwest wind will always deliver significant amounts of rain.

In regard to model assumptions, the wet season will assist in the removal of mechanically generated dust through the mechanism known as wet depletion or wet deposition. This has not been modelled. The inclusion of dry depletion was found to reduce the maximum incremental impact by 5.5 µg/m³. Consequently, it is reasonable to expect that the wet depletion mechanism will remove at least an equivalent amount of dust. Therefore, this will result in only two days of exceedences of the PM_{10} standard per year. This is likely to be well within the requirements of the Air NEPM PM_{10} standard as the predicted highest incremental ground level concentrations of PM_{10} at Werenbun occur during the wet season when background dust levels are likely to be relatively low due to moist soil conditions and no seasonal vegetative burning.

In addition, significant rain events are also likely to enhance dust controls such as water sprays that are already being applied. Notwithstanding this, the NPI (2012) and other regulatory authorities do not provide guidance on the characterisation, control and assessment of dust emissions in monsoonal conditions. Consequently, the modelling assumptions made in this assessment are considered to be highly conservative and likely to provide for the overestimation of dust emissions.

10.3 Assessment of Risk Level

The application of the risk matrix presented in Appendix D, and using the results in Table 16, indicates that the level of risk associated with dust emissions at the Werenbun community is ranked as "**Low**" for both methods of modelling, i.e. with and without dry particle depletion.

11. Interpretation of Assessment Findings

The air quality assessment found that the air quality standards for the protection of human health, of the key air pollutants for the study PM_{10} and $PM_{2.5}$, have the potential to be exceeded at the Werenbun community between two and seven times per year. Notwithstanding this, the findings were also found to be extremely sensitive to a variety of important assumptions made in the modelling assessment, and that depending on assumptions made to determine the existing background it is highly likely that air quality standards of PM_{10} and $PM_{2.5}$ would be met. This is due to a combination of ambient environment and site conditions.

During the wet season northwest winds due to monsoon wind patterns, and increased rainfall, surface and soil moisture is likely to reduce natural dust emissions sources and ambient dust concentrations. Consequently, a reduction in the cumulative dust impact of the project at Werenbun is expected.

The mitigation measures assumed in this modelling, in particular the use of chemical stabilisation and dust suppression agents on all active haul roads to achieve an emission reduction of greater than 90 per cent, were found to be insufficient as the Air NEPM standards were exceeded at the Werenbun sensitive receptor. Notwithstanding this, all of the predicted peak dust impacts at the Werenbun community occur during the wet season months, when the prevailing southeast wind turns to the northwest. During the wet season, it is highly likely that the winds will be associated with a significant amount of rainfall and therefore the generation of dust is likely to be significantly lower than the conservative values estimated for this assessment. There is no current guidance documentation as to how to characterise emissions and emission controls during monsoonal events. In addition to this, proactive and interactive dust management strategies can be implemented to minimise dust emissions during worst case conditions, in order to reduce the impacts on the days when the highest concentrations are predicted.

The influence of the wet season meteorological conditions to cause elevated ground level concentrations is further supported by the findings for the incremental annual averages of TSP, $PM_{2.5}$ and deposited dust. While the wind primarily blows from either the southeast or northwest, the incremental annual averages of these fractions were predicted to be very low. This indicates that there may be some extraordinary conditions that occur periodically that cause the highest ground level concentrations, with average conditions causing only a minor impact. By identifying and managing the mining process and meteorological conditions under which the highest ground level concentrations occur, compliance with all air quality standards can be achieved.

It is also noted that the predicted exceedence of the annual average standard of $PM_{2.5}$ is due to the very high background concentration adopted for this assessment. In the absence of a complete site-specific monitoring station dataset, the reported 75th percentile 24-hour average background concentration of $PM_{2.5}$ at Casuarina was adopted for the annual average background. This is considered to be conservative, particularly as the background concentration exceeds the standard by 40 per cent. The predicted annual average of TSP was found to emphatically comply at 54 per cent of the assessment criterion.

In regard to the assessment of PM_{10} in sensitive ecological areas that are not inhabited by humans, it is not clear that the Air NEPM standards apply. A more appropriate approach to manage air quality in the areas surrounding the mining lease may be sought through the application of the EPA Victoria *Protocol for Environmental Management 2007* (PEM) for Mining and Extractive Industries. This is discussed further in Section 12.

Figure 11 shows that predicted maximum 24-hour average ground level concentrations of PM_{10} during maximum mining activity are predicted to exceed the Air NEPM standard at significant distances from the site boundary to the northwest and south-southeast. These impacts will be managed through the implementation of a site Dust Management Plan to identify the worst case conditions and alter production and control methods to minimise ground level concentrations in sensitive areas.

12. Mitigation Measures

12.1 Dust Controls Assumed in the Assessment

Dust mitigation measures assumed in the modelling include:

- chemical stabilisation of haul roads to achieve a 90 per cent emissions reduction;
- regular water spraying of stockpiles to achieve a 50 per cent emissions reduction;
- water spraying while loading and unloading of stockpiles and processing equipment, including conveyor transfer points, i.e. primary crusher, to achieve a 50 per cent emissions reduction as indicated as the maximum allowable in NPI (2012). However, it is expected that water spraying during these activities will result in an 80 per cent reduction. The more conservative NPI (2012) control factor has been applied to the modelling;
- application of water to the ore prior to crushing to obtain a minimum moisture content of 4 per cent;
- hooding of crushers with a dust collection system capable of achieving a 75 per cent emissions reduction; and
- enclosure of the HPGR to achieve a 99 per cent emissions reduction.

12.2 Proposed Additional Dust Control Measures

Further mitigation measures can be progressively implemented as required to meet required air quality objectives. The following mitigation measures, either individually or in combination, are available:

- all construction and maintenance equipment/vehicles to be operated and maintained to manufacturers' specifications in order to minimise exhaust emission;
- defined haul routes to be used wherever it is necessary for vehicles to traverse unsealed surfaces or unformed roads;
- all gravel roads to and from the Project location can be upgraded from gravel to a spray sealed surface of "all weather" road designation;
- vehicular speeds can be limited to 25 km/h on areas of unconsolidated or unsealed soil associated with the Project;
- watering of exposed stockpiles and ROM surfaces as required;
- water spraying onto roads to suppress dust using a water cart;
- application of environmentally benign surfactants may be used on road surfaces to reduce the water demand for dust suppression;
- full enclosure of processing equipment including crushers, screens and transfer points;
- prompt mitigation of visible dust emissions from operations, which may involve a combination of:
  - stabilisation of surface silt content through application of localised water sprays, or the use of chemical dust suppressants (suitable for access roads which are traversed less frequently);
  - control of mechanically induced dust emissions (from clearing, scraping, excavation, loading, dumping filling and levelling activates etc.) by application of water sprays;
  - areas of disturbed soil are to be re-vegetated as soon as practical; and

– minimising exposed subsoil through progressive clearing and reinstatement;

- retention of existing vegetation around the boundary as a buffer, and to limit potential dust sources;
- covering areas of disturbed soil, stockpiles and temporary spoil containment with mulch or other material as best as practicable;
- a Dust Management Plan (DMP) typically includes some audit monitoring to indicate how well the system is performing and whether additional mitigation is required. It is recommended that such monitoring be done at the site boundary with higher levels of mitigation to be implemented when dust levels are found to be excessive, as predicted for the worst case modelling; and
- the PEM for Mining (EPAV, 2007) provides guidance on operational control requirements and monitoring for reactive management purposes which can be adopted by Northern Territory industries as there are no specific Territory guidelines. The principles used could be adopted for use in the Project. In this operational environment, the use of dust deposition monitors to establish the effectiveness of management practices is most appropriate. The reactive management approach dictates, on a monthly basis, that if dust levels exceed monthly trigger levels inclusive of adjustment for background being the lowest reading in the month for the gauge network, the DMP is reviewed and additional dust control measures used to reduce dust levels to the guideline value.

13. Conclusions and Recommendations

Subject to the Limitations outlined in Section 14, GHD draws the following conclusions from this Air Quality Impact Assessment:

- Based on a series of conservative assumptions for dust emission estimation, maximum rates of mining activity during the highest production year (year 3) and worst case meteorological conditions, the proposed Mt Todd Gold Project is predicted to exceed the Air NEPM standards of PM_{10} and $PM_{2.5}$, at the sensitive receptor location of Werenbun on up to seven days;
- The number of exceedences of the Air NEPM standards have the potential to be reduced to zero through further refinement of the:
  - assumptions used in the modelling;
  - further implementation of dust mitigation strategies;
  - mining process during the year of maximum activity to ensure maximum earth moving works do not take place on days when the worst case dust impacts are expected to occur;
- Compliance with Air NEPM standards was predicted to occur at the townships of Katherine and Pine Creek for the worst case scenario;
- Compliance with the impact assessment criteria of TSP and dust deposition is predicted at all sensitive places;
- An environmental risk assessment evaluated the level of risk associated with predicted ground level concentration of PM_{10} at the community of Werenbun. This risk was found to be low;
- GHD considers that the application of the Air NEPM standards of PM_{10}, and particularly $PM_{2.5}$, are not appropriate to assess the level of risk associated with dust impacts from mines in the Northern Territory. The EPA Victoria Mining PEM (2007) approach to the assessment and management of mining related dust impact is considered to be more appropriate. In accordance with the Mining PEM (2007) the air quality criteria is expected to be met at sensitive receptor locations and not the mine site boundaries;
- The progressive nature of open cut mining will result in continual changes in mine and haul road locations throughout the Project lifespan, including progressive rehabilitation of disturbed areas. As such, the impacts associated with these sources, in combination with other fixed location sources will vary over the Project lifespan; and
- Targeted particulate emission mitigation measures can be considered if Air NEPM standards are to be met at the site boundary. A Dust Management Plan can be implemented to assess the need for or effectiveness of these mitigation measures.

14. Limitations

This Report has been prepared by GHD for Vista Gold Australia Pty Ltd and may only be used and relied on by Vista Gold Australia Pty Ltd for the purpose agreed between GHD and Vista Gold Australia Pty Ltd as set out in Section 1 of this Report.

GHD otherwise disclaims responsibility to any person other than Vista Gold Australia Pty Ltd arising in connection with this Report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in the Report and are subject to the scope limitations set out in the Report.

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD described in this Report and provided by Vista Gold. GHD disclaims liability arising from any of the assumptions being incorrect.

This report presents the results of an air quality impact assessment prepared for the purpose of this commission. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent engineer / scientist before being used for any other purpose. GHD accepts no responsibility for other use of the data.

Where monitoring results, physical tests, data collection and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

An understanding of site’s environmental impact depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experience based. Hence this report should not be altered, amended or abbreviated, issued in part or issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of a report that has been modified in any way as outlined above.

The results and therefore the conclusions from this desktop study are based on a number of assumptions which may or may not alter the outcomes if they were subsequently found to be inaccurate or inappropriate. All reasonable efforts have been made by GHD to use the most appropriate data and models for the specific process.

15. References

Buonicore and Davis, 1992. Air Pollution Engineering Manual. Chapter 4: Fugitive Emissions (Kinsey, J.S. and Cowherd, C., pp.133-146) Air and Waste Management Association, United States, 1992.

Dames & Moore and TUNRA Ltd 1986, Particle size distributions in dust from open cut coal mines in the Hunter Valley, State Pollution Control Commission, Sydney.

DECC NSW, 2005. Approved Methods for the Modelling and Assessment of Air pollutants in New South Wales. Department of Environment and Conservation, 59–61 Goulburn Street, Sydney, NSW. DEC 2005/361, August 2005.

Department of Natural Resources, The Environment, Arts and Sport 2008, Annual compliance report for the Northern Territory. Ambient Air NEPM: Report to the National Environment Protection Council (NEPM), viewed 21 March 2011,

EPP (Air), 2008. Environment Protection (Air) Policy 2008. Queensland Government.

EPA Victoria 2007. Protocol for Environmental Management: Mining and Extractive Industries, EPA Victoria Publication 1191, December 2007.

EPA (formerly NRETAS), 2011. Guidelines for the Preparation of an Environmental Impact Statement. Mount Todd Gold Project Katherine Region, NT. Vista Gold Australia Pty Ltd. September 2011. Prepared by the Department of Natural Resources, Environment, The Arts and Sport, Northern Territory Government.

GHD, 2011. Vista Gold Australia Mt Todd Gold Project Notice of Intent April 2011. Prepared by GHD. Document reference 43/21801/31120 Rev 0.

NEPM, 2003. National Environment Protection (Ambient Air Quality) Measure. National Environment Protection Council of Australia 7 July 2003. (http://www.nepc.gov.au/taxonomy/term/23)

NPI, 2012. Emission Estimation Technique Manual for Mining, Version 3.1, National Pollutant Inventory, Canberra, January 2012.

NPI, 2008. Emission Estimation Technique Manual for Combustion Engines Version 3.0 EETM NPI Jun, 2008.

NPI, 2006. Emission Estimation Technique Manual for Gold Ore Processing Version 2.0 EETM NPI, Dec 2006.

NSR, 1992. Mt Todd Gold Project Draft Environmental Impact Statement. Prepared by NSR Environmental Consultants Pty Ltd for Zapopan NL.

SEPP(AQM), 2001. State Environment Protection Policy (Air Quality Management) EPA Victoria. Victorian Government Gazette. No S 240 Friday 21 December 2001.

SEPP(AAQ) 1999. State Environment Protection Policy (Ambient Air Quality). Victoria Government Gazette. No. S 19 Tuesday 9 February 1999.

US EPA AP-42, 2006. Industrial Wind Erosion, Chapter 13.2.5.

US EPA AP-42, 1995. Heavy Construction Operation Guideline. Chapter 13.2.3.

US EPA, 1986. Generalised Particle Size Distributions for Use in Preparing Size Specific Particulate Emission Inventories. Document Number: EPA-450/4-86-013 July 1986.

Witt, P., Carey, K. and Nguyen, T., 1999. *Prediction of Dust Loss from Conveyors using CFD Modelling*. Second International Conference on CFD in the Minerals and Process Industries, CSIRO, Melbourne, Australia, 6-8 December, 1999.

Appendices

Appendix A - Mine Operations Emissions Estimates

Emissions Inventory Calculations

A1.1 Blasting

Emissions from blasting were estimated using the following equation:

$$E_i = n\, EF_i$$

where

E_i = emission rate of species i (kg/y)

n = number of blasts per year (blasts/y)

EF_i = Uncontrolled emissions factor for species i (kg/blast)

The number of blasts per year, n, was assumed to be one every day.

The uncontrolled emission factor for TSP was calculated using NPI (2012, equation 19, p.53):

$EF_{TSP} = 0.00022A^{1.5}$ [kg/blast]

where

A = blast area, assumed to be 2000 m².

PM_{10} was assumed to be 52 per cent of TSP, as per NPI (2012).

$PM_{2.5}$ was assumed to be 15 per cent of TSP.

Blasting emissions were modelled as evenly distributed throughout the year from the pit, with pit retention factors of 50 per cent for TSP and 5 per cent for PM_{10} and $PM_{2.5}$ applied.

A1.2 Shovel Excavators on Overburden

Emissions from shovel excavator operations inside the pit to load haul trucks with ore and waste rock, assumed to be overburden as described in NPI (2012), were estimated using the following equation:

$$E_i = M \times EF_i$$

where

E_i = emission rate of species i (kg/y)

M = number of tonnes of overburden removed per year (tonne/y)

EF_i = Uncontrolled emissions factor for species i (kg/tonne)

The number of tonnes of ore (or overburden) removed from the pit was based on detail supplied by Vista Gold. The ore tonnage per year modelled is:

- Year 3: 102,169,000 tonne/y

The uncontrolled emission factors for TSP and PM_{10} used the specified site average wind speed, U (m/s), and soil moisture content, M (%), related equations as per NPI (2012, p.48).

$$EF_{TSP} = 0.74 \times 0.0016 \left(\frac{U}{2.2}\right)^{1.3} \left(\frac{M}{2.0}\right)^{-1.4} \text{[kg/tonne]}$$

$$EF_{PM10} = 0.35 \times 0.0016 \left(\frac{U}{2.2}\right)^{1.3} \left(\frac{M}{2.0}\right)^{-1.4} \text{[kg/tonne]}$$

where

U = average wind speed of 2.46 m/s (From TAPM Modelling).

M = soil moisture content of 2 per cent by weight (Assumed NPI (2012) Default).

$PM_{2.5}$ was assumed to be 15 per cent of TSP

Shovel excavator emissions from the pit were modelled as evenly distributed throughout the year.

A similar approach was applied to other sources where front end loaders were used to load ore, for example, loading of the primary crusher.

A1.3 Bulldozers on Overburden

Emissions from bulldozer operations were modelled from the Tailings Storage Facility 1 (TSF1) for year 3 operations. Emissions from an overburden source were estimated using the following equation:

$E_i = n \times EF_i$

where

E_i = emission rate of species i (kg/y)

n = total number of operational hours of all bulldozers per year (veh.h/y)

EF_i = Uncontrolled emissions factor for species i (kg/veh.h)

It was assumed that 1 bulldozer operates continually for a 12 hour day every day of the year – 4380 hours per year.

The default uncontrolled emission factors for TSP and PM_{10} were used as per NPI (2012, p.51).

EF_{TSP} = 17 [kg/veh.hr]

EF_{PM10} = 4 [kg/veh.hr]

$PM_{2.5}$ was assumed to be 15 per cent of TSP

Bulldozer operation emissions on overburden were modelled as evenly distributed throughout the 12 hour operational day across the WRD.

A1.4 Trucks Dumping Overburden

Emissions from haul trucks dumping overburden at the waste rock dump, Low Grade Ore stockpile and TSF1 construction were estimated using the following equation:

$E_i = M \times EF_i$

where

E_i = emission rate of species i (kg/y)

M = number of tonnes of overburden dumped per year (tonne/y)

EF_i = Uncontrolled emissions factor for species i (kg/tonne)

The mass of overburden removed dumped on each location was based on details supplied by Vista Gold. The waste tonnes per year is summarised below for year 3:

- Waste Rock Dump: 78,227,398 tonne/y
- Low Grade Ore Stockpile: 6,941,362 tonne/y
- TSF1 Construction: 11,272,727 tonne/y

The uncontrolled emission factors, EF_i, for TSP and PM_{10} used the default factors as per NPI (2011, p.51).

EF_{TSP} = 0.012 [kg/tonne]

EF_{PM10} = 0.0043 [kg/tonne]

$PM_{2.5}$ was assumed to be 15 per cent of TSP

Overburden dumping operation emissions were modelled as evenly distributed throughout the year and across waste dump source.

A1.5 Trucks Unloading Ore at ROM Pads

Emissions from haul trucks unloading ore at ROM pads were estimated using the following equation:

$$E_i = M \times EF_i$$

where

E_i = emission rate of species i (kg/y)

M = total mass of ore (in tonnes) removed per year (tonne/y)

EF_i = Uncontrolled emissions factor for species i (kg/tonne)

The number of tonnes of ore unloaded at the ROM pad from the pit was based on details supplied by Vista Gold. The ore extraction rate per year is summarised below:

- Year 3: 17,750,014 tonne/y

The uncontrolled emission factors, EF_i, for TSP and PM_{10} used the default values as per NPI (2011, p.16).

EF_{TSP} = 0.004 [kg/tonne]

EF_{PM10} = 0.0017 [kg/tonne]

$PM_{2.5}$ was assumed to be 15 per cent of TSP

Ore unloading from truck emissions was modelled as evenly distributed throughout the year and across the ROM pad source.

A1.6 Loading Primary Crusher

Emissions from loading of the primary crusher were estimated using the following equation:

$$E_i = M \times EF_i$$

where

E_i = emission rate of species i (kg/y)

M = total mass of ore (in tonnes) process per year (tonne/y)

EF_i = Uncontrolled emissions factor for species i (kg/tonne)

The number of tonnes of ore processed by the primary crusher from the pit was based on details supplied by Vista Gold. The ore extraction rate per year is summarised below:

- Year 3: 17,750,014 tonne/y

The uncontrolled emission factors, EF_i, for TSP and PM_{10} used the suggested Equation 10 in NPI (2012, p.48) assuming that the primary crusher was being loaded by a front end loader as per NPI.

$$EF_{TSP} = 0.74 \times 0.0016 \left(\frac{U}{2.2}\right)^{1.3} \left(\frac{M}{2.0}\right)^{-1.4} \text{[kg/tonne]}$$

$$EF_{PM10} = 0.35 \times 0.0016 \left(\frac{U}{2.2}\right)^{1.3} \left(\frac{M}{2.0}\right)^{-1.4} \text{[kg/tonne]}$$

$PM_{2.5}$ was assumed to be 15 per cent of TSP

Loading of the primary ore crusher was modelled as evenly distributed throughout the year.

It was assumed that all ore would be processed by the primary crusher.

A1.7 Primary Crusher Emissions

Emissions from the primary crusher were estimated using the following equation:

$$E_i = M \times EF_i$$

where

E_i = emission rate of species i (kg/y)

M = total mass of ore (in tonnes) process per year (tonne/y)

EF_i = Uncontrolled emissions factor for species i (kg/tonne)

The number of tonnes of ore processed by the primary crusher from the pit was based on details supplied by Vista Gold. The processed ore rate per year is summarised below:

- Year 3: 17,750,014 tonne/y

The uncontrolled emission factors, EF_i, for TSP and PM_{10} used the default values assuming that the ore was “high” in moisture as per NPI (2012, p.62) guidelines.

$$EF_{TSP} = 0.01 \text{ [kg/tonne]}$$

$$EF_{PM10} = 0.004 \text{ [kg/tonne]}$$

$PM_{2.5}$ was assumed to be 16 per cent of TSP.

The primary crusher was modelled as having operational hours evenly distributed throughout the year and occurring at the Benefication Plant.

It was assumed that all ore would be processed by the primary crusher.

A1.8 Secondary Crusher Emissions

Emissions from secondary crusher were estimated using the following equation:

$$E_i = M \times EF_i$$

where

E_i = emission rate of species i (kg/y)

M = total mass of ore (in tonnes) process per year (tonne/y)

EF_i = Uncontrolled emissions factor for species i (kg/tonne)

The number of tonnes of ore processed by the secondary crusher from the pit was based on details supplied by Vista Gold. The secondary crushed ore rate per year for the operations are summarised below:

- Year 3: 17,750,014 tonne/y

The uncontrolled emission factors, EF_i, for TSP and PM_{10} used the default values assuming that the ore was "high" in moisture as per NPI (2012, p.62) guidelines.

EF_{TSP} = 0.03 [kg/tonne]
EF_{PM10} = 0.012 [kg/tonne]

$PM_{2.5}$ was assumed to be 16 per cent of TSP.

The secondary crusher was modelled as having operational hours evenly distributed throughout the year and occurring at the Benefication Plant.

It was assumed that 120 per cent of the ore would be processed by the secondary crusher.

A1.9 Screening Emissions

Emissions from screens were estimated using the following equation:

$$E_i = M \times EF_i$$

where

E_i = emission rate of species i (kg/y)

M = total mass of ore (in tonnes) process per year (tonne/y)

EF_i = Uncontrolled emissions factor for species i (kg/tonne)

The number of tonnes of ore processed by each of the individual screens (coarse and fine screens) was based on details supplied by Vista Gold. The screened ore rate per year for the operations are summarised below:

- Year 3: 17,750,014 tonne/y

The uncontrolled emission factors, EF_i, for TSP and PM_{10} used the default values assuming that the ore was "high" in moisture as per NPI (2012, p.62) guidelines.

EF_{TSP} = 0.03 [kg/tonne]
EF_{PM10} = 0.012 [kg/tonne]

$PM_{2.5}$ was assumed to be 16 per cent of TSP.

The coarse and fine screens were modelled as having operational hours evenly distributed throughout the year and occurring at the Benefication Plant.

It was assumed that 120 per cent of the ore would be processed by the screens.

The screens cannot be considered as part of the crusher units as they are separated by a considerable distance using conveyors.

A1.10 Grinding Emissions

Emissions from high pressure grinding rolls were estimated using the following equation:

$$E_i = M \times EF_i$$

where

E_i = emission rate of species i (kg/y)

M = total mass of ore (in tonnes) process per year (tonne/y)

EF_i = Uncontrolled emissions factor for species i (kg/tonne)

The number of tonnes of ore processed by the HPGR from the pit was assumed to be all of the ore passing through the primary crusher. The HPGR ore rate per year for the operations are summarised below:

- Year 3: 17,750,014 tonne/y

The uncontrolled emission factors, EF_i, for TSP and PM_{10} used the default values assuming that the grinding process did not include air conveying of classification, as per NPI (2012, p.20) guidelines.

EF_{TSP} = 1.2 [kg/tonne]

EF_{PM10} = 0.16 [kg/tonne]

$PM_{2.5}$ was assumed to be 16 per cent of TSP.

The HPGR was modelled as having operational hours evenly distributed throughout the year and occurring at the Benefication Plant.

It was assumed that 120 per cent of the ore would be processed by the HPGR.

A1.11 Overland Conveyor Emissions

Emissions from conveyors were estimated using the relationship derived by Witt et al. (1999).

With respect to the location, the relationships indicate that the wind speed is not great enough to pick-up particles smaller than 60 µm from the surface of the conveyor.

Therefore, conveyor emissions were modelled as zero.

A1.12 Unpaved Haul Roads

Emissions from haul trucks travelling along unpaved haul roads were estimated using the following equation:

$$E_i = VKT \times EF_i$$

where

E_i = emission rate of species i (kg/y)

VKT = total vehicle kilometres travelled by all haul vehicles (in km) per year (VKT/y)

EF_i = Uncontrolled emissions factor for species i (kg/VKT)

The uncontrolled emission factors, EF_i, for TSP and PM_{10} used the as per NPI (2011, p.16) equations which relate to heavy vehicle movement at industrial sites.

$EF_{TSP} = 1.38 \left(\frac{s}{12}\right)^{0.9} \left(\frac{W}{3}\right)^{0.45}$ [kg/VKT]

$EF_{PM10} = 0.42 \left(\frac{s}{12}\right)^{0.9} \left(\frac{W}{3}\right)^{0.45}$ [kg/VKT]

where

s = average silt content of 10 precent. (NPI Default)

W = haul truck total mass (tonne).

$PM_{2.5}$ was assumed to be 15 per cent of TSP.

The NPI Mining (2012) emissions estimation equations separate emissions from heavy vehicles and light vehicles, with heavy vehicle movement generated dust emissions independent of vehicle speed and soil moisture content, unlike previous versions of the NPI Mining manual.

Haul truck movements were modelled as evenly distributed throughout the year and across all haul roads based on the amount of earth moved and the haul vehicle capacity – 218 tonnes. Furthermore, haul truck movement generated dust from within the pit has been assumed to be "released from the pit" at ground level. The number of truck movements required to determine the total annual VKT were based a Caterpillar Type 793C trucks. These have a haul capacity of 218 tonnes and a vehicle mass when full of 385 tonnes.

Emission factors were based on the average of the fully loaded haul truck and empty returning haul truck.

The number of tonnes of ore required to be removed from the pit was based on details supplied by Vista Gold. The total earth extraction rate per year are summarised below:

Estimates of haul road distances were based on preliminary mine plan.

The total haul road distance was estimated to be approximately 11.4 km. This was based on supplied drawings for year 3 and straight line distances to the centre of designated stockpile areas.

Based on the fleet of trucks, the estimated number of required trips to move the amount of ore was determined. This enabled an estimate of the total annual VKT's for various parts of the mining operation. A summary of the calculated VKTs is given below.

- Year 3:
  - Number of Cat 793C trucks: 38
  - Total Haul Road Distance: 11.4 km
  - Total Earth Mined from Pit: 102,169,000 tonne/year
  - Total Ore to ROM: 17,750,014 tonne/year
  - Total Ore to LGO Stockpile: 6,191,349 tonne/year
  - Total Waste Rock to TSF1 Construction: 11,272,727 tonne/year
  - Total Waste Rock to WRD: 78,227,398 tonne/year
  - Total number of Haul trips out of Pit: 468,665 loaded trips per year

Estimated Haul Road Distances

Route	Year 3 Distance (km)
In Pit	4.0
Pit to WRD	1.5
Pit to LGO stockpile	1.6
Pit to ROM stockpile to Processing Plant	0.4
Pit to TSF1	3.9
Total	11.4

A1.13 Wind Erosion

Emissions by wind erosion from exposed surfaces were estimated using the following equation:

$$E_i = A \times EF_i$$

where

E_i = emission rate of species i (kg/y)

A = total amount of exposed or disturbed surface area (plan) (ha)

EF_i = Uncontrolled emissions factor for species i (kg/ha/y)

Wind erosion was based on the NPI (2012) defaults of 0.4 kg/ha/h for TSP and 0.2 kg/ha/h for PM_{10}. $PM_{2.5}$ was assumed to be 8 per cent of TSP. These are conservative estimates and are normally applied as they are simple to implement, especially when a source is of comparatively low magnitude to some of the other sources, for example wheel generated dust from haul roads. However, to improve the model accuracy wind erosion from all surface area sources was modelled as wind speed dependent, based on a third order relationship with respect to wind speed. That is:

$$EF_{iTSP} = k\,U^3 \quad \text{(kg/ha/y)}$$

Where U is the wind speed at the reference height of 10 m and k is a proportional constant to maintain total annual emissions as a fixed total. This annual fixed total amount was derived from the default emission factors, i.e. 0.4 kg/ha/h multiplied by 5856 hours (244 days in the modelled year) to give 2342.4 kg/ha/year. For the modelled conditions at the Mt Todd location, wind erosion was considered non-existent during the wet season months of December, January, February and March (122 days), which reduced the annual emissions accordingly, but did not reduce the rate of wind erosion emissions for each hour that they did occur.

In effect, the annualised emissions as determined by the default NPI (2012) emission factors are distributed throughout the year based on a wind dependent relationship. The emission factors were "binned" to different wind speeds, based on the default wind categories used by AUSPLUME. The uncontrolled wind erosion EF's are summarised below. A variable emissions file was created to implement the model.

Uncontrolled Wind Erosion Emission Factors

AUSPLUME Wind Speed Upper Value (m/s)	Category Fraction	Emission Factor (kg/ha/h)		
		TSP	PM_{10}	$PM_{2.5}$
1.54	0.241	0.003	0.002	0.0002
3.09	0.463	0.095	0.047	0.004
5.14	0.185	0.531	0.265	0.025
8.23	0.110	2.271	1.136	0.106
10.8	0.001	6.545	3.273	0.306
10.8+	0.000	–	–	–

Appendix B - AUSPLUME Area, Volume and Point Sources

Mine Site Emissions

The location of emissions sources was determined based on supplied information. In particular, information supplied in Figure 2 (proposed development layout) and Appendix C (process plant map) were used.

Area Sources

Area sources were input into the model with associated areas as given below. Area sources were located as close as possible to the supplied mine plan as practicable. Actual emissions rates, in g/s/m², were determined based on total annual emissions and the associated "modelled" area as opposed to the actual mine surface area that is indicated in the mine plan supplied documentation. This conserves total mass emission rates, which will not make a significant difference to the predicted off-site emissions at identified sensitive receiver locations.

Individual haul roads were not specifically modelled, except for the longer haul road to the TSF1. Haul road emissions were based on estimates of vehicle kilometres travelled (VKT) in each of the individual areas, and then distributed across the entire area as haul road locations will change during the 12 years of operations.

Area Source Model Settings.

Type of Area Source	Description	Modelled Area (m²)	Emission Rate (g/s/m²)		
			$PM_{2.5}$	PM_{10}	TSP
Wind Erosion	Mine Pit	1,344,161	WS Dep.	WS Dep.	WS Dep.
	Haul Roads - Wind Erosion only for TSF1 transport	48,000	WS Dep.	WS Dep.	WS Dep.
	RoM Stockpile	84,513	WS Dep.	WS Dep.	WS Dep.
	Low Grade Ore Stockpile	436,373	WS Dep.	WS Dep.	WS Dep.
	Waste Rock Dump	2,131,338	WS Dep.	WS Dep.	WS Dep.
	Coarse Ore Stockpile	20,106	WS Dep.	WS Dep.	WS Dep.
Wheel Generated Dust	In-pit Haul Roads	1,344,161	1.21×10^{-5}	2.38×10^{-5}	4.25×10^{-5}
	ROM Haul Roads	84,513	1.90×10^{-5}	3.75×10^{-5}	1.27×10^{-4}
	LGO Haul Roads	436,373	7.87×10^{-6}	1.55×10^{-5}	5.25×10^{-5}
	WRD Haul Roads	2,131,338	9.71×10^{-7}	1.91×10^{-6}	6.48×10^{-6}
TSF2 Haul Road	Transport of Waste Rock for TSF1 construction	48,000	7.79×10^{-5}	1.53×10^{-4}	5.19×10^{-4}

Volume Sources

Volume sources were input into the model with locations as given below. Volume sources were located at the indicated location as supplied in the processing plant map (Appendix C) or at representative central mine site locations as indicated in Figure 2 (proposed development).

This was to provide a representative scenario for emission distributions. Appropriate source release height and initial dispersion characteristics were applied to each of the volume sources, as specified in the AUSPLUME guidance documentation.

All volume sources were modelled as continuous, except for blasting emissions that wre modelled as occurring at 8 am, for one hour, each day of the year and for the construction of the TSF1, which was assumed to occur during 12 daylight hours each day of the year.

Volume Source Model Settings

Source	Description	Coordinates UTM Zone 53 (mE, mN)	Emission Rate (g/s)		
			$PM_{2.5}$	PM_{10}	TSP
Mine Pit	Blasting	187140, 8435150	0.8 /blast	2.7 /blast	2.73 /blast
	Loading Haul Trucks	187140, 8435150	0.63	2.0	2.2
LGO	Loading LGO stockpile	188140, 8435740	0.18	0.41	1.18
ROM Pad	Loading - ROM Stockpile	187750, 8434650	0.51	1.18	3.4
Processing Plant	Loading Primary Crusher	187800, 8434450	0.03	0.11	0.23
	Primary Crusher	187820, 8434450	0.23	0.56	1.41
	Loading Secondary Crusher	187860, 8434440	0.01	0.03	0.06
	Secondary Crusher	187860, 8434440	0.81	2.0	5.1
	Loading Coarse Screen	188040, 8434390	0.01	0.03	0.06
	Coarse Screening	188040, 8434390	2.2	10.1	13.5
	Loading Coarse Ore Stockpile (Re-Claim stockpile)	188250, 8434300	0.18	0.47	1.12
	Apron Feeder Re-Claim	188200, 8434350	0.009	0.03	0.05
	Loading HPGR	188030, 8434500	0.01	0.03	0.06
	High Pressure Grinding Roll	188030, 8434500	1.3	1.05	8.1
	Loading Fine Screening	188010, 8434730	0.01	0.03	0.06
	Fine Screen	188010, 8434730	0.09	0.41	0.54

	Loading Grinder	188030, 8434730	0.009	0.03	0.05
TSF2	Bulldozer on TSF2	189150, 8436400	0.71	1.13	4.7
	Unloading Waste Rock	189150, 8436400	1.3	3.0	8.6
WRD	Unloading Waste Rock	188000, 8433500	3.8	8.9	25.5

Stack Sources

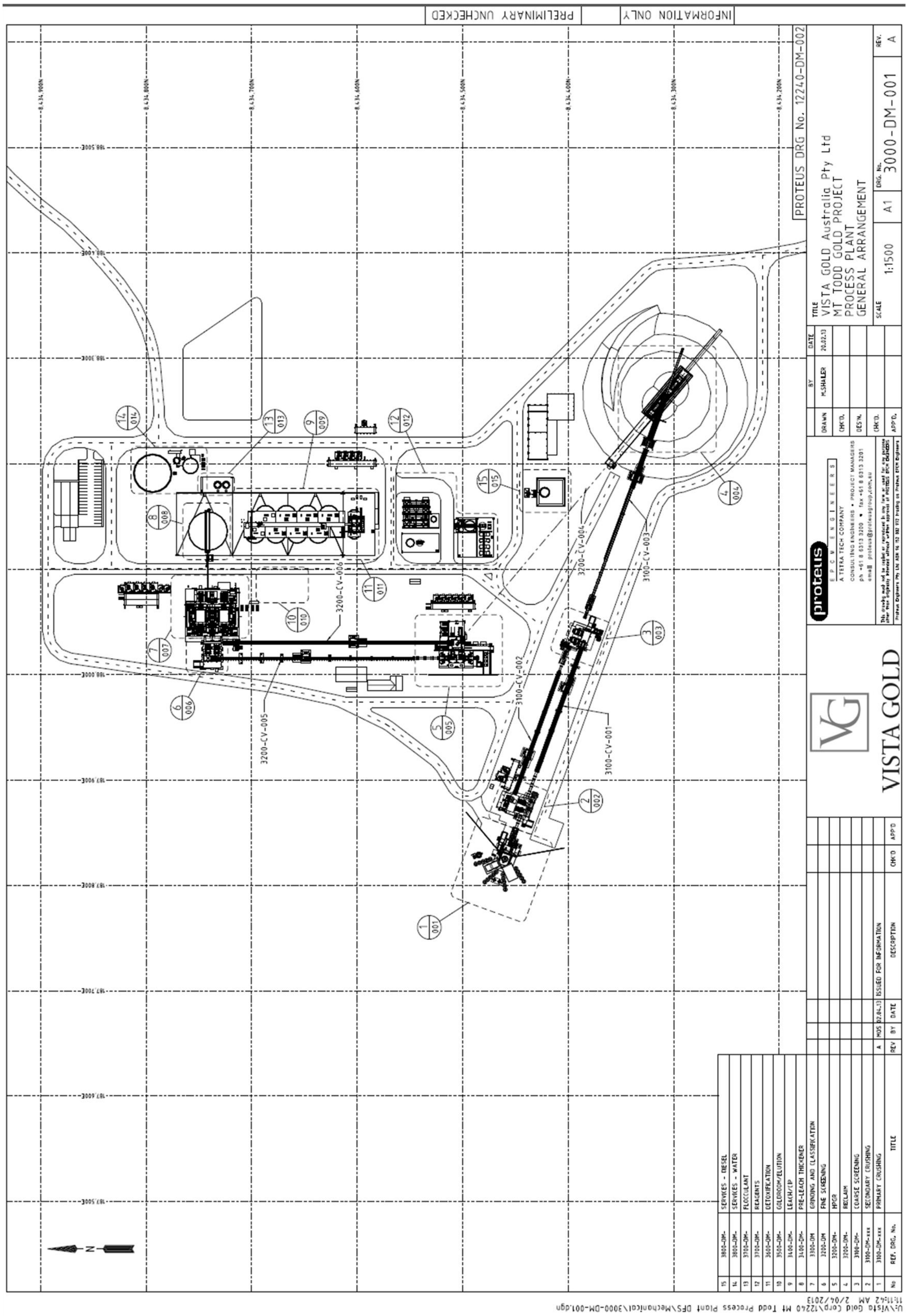
Power generation from the three on-site gas engines was modelled with the stack characteristics detailed below. NO_2 emissions rates were based on vendor supplied emissions of oxides of nitrogen and the conservative assumption of an NO_2:NOx ratio of 30 per cent.

Stack source model settings

Parameter	Gas Turbine	Reciprocating Engines	
Model	Rolls-Royce Trent 60	MAN 20V35/44	MAN 20V35/44
Exit Velocity (m/s)	48.3	12.5	12.5
Exit Temperature (^{o}C)	422	298	298
Stack Diameter (m)	3.0	1.83	1.83
Stack Height (m)	21.3	21.3	21.3
Number of Stacks	1	1	1
Stack Location (mE, mN)	188820, 8433590	188820, 8433580	188820, 8433600
NO_2 Emissions (g/s)	1.84	2.32	2.32
CO Emissions (g/s)	6.69	4.66	4.66

Appendix C – Process Plant Map

Supplied by Vista Gold


PRELIMINARY UNCHECKED
INFORMATION ONLY
PROTEUS DRG No. 12240-DM-002
VISTA GOLD Australia Pty Ltd
MT TODD GOLD PROJECT
PROCESS PLANT
GENERAL ARRANGEMENT
1:1500
A1
3000-DM-001
A
VISTA GOLD
proteus
3100-CV-001
3100-CV-002
3100-CV-003
3200-CV-004
3200-CV-005
3200-CV-006
PRIMARY CRUSHING
SECONDARY CRUSHING
COARSE SCREENING
RECLAIM
HPGR
FINE SCREENING
GRINDING AND CLASSIFICATION
PRE-LEACH THICKENER
LEACH/CIP
GOLDROOM/ELUTION
DETOXIFICATION
REAGENTS
FLOCCULANT
SERVICES - WATER
SERVICES - DIESEL
ISSUED FOR INFORMATION

Appendix D – Environmental Risk Assessment

Development of Risk Descriptors for Assessment of Impact

Background

The Victorian *State Environment Protection Policy (Air Quality Management)* ('SEPP (AQM)') and the NSW *Approved Methods* specifies design criteria for individual pollutants, where the design criterion is the concentration that is not to be exceeded in ambient respirable air.

The SEPP (AQM) allows for a risk assessment to be conducted in the event that design criteria cannot be met, to determine the consequences of non-compliance. Where the emission is of a toxic substance with a design criterion based on health effects (such as a carcinogen), the risk assessment will take the form of a Health Risk Assessment (HRA). Where the emission is an unclassified substance such as odour or nuisance dust, then the criterion is based on amenity, and the risk assessment is termed an Environmental Risk Assessment (ERA).

To date no Australian government authority (such as an EPA) has developed an ERA for dust emissions. However, there have been some draft ERA methodologies for odour emissions and impact for the broiler industry, and one of the early drafts (January 2006) used an approach based on the Risk Management standard AS/NZS 4360:2004, developing measures of 'likelihood' and 'consequence' to evaluate risk. In this draft ERA methodology, if the risk of nearby sensitive uses (i.e. residences) being exposed to dis-amenity from odour is 'Low', then the responsible authority may accept the proposed facility. If the risk is 'Medium', then mitigation measures would be needed. If the risk is 'High', then another site must be found. However, a set of descriptors and matrix for determining the risk level in terms of these three categories has not been provided. Later draft ERA methodologies developed by EPA Victoria appear to have drawn away from this risk assessment approach, but no alternate methodology has been provided. EPA Victoria has since issued guidance relating to landfill licence assessments[7] in which a risk matrix approach has been applied, and this supports the use of the risk matrix approach to assessing risk.

In the absence of published guidance specific to odour emissions, it has been the practice of professionals in this field to develop and apply risk matrix schemes that they consider reflect the level of risk of odour emissions from premises. Similarly, a risk matrix has been developed here to assess the level of risk of dust emissions from the Mt Todd project on the nearest identified sensitive human receptors located at the Werebun community.

Basis for Development of Risk Descriptors

GHD has previously developed (and has used for some years) an approach to risk assessment for odour, which is now being applied here for dust. This risk assessment approach was developed with consideration to relevant regulatory requirements, policies, guidance documents and standards, including:

- AS/NZS ISO 31000:2009 – Risk Management: Principles and Guidelines
- The SEPP (AQM)
- EPA Publication AQ 2/86 – Recommended Buffer Distances for Industrial Residual Air Emissions
- EPA, Draft Guidelines for Environmental Risk Assessments Code for Broiler Farms, January 2006
- EPA Publication 1321.2 Licence Assessment Guidelines

In June 2011, the Victorian Civil and Administrative Tribunal (VCAT) proposed a risk assessment matrix for odour similar to that of GHD, but with a more conservative selection of risk weighting (refer to page 21 of the Victorian Civil and Administrative Tribunal (VCAT)

[7] EPA Publication 1321.2 *Licence Assessment Guidelines*

decision 1146). Though this decision was in relation to a request for expansion of a broiler farm in a rural area, it is likely to set a precedent for any industry where the standard criteria are often not met, i.e. waste water treatment plants, landfills and composting operations. The risk matrix presents the level of risk as a function of consequence (i.e. odour level) and likelihood (i.e. frequency of odour event). In the absence of a regulatory risk assessment approach for dust impacts, this odour based system has been adopted for this investigation.

In developing the risk table below, GHD has considered the level of risk that would result from the application of the matrix, and consider that it would appear to provide a reasonable description of the level of risk. It is expected that the outcome of the application of the matrix will be the subject of review by numerous environmental regulatory agencies and other third parties, and some further adjustment may be found to be necessary.

The risk matrix has taken into account the NEPM allowance of 5 days per year of exceedence of the 50 µg/m³ standard, the EPA Victoria SEPP(AQM) air quality intervention level of 60 µg/m³ and the EPA Victoria SEPP(AQM) nuisance dust level of 330 µg/m³ and adjusted for equivalent time averaging.

Adopted risk matrix for dust impact

Frequency	**PM_{10} 24 hour Average Concentration (µg/m³)**				
	>100 µg/m³	**>80 µg/m³ and ≤ 100 µg/m³**	**>60 µg/m³ and ≤ 80 µg/m³**	**>50 µg/m³ and ≤ 60 µg/m³**	**≤ 50 µg/m³**
More than once per week (>52 per year)	Extreme	Extreme	High	Medium	Negligible
1 per week to 1 per fortnight (>26 to ≤52 per year)	Extreme	High	High	Medium	Negligible
1 per fortnight to 1 per month (>12 to ≤26 per year)	High	High	Medium	Low	Negligible
1 per month to 1 per 2 months (>6 to ≤12 per year)	Medium	Medium	Medium	Low	Negligible
Every 2 months to every 4 months (>3 to ≤6 per year)	Low	Low	Low	Low	Negligible
Once to 3 times (>1 to ≤3 per year)	Low	Low	Low	Negligible	Negligible

Appendix E - AUSPLUME Output Text Files

Mine Site PM_{10} Ground Level Concentrations

1

Mt Todd May 2013 var emiss W/E cont 22/5/13 PM10 no depletion

Concentration or deposition	Concentration
Emission rate units	grams/second
Concentration units	microgram/m3
Units conversion factor	1.00E+06
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m
Use the convective PDF algorithm?	No

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Pasquill-Gifford
Vertical dispersion curves for sources >100m high	Pasquill-Gifford
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.100m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Rural" values (unless overridden by met. file)

AVERAGING TIMES
24 hours
average over all hours

1

Mt Todd May 2013 var emiss W/E cont 22/5/13 PM10 no depletion

SOURCE CHARACTERISTICS

INTEGRATED POLYGON AREA SOURCE: PIT

X0(m)	Y0(m)	Ground El	No. Vertices	Ver. spread	Height
187270	8435950	0m	19	1m	0m

```
          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  187270 8435950         2  187431 8435901
                    3  187631 8435745         4  187734 8435473
                    5  187801 8435254         6  187734 8435067
                    7  187703 8434849         8  187631 8434684
                    9  187431 8434612        10  187315 8434474
                   11  187176 8434407        12  186873 8434389
                   13  186664 8434648        14  186606 8434933
                   15  186601 8435165        16  186788 8435460
                   17  186878 8435682        18  187052 8435825
                   19  187167 8435946
             (Constant) emission rate = 1.00E+00 grams/second per square metre

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED POLYGON AREA SOURCE: WRD

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 188000 8434350         0m            19           88m    175m


          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  188000 8434350         2  188406 8434074
                    3  188611 8433784         4  188812 8433400
                    5  188776 8433119         6  188620 8432856
                    7  188232 8432789         8  187670 8432722
                    9  187313 8432709        10  187318 8432950
                   11  187197 8433142        12  187278 8433396
                   13  187295 8433686        14  187300 8433882
                   15  187269 8434225        16  187278 8434399
                   17  187518 8434430        18  187764 8434444
                   19  187902 8434390
             (Constant) emission rate = 1.00E+00 grams/second per square metre

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED POLYGON AREA SOURCE: LGO

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 188000 8436160         0m            14           10m     20m


          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  188000 8436160         2  188305 8436151
                    3  188332 8435935         4  188375 8435788
                    5  188395 8435549         6  188381 8435311
                    7  188328 8435188         8  188123 8435099
                    9  188058 8435047        10  188002 8435257
                   11  187913 8435500        12  187918 8435748
                   13  187891 8435982        14  187938 8436140
             (Constant) emission rate = 1.00E+00 grams/second per square metre

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED POLYGON AREA SOURCE: ROM

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 187740 8434830         0m            15            5m     10m


          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  187740 8434830         2  187912 8434830
                    3  187934 8434790         4  187896 8434692
                    5  187840 8434634         6  187780 8434591
                    7  187742 8434509         8  187682 8434489
                    9  187555 8434464        10  187537 8434442
                   11  187430 8434520        12  187457 8434556
```

```
                 13  187519 8434596        14  187662 8434661
                 15  187718 8434750
           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED CIRCULAR AREA SOURCE: RCST

  X0(m)   Y0(m)  Ground El  Radius  No. Vertices  Ver. spread  Height
 188250 8434300         0m     80m             8           8m     16m

           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: WEPIT

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 187270 8435950         0m            19           1m      0m


         Integrated Polygon Area Source Vertice Locations (in metres)
                 No.       X       Y       No.       X       Y
                   1  187270 8435950         2  187431 8435901
                   3  187631 8435745         4  187734 8435473
                   5  187801 8435254         6  187734 8435067
                   7  187703 8434849         8  187631 8434684
                   9  187431 8434612        10  187315 8434474
                  11  187176 8434407        12  186873 8434389
                  13  186664 8434648        14  186606 8434933
                  15  186601 8435165        16  186788 8435460
                  17  186878 8435682        18  187052 8435825
                  19  187167 8435946
           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: WEWRD

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 188000 8434350         0m            19          88m    175m


         Integrated Polygon Area Source Vertice Locations (in metres)
                 No.       X       Y       No.       X       Y
                   1  188000 8434350         2  188406 8434074
                   3  188611 8433784         4  188812 8433400
                   5  188776 8433119         6  188620 8432856
                   7  188232 8432789         8  187670 8432722
                   9  187313 8432709        10  187318 8432950
                  11  187197 8433142        12  187278 8433396
                  13  187295 8433686        14  187300 8433882
                  15  187269 8434225        16  187278 8434399
                  17  187518 8434430        18  187764 8434444
                  19  187902 8434390
           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: WELGO

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 188000 8436160         0m            14          10m     20m


         Integrated Polygon Area Source Vertice Locations (in metres)
                 No.       X       Y       No.       X       Y
                   1  188000 8436160         2  188305 8436151
```

```
                 3  188332 8435935         4  188375 8435788
                 5  188395 8435549         6  188381 8435311
                 7  188328 8435188         8  188123 8435099
                 9  188058 8435047        10  188002 8435257
                11  187913 8435500        12  187918 8435748
                13  187891 8435982        14  187938 8436140
           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: WEROM

 X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
187740 8434830         0m            15            5m     10m


            Integrated Polygon Area Source Vertice Locations (in metres)
                No.       X       Y       No.       X       Y
                 1  187740 8434830         2  187912 8434830
                 3  187934 8434790         4  187896 8434692
                 5  187840 8434634         6  187780 8434591
                 7  187742 8434509         8  187682 8434489
                 9  187555 8434464        10  187537 8434442
                11  187430 8434520        12  187457 8434556
                13  187519 8434596        14  187662 8434661
                15  187718 8434750
           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED CIRCULAR AREA SOURCE: WERCST

 X0(m)   Y0(m)  Ground El  Radius  No. Vertices  Ver. spread  Height
188250 8434300         0m     80m             8            8m     16m

           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED AREA SOURCE: HRROM

 X0(m)   Y0(m)  Ground El  Length X  Length Y  Or. Angle  Ver. spread  Height
187500 8434600         0m      400m       20m     -15deg           3m      6m

           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED AREA SOURCE: HRLGO

 X0(m)   Y0(m)  Ground El  Length X  Length Y  Or. Angle  Ver. spread  Height
187500 8434600         0m     1350m       20m     -60deg           3m      6m

           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
     this emission factor.
               No gravitational settling or scavenging.


                 INTEGRATED AREA SOURCE: HRWRD

 X0(m)   Y0(m)  Ground El  Length X  Length Y  Or. Angle  Ver. spread  Height
187500 8434600         0m     1350m       20m      65deg           3m      6m

           (Constant) emission rate = 1.00E+00 grams/second per square metre

     Hourly multiplicative factors will be used with
```

```
       this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED AREA SOURCE: HRTS1

  X0(m)   Y0(m)  Ground El  Length X  Length Y  Or. Angle  Ver. spread  Height
 187740 8434880         0m     2400m       20m     -20deg           3m      6m

             (Constant) emission rate = 1.00E+00 grams/second per square metre

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED AREA SOURCE: WHRTS1

  X0(m)   Y0(m)  Ground El  Length X  Length Y  Or. Angle  Ver. spread  Height
 187740 8434880         0m     2400m       20m     -20deg           0m      0m

             (Constant) emission rate = 1.00E+00 grams/second per square metre

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  VOLUME SOURCE: BLAST

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
 187140  8435150             0m             0m         50m            1m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  VOLUME SOURCE: LHTR

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
 187140  8435150             0m             0m         50m            1m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  VOLUME SOURCE: UROM

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
 187750  8434650             0m             4m         20m            2m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  VOLUME SOURCE: ULGO

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
 188140  8435740             0m             4m         50m            2m

             (Constant) emission rate = 1.00E+00 grams/second

       Hourly multiplicative factors will be used with
       this emission factor.
                 No gravitational settling or scavenging.


                  VOLUME SOURCE: UWRD

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
 188000  8433500             0m             4m         50m            2m
```

```
        (Constant) emission rate = 1.00E+00 grams/second

  Hourly multiplicative factors will be used with
  this emission factor.
            No gravitational settling or scavenging.


             VOLUME SOURCE: LPCR

  X(m)    Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
187800  8434450           0m             2m          2m             1m

        (Constant) emission rate = 1.00E+00 grams/second

  Hourly multiplicative factors will be used with
  this emission factor.
            No gravitational settling or scavenging.


             VOLUME SOURCE: PCR

  X(m)    Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
187820  8434450           0m             4m          5m             2m

        (Constant) emission rate = 1.00E+00 grams/second

  Hourly multiplicative factors will be used with
  this emission factor.
            No gravitational settling or scavenging.


             VOLUME SOURCE: LSCR

  X(m)    Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
187860  8434440           0m             4m          5m             2m

        (Constant) emission rate = 1.00E+00 grams/second

  Hourly multiplicative factors will be used with
  this emission factor.
            No gravitational settling or scavenging.


             VOLUME SOURCE: SCR

  X(m)    Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
187860  8434440           0m             4m          5m             2m

        (Constant) emission rate = 1.00E+00 grams/second

  Hourly multiplicative factors will be used with
  this emission factor.
            No gravitational settling or scavenging.


             VOLUME SOURCE: LCS

  X(m)    Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
187040  8434390           0m             4m          5m             2m

        (Constant) emission rate = 1.00E+00 grams/second

  Hourly multiplicative factors will be used with
  this emission factor.
            No gravitational settling or scavenging.


             VOLUME SOURCE: CS

  X(m)    Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
187040  8434390           0m             4m          5m             2m

        (Constant) emission rate = 1.00E+00 grams/second

  Hourly multiplicative factors will be used with
  this emission factor.
            No gravitational settling or scavenging.
```

```
                 VOLUME SOURCE: LREC

  X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
188250  8434300             0m            30m         5m            2m

            (Constant) emission rate = 1.00E+00 grams/second

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 VOLUME SOURCE: APFRC

  X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
188200  8434350             0m             1m         5m            2m

            (Constant) emission rate = 1.00E+00 grams/second

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 VOLUME SOURCE: LHPGR

  X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
188030  8434500             0m             5m         5m            2m

            (Constant) emission rate = 1.00E+00 grams/second

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 VOLUME SOURCE: HPGR

  X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
188030  8434500             0m             5m         5m            2m

            (Constant) emission rate = 1.00E+00 grams/second

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 VOLUME SOURCE: LFSCR

  X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
188010  8434730             0m             5m         5m            2m

            (Constant) emission rate = 1.00E+00 grams/second

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 VOLUME SOURCE: FSCR

  X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
188010  8434730             0m             5m         5m            2m

            (Constant) emission rate = 1.00E+00 grams/second

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 VOLUME SOURCE: LGR

  X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
188030  8434730             0m             5m         5m            2m

            (Constant) emission rate = 1.00E+00 grams/second

      Hourly multiplicative factors will be used with
```

```
        this emission factor.
                  No gravitational settling or scavenging.


                   VOLUME SOURCE: TSF1B

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
  189150  8436400            0m             5m       500m           2m

              (Constant) emission rate = 1.00E+00 grams/second

        Hourly multiplicative factors will be used with
        this emission factor.
                  No gravitational settling or scavenging.


                   VOLUME SOURCE: TSF1UL

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
  189150  8436400            0m             5m       500m           2m

              (Constant) emission rate = 1.00E+00 grams/second

        Hourly multiplicative factors will be used with
        this emission factor.
                  No gravitational settling or scavenging.


                   VOLUME SOURCE: TSF2B

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
  191000  8434500            0m             5m       500m           2m

              (Constant) emission rate = 1.00E+00 grams/second

        Hourly multiplicative factors will be used with
        this emission factor.
                  No gravitational settling or scavenging.


                   VOLUME SOURCE: TSF2UL

   X(m)     Y(m)     Ground Elevation    Height   Hor. spread   Vert. spread
  191000  8434500            0m             5m       500m           2m

              (Constant) emission rate = 1.00E+00 grams/second

        Hourly multiplicative factors will be used with
        this emission factor.
                  No gravitational settling or scavenging.

 _____________________________________________________________________________

1       _________________________________________________________________

          Mt Todd May 2013 var emiss W/E cont 22/5/13 PM10 no depletion

                              RECEPTOR LOCATIONS

        _________________________________________________________________

 The Cartesian receptor grid has the following x-values (or eastings):
 178680.m  179080.m  179480.m  179880.m  180280.m  180680.m  181080.m
 181480.m  181880.m  182280.m  182680.m  183080.m  183480.m  183880.m
 184280.m  184680.m  185080.m  185480.m  185880.m  186280.m  186680.m
 187080.m  187480.m  187880.m  188280.m  188680.m  189080.m  189480.m
 189880.m  190280.m  190680.m  191080.m  191480.m  191880.m  192280.m
 192680.m  193080.m  193480.m  193880.m  194280.m  194680.m  195080.m
 195480.m  195880.m  196280.m  196680.m  197080.m  197480.m  197880.m
 198280.m

 and these y-values (or northings):
8424229.m 8424629.m 8425029.m 8425429.m 8425829.m 8426229.m 8426629.m
8427029.m 8427429.m 8427829.m 8428229.m 8428629.m 8429029.m 8429429.m
8429829.m 8430229.m 8430629.m 8431029.m 8431429.m 8431829.m 8432229.m
8432629.m 8433029.m 8433429.m 8433829.m 8434229.m 8434629.m 8435029.m
8435429.m 8435829.m 8436229.m 8436629.m 8437029.m 8437429.m 8437829.m
8438229.m 8438629.m 8439029.m 8439429.m 8439829.m 8440229.m 8440629.m
8441029.m 8441429.m 8441829.m 8442229.m 8442629.m 8443029.m 8443429.m
8443829.m
```

```
DISCRETE RECEPTOR LOCATIONS (in metres)

No.      X        Y    ELEVN  HEIGHT       No.      X        Y    ELEVN  HEIGHT
 1  193545 8430319     0.0    0.0         5  187685 8436800     0.0    0.0
 2  193111 8431033     0.0    0.0         6  183000 8435000     0.0    0.0
 3  187685 8436064     0.0    0.0         7  157800 8469350     0.0    0.0
 4  187685 8431900     0.0    0.0         8  205000 8400000     0.0    0.0
_____________________________________________________________________________

            METEOROLOGICAL DATA : Ausplume- Mt Todd Mine - TAPM

----------------------------------------------------------------------

             HOURLY VARIABLE EMISSION FACTOR INFORMATION
             -------------------------------------------

The input emission rates specfied above will be multiplied by hourly varying
factors entered via the input file:
G:\43\2180110\Tech\Ausplume\may2013\input\PM10_yr3_var_emissions01.csv
For each stack source, hourly values within this file will be added to each
declared exit velocity (m/sec) and temperature (K).

Title of input hourly emission factor file is:
Mt Todd - PM10 Variable Emissions File May 2013 Year 3

             HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION
             ---------------------------------------------

Prefix WEPIT  allocated: WEPIT
Prefix WELGO  allocated: WELGO
Prefix WERCST allocated: WERCST
Prefix WEROM  allocated: WEROM
Prefix WEWRD  allocated: WEWRD
Prefix WHRTS1 allocated: WHRTS1
Prefix PIT    allocated: PIT
Prefix WRD    allocated: WRD
Prefix HRLGO  allocated: HRLGO
Prefix HRROM  allocated: HRROM
Prefix HRTS1  allocated: HRTS1
Prefix HRWRD  allocated: HRWRD
Prefix LGO    allocated: LGO
Prefix RCST   allocated: RCST
Prefix ROM    allocated: ROM
Prefix BLAST  allocated: BLAST
Prefix LHTR   allocated: LHTR
Prefix UROM   allocated: UROM
Prefix ULGO   allocated: ULGO
Prefix UWRD   allocated: UWRD
Prefix LPCR   allocated: LPCR
Prefix PCR    allocated: PCR
Prefix LSCR   allocated: LSCR
Prefix SCR    allocated: SCR
Prefix LCS    allocated: LCS
Prefix CS     allocated: CS
Prefix LREC   allocated: LREC
Prefix APFRC  allocated: APFRC
Prefix LHPGR  allocated: LHPGR
Prefix HPGR   allocated: HPGR
Prefix LFSCR  allocated: LFSCR
Prefix FSCR   allocated: FSCR
Prefix LGR    allocated: LGR
Prefix TSF1B  allocated: TSF1B
Prefix TSF1UL allocated: TSF1UL
Prefix TSF2B  allocated: TSF2B
Prefix TSF2UL allocated: TSF2UL
____________________________________________________________________________

1       HIGHEST RECORDINGS FOR EACH RECEPTOR  (in microgram/m3)
        AVERAGING TIME = 24 HOURS

 At the discrete receptors:
  1: 4.97E+01 @Hr24,17/02/08     5: 1.70E+02 @Hr24,20/07/08
  2: 5.99E+01 @Hr24,17/02/08     6: 2.08E+02 @Hr24,12/06/08
  3: 4.08E+02 @Hr24,01/01/08     7: 1.74E+01 @Hr24,14/08/08
  4: 2.15E+02 @Hr24,04/11/07     8: 1.26E+01 @Hr24,01/12/07
____________________________________________________________________________
```

1 SECOND-HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 24 HOURS

At the discrete receptors:

1: 4.96E+01 @Hr24,18/02/08	5: 1.31E+02 @Hr24,01/01/08
2: 5.95E+01 @Hr24,18/02/08	6: 1.88E+02 @Hr24,13/06/08
3: 3.49E+02 @Hr24,01/02/08	7: 1.69E+01 @Hr24,17/04/08
4: 2.11E+02 @Hr24,12/11/07	8: 7.55E+00 @Hr24,23/11/07

1 Peak values for the 100 worst cases (in microgram/m3)
Averaging time = 24 hours

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	5.83E+03	24,26/02/08	(187080, 8434229, 0.0)
2	5.50E+03	24,19/02/08	(187080, 8434229, 0.0)
3	4.24E+03	24,25/02/08	(187080, 8434229, 0.0)
4	3.93E+03	24,05/02/08	(187080, 8434229, 0.0)
5	3.85E+03	24,04/11/07	(187080, 8434229, 0.0)
6	3.84E+03	24,09/10/07	(187080, 8434229, 0.0)
7	3.82E+03	24,08/10/07	(187080, 8434229, 0.0)
8	3.77E+03	24,31/01/08	(187080, 8434229, 0.0)
9	3.68E+03	24,28/01/08	(187080, 8434229, 0.0)
10	3.67E+03	24,12/03/08	(187080, 8435029, 0.0)
11	3.55E+03	24,27/02/08	(187080, 8434229, 0.0)
12	3.53E+03	24,11/10/07	(187080, 8434229, 0.0)
13	3.46E+03	24,09/02/08	(187080, 8434229, 0.0)
14	3.32E+03	24,03/02/08	(187080, 8434229, 0.0)
15	3.22E+03	24,08/02/08	(187080, 8434229, 0.0)
16	3.22E+03	24,27/11/07	(187080, 8434229, 0.0)
17	3.20E+03	24,17/12/07	(187080, 8434229, 0.0)
18	3.13E+03	24,07/10/07	(187080, 8434229, 0.0)
19	3.12E+03	24,30/04/08	(186680, 8434629, 0.0)
20	3.12E+03	24,17/11/07	(187080, 8434229, 0.0)
21	3.08E+03	24,30/01/08	(187080, 8434229, 0.0)
22	3.06E+03	24,29/12/07	(187080, 8434229, 0.0)
23	3.04E+03	24,28/02/08	(187080, 8434229, 0.0)
24	3.02E+03	24,15/02/08	(187080, 8434229, 0.0)
25	2.97E+03	24,20/01/08	(187080, 8434229, 0.0)
26	2.95E+03	24,10/02/08	(187080, 8434229, 0.0)
27	2.94E+03	24,07/01/08	(187080, 8434229, 0.0)
28	2.92E+03	24,28/12/07	(187080, 8435029, 0.0)
29	2.92E+03	24,27/01/08	(187080, 8434229, 0.0)
30	2.91E+03	24,08/01/08	(187080, 8434229, 0.0)
31	2.90E+03	24,19/01/08	(187080, 8434229, 0.0)
32	2.89E+03	24,11/03/08	(187880, 8433429, 0.0)
33	2.87E+03	24,14/12/07	(187080, 8434229, 0.0)
34	2.86E+03	24,24/03/08	(187080, 8435029, 0.0)
35	2.82E+03	24,01/03/08	(187080, 8434229, 0.0)
36	2.81E+03	24,24/01/08	(187480, 8435029, 0.0)
37	2.79E+03	24,26/11/07	(187080, 8434229, 0.0)
38	2.79E+03	24,13/02/08	(187080, 8434229, 0.0)
39	2.78E+03	24,10/12/07	(187080, 8434229, 0.0)
40	2.74E+03	24,25/03/08	(187080, 8434229, 0.0)
41	2.74E+03	24,23/12/07	(187080, 8435029, 0.0)
42	2.73E+03	24,08/12/07	(187080, 8434229, 0.0)
43	2.73E+03	24,03/03/08	(186680, 8434629, 0.0)
44	2.72E+03	24,04/02/08	(187080, 8434229, 0.0)
45	2.72E+03	24,25/01/08	(187880, 8433429, 0.0)
46	2.70E+03	24,18/11/07	(187080, 8434229, 0.0)
47	2.69E+03	24,26/01/08	(187080, 8435029, 0.0)
48	2.69E+03	24,26/12/07	(186680, 8434629, 0.0)
49	2.68E+03	24,03/05/08	(186680, 8434629, 0.0)
50	2.64E+03	24,27/12/07	(187880, 8433429, 0.0)
51	2.63E+03	24,27/03/08	(187080, 8435029, 0.0)
52	2.61E+03	24,26/03/08	(187080, 8435029, 0.0)
53	2.61E+03	24,07/11/07	(187080, 8434229, 0.0)
54	2.61E+03	24,29/04/08	(186680, 8434629, 0.0)
55	2.60E+03	24,15/12/07	(187080, 8434229, 0.0)
56	2.60E+03	24,20/07/08	(187080, 8434229, 0.0)
57	2.57E+03	24,22/03/08	(187080, 8435029, 0.0)
58	2.57E+03	24,20/11/07	(187080, 8434229, 0.0)
59	2.55E+03	24,21/12/07	(187080, 8434229, 0.0)
60	2.54E+03	24,23/10/07	(187080, 8434229, 0.0)
61	2.54E+03	24,21/03/08	(187080, 8435029, 0.0)
62	2.53E+03	24,11/12/07	(187080, 8435029, 0.0)
63	2.52E+03	24,05/11/07	(187080, 8435029, 0.0)
64	2.51E+03	24,28/05/08	(186680, 8434629, 0.0)
65	2.51E+03	24,02/02/08	(187080, 8434229, 0.0)

66	2.48E+03	24,11/02/08	(187080,	8434229,	0.0)
67	2.47E+03	24,07/07/08	(186680,	8434629,	0.0)
68	2.44E+03	24,20/03/08	(187880,	8433429,	0.0)
69	2.44E+03	24,29/01/08	(187080,	8435029,	0.0)
70	2.43E+03	24,10/01/08	(187080,	8434229,	0.0)
71	2.43E+03	24,23/04/08	(186680,	8434629,	0.0)
72	2.42E+03	24,30/12/07	(187480,	8435029,	0.0)
73	2.39E+03	24,09/12/07	(187080,	8434229,	0.0)
74	2.38E+03	24,22/10/07	(187080,	8434229,	0.0)
75	2.37E+03	24,16/02/08	(187080,	8434229,	0.0)
76	2.36E+03	24,23/01/08	(187080,	8434229,	0.0)
77	2.35E+03	24,19/05/08	(186680,	8434629,	0.0)
78	2.35E+03	24,24/04/08	(186680,	8434629,	0.0)
79	2.33E+03	24,09/01/08	(187080,	8434229,	0.0)
80	2.31E+03	24,30/03/08	(186680,	8434629,	0.0)
81	2.30E+03	24,02/01/08	(187480,	8434629,	0.0)
82	2.30E+03	24,12/11/07	(187080,	8434229,	0.0)
83	2.29E+03	24,31/03/08	(186680,	8434629,	0.0)
84	2.28E+03	24,07/04/08	(186680,	8434629,	0.0)
85	2.28E+03	24,06/10/07	(187080,	8434229,	0.0)
86	2.27E+03	24,01/07/08	(186680,	8434629,	0.0)
87	2.26E+03	24,30/10/07	(187080,	8434229,	0.0)
88	2.26E+03	24,21/02/08	(187080,	8434229,	0.0)
89	2.25E+03	24,01/02/08	(187480,	8435029,	0.0)
90	2.24E+03	24,05/05/08	(186680,	8434629,	0.0)
91	2.24E+03	24,08/04/08	(186680,	8434629,	0.0)
92	2.23E+03	24,29/11/07	(187080,	8434229,	0.0)
93	2.23E+03	24,06/08/08	(186680,	8434629,	0.0)
94	2.22E+03	24,06/12/07	(187080,	8434229,	0.0)
95	2.22E+03	24,15/03/08	(187880,	8433429,	0.0)
96	2.20E+03	24,13/03/08	(187080,	8435029,	0.0)
97	2.19E+03	24,12/04/08	(187880,	8433429,	0.0)
98	2.18E+03	24,27/05/08	(186680,	8434629,	0.0)
99	2.18E+03	24,29/10/07	(187080,	8434229,	0.0)
100	2.18E+03	24,27/04/08	(186680,	8434629,	0.0)

GHD

180 Lonsdale Street
Melbourne, Victoria 3000
T: (03) 8687 8000 F: (03) 8687 8111 E: melmail@ghd.com.au

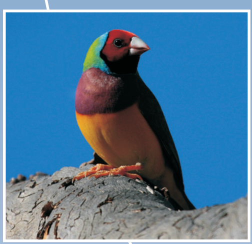
N:\AU\Melbourne\Projects\43\2180110\WP\222347_Air_Quality_45kt_May2013.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	D Featherston B Cook	Andrew Balch	Andrew Balch	Ian McCardle	I McCardle	6/6/2013

APPENDIX U

Noise and Vibration Assessment



CLIENTS | PEOPLE | PERFORMANCE

Vista Gold Australia Pty Ltd

Mt Todd Gold Project

Noise and Vibration Assessment

June 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

Appendices

Glossary – Noise and Vibration Terms

Term	Definition
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dB(A)	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A10(period)}$	The sound pressure level that is exceeded for 10% of the measurement period.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
L_{Amax}	The maximum sound level recorded during the measurement period.
$L_{A1(period)}$	The sound pressure level that is exceeded for 1% of the measurement period.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day / evening / night) over the whole monitoring period.
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).
Ground borne vibration	Ground borne vibration is vibration transmitted from source to receptor via the medium of the ground.
Ground borne noise	Ground borne noise describes noise transmitted as vibration through the ground and into structures, radiated as low frequency rumbling noise.
Peak Particle Velocity	Current practice for assessments of the risk of structural damage to buildings use measurements of Peak Particle Velocity (PPV) ground vibration (v_p), which is the maximum vector sum of three orthogonal time-synchronised velocity components.
RMS	Root mean square.

Executive Summary

Vista Gold Australia Pty Ltd (Vista Gold) is proposing to develop the Mt Todd Gold Project (the Project) consisting of the re-establishment, operation and rehabilitation of the Mt Todd Gold Mine.

This report has been prepared to assess potential noise and vibration impacts relevant to the construction and operation of the Project and will form part of an Environmental Impact Statement.

Baseline Monitoring

Baseline noise monitoring was conducted at two locations in the vicinity of the Project area. Operational noise criteria were determined based on background noise monitoring results and with consideration to the New South Wales Industrial Noise Policy (INP) (EPA, 2000), in the absence of Northern Territory noise and vibration guidelines or criteria. Construction and operational noise and vibration criteria including blasting vibration and overpressure criteria are outlined in this report.

Construction Noise and Vibration

The results of the construction assessment indicate that the construction noise and vibration impact of the mine are expected to comply with the project specific noise criteria at all sensitive receptors.

Operational Noise and Vibration

Acoustic modelling was undertaken to predict the effects of operational noise from the Project. The results of the operational assessment indicate that the operational noise and vibration impact of the Mt Todd Gold Mine are expected to comply with the project specific noise criteria at all known sensitive receptors assessed under neutral and adverse weather conditions and under the modelling assumptions outlined in this report.

The estimated increase in traffic noise levels due to the Project is not expected to be noticeable to the Werenbun receptor.

Airblast overpressure and ground vibration from blasting activities at the mine are predicted to be below the allowable criteria outlined in the ANZECC Guidelines.

Based on available literature it is unlikely that any adverse noise and vibration impacts on livestock and native fauna would be associated with the Project. As such, no specific noise and vibration mitigation measures are required.

Although not expected to cause adverse noise impacts, it is recommended that the management measures detailed in this report be considered for operation of the Project, in order to minimise the risk of noise impact.

1. Introduction

1.1 Background

Vista Gold Australia Pty Ltd (Vista Gold) is proposing to develop the Mt Todd Gold Project (the Project) by undertaking the re-establishment, operation and rehabilitation of the Mt Todd Gold Mine.

The Mt Todd Gold Mine site is located approximately 55 km north-west of Katherine and 250 km south of Darwin in the Northern Territory.

GHD has been engaged to prepare a draft Environmental Impact Statement (EIS) on behalf of Vista Gold. This report provides the relevant noise and vibration information requirements outlined in the Guidelines for the Preparation of an EIS (EPA (formerly NRETAS) September 2011).

Table 1 provides a cross-reference with the section of this report and the Project EIS requirements.

Table 1 Project EIS Requirements Cross Reference

Section Number	Project EIS Requirement	Is this included in this report?	Section of this report
Section 7.6	The ability of identified stands of vegetation and fauna to withstand any increased pressure resulting from the Project (e.g., increase in dust, light, noise, vibration, traffic and fire) and measures proposed to mitigate impacts.	Yes	Section 5.3.6
Section 10.3	Describe proposed safeguards, management and monitoring strategies that will be implemented to minimise potential transport impacts during construction and operation including, but not limited to: ◗ Measures to reduce any road traffic noise impacts.	Yes	Section 5.3.4

1.2 Scope of Work

The scope of works for the noise and vibration impact assessment, as a component study required for the EIS is as follows:

- Initial desk top review to identify key environmental noise catchment areas and noise sensitive receptors from aerial photography;
- Unattended noise monitoring for a period of one week at two (2) locations. One logger was deployed close to and representative of the nearest residential receiver, and one logger was deployed at the site boundary.

  Attended noise measurements have also been undertaken at the existing site, as well as around the nearest noise sensitive receptor (Werenbun community) to supplement the unattended measurements.

- Based on monitoring results, determination of project specific noise and vibration goals for the construction and operation of the proposed Mount Todd Mine, with consideration to the following guidelines:
  – NT EPA – Noise guidelines for development sites in the Northern Territory (NT EPA 2013).
  – NSW Environment Protection Authority (NSW EPA) Industrial Noise Policy (2000), in the absence of equivalent NT noise guidelines;
- Identification of the likely principal noise and vibration sources during construction and operation;
- Noise modelling using Computer Aided Noise Abatement (CadnaA) software to predict sound pressure levels emanating from the proposed operation of the mine site at the nearest identified noise receiver;
- Desktop noise assessment of construction activities;
- Desktop assessment of blasting vibration and overpressure impacts; and
- Provision of in-principle noise and vibration mitigation measures.

2. Project Description

The Mt Todd Gold Mine site is a brownfield/disturbed site that was most recently mined for gold in the 1990’s until the year 2000. Mining infrastructure such as tailing dams, waste rock dumps and remains of processing facilities remain on site.

The Project, based on current known data, will have a life of around 19 years inclusive of construction, operations and closure. Construction is anticipated to commence in the first quarter of 2014 and take two years, including 6 months pre-production. The mine is scheduled to operate for a further 13 years. Closure and rehabilitation of the mine is expected to take four years.

The construction and operations workforces are expected to peak at 450 and 350 personnel respectively.

The Project area is shown in (Figure 1). The key elements of the Project are listed in the Sections below.

2.1 Mining and Mining Infrastructure

- extension of the existing Batman Pit from its current depth of 114 m to approximately 588 m (RL -400 m) and surface area of 40 hectares (ha) to approximately 137 ha;
- expansion of the existing waste rock dump (WRD) from a height of 24 m above ground level to approximately 350 m above ground level (RL 470 m), and a footprint of 70 ha to approximately 217 ha. The dump currently contains 16 Mt of waste rock and the expansion will provide total capacity of up to 510 Mt;
- construction of a Run of Mine (ROM) pad and ore stockpile;
- construction of an Ammonium Nitrate and Fuel Oil (ANFO) Facility;
- construction of heavy and light vehicle workshop and administration offices, and facilities comprising wash down area, tyre change facility, lube storage facility etc; and
- construction of haul roads and access roads.

2.1.1 Process Plant and Associated Facilities

- Ore Processing Plant capable of processing approximately 50,000 tonnes per day (tpd) of ore;
- processing and / or reclamation of the existing low grade ore (LGO) stockpile and scats stockpile, and construction and processing of new LGO stockpile with a footprint of approximately 47 ha;
- raising the existing tailings storage facility (TSF1) from 16 m to approximately 34 m above ground level;
- construction of a new tailing storage facility (TSF2), approximately 300 ha in area and up to 60 m high (RL 175 m);
- diversion of Horseshoe Creek and Stow Creek adjacent to TSF2 to provide flood protection;
- rehabilitation of the existing heap leach pad (HLP), if residual HLP material is not processed through the new plant;
- chemical and reagent storage and handling facility; and
- process plant workshops, administration offices, control room etc.

2.1.2 Other Infrastructure

- gas-fired power station, including re-routing of the existing gas pipeline;
- anaerobic treatment wetlands, approximately 10 ha in area;
- a 2 m high raising of the raw water dam (RWD) and an increase in the area of inundation;
- construction of saddle dams at the RWD and TSF1;
- construction of three coffer dams at Retention Pond 1 (RP1) and deepening of RP1;
- water treatment plant;
- security gate house;
- potential re-alignment of access roads;
- site wide drainage, sediment traps; and
- modification to existing fuel storage and distribution facility.

2.2 Mining Operations and Processing

2.2.1 Mine Production Schedule and Pit Development

Proven and probable reserves have been used to schedule mine production. The production schedule of up to 216 Mt of processed ore will occur over a 13 year period not including pre-production mining during the construction phase.

Based on a review of geological data and current bench slopes, a detailed pit design has been completed. The ultimate pit is achieved by mining in four separate phases, or cut backs, outlined below:

- phase one: mining during pre-production starts from the current pit pushback limit that was started by previous operators and mines it to RL -188 m;
- phase 2: during year 1 mining around the phase 1 pit and deepens the mined pit to RL -246 m;
- phase 3: during year 3 mining around the south end of the phase 2 pit and achieves a RL of -336 m;
- phase 4: during year 5 completion of mining in the north and below phase 3 to a RL of -400 m.

2.2.2 Mining

Mine operations will be 24 hour, split across two shifts (6:00 am – 6:00 pm and 6:00 pm – 6:00 am).

Drilling and blasting, to loosen rock ahead of mining, will be undertaken in order to produce rock sizes that conform to processing requirements. Blasted ore will be loaded into haul trucks for transportation either directly to the primary crusher, ROM pad or LGO. Ore will be reclaimed from the ROM pad and LGO by front-end loader and fed to the primary crusher.

The Batman Pit will be significantly deepened and enlarged from its current depth of 114 m to a proposed depth of 588 m (RL - 400). The surface area of the pit will be increased from approximately 40 ha to 137 ha.

Rock will be blasted and mined by conventional truck and shovel methods. Walls will be scaled during the mining operation in order to maintain a safe work place. Safety berms will be utilised as required to maintain safe working areas. In some cases, primarily on the east wall, these safety berms will be incorporated into haul roads. Where this is done, a berm along the road will be built to contain any sloughing material.

The pit will incorporate 6 m benches for mining. In areas where the material is consistently ore or waste, benches may be mined in 12 m heights.

Water will be sprayed onto roads to suppress dust using a water cart. Environmentally benign surfactants will also be used on road surfaces to reduce the water demand for dust suppression where practical and economically viable.

2.2.3 Ore Processing

A new ore processing facility will be constructed on the previous process plant site. The existing disturbed area will not change significantly.

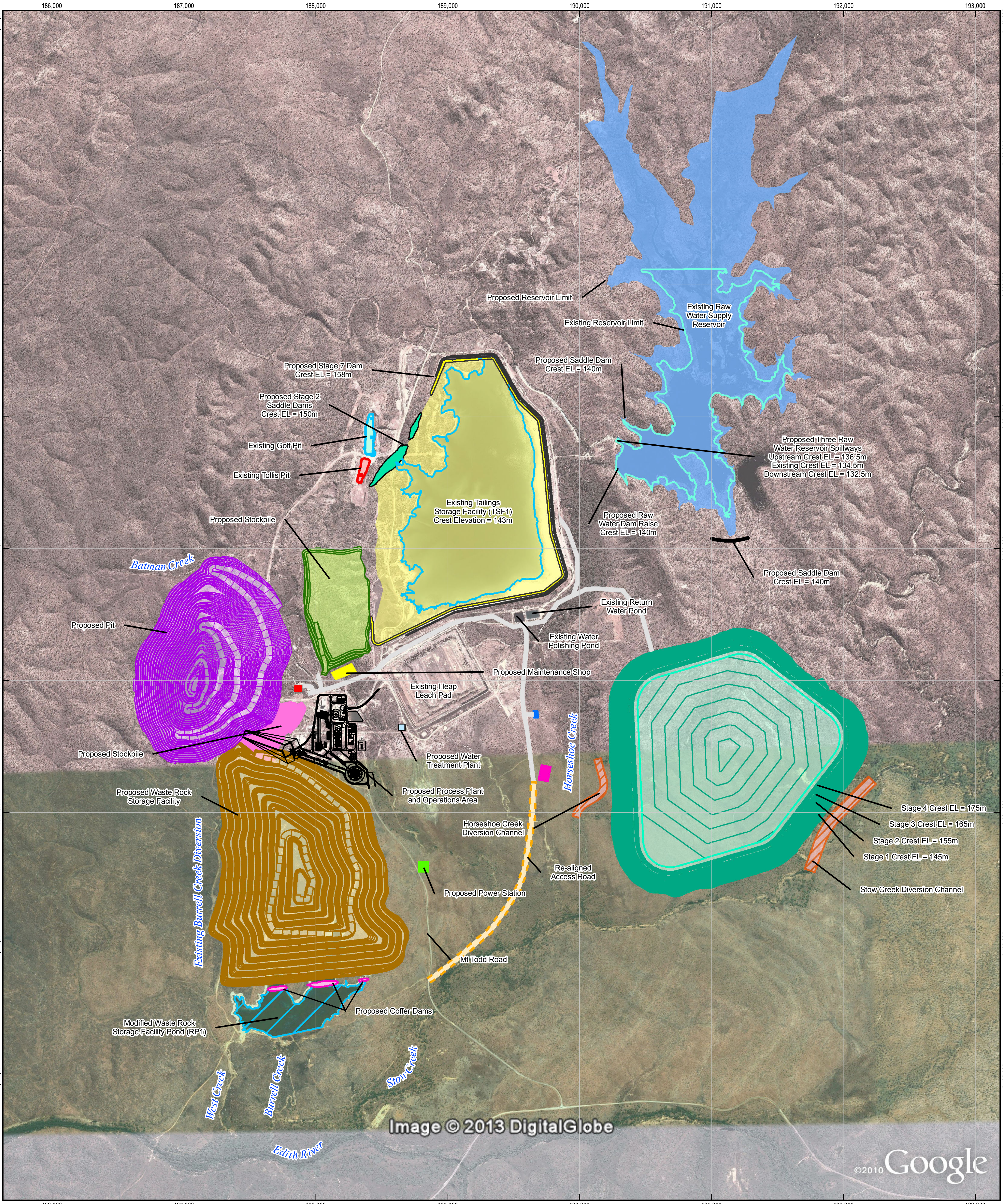
The process plant has been designed to treat free milling ore using conventional technology to recover cyanide leachable gold using a carbon in leach (CIL) process.

The process plant will consist of a gyrator crusher, secondary crushers, coarse screening, coarse ore stockpile, high pressure grinding rolls (HPGR), fine screening, classification, ball mills, pre-leach thickener, CIL circuit, elution circuit, gold room, cyanide detoxification and tailings pumps. Support services include reagent mixing and dosing facilities, and a centralised control room.

The following are key components of the Ore Processing Plant:

- Comminution (crushing and grinding of ore);
- Adsorption and detoxification; and
- Gold extraction.

Figure 2 illustrates the ore processing plant layout.



LEGEND

Process Plant	Power Plant	Explosives Magazine	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Proposed Saddle Dam (Raw Water Dam)
Golf Pit	Proposed Haul Road	Diversion Channels	Proposed Saddle Dam	TSF2 Contours (Year 12)	Retention Pond 1
Tollis Pit	Re-aligned Access Road	Raw Water Dam Existing Water Body	TSF1	TSF2 Footprint (Year 12)	Batman Pit Footprint (Year 12)
Fuel Bays	Coffer Dams	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Water Treatment Plant	Waste Rock Dump Contours (Year 10)
Proposed Maintenance Shop	ANFO Facility	TSF1 Contours	Low Grade Ore Stockpile	Batman Pit Contours (Year 12)	Waste Rock Dump Footprint (Year 10)

Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Project Area

Job Number	43-21801
Revision	1
Date	13 Jun 2013

Figure 1

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_401.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names (2011). Created by: CM

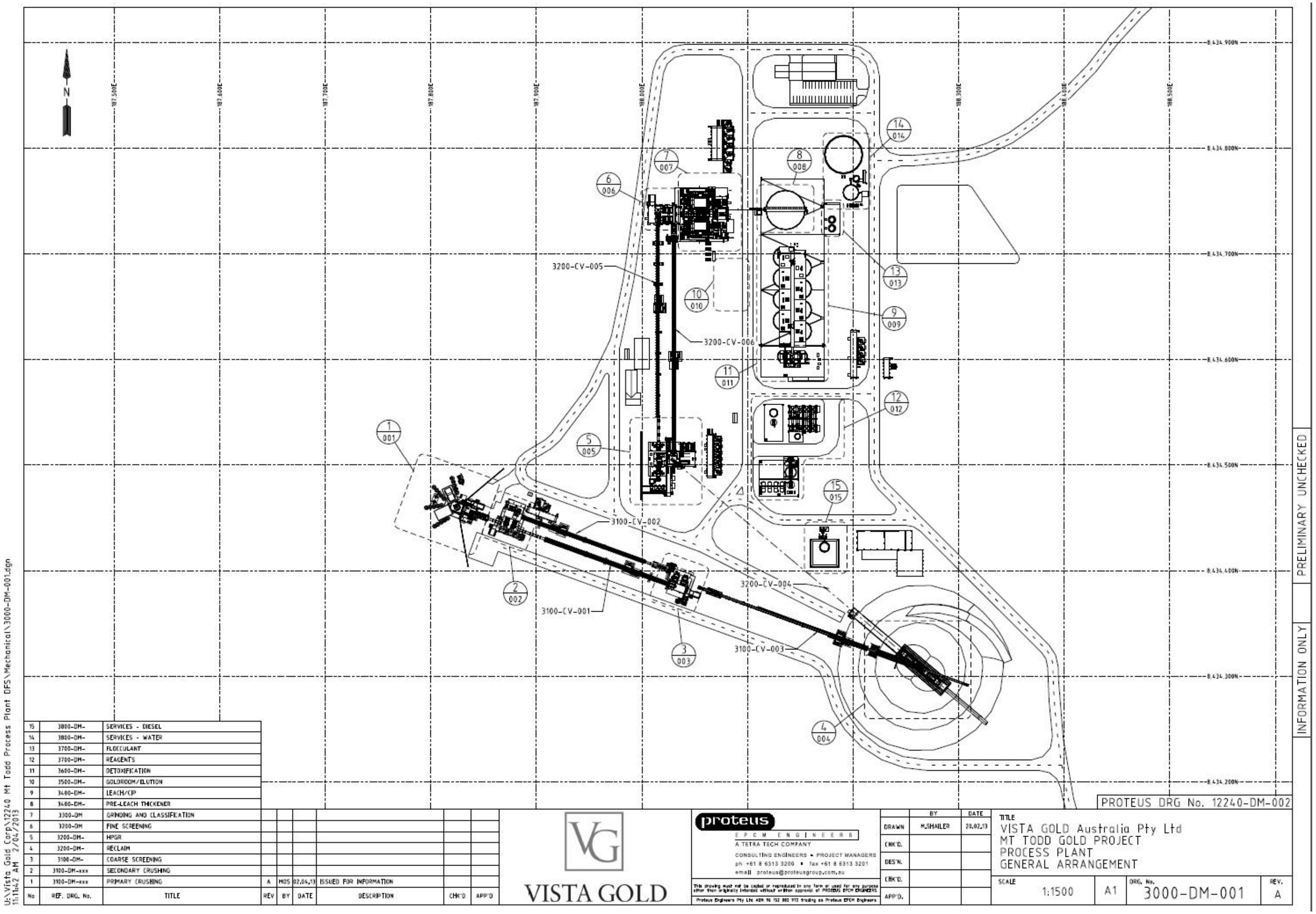


Figure 2 Process Plant Layout

2.2.4 Comminution

Ore will be fed into a primary gyratory crusher, either directly by haul truck from the pit or by front-end loader from the ROM pad and LGO. Ore contained within the existing LGO stockpile and scats from the scats stockpile will also be reprocessed. Primary crusher product will be reclaimed from the discharge vault by the apron feeder and discharged onto a conveyor.

Primary crushed ore will be secondary crushed using cone crushers. Crusher product will be screened on banana screens with oversize transferred back to the secondary crusher feed conveyor. Screen undersize will be transferred onto a coarse ore stockpile where ore will be reclaimed by a feeder, onto a conveyor to the High Pressure Grinding Rolls (HPGR). HPGR product will be conveyed by belt conveyors to a fine ore splitter where it will be transferred across a fine ore screen by two belt conveyors operating in parallel. Screen oversize will be conveyed back to the HPGR feed conveyor with undersize gravitating to a hydrocyclone feed sump. Slurry from the feed sump will be pumped into a hydrocyclone cluster. Hydrocyclone underflow gravitates to two ball mills where it will undergo further size reduction. The hydrocyclone overflow slurry will flow by gravity onto three trash removal screens. Screen undersize slurry will gravitate into a pre-leach thickener, after which thickened slurry will be pumped to the CIL circuit.

2.2.5 Adsorption and Detoxification

The CIL circuit will consist of a pre-leach thickening stage followed by conventional leaching and adsorption. Pre-aeration reduces cyanide consumption during CIL leaching. Cyanide will be added to the slurry to dissolve the gold after which carbon is added to adsorb the solubilised gold. Reactivated carbon, supplemented with fresh carbon as necessary, will be added to the final tank in the circuit.

CIL plant tailing will be directed to a cyanide detoxification circuit in which the cyanide is reduced and / or eliminated. The slurry exiting the detoxification tanks will gravitate into a tailings pump hopper. From here the slurry will be pumped to tailings storage.

2.2.6 Transport and Ancillary Operations

The gold bars will be stored in a secured area at the project site and transported by secure shipment to a refinery.

Carbon will be regularly washed in a mild cold hydrochloric acid wash which removes carbonates that may have built up on the carbon during the CIL process. Carbon activity is reduced after use in the CIL leaching process. Carbon reactivation will be undertaken in a reactivation kiln after carbon stripping. The reactivated carbon will be screened to remove carbon fines and reintroduced into the CIL circuit.

2.2.7 Site Vehicles

Vehicles will operate at Mt Todd to undertake mining, stockpile management, plant feeding, road maintenance, dust suppression, general personnel movement etc. The vehicle fleet will include:

- 8 Atlas Copco Pit Vider 235 blast-hole drills;
- 1 Atlas Copco 45K rotary drill rig;
- 2 ammonium nitrate / fuel oil truck;
- 2 Cat 834H rubber tire dozer;
- 1 36t capacity crane;
- 1 Cat 321DL excavator;

- 1 skid loader;
- 4 Hitachi EX5500 hydraulic shovels;
- 2 Cat 994 loader;
- up to 38 Cat 793C trucks during the mine life;
- 1 Cat D8 track dozer;
- 2 Cat D9 track dozers;
- 2 Cat 16H motor grader;
- 2 Cat 777B with a 70kL water truck;
- 1 low-boy trailer with 60t haul truck;
- 1 flatbed truck;
- 1 rock breaker attached to the 321DL excavator;
- 4 light plants;
- 1 fuel / lube truck;
- 16 4WD utes; and
- 2 passenger vans.

2.2.8 Infrastructure

Power Supply

During operations, site electrical normal demand (steady state) is 86MW and the peak demand is approximately 95MW.

Electrical demand will be met by the installation of Rolls Royce Trent 60 Wet Low Emissions single gas turbine generator (Figure 3) and two reciprocating engines (Figure 4) located along the south side of the main entrance road. Any shortfall to meet power demand will be drawn from the utility grid.

The flue gas nominal stack exit conditions for the Rolls-Royce Trent 60 gas turbine were given as:

- Mass flow rate of 166 kg/s;
- Exit velocity of 48.3 m/s;
- Exit temperature of 422 ˚C; and
- A single discharge vertical stack of:
  - Stack height of 21.3 m; and
  - Stack diameter of 3.05 m.

The flue gas nominal stack exit conditions for the two MAN 20V35/44 gas engines were given as follows:

- Exit velocity of 12.5 m/s;
- Exit temperature of 298 ˚C; and
- Two discharge vertical stacks (each) of:
  - Stack height of 21.3 m; and
  - Stack diameter of 1.83 m.

Figure 3 Rolls Royce Trent 60 Gas Turbine

Figure 4 MAN 20V35/44 SG Reciprocating Engine

2.3 Construction Activities

2.3.1 Overview

Subject to statutory approvals, construction activities will commence during the first quarter of 2014.

Construction works will take place largely between 6am to 6pm, with construction workers operating on 12 hour rotating shifts. Administration and management personnel will work a standard 5 x 2 day roster. Occasional night works may be required, for example for concrete pours during hotter months, or to catch up on schedule delays.

Construction works will include the following:

- demolition and disposal of existing process plant and other facilities such as the gate house;
- construction of temporary facilities (i.e. lay down areas, offices, workshops, etc);
- construction camp;
- on site concrete batch plant/s;
- administration and plant site buildings including:
  - mine and plant workshops, warehouses and maintenance facilities;
  - offices, medical facilities and training facilities;
  - security gate house, weighbridge etc;
  - crib room and ablutions;
  - laboratory.
- ore processing plant;
- power station;
- water treatment plant (WTP);
- sludge disposal cell and equalisation pond;
- site roads;
- pumps and pipelines; and
- new sumps, decant towers, decant ponds, collection ditches and diversions.

In addition, associated with ongoing operations the following activities will progressively occur:

- raising of TSF1 from 16 m in height to approximately 34 m in height in six phases;
- construction of TSF2 to 60 m in height over four stages;
- increase in the height of the existing waste rock dump from 24 m to approximately 350 m;
- development of a clay borrow area(s);
- construction of LGO stockpile, collection ditch and lined sump;
- construction of water treatment wetlands; and
- potential construction of a re-aligned access road.

2.3.2 Construction Equipment

The Project will use standard construction machinery, general trade equipment and specialised equipment as required. The indicative number and type of construction equipment required is shown in Table 2.

Plant, equipment and construction materials will be transported to the site by road. Transportation vehicles will be a combination of standard and oversize loads. Larger plant and equipment that cannot be assembled on-site will be transported under appropriate permits.

Any imports via the Port of Darwin will use existing freight receiving and staging areas. Trucking numbers will be established by contractors involved in the construction phase.

Table 2 Indicative Construction Equipment

Equipment	Indicative Number
Scraper/Roller 11T	4
Excavator	4
Front-end loader	6
Grader	2
Crane	6
Water tanker	2
Concrete trucks / pumps	6
Concrete batch plant	1
Dozer D8	2
Dozer D7	1
Rear Dumps or Highway	10

3. Existing Noise Environment

3.1 Sensitive Receptors

The Project is located within a predominantly rural area.

Aerial photography and a site visit in May 2011 were used to determine the proximity of the closest sensitive receptors.

The community of Werenbun is the closest human sensitive receptor location to the mine. Werenbun is approximately 4 km to the southeast of the mine site entry and 7 to 10 km from mine site facilities, and is accessed off Edith Falls Road. In the community of Werenbun there are about 10 houses, 30 people and an open undercover area used as a community school by the NT School of the Air.

Parts of the mine lease and surrounding area supports populations of Gouldian finch, a species protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. This species has the potential to be affected by noise and vibration from the Project.

3.2 Existing Noise Sources

Noise sources in the subject area include:

- Traffic noise from the Stuart Highway;
- Rail noise from Adelaide-Darwin rail line; and
- Natural noise from wind, insects and other animals.

3.3 Noise Monitoring Methodology

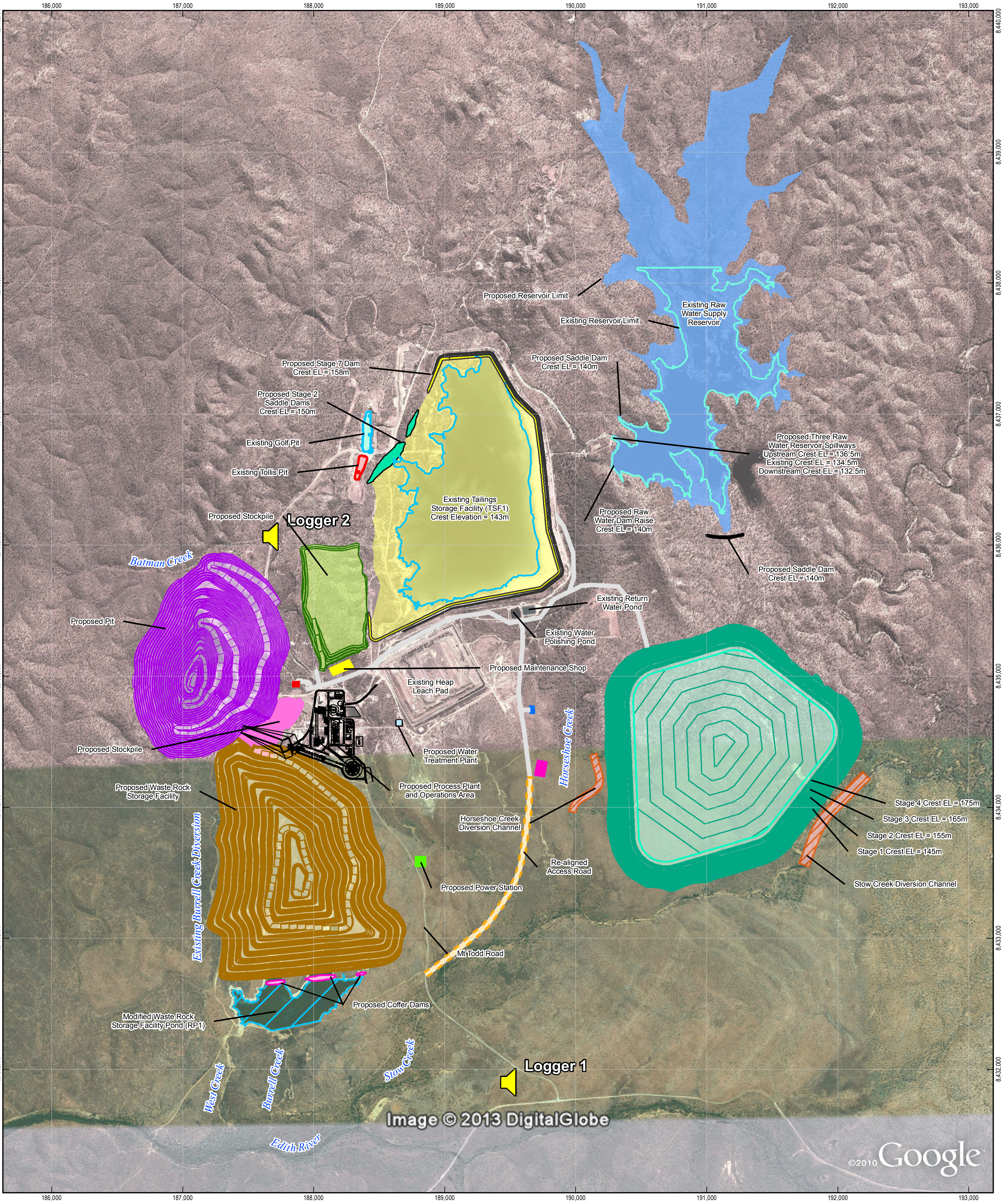
Attended and unattended noise monitoring was conducted in the area surrounding the proposed mine site. The purpose of noise monitoring was to determine the existing noise levels in the area to provide a baseline and assist in setting operational noise goals for the Project.

All sampling activities were undertaken with consideration to the specifications outlined in Australian Standard AS1055 '*Description and Measurement of Environmental Noise'* and, in the absence of relevant NT noise policies/standards, with consideration to the NSW INP (EPA, 2000).

Long-term unattended noise monitoring took place between 3rd May 2011 and 13th May 2011. Monitoring occurred at the mine site as shown in Figure 5.

Two noise loggers were located in areas that are considered representative of the local background noise levels, including the community of Werenbun. Monitoring locations were also chosen as being a safe and secure place for staff and unattended equipment, minimising the risk of theft, vandalism, or damage by natural causes. Land access permission was also a factor that contributed to the final selection of the locations. Two noise loggers were used to gain a wider appreciation of noise levels in the area and also in case one noise logger failed. Attended monitoring was also completed at these locations to better understand the noise sources contributing to overall existing noise levels.

Weather data was obtained from the Bureau of Meteorology automated weather station at RAAF Base Tindal (AWS site 014932), situated approximately 55km southeast of the mine site. This data is considered adequate for the purpose of filtering high wind events and rainfall from the noise data set.



LEGEND

- Noise Monitoring Locations
- Process Plant
- Golf Pit
- Tollis Pit
- Fuel Bays
- Proposed Maintenance Shop
- Power Plant
- Proposed Haul Road
- Re-aligned Access Road
- Coffer Dams
- ANFO Facility
- Explosives Magazine
- Diversion Channels
- Raw Water Dam Existing Water Body
- Indicative Raw Water Dam
- TSF1 Contours
- TSF1 Existing Water Body
- Proposed Saddle Dam
- TSF1
- Low Grade Ore Stockpile Contours
- Low Grade Ore Stockpile
- TSF2 Impounded Surface Area (Year 12)
- TSF2 Contours (Year 12)
- TSF2 Footprint (Year 12)
- Water Treatment Plant
- Batman Pit Contours (Year 12)
- Proposed Saddle Dam (Raw Water Dam)
- Retention Pond 1
- Batman Pit Footprint (Year 12)
- Waste Rock Dump Contours (Year 10)
- Waste Rock Dump Footprint (Year 10)
- Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	07 Jun 2013

Noise Monitoring Locations

Figure 5

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_402.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names, Noise Monitoring Locations (2011). Created by: CM

3.4 Unattended Noise Monitoring Results

Two RION NL-21 sound level loggers were used for unattended noise monitoring. The loggers are capable of measuring continuous sound pressure levels and able to record L_{A90}, L_{A10}, L_{Aeq} and L_{Amax} noise descriptors. The instruments were programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period. Noise descriptors reported in this chapter, in dB(A), include L_{A90} and L_{Aeq} which are representative of background noise levels and ambient noise levels for the period of measurement respectively.

The loggers were calibrated with a sound pressure level of 94dB at 1kHz using a RION NC-73 sound level calibrator (serial number 10530430) prior to deployment. At completion of the monitoring period, the loggers were retrieved and calibration was rechecked. The difference was less than +/- 0.5dB. Data collected by the loggers was downloaded and analysed, and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5m/s, when rainfall occurred, or for when anomalous noise levels occurred.

Table 3 provides the details of each noise logger. Photos of the noise monitoring locations are presented in Figure 6 and Figure 7.

Table 3 Unattended Noise Logger Details

Noise logger	Logger 1	Logger 2
Monitoring Location	Mine Site Entry (Near Edith Falls Road)	Mine Site West (Near Batman Creek Crossing)
Logger Serial No.	01277353	01043718
Measurement Started	3/5/11 12:15	3/5/11 14:45
Measurement Ceased	13/5/11 11:45	13/5/11 09:00
Pre-measurement Calibration	94.0 dB(A)	93.9 dB(A)
Post-measurement Calibration	93.6	93.4
Freq. Weighting	A	A
Time response	Fast	Fast

Figure 6 Noise Logger 1 – Southern Side of Mine Site

Figure 7 Noise Logger 2 – Western Side of Mine Site

Table 4 and Table 5 present a summary of the long-term noise monitoring data. Statistical noise results are also presented in graphical format in Appendix A.

Table 4 Summary of Noise Monitoring Results – Logger 1

Logger	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Tuesday 3 May 2011	24	24	24	42	41	40
Wednesday 4 May 2011	-	27	22	-	41	41
Thursday 5 May 2011	26	26	21	43	43	39
Friday 6 May 2011	24	26	22	43	45	41
Saturday 7 May 2011	22	27	22	40	44	42
Sunday 8 May 2011	22	26	22	40	39	37
Monday 9 May 2011	24	24	25	42	38	37
Tuesday 10 May 2011	-	23	23	-	38	39
Wednesday 11 May 2011	-	24	26	-	34	38
Thursday 12 May 2011	-	23	20	-	38	37
RBL and L_{eq} Overall	**24**	**25**	**22**	**42**	**41**	**39**

Note: '-' refers to invalid data that has been excluded from the data set.

Table 5 Summary of Noise Monitoring Results – Logger 2

Logger	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Tuesday 3 May 2011	25	23	24	40	48	44
Wednesday 4 May 2011	24	24	20	-	43	34
Thursday 5 May 2011	21	21	19	41	40	28
Friday 6 May 2011	21	20	20	35	47	42
Saturday 7 May 2011	20	27	20	34	46	34
Sunday 8 May 2011	21	22	24	33	46	42
Monday 9 May 2011	-	21	27	-	42	42
Tuesday 10 May 2011	-	25	20	-	42	37
Wednesday 11 May 2011	20	22	19	40	34	41
Thursday 12 May 2011	22	18	17	41	36	32
RBL and Leq Overall	**21**	**22**	**20**	**38**	**45**	**40**

Note: '-' refers to invalid data that has been excluded from the data set.

3.5 Attended Noise Monitoring Results

Attended noise monitoring was conducted over 15 minute periods at each of the long term monitoring locations. Attended measurements were undertaken using a Bruel and Kjaer 2250 sound level meter (SLM) (serial number 2449936). This SLM is capable of measuring continuous sound pressure levels and is able to record L_{Amin}, L_{A90}, L_{A10}, L_{Amax} and L_{Aeq} noise descriptors. Calibration was checked prior to the commencement of measurements and at completion of the measurements. The difference was less than +/- 0.5dB. Details of the existing noise environment including noise sources and ambient/background noise levels were recorded during these monitoring periods. Photos of attended noise monitoring locations are presented in Figure 8.

Figure 8 Receptor 01 – Werenbun

The results of attended monitoring are shown in Table 6.

Table 6 Attended Noise Measurements

Site Location	Time	L_{A90}	L_{Aeq}	L_{A10}	Comments
Mine Site 2 – Batman Creek	3/05/2011 11:44	23.3	32.1	35.7	Low background noise, some noise from birds and gusts of wind. Wind gusts up to 35dB(A), lulls in wind around 25dB(A). Drilling or any site activities not audible
East of Tailings Dam	3/05/2011 12:19	33.9	47.3	47.7	Strong gusty winds up to 50dB(A). Wind blowing from the south, birds.
Werenbun Community	3/05/2011 14:20	40.5	49.2	48.8	Strong wind the entire monitoring period, and bird noise. No other noise sources identified.
Werenbun community entry	3/05/2011 22:07	21.7	26.3	27.3	Located at the entry to the Werenbun community, approximately 1km from housing. Very low noise levels. Small peaks from insects at 5kHz.
Mine Site 2 – Batman Creek	3/05/2011 22:49	42.6	44.3	45.5	No wind, insects in 5 – 6.3kHz range dominant the entire measurement ~ 40 – 45dB(A). Drilling noise just audible (other site investigations), however below background.
Mine Site 1 – Site Entry	3/05/2011 23:28	30.0	35.8	40.6	No wind, insect noise dominant during measurement (6.3KHz).
Werenbun community entry	4/05/2011 8:45	34.2	44.5	44.4	Wind related noise, wind gusty at times. Birds calling, no traffic. In calmer periods noise level approximately 30dB(A).
Mine Site 2 – Batman Creek	4/05/2011 9:27	34.5	38.8	41.8	High winds the entire monitoring period, some birds. Drilling noise not audible.
Mine Site 1 – Site Entry	4/05/2011 11:16	38.7	46.6	49.0	High wind noise, up to 50dB(A). In calmer periods, noise levels approximately 35dB(A).

3.6 Meteorology

Mt Todd mine site is classified as having a tropical savannah climate being located between the Inter-Tropical Convergence Zone (ITCZ) and the subtropical high. There is a distinct wet and dry season with little variation in temperature throughout the year. Inland regions experience hot and dry conditions outside the wet season (http://bom.gov.au/climate/environ/other/koppen_explain.shtml).

Annual Wind Climate

The annual wind rose for RAAF Base Tindal (Figure 9) shows the prevailing wind to be from the southeast quadrant. Winds from the southeast comprise 18% of annual winds, followed in frequency by winds from the east-southeast (15.5%). This pattern reflects the easterly trade winds experienced at mid-latitudes.

The incidence of light winds (less than 2m/s) is also highest from the southeast, comprising of 7.5%. The annual average wind speed at the RAAF Base Tindal AWS is 2.8m/s.

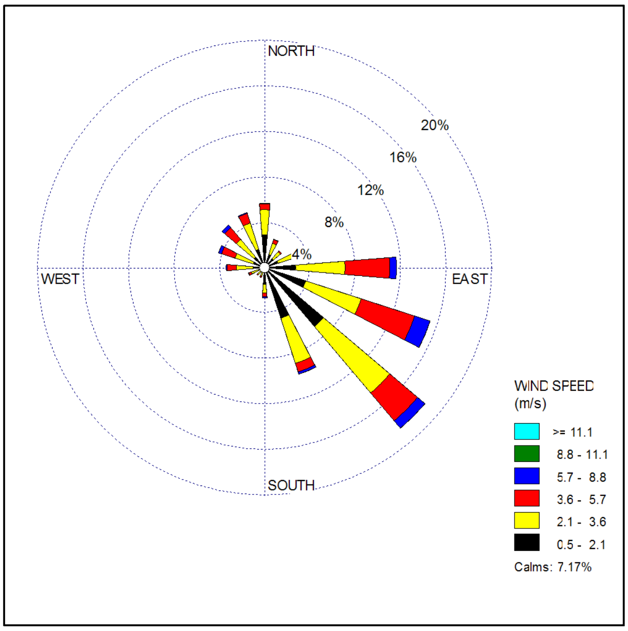


Figure 9 Annotated Wind Rose for RAAF Base Tindal

Seasonal Wind Climate

Figure 10 shows that there is a clear distinction in incident wind direction between the wet and dry season. The wet season is determined to begin in December and end in March. During the wet season the Australian Monsoon dominates synoptic flows with the prevailing wind from the northwest with an average wind speed of 2.7m/s. Synoptic flows during the dry season are characterised by the easterly Trade Winds with a greater incidence from the southeast and an average wind speed of 2.9m/s.

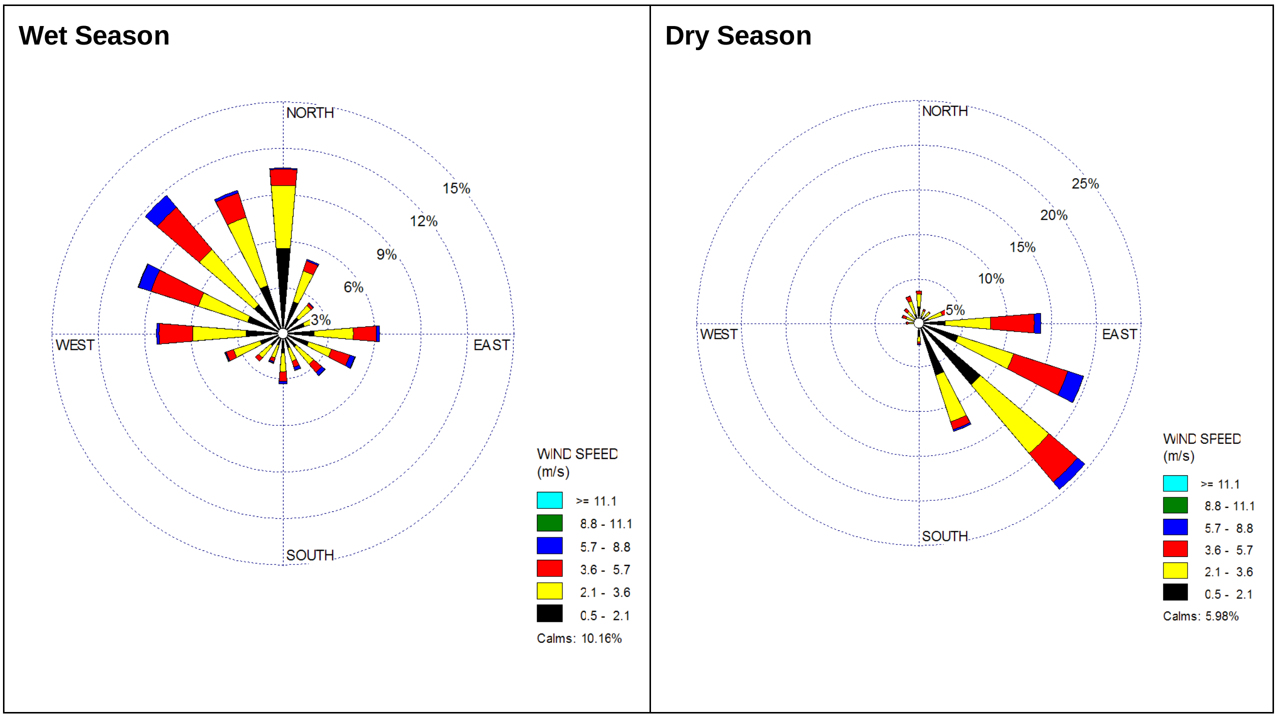


Figure 10 Seasonal Wind Roses for RAAF Base Tindal

The INP states that wind effects need to be assessed where wind is a feature of the area. Based on analysis of meteorological data for the mine, wind is considered to be a feature where-source-to-receiver wind speeds of 3m/s or below occur for 30% of the time or more in any assessment period (day, evening, night) in any season. Therefore, this assessment has included consideration of mine noise enhancement due to wind effects.

Atmospheric Stability

Atmospheric stability can influence noise propagation. The Pasquill/Gifford scale of atmospheric stability consists of six stability classes. A, B and C represent strongly, moderately and slightly unstable atmospheres respectively.

Category D classifies a neutral atmosphere and E and F slightly and moderately stable atmospheres respectively. Stable conditions will generally develop at night, under clear skies and weak gradient winds. Such conditions are often coupled with ground based, radiation forced temperature inversions, sometimes with fog, mist or frost. Temperature inversion will cause sound wanes to be reflected back towards the ground, thereby increasing noise levels compared to neutral conditions. It is commonly stable conditions that result in off-site noise impact at a maximum range.

The annual stability rose for the data set is depicted in Figure 11. The following features are portrayed:

- Stability class D (neutral) is the most frequently experienced atmospheric condition, present 38% of the time;
- Stable classes E & F combined comprise 34% of atmospheric condition; and
- The highest incidence of E & F conditions are seen from the southeast.

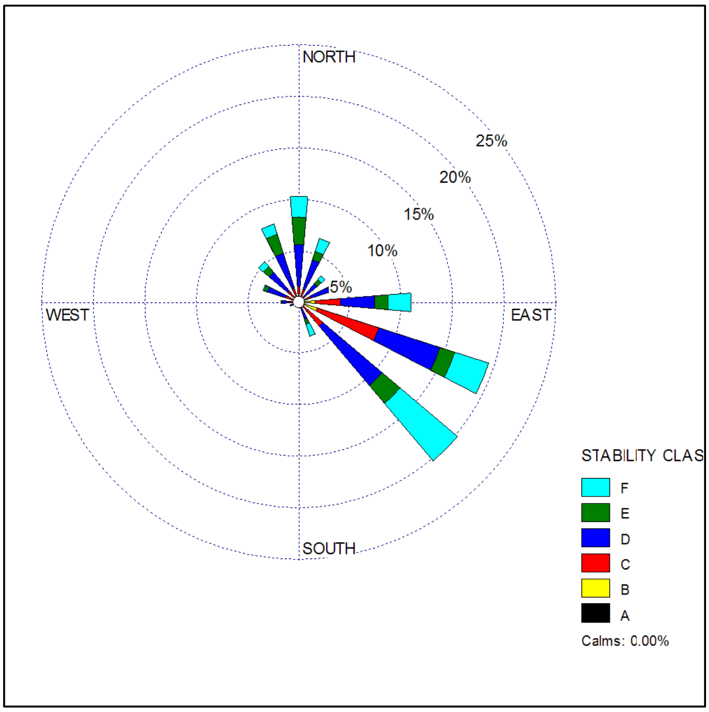


Figure 11 Annual Stability Rose - Mine site

When season is taken into account, it is seen that the highest incidence of stable conditions corresponds to the change in prevailing wind (Figure 12).

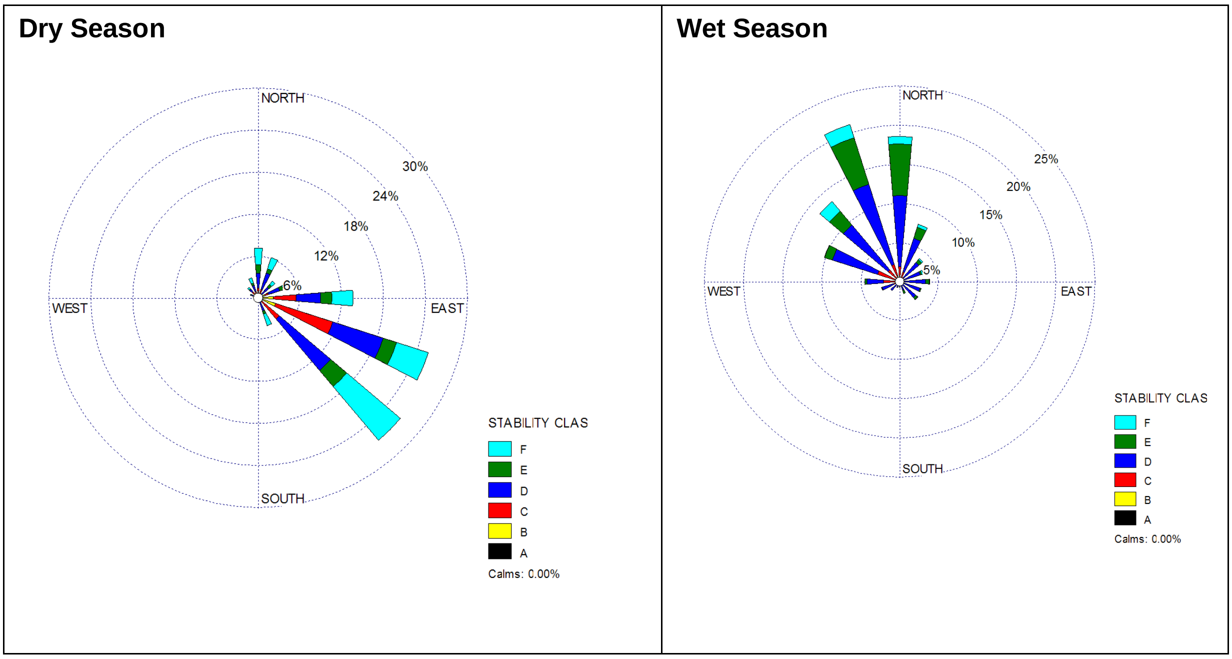


Figure 12 Seasonal Stability Roses – Mine Site

As per the INP, assessment of impacts is confined to the night noise assessment period (10pm to 7am), as this is the time likely to have the greatest impact - that is, when temperature inversions usually occur and disturbance to sleep is possible.

The INP states that an occurrence of 30% of the total night-time during winter (June, July and August) is selected as representing a significant noise impact warranting further assessment.

Based on analysis of meteorological data for the mine, F class atmospheric conditions occur for more than 30% of the total winter night-time. Therefore, this assessment has included consideration of mine noise enhancement due to temperature inversion.

4. Noise and Vibration Criteria

4.1 Operational Noise Criteria

The *Waste Management and Pollution Control Act* 1998 arose as the initial action in the development of a Strategy for Waste Management and Pollution Control in the Northern Territory that began in 1995.

The Act has no provision for the assessment criteria for operational noise and vibration. There are no other relevant Northern Territory guidelines and criteria for operational noise or vibration. Therefore, operational noise criteria applicable to site noise sources were determined with consideration to the NSW INP (EPA, 2000). The policy is specifically aimed at assessing noise from industrial noise sources scheduled under the NSW *Protection of the Environment Operations Act 1997*. It is typically used as a guide by NSW Environment Protection Authority (EPA) officers for setting statutory limits in licences for these sources. The policy is designed for large and complex industrial sources and specifies substantial monitoring and assessment procedures. The INP is typically the preferred noise guideline in the absence of other noise policies and guidelines. The INP provides guidance on the assessment of operational noise impacts. The guidelines include Intrusive and Amenity criteria designed to protect receptors from noise significantly louder than the background level and to limit the total noise level from all sources near a sensitive receptor.

Intrusive noise limits set by the INP control the relative audibility of operational noise compared to the background level. The amenity criteria limit the total level of extraneous noise. Both sets of criteria are calculated and the more stringent of the two in each time period applies with consideration to the Office of Environment and Heritage (OEH) Application Notes pertaining to Section 2.4 of the INP. Table 2.2 in the INP provides modifications to the amenity criteria for existing levels of industrial noise.

Attended observations noted that existing levels of industrial noise in the area are not a contributor to the existing ambient noise level in the vicinity of the development. Therefore the amenity noise criteria do not require adjustment.

The amenity criteria are determined based on the overall acoustic characteristics of the receptor area, and the existing level of noise excluding other noises that are uncharacteristic of the usual noise environment. Residential receptor areas are characterised into ‘urban’, ‘suburban’, ‘rural’ or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic. The nearest residential receptors to this development were classified as rural.

The recorded noise data from Logger 2 exhibited slightly lower values than Logger 1, possibly due to being located within the mine site within a more sparsely vegetated area than Logger 1. Results from both loggers were less than 30dB(A), and the NSW INP states that where the background level is found to be less than 30dB(A) then it is set to 30dB(A).

The project specific noise levels for the proposed mine at identified sensitive receptors at Werenbun are provided in Table 7.

The above levels apply at the boundary of the most affected residences or within 30m from the residence where the property boundary is more than 30m from the residence.

Table 7 Project Specific Noise Levels – Werenbun Receptors

Criterion	Nearest residential receptors		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
A: Rating background level	24 $L_{A90(day)}$	25 $L_{A90(evening)}$	22 $L_{A90(night)}$
B: Intrusiveness criteria (A + 5dB)	35 $L_{Aeq(15min)}$	35 $L_{Aeq(15min)}$	35 $L_{Aeq(15min)}$
C: Rural amenity criteria (Table 2.1 INP)	50 $L_{Aeq(day)}$	45 $L_{Aeq(evening)}$	40 $L_{Aeq(night)}$
D: Amenity criteria: (INP Table 2.2 Adjusted)	-	-	-
Project specific noise level (Page 21 INP)	35 $L_{Aeq(15min)}$	35 $L_{Aeq(15min)}$	35 $L_{Aeq(15min)}$

Note: The NSW INP states where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A).

(-) denotes not applicable since there is no existing industrial noise at the monitoring locations.

4.1.1 Low Frequency Noise

The INP is considered to address noise sources with inherent dominant infrasound or (very) low frequency noise characteristics. The proposed power station at the mine site has the potential to generate low frequency noise components below 200Hz.

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Table 4.1 in the INP sets out the corrections to be applied for tonal, impulsive, intermittent and low-frequency noise. The corrections specified are to be added to the measured or predicted noise levels at the receiver before comparison with the criteria. Correction of 5dB for low frequency noise is to be applied if the difference between the measurements of C-weighted and A-weighted levels over the same period is 15dB or more.

4.2 Construction Noise Criteria

Construction noise emitted from the Project is assessed with consideration to the Northern Territory Environment Protection Authority (NT EPA) *Noise guidelines for development sites in the Northern Territory* (NT EPA 2013). The NT EPA recommends standard hours for construction activity as detailed in Table 8.

Extended working hours would be required on some week nights, particularly for concrete pours during the hotter months, or to catch up on schedule delays. However, given the location of the mine site and the large distance between sources and receptors, this is not expected to be an issue.

The need for extended working hours will be determined during detailed design and during the construction period.

It is unlikely that blasting will be required during construction. This will be confirmed on finalisation of the relevant geotechnical studies.

Table 8 NT EPA Acceptable Construction Times

Work type	Acceptable construction times
Normal construction	Monday to Saturday: 7am to 7pm. Sunday or Public Holiday: 9am to 6pm.

The NT EPA provides a noise limit for construction noise levels at residential receptors/residential area uses during the acceptable construction times. These noise limits are calculated based on the adopted rating background level at nearby residential locations, as shown in Table 9.

Table 9 NT EPA Construction Noise Criteria during Acceptable Construction Times

Designation Area	Construction Noise Limit $L_{Aeq(15\ min)}$
Residential uses areas	Background noise + 5dB(A)

The above levels apply within 15 metres of a Noise Sensitive Receiver (NSR) or at or on the boundary of the NSR (adjusted for tonality, impulsiveness, and/or modulation) during acceptable construction times.

"*NT EPA regards noise emitted from a development site may be considered an environmental nuisance or pollution if:*

a) the construction activity is conducted;

i. outside the hours of 7am and 7pm Monday to Saturday; or

ii. on a Sunday or public holiday outside the hours of 9am and 6pm; and

b) the construction activity was not carried out in accordance 'AS 2436 Guide to Noise Control on Construction, Maintenance and Demolition Sites'; and

c) 48-hours notice was not given to the occupiers of all noise-receiving premises where noise levels for the development site are likely to be of concern including;

i. a description of proposed construction activity likely to cause nuisance;

ii. the time(s) and date(s) for the construction activity; and

iii. the name and phone number of the person to whom a complaint may be made about noise emissions from the site;

OR

d) the activity was not carried out in accordance with a Noise Management Plan registered with NT EPA."

Where the above construction noise limit is exceeded, all feasible and reasonable work practices to minimise noise should be applied and all potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a method of contact. This would include the preparation Noise Management Plan (NMP) provided to NT EPA, which is discussed in Section 6 of this report.

Based on the above and the RBL determined from site monitoring (see Section 3), construction noise goals were derived based on Logger 1 location, as shown in Table 10.

Table 10 Construction Noise Goals dB(A) L_{Aeq}

Monitor ID	Within Acceptable Construction Times
L1 (Logger 1)	29

4.3 NSW Sleep Disturbance Criteria

The NSW OEH, Noise Guide for Local Government (NGLG) provides guidelines for assessing sleep disturbance from short-term noise events. To assess potential disturbance during night-time hours (10pm to 7am), Section 2.4.5 of the NGLG recommends that $L_{A1\ (1min)}$ levels outside a bedroom window should not exceed the background level by more than 15dB. Based on a measured background noise level of 22dB(A) (refer to Section 3.4), the sleep disturbance noise goal for the night-time period is $L_{A1\ (1min)}$ 37dB(A) for all the surrounding residential receptors.

4.4 Vibration Criteria

4.4.1 Human comfort vibration criteria

In the absence of any Northern Territory or Australian guidelines relating to human comfort criteria for vibration, criteria have been adopted with consideration to the British Standard 6472 – 2008, *Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting (BS 6472-1:2008)*, which are recognised as the preferred standard for assessing the "human comfort criteria" for residential building types.

Typically, mine activities generate ground vibration of an intermittent nature. Under BS 6472-1:2008, intermittent vibration is assessed using the vibration dose value (VDV). Table 11 includes acceptable values of vibration dose for residential receptors for daytime and night-time periods.

Table 11 Vibration Dose Value Ranges and Probabilities for Adverse Comment to Intermittent Vibration ($m/s^{1.75}$)

Location	Low probability of adverse comment[1]	Adverse comment possible	Adverse comment probable[2]
Residential buildings 16 hour day (0700 – 2300 hrs)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hour night (2300 to 0700 hrs)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

1 Below these ranges adverse comment is not expected.
2 Above these ranges adverse comment is very likely.

These values represent the best judgement available at the time the standard was published and may be used for both vertical and horizontal vibration, providing that they are correctly weighted. Because there is a range of values for each category, it is clear that the judgement can never be precise.

Whilst the assessment of response to vibration in BS 6472-1:2008 is based on VDV and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of peak particle velocity (PPV), since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels that are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard 5228-2:2009 *Code of practice for noise and vibration on construction and open sites – Part 2: Vibration* (BS 5228-2:2009) as shown below in Table 12.

Table 12 Guidance on the Effects of Vibration Levels

Approximate Vibration Level	Degree of Perception
0.14mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.30mm/s	Vibration might be just perceptible in residential environments.
1.00mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10.00mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

4.4.2 Structural damage vibration criteria

There is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance limiting vibration is attained by reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures* (DIN 4150-3).

Table 8 of DIN 4150-3 presents guideline values for the maximum absolute value of the velocity *"…at the foundation of various types of building. Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible*."

Measured values exceeding those listed in Table 13 "*…does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary.*"

The vibration criteria presented in this standard exceed the human comfort criteria presented above. Therefore, as indicated above, the human comfort criteria should be the over-riding criteria for the assessment of any vibration.

Table 13 Guideline Values for Short Term Vibration on Structures

Line	Type of Structure	Guideline Values for Velocity, (mm/s)		
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz[a]
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

[a] Where frequencies are above 100 Hz the values given in this column may be used as minimum values.

4.5 Blasting

OEH refers to Australian and New Zealand Environment and Conservation Council (ANZECC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (1990) when dealing with potential blasting noise and vibration. This guideline recommends the noise and vibration limits shown in Table 14.

Table 14 Recommended ANZECC 1990 Blasting Limits

Airblast Overpressure	Ground Vibration
115dB(lin) peak	5mm/s PPV
The level of 115dB(lin) may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120dB(lin) peak.	The level of 5mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10mm/s.

ANZECC guideline recommends that blasting should only be permitted during the following hours:

- Monday to Saturday, 9am to 5pm;
- No blasting on Sundays or Public Holidays.

Blasting should generally not take place more than once per day. This requirement does not apply to minor blasts such as clearing crushers, feed chutes, etc (ANZECC 2990).

When considering a time to initiate the blast - weather conditions must be assessed. Generally the atmosphere is most stable early morning and late afternoon due to the absence of direct ground heating from the sun (Queensland Guidance Note QGN 20 v 3, DEEDE, 2011).

4.6 Road Traffic Noise Criteria

Stuart Highway is the only government controlled road potentially affected by the Project. It is not planned for redevelopment or upgrade. The developer is solely responsible for managing traffic noise impacts on sensitive receptors.

The former Northern Territory Department of Planning and Infrastructure (DPI) *Road Traffic Noise on NT Government Controlled Roads* Policy (DPI 2006) provides guidance on efficient road transport infrastructure and controlling the adverse effects of road traffic noise on adjacent land uses. The requirements for proposed developments are summarised in Table 15.

Table 15 NT Criterion for Road Traffic Noise

Road Category	Type of project/land use
Road Traffic Noise on NT Government Controlled Roads Policy (2006)	**Existing Road – Unplanned Significant Development** *Existing Residential* Where there is both a predicted increase in noise level of >5 dB(A) and the predicted noise target level is >$L_{A10\ 18hour}$ 68 dB(A), target $L_{A10\ 18hour}$ 68 dB(A). *Existing Noise Sensitive** Where there is both a predicted increase in noise level >5 dB(A) and the predicted noise level is > $L_{A10\ 18hour}$ 63 dB(A), target $L_{A10\ 18hour}$ 63 dB(A). *Future Residential and Noise – Sensitive* Responsibility for noise management of developments undertaken adjacent to an existing or planned future road rests with the proponent (private or government agency).

**Existing noise sensitive* – includes aged care, nursing homes and may include schools, libraries and hospitals. Commercial accommodation facilities relying on passing trade are not considered as noise sensitive developments under this policy.

5. Impact Assessment

5.1 Construction Noise Assessment

Typical noise levels produced by construction plant anticipated to be used on site were sourced from Australian Standard AS 2436 – 2010 *Guide to Noise Control on Construction, Maintenance and Demolition Sites* and from GHD's internal database.

Indicative acoustic modelling was undertaken using Computer Aided Noise Abatement (CadnaA) V4.3 to provide preliminary prediction on the effects of construction-related noise from the proposed development.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. For the purpose of indicative construction noise modelling, CadnaA calculates environmental noise propagation according to ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors". Propagation calculations take into account ground topography, sound intensity losses due to hemispherical spreading, atmospheric absorption and soft soil ground absorption. Additional factosr such as directivity was not considered in the noise calculations. This provides a measure of conservatism.

The ISO 9613 algorithms also take into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm night or 'downwind' conditions which are favourable to sound propagation. As a result, predicted received noise levels are expected to overstate actual received levels and thus provide a measure of conservatism.

Table 16 presents the sound power level associated with the indicative construction equipment detailed in Section 2.3.2,

Table 16 Indicative Construction Equipment Sound Power Levels SWL (re: 20 µPa)

Plant Item	Number of Items Used	dB(A) L_w Per Item
Crane	6	110
Concrete truck /pump	6	109
Dump truck	10	108
Water tanker	2	109
Scraper/Roller 11T	4	114
Excavator	4	107
Front-end Loader	6	113
Grader	2	110
Dozer D8	2	107
Dozer D7	1	113
Concrete batch plant	1	113

Construction equipment was modelled assuming simultaneous operation at full capacity in the proximity of ore processing plant areas. Results are detailed in Table 17.

Table 17 Predicted Construction Noise Levels at Nearby Sensitive Receiver

Sensitive Receiver Location	Predicted Noise Levels dB(A) L_{Aeq}
Werenbun	24

The distance between the proposed construction works and the identified receptors at Werenbun will be in the order of 7km at the minimum. The predicted results shown in the above table suggest that all construction activity noise will be under the daytime construction noise criteria of 29dB(A).

5.1.1 Sleep Disturbance

The Project criteria for night-time sleep disturbance of 37dB(A) $L_{A1,1min}$ external to the dwelling is predicted to be met at all receptors.

5.2 Construction Vibration

Some construction equipment can generate high vibration levels and need to be assessed to minimise potential adverse impacts on the surrounding residential receptors.

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuate with distance. The magnitude and attenuation of ground vibration is dependent on:

- The efficiency of the energy transfer mechanism of the equipment (i.e., impulsive; reciprocating, rolling or rotating equipment);
- The frequency content;
- The impact medium stiffness;
- The type of wave (surface or body); and
- The ground type and topography.

The above factors cause inherent variability in ground vibration predictions in the absence of site-specific measurement data. The NSW RTA Environmental Noise Management Manual (RTA, 2001) provides typical construction equipment ground vibration levels at 10m. The rate of vibration attenuation can be calculated from the following regression analysis formula:

$V = kD^{-n}$ where

V = PPV

D = Distance

n = attenuation exponent. The value of n generally lies between 1 and 2 with a relatively common value of 1.5[1].

k = Velocity (PPV) at D=1 unit of distance

[1] Construction Vibrations: State of the Art (Wiss, 1981)

The predicted ground vibrations at various distances are shown in Table 18 for typical construction equipment.

Table 18 Predicted Construction Equipment Vibration Levels (mm/s PPV)

Plant Item[2]	Human Perception Preferred Criteria *(Maximum Criteria)*		Predicted Ground Vibration				
	Day	Night	10m	20m	50m	100m	300m
15t roller	0.28 *(0.56)*	0.2 *(0.4)*	7 to 8	3.8	1.5	0.8	<0.1
Dozer	0.28 *(0.56)*	0.2 *(0.4)*	2.5 to 4	1.6	0.7	0.3	<0.1
Excavator	0.28 *(0.56)*	0.2 *(0.4)*	3	1	0.3	0.1	<0.1
Grader	0.28 *(0.56)*	0.2 *(0.4)*	3	1	0.3	0.1	<0.1

Given the distance to the nearest receptor from the mine site is approximately 7km, construction vibration will not exceed the human perception criteria and is not discussed further in this assessment.

5.3 Operational Noise Assessment

5.3.1 Noise Modelling Methodology

Acoustic modelling was undertaken using CadnaA V4.3 noise modelling software to predict the effects of industrial noise generated by the proposed mine. CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to the CONCAWE noise prediction method. Terrain topography, ground absorption, atmospheric absorption and relevant shielding objects are taken into account in the calculations.

CONCAWE is a mathematical model developed to predict community noise levels from petrochemical and industrial plant for a range of meteorological conditions. A full description of the mathematical model is provided in the report prepared for the Conservation of Clean Air and Water in Europe *Report No. 4/81 -The propagation of noise from petroleum and petrochemical complexes to neighbouring communities* (CONCAWE, 1981). The CONCAWE prediction method is widely used in Australia for predicting noise impacts of mines, power stations, and other industry.

Note that the assessment has been modelled based on available data. The proposed layouts for the mine and noise generating equipment were based on information provided at the time of the assessment.

Other parameters used in the model are listed in Table 19.

[2] NSW RTA Environment noise management manual, 2001

Table 19 Model Settings

Model Setting				
Industry Algorithm	CONCAWE			
Ground absorption	0.5			
Terrain	5m resolution for the mine site and 50m resolution outside the mine site			
Model Scenarios	Temperature Inversion	Wet Season	Dry Season	Neutral Meteorological Conditions
Temperature (^{o}C)	10	20	10	20
Humidity	50%	80%	50%	80%
Stability Class	F	D	D	D
Wind Speed	2m/s	3m/s	3m/s	0m/s
Wind Direction	315º	315º	135º	0º

5.3.2 Primary Noise Sources

Modelled overall sound power levels for mobile and fixed sources for the proposed mine are summarised in Table 20 and Table 21 respectively. These sound power levels are maximum predicted levels produced when machinery is operating under full load.

Typical mining equipment noise levels have been obtained from noise assessments conducted on similar projects[3] and GHD's noise source database.

In addition to the above, based on manufacturer information, the power station has been modelled to include:

- One (1) Rolls Royce Trent 60 power generation package with a far field noise level (100m from plant) of 65dB(A). For worst-case scenario, the Rolls Royce Trent 60 power generation was modelled as a point source with 10 m high above ground level.
- Two (2) MAN 20V35/44G reciprocating engines with an unsilenced exhaust sound power level of 141dB(A). A silencer has been assumed to be used on the exhaust that provides a minimum attenuation of 25 dB(A). This is considered to be a low level of attenuation and would be the minimum attenuation achieved by using silencers on the facility. The following MAN engines sound data was sourced from the product specification.

[3] Sound power levels sourced from Olympic Dam Expansion Draft EIS (BHP Billiton, 2009), Clermont Coal Project EIS (Rio Tinto, 2004), Cloncurry Copper Project (ASK, 2009), Wandoan Coal Project EIS (PB, 2008), Grosvenor Coal Project EIS (Bridges Acoustics, 2010).

Table 20 Modelled Noise Sources – Primary Mobile Sources

Noise Source	Number of Items Modelled	Sound Power Level (L_w) dB(A)	Modelled Height (m)
Cat D8 Dozer	1	111	3
Cat D9 Dozer	2	111	3
Cat 834 H Dozer	2	115	4
Cat 994 Front End Loader	2	112	4
Cat 16H Grader	2	110	4
Cat 226B Skid Loader	1	105	4
Cat 777B Water Truck	2	115	4
Cat 793C Truck	38	119	4
Cat 785C	4	110	4
Hitachi Ex 5500	4	118	4
Cat 321 DL Excavator	1	113	4
36 Tonne Crane	1	98	4
Atlas Copco Pit Vider 235 blast-hole drills	8	119	4
Atlas Copco 45K rotary drill rig;	1	119	4
Flatbed Truck	1	103	4
60t Haul Truck	1	103	4
ANFO Truck	2	103	4
4WD utes	16	82	1.5
Passenger vans	2	82	1.5
Rock breaker attached to Cat 321DL Excavator	1	118	1
Light Plants	4	90	1

Table 21 Modelled Noise Sources – Fixed Sources

Noise Source	Number of Items Modelled	Sound Power Level (L_W) dB(A)	Modelled Height (m)
Primary Crusher	1	116	2
Secondary Crusher	1	112	2
Screening Plant – Finlay 683	1	111	2
Screening Plant – Finlay 640	1	108	2
Conveyor	1	94 per linear metre	1
Tailings Pumps	2	93	2
HPGR Mills 1	1	118	4
HPGR Mills 2	1	117	4
Reclaimer	1	115	10
Ball Mill	3	117	1
Diesel Generator	1	97	1
Water Treatment Plant	1	85	2

Table 22 MAN Engine Sound Power Level SWL (10^{-12} Watt)

MAN Engine V35/44G	Lw dB(A)	Octave Centre Frequency (Hz)/dB(linear)								Data Source
		63	125	250	500	1000	2000	4000	8000	
Intake	142.7	106.3	105.6	110.7	113.1	134.9	137.2	137.2	133.9	Product Specification
Exhaust (unsilenced)	141	149.8	142.0	137.9	136.5	135.0	133.6	132.2	129.2	Product Specification
Engine noise	113	80.8	93.7	99.6	109.2	107.1	104.8	103.1	96.2	Product Specification

The following assumptions are considered for modelling the MAN engine noise sources:

- It is assumed that the MAN engines were located inside a 5 metre high building, constructed of 0.6 mm thick steel shed with acoustic rating of Rw 24;
- Two MAN exhaust stacks were modelled with stack parameter as detailed in Section 2;
- Note that the MAN engine intakes were modelled unsilenced and as point sources located at a height of 2 metres above ground, within 2 metres from the MAN building. They have been modelled such that they do not have direct line of sight to the Werenbun noise sensitive receiver (i.e. the modelled MAN building as the intervening object between the MAN engine intake and the sensitive receiver). Should the final design of the power station layout does not reflect the above configuration characteristics applied to the noise model, further noise assessment may be required to determine the necessity of noise attenuation at the MAN engine intakes to ensure compliance with the prescribed noise criteria.

Note that HV workshop, pre-leach thickener, etc. are not considered primary noise sources. The noise contribution from these sources to the overall noise level emanating from the mine site would not be considered significant and therefore was not considered in the assessment.

5.3.3 Mine Operation Noise Impact

Due to staging, noise impact will vary over the proposed 13 year life of the mine, depending on where machinery is operating. Areas where these changes will occur are Batman Pit and the waste rock dump. For the noise assessment, a worst case scenario has been modelled, which includes machinery operating in the southern most area of the waste rock dump to represent the latter stage of the mine operation (ultimate waste rock dump boundary). A map showing the worst-case staging for noise impact is presented in Figure 13.

The processing facilities and the power station will operate 24 hours a day, 365 days per year. Prevailing winds during the dry season are from the south-east, which are directed away from the nearest noise sensitive receptors at Werenbun. Prevailing winds during the wet season are from the north west, which are directed toward Werenbun.

Noise propagation modelling has been undertaken with four scenarios:

- Temperature inversion;
- 3m/s wind from the south-east (dry season);
- 3m/s wind from the north-west (wet season) and
- Neutral conditions (no wind).

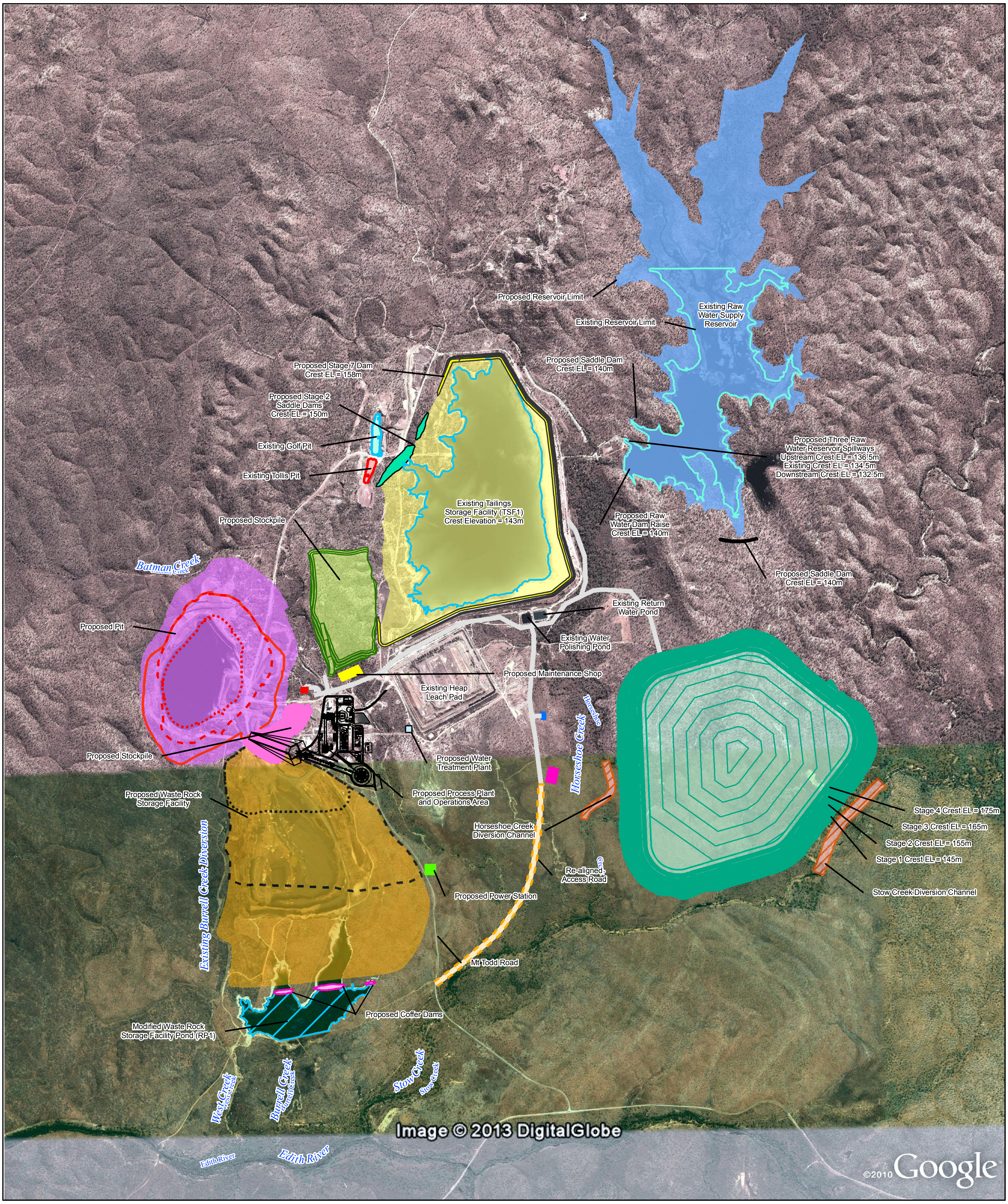
Predicted noise impact at the nearest noise sensitive receptor is summarised in Table 23.

Table 23 Summary of Results dB(A) – 1.5m above Ground Level

Receptor	24-Hours Noise Impact [dB(A) SPL re:20μPa]				Project Specific Noise Goals L_{Aeq} dB(A)
	Temperature Inversion	Dry Season	Wet Season	Neutral Meteorological Conditions	
Werenbun	29	20	30	23	35

The four noise contour scenarios are presented in Figure 14 to Figure 17. The wind assisted conditions during the wet season are presented as the most adverse conditions during operation of the mine. Operational noise levels assessed under all weather conditions are predicted to be below the noise criteria of 35 dB(A) at all times.

Noise model results indicate the predicted low frequency difference for C-weighted and A-weighted noise levels over the same period is less than 15 dB. The correction for low frequency noise, as specified in INP, was not required to be added to the predicted noise levels at the receiver. Even if required, the site noise emissions would still be expected to comply with the relevant noise criteria.



LEGEND

Batman Pit	Waste Rock Dump					
Year -1	Year 1	Low Grade Ore Stockpile	TSF2 Footprint (Year 12)	Proposed Haul Road	Raw Water Dam Existing Water Body	Stockpile
Year 1	Year 2	TSF1 Contours	Golf Pit	Re-aligned Access Road	Indicative Raw Water Dam	
Year 3	Ultimate Boundary	TSF1 Existing Water Body	Tollis Pit	Coffer Dams	Proposed Saddle Dam	
Year 5	Process Plant	TSF1	Fuel Bays	ANFO Facility	Water Treatment Plant	
	Low Grade Ore Stockpile Contours	TSF2 Contours (Year 12)	Proposed Maintenance Shop	Explosives Magazine	Proposed Saddle Dam (Raw Water Dam)	
		TSF2 Impounded Surface Area (Year 12)	Power Plant	Diversion Channels	Retention Pond 1	

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number 43-21801
Revision 1
Date 07 Jun 2013

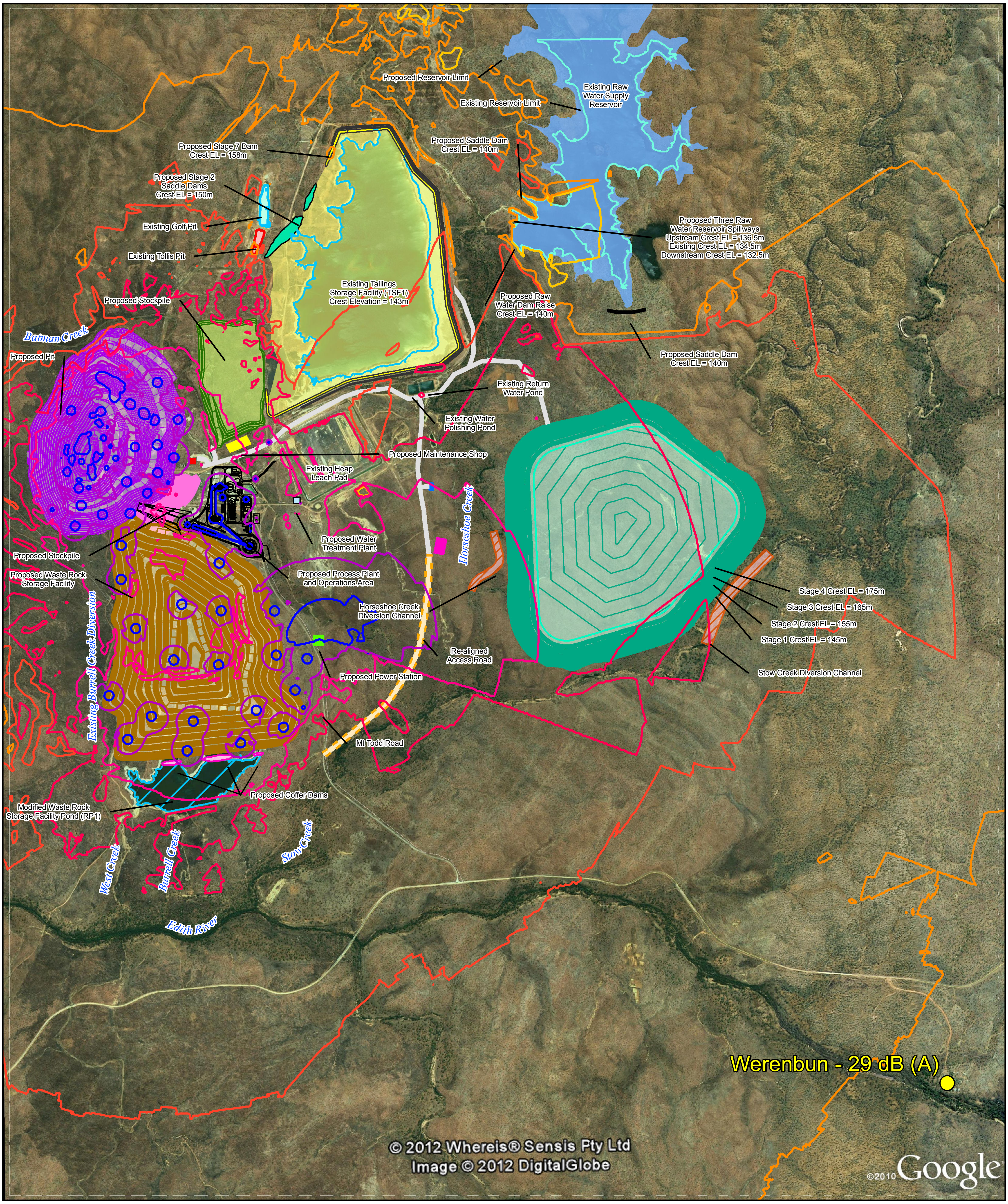
Proposed Mine Site Staging

Figure 13

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_404.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names (2011). Created by: CM



LEGEND

Werenbun Noise Level	40	Golf Pit	Re-aligned Access Road	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Batman Pit Contours (Year 12)
Sound pressure level dB(A)	50	Tollis Pit	Coffer Dams	TSF1 Contours	Low Grade Ore Stockpile	Proposed Saddle Dam (Raw Water Dam)
20	60	Fuel Bays	ANFO Facility	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Retention Pond 1
30	70	Proposed Maintenance Shop	Explosives Magazine	Proposed Saddle Dam	TSF2 Contours (Year 12)	Batman Pit Footprint (Year 12)
	80	Power Plant	Diversion Channels	TSF1_Wall_VG_20130517	TSF2 Footprint (Year 12)	Waste Rock Dump Contours (Year 10)
	Process Plant	Proposed Haul Road	Raw Water Dam Existing Water Body	TSF1	Water Treatment Plant	Waste Rock Dump Footprint (Year 10)

Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number 43-21801
Revision 1
Date 07 Jun 2013

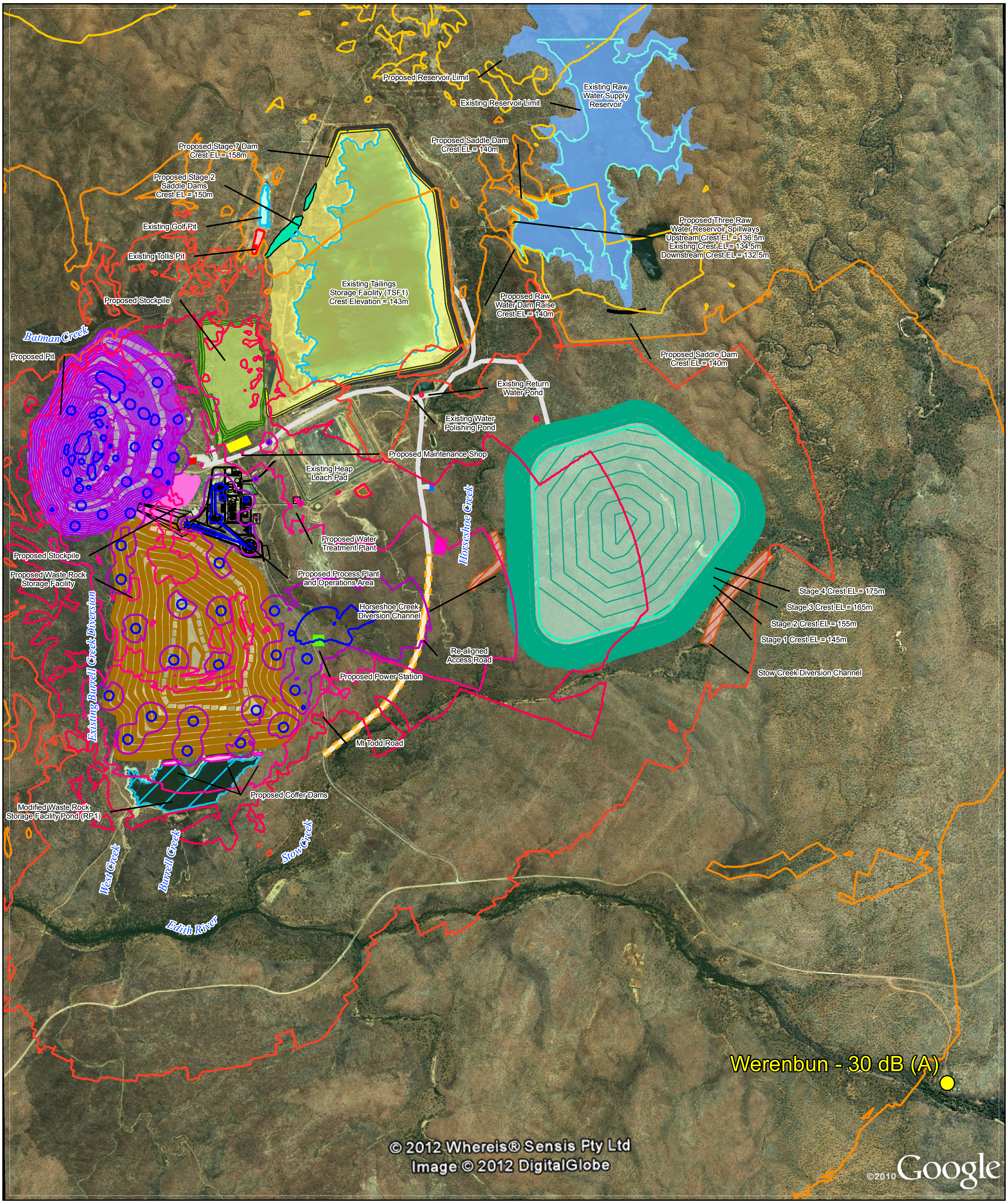
Predicted Mine Operation
Noise Levels Temperature Inversion

Figure 14

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_405.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013).
GHD - Creek Names, Noise Contours, Werenbun Noise Level (2011). Created by: CM



0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Predicted Mine Operation Noise Levels Wet Season

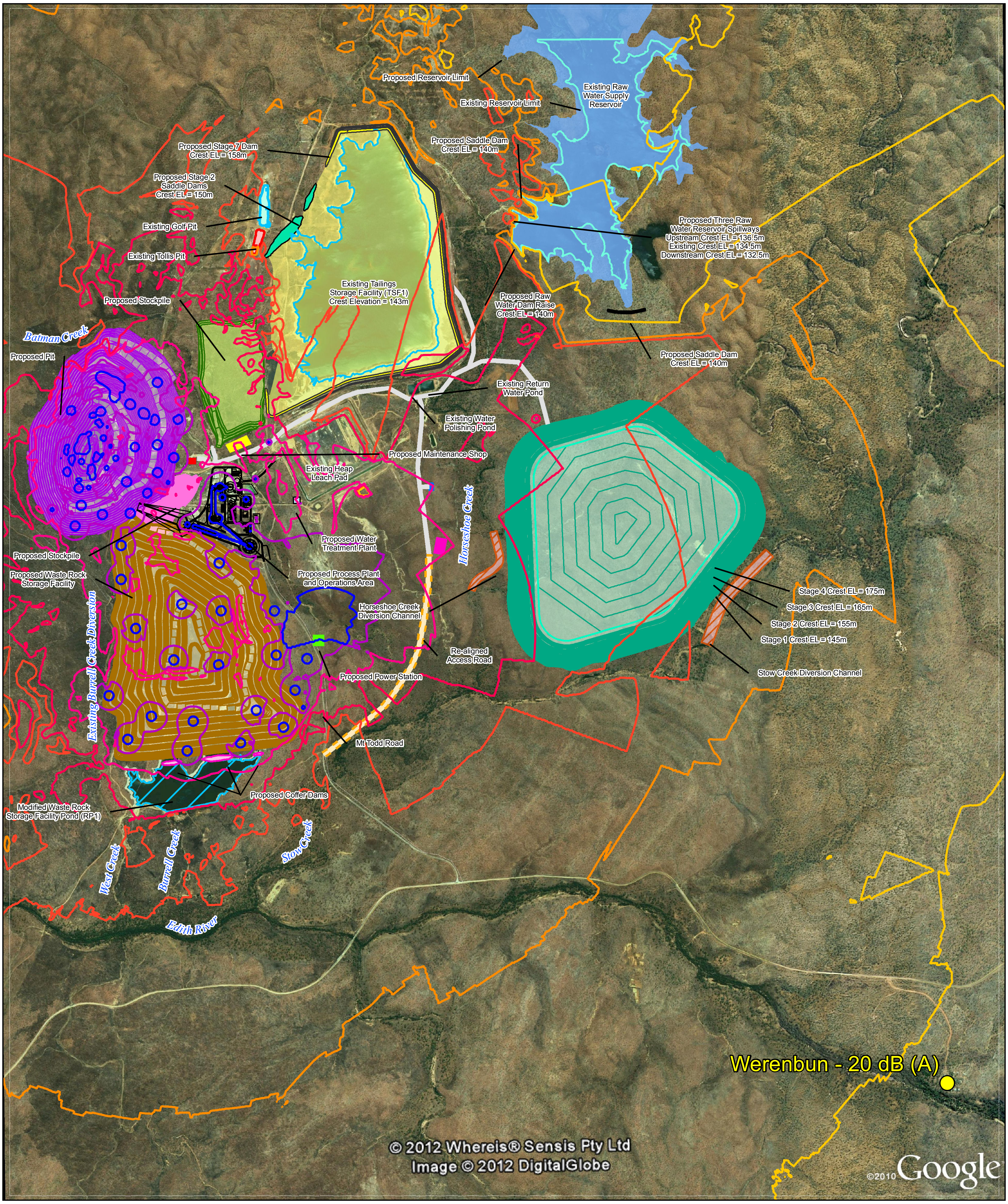
Job Number	43-21801
Revision	1
Date	07 Jun 2013

Figure 15

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_406.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names, Noise Contours, Werenbun Noise Level (2011). Created by: CM



LEGEND

Werenbun Noise Level	40	Golf Pit	Re-aligned Access Road	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Batman Pit Contours (Year 12)
Sound pressure level dB(A)	50	Tollis Pit	Coffer Dams	TSF1 Contours	Low Grade Ore Stockpile	Proposed Saddle Dam (Raw Water Dam)
20	60	Fuel Bays	ANFO Facility	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Retention Pond 1
30	70	Proposed Maintenance Shop	Explosives Magazine	Proposed Saddle Dam	TSF2 Contours (Year 12)	Batman Pit Footprint (Year 12)
	80	Power Plant	Diversion Channels	TSF1_Wall_VG_20130517	TSF2 Footprint (Year 12)	Waste Rock Dump Contours (Year 10)
	Process Plant	Proposed Haul Road	Raw Water Dam Existing Water Body	TSF1	Water Treatment Plant	Waste Rock Dump Footprint (Year 10)

Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number 43-21801
Revision 1
Date 07 Jun 2013

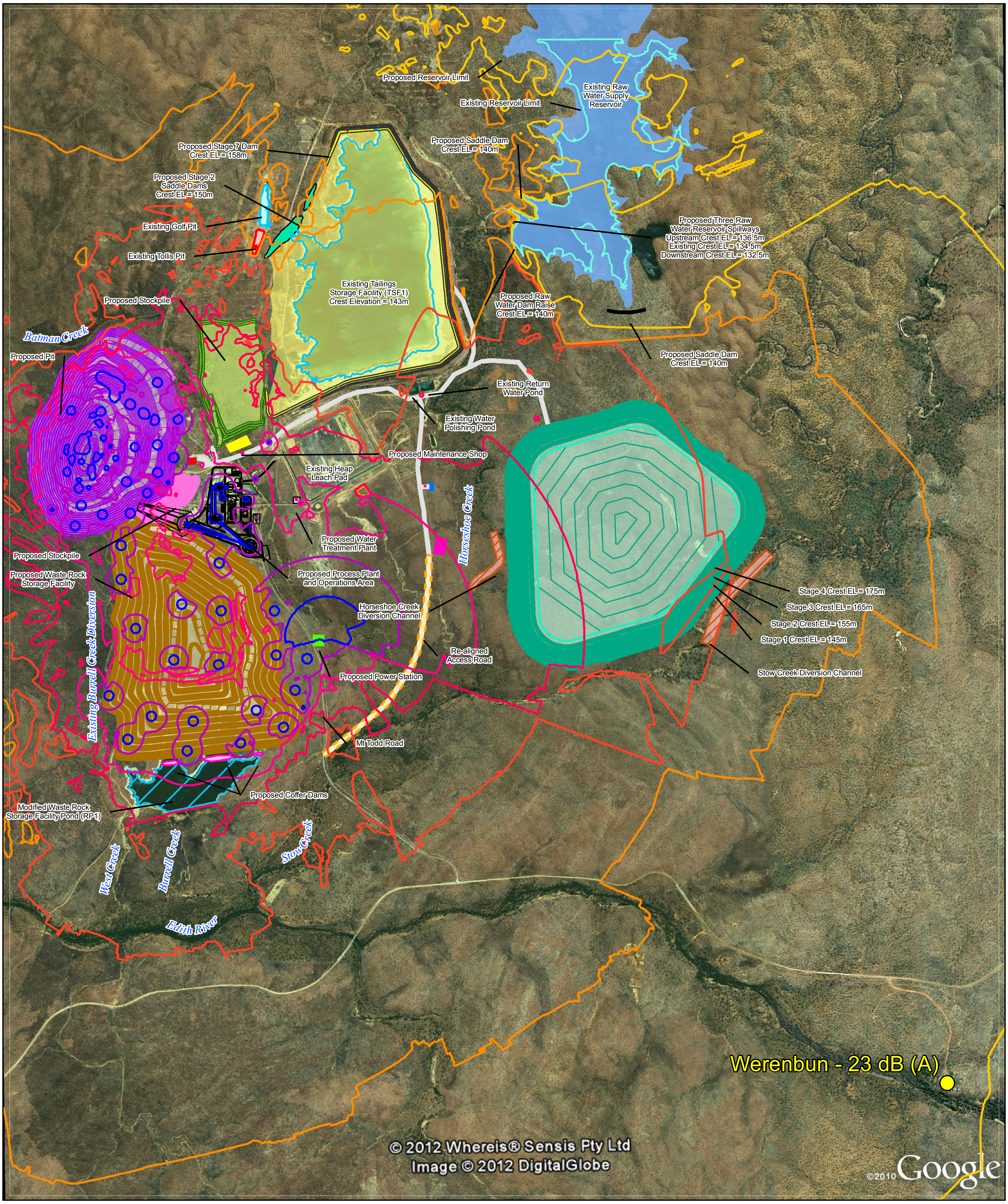
Predicted Mine Operation Noise Levels Dry Season

Figure 16

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_407.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names, Noise Contours, Werenbun Noise Level (2011). Created by: CM



LEGEND

Werenbun Noise Level	40	Golf Pit	Re-aligned Access Road	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Batman Pit Contours (Year 12)
Sound pressure level dB(A)	50	Tollis Pit	Coffer Dams	TSF1 Contours	Low Grade Ore Stockpile	Proposed Saddle Dam (Raw Water Dam)
20	60	Fuel Bays	ANFO Facility	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Retention Pond 1
30	70	Proposed Maintenance Shop	Explosives Magazine	Proposed Saddle Dam	TSF2 Contours (Year 12)	Batman Pit Footprint (Year 12)
	80	Power Plant	Diversion Channels	TSF1_Wall_VG_20130517	TSF2 Footprint (Year 12)	Waste Rock Dump Contours (Year 10)
	Process Plant	Proposed Haul Road	Raw Water Dam Existing Water Body	TSF1	Water Treatment Plant	Waste Rock Dump Footprint (Year 10)

Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number 43-21801
Revision 1
Date 07 Jun 2013

Predicted Mine Operation Noise Levels Neutral Conditions

Figure 17

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_408.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013).
GHD - Creek Names, Noise Contours, Werenbun Noise Level (2011). Created by: CM

5.3.4 Traffic Noise Impacts

Road access for the traffic including construction, service, delivery and workforce vehicles will be exclusively through the existing road infrastructure (Edith Falls Road/Jatbula Road).

The closest noise sensitive receptor to the Edith Falls Road / Jatbula Road intersection is Werenbun, approximately 4km away. As such, the estimated increase in traffic noise due to the Project will not be noticeable to Werenbun receptors. A potential internal realignment of Jatbula Road is not expected to increase off-site noise levels.

5.3.5 Operation Blasting Impact

Blasting impacts were indicatively estimated with consideration to Australian Standard 2187.2-2006 Explosives – Storage and use Part 2: Use of Explosives (AS2187.2-2006) and are based on available information. Blasting vibrations are non-linear in nature and variability in ground type and meteorological conditions makes it difficult to accurately predict ground vibration and airblast overpressure without site specific measurement data. The blasting predictions provided below should only be used as a guide.

As required in the ANZECC guideline, blasting should only occur between the hours of 9am to 5pm (Monday to Friday), as well as on Sundays or Public Holidays.

Estimation of Airblast Overpressure from Blasting

Airblast overpressure can be estimated using the following equation:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

Where:

P is the pressure (kPa)

R is the distance from charge (m)

Q is the charge mass (kg)

Ka is the site constant. AS2187.2-2006 suggests that, for confined blasthole charges values, are commonly in the range of 10 to 100. A value of 50 has been adopted for this assessment.

a site exponent. For confined blasthole charges AS 2187.2-2006 suggests a = -1.45 as a satisfactory estimate.

Airblast overpressure propagation can be increased with unfavourable meteorological conditions and decreased with topographic shielding. Unconfined surface charges would considerably increase the airblast overpressure propagation.

Estimation of Ground Vibration from Blasting

Ground vibration was estimated using the following equation:

$$V = K_G \left(\frac{R}{Q^{1/2}} \right)^{-1.6}$$

Where:

V is the peak vector sum ground vibration ppv (mm/s)

R	is the distance from charge (m)

Q	is the maximum instantaneous charge (MIC) (kg)

K_G	is the ground constant. AS 2187.2-2006 gives a site constant for a free face in average field conditions of 1140, which has been used for the predictions. This value can vary from 1/5 times to 4 times depending on ground conditions and other factors.

Blasting Predictions

Reducing the charge mass or increasing the distance reduces the airblast overpressure and ground vibration. Airblast overpressure and ground vibration were predicted for a range of charge masses.

Charge mass estimates to achieve the maximum operation airblast overpressure criteria of 115dB(L) and ground vibration criteria of 5mm/s PPV are shown in Table 24.

Table 24 Charge Mass Estimates

Distance to Receptor (m)	MIC (kg) to Meet 115dB(L)	MIC (kg) to Meet 5mm/s PPV
7,000	>100	>100
6,000	>100	>100
5,000	>100	>100
4,000	>100	>100
3,000	>100	>100
2,000	>100	>100
1,000	28	>100
500	3.5	>100

No details of the blast configuration and design have been supplied at this stage. Generally, a maximum instantaneous charge (MIC) of greater than 100kg should not be required and a charge of 50kg or less is likely to be appropriate. As the nearest receptor is greater than 7 km away, ground vibration from blasting is not predicted to be an issue.

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods. This should not affect blasting so long as it occurs during the hours recommended in the ANZECC guideline.

The above information is provided for guidance only. Any blast on site should be designed by a qualified contractor and include consideration of the blasting noise and vibration limits outlined in this report.

5.3.6 Noise Impacts on Native Fauna and Livestock

Overview

Research indicates that there are no government policies or widely accepted guidelines with regard to noise criteria for animals at this point in time. Information is provided in technical literature and has been reviewed for the Project.

Livestock

The noise goals provided in this report are based on human response and annoyance factors and, as such, are not applicable to livestock or other non-human receivers. Sudden noise has the potential to startle or upset domestic livestock and pets.

Heggies Pty Ltd conducted a literature review as part of their assessment of blasting noise impacts on livestock for the proposed Caval Ridge Coal Mine Project (Heggies, 2009). Heggies cites results from a study on the response of farm animals to sonic booms (sonic booms being similar in character to airblast from blasting), which indicated that reactions of sheep, horses and cattle to sonic booms (125dB to 136dB) were considered slight to mild.

The numbers of animals observed under sonic boom conditions include 10,000 commercial feedlot beef cattle, 100 horses, 150 sheep and 320 lactating dairy cattle.

Booms test schedule was designed at varying intervals during morning hours Monday to Friday of each week.

Results showed that there was only 19 of 104 booms caused even a mild reaction on sheep, horses and dairy cattle in temporary cessation of eating, rising of heads and slight startle effects. The total individual milk yield has been observed during the test period and no affect has been found on the overall milk production.

Given these conclusions, it is considered unlikely that the Project would have an adverse effect on livestock in the vicinity of the Project.

Native Fauna

The effect of noise on wildlife can be similar to the effects observed in humans. Noise can adversely affect wildlife by interfering with communication, masking the sounds of predators and prey, cause stress or avoidance reactions and (in the extreme) result in temporary or permanent hearing damage. Experiments have shown that exposure to noise impulses throughout the night-time sleep period resulted in poorer daytime task performance by animals (see Fletcher & Busnel, 1978).

The learning ability of many animal species, in regard to familiarisation, is discussed by Fletcher & Busnel, 1978. The animal's initial reaction to a new noise source is fright and avoidance but if other sensory systems are not stimulated (for instance optical or smell), the animal learns quite quickly to ignore the noise source, particularly when it exists in the presence of man.

Migratory birds have the potential to be influenced by noise from the Project. Studies of birds (Larkin *et al*, 1996) have shown that they will habituate to loud noises that are not biologically meaningful for them. For example if the noise is associated with possible harm such as thunder on a cloudy day, birds will avoid it, but routine noises such as traffic will not disturb them. Moreover, Heggies states that sudden impulsive noise could cause birds or other wild animals to become startled, which would affect the feeding and breeding habits on some species should long term exposure occurs. However, it was observed that they have high tolerance on intermittent or moderate noise events, such as traffic noise, (Heggies , 2009). Examples are provided of sea-birds that voluntarily co-exist with relatively loud noise environments, such as around airports, and birds roosting on light-posts above busy motorways.

Attempts at using noise to deliberately scare birds away from an area, for example to protect farming crops, have been shown to grow less effective over time as birds habituate to the noise. Larkin suggests that keeping the noise as consistent as possible both in the sound produced and the frequency with which it occurs may also help mitigate its effects on birds. Poole (1982) and Algers *et. al.* (1978) shows that birds tend to adapt to steady state noise levels, even of a relatively high level (in the order of 70 dB(A)). Given the predicted steady noise levels around the Project are expected to be much less than this level, noise impacts on birds surrounding the Project is considered acceptable.

Summary

Available literature suggests that the impact of noise from the Project is unlikely to result in negative impacts to either livestock or native fauna. As such, it is not proposed to provide any specific management measures, other than those proposed in regard to management of impacts to human receptors.

6. Mitigation and Control Measures

Although not expected to cause adverse noise impacts, GHD recommends that the following measures be taken into consideration during construction and operation of the Project in order to minimise the risks of noise impact.

6.1 Construction Noise

NT EPA has recommended the development of a Noise Management Plan (NMP), which is to include, as a minimum:

- Justification for work on the development site, that is likely to be undertaken outside of the acceptable construction times (between the hours of 7 am and 7 pm Monday to Saturday and/or between the hours of 9 am to 6 pm on a Sunday or Public Holidays);
- Details and the duration of the activities on the development site likely to cause noise emissions that may exceed the construction noise levels defined in Noise guidelines for development sites in the Northern Territory (NT EPA 2013) during a period specified in Clause 10.1;
- Details clearly demonstrating how site activity will comply with ‘AS 2436 Guide to Noise and Vibration Control on Construction, Maintenance and Demolition Sites’;
- Documented complaint response procedures and how the procedures will be implemented;
- Documentation on the verifiable consultation and feedback program with occupants of all affected premises, demonstrating that all occupants were provided with advice on dates, times and nature of any potentially noisy and disruptive activity including measures proposed to mitigate such activity as well as noise complaint contact details; and
- Name of the onsite person who will be responsible for implementing the NMP and the name and phone number of the person to whom a complaint may be made about noise emissions from the site.

In addition, the following general construction noise mitigation measures could be implemented:

- All work should be kept within the standard working hours prescribed by the NT EPA;
- Review available fixed and mobile equipment fleet and prefer more recent and silenced equipment whenever possible. In any case, all equipment used on site should be in good condition and good working order;
- Plan to use equipment which is fit for the required tasks in terms of power requirements;
- All engine covers should be kept closed while equipment is operating;
- As far as possible, material drop heights into or out of trucks should be minimised;
- Broadband reversing alarms (audible movement alarms) should be used for all site equipment, subject to meeting occupational health and safety requirements;
- All combustion engine plant, such as generators, compressors and welders should be checked to ensure they produce minimal noise with particular attention to residential grade exhaust silencers;
- Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes should be eliminated, where practicable;

- Where practical, machines should be operated at low speed or power and should be switched off when not being used rather than left idling for prolonged periods;
- Machines found to produce excessive noise compared to industry normal standard should be removed from the site or stood down until repairs or modifications can be made; and
- Where practical, impact wrenches should be used sparingly with hand tools or quiet hydraulic torque units preferred.

6.2 Operational Noise

6.2.1 General Noise Mitigation Measures

- All mobile equipment should be selected to minimise noise emissions and maintained in good repair. Equipment should be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations should be removed from the site or stood down until repairs or modifications can be made;
- Haul roads should be kept smooth and free of potholes and bumps; and
- Broadband reversing alarms (audible movement alarms) should be used for all site equipment, subject to meeting occupational health and safety requirements.

6.2.2 General Work Practices

All site workers should be aware of the potential for noise impacts and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities. These measures should include:

- Avoiding the use of loud radios;
- Avoiding shouting and slamming doors;
- Where practical, machines should be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods;
- Informing truck drivers of designated vehicle routes, parking locations and delivery hours;
- Minimising reversing;
- Avoiding dropping materials from height;
- Avoid metal to metal contact on material; and
- All engine covers should be kept closed while equipment is operating.

6.2.3 Complaint Management

Although it is not expected the operations of the mine will cause adverse noise or vibration impacts, a complaint system will be implemented during construction of the Project. The complaint system will include the following measures as relevant:

- A community liaison phone number and permanent site contact number should be established and made available to nearby residents and other noise sensitive receptors so that noise related complaints can be received and addressed in a timely manner;

- Investigation as to whether any unusual activities were taking place at the time of the complaint that may have generated higher noise levels than usual;
- Conduct noise and/or vibration (as applicable) monitoring at the location of the complainant if the complaint is deemed justified. Monitoring would be undertaken and reported within five days of receiving a complaint, if that activity is continuing, so that the monitoring findings can be incorporated to the written response provided to the complainant; and
- If exceedances are detected, corrective actions would be implemented, included in the response to the complainant and recorded.

Upon receipt of a noise and/or vibration complaint, complaints would be addressed in accordance with the above complaint management system. Based on experience with similar projects, response to the complaint would include but not limited to:

- Provision of a written response to a complaint within seven days; and
- Provision of an email response to an electronic complaint within two days if the complaint cannot be resolved by an initial response.

6.2.4 Blasting Mitigation Measures

Any blast on site should be designed by a qualified contractor and include consideration of the blasting noise and vibration limits outlined in this report.

7. Conclusion

7.1.1 Existing Noise levels

Measured background noise levels at the mine site are low and typical of a rural environment.

7.1.2 Construction Noise and Vibration

The results of the construction assessment indicate that noise and vibration levels of the mine are expected to comply with nominated noise criteria at all times for noise and vibration sensitive receptors.

Construction noise is not expected to cause adverse impacts at noise receptors. However, in order to reduce the risk of noise impact, the mitigation measures outlined in Section 6 of this report should be taken into consideration during construction.

7.1.3 Operational Noise and Vibration

The results of the operational assessment indicate that the operational noise and vibration impact of the Mt Todd Gold Project is expected to comply with the nominated noise criteria at all times for noise and vibration sensitive receptors assessed under all weather conditions.

Noise model results indicate the predicted low frequency difference for C-weighted and A-weighted noise levels over the same period is less than 15dB. Therefore, the correction for low frequency noise as specified in INP was not added to the predicted noise levels at the receiver.

A mine site noise model predicts potential noise levels for a worst-case mine operating scenario which assumed mining activities operating in the southern most area of the waste rock dump during the latest staging of the project. The model predicted noise levels under varying meteorological conditions, and has assumed that all machinery and plant on the mine site are operating continuously. Operational noise modelling results are valid for the modelled scenario, which assumes the air intakes of the MAN engines are effectively shielded by the engine hall in the direction of the Werenbun community. Once available the final layout of the facility should be reviewed to make sure the findings outlined in this report remain valid. If not, this may trigger noise attenuation requirements on the MAN engines air intakes.

Predicted noise levels under 'worst case' conditions (wind assisted conditions during the wet season) at the nearest noise sensitive receptor (Werenbun) is 30dB(A), which is below the noise criteria of 35dB(A).

The estimated increase in traffic noise levels due to the Project is not expected to be noticeable at Werenbun.

The nature and levels of vibration emitted by the mine will vary with the activities being undertaken on-site, however, due to the distances between the sources and receptors, vibration is unlikely to have a significant impact.

Airblast overpressure and ground vibration from blasting activities at the mine are predicted to comply with the project specific criteria.

Available literature suggests that the impact of noise from the Project is unlikely to result in negative impacts to either livestock or native fauna. As such, no specific management measures, other than those proposed in regard to management of impacts to human receptors, are suggested.

8. References

Algers, B., Ekesbo, I. and Stromberg, S. 1978. *The impact of continuous impact of noise on animal health.* Acta Veterinaria Scandinavica (Supplementum) 67:1-26.

ANZECC. 1990. *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*, September 1990. Australian and New Zealand Environment Council.

Australian Standard AS 2436 – 1981. *Guide to Noise Control on Construction, Maintenance and Demolition Sites.*

Australian Standard AS1055.1. *Acoustics – Description and measurement of environmental noise – Part 1: General Procedures*.

Australian Standard 2187.2 - 2006. Explosives – Storage and use Part 2: Use of Explosives, 2006

ASK. 2009. Cloncurry Copper Project.

BHP Billiton, 2009. Olympic Dam Expansion Draft EIS.

Bridges Acoustics, 2010. Grosvenor Coal Project EIS.

British Standard 6472 – 2008. *Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting, 2008*.

British Standard 5228-2:2009. *Code of practice for noise and vibration on construction and open sites – Part 2: Vibration*, 2009.

CONWAVE. 1981. Conservation of Clean Air and Water in Europe titled CONCAWE Report No. 4/81 - *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities.*

DECC. 2009. *Interim Construction Noise Guidelines*. Department of Environment and Climate Change, NSW.

DECCW. 2011. *NSW Road Noise Policy*. Department of Environment, Climate Change and Water, NSW.

DEEDI. 2011. *Management of oxides of nitrogen in open cut blasting Queensland* Guidance Note QGN 20 v 3, 2011. Department of Employment, Economic Development and Innovation.

DPI. 2006. *Road Traffic Noise on NT Government Controlled Roads*. Department of Planning and Infrastructure.

EPA. 2000. *Industrial Noise Policy*. NSW Environment Protection Authority.

Fletcher, J.L. and Busnel, R.G. (eds.). 1978. *Effects of Noise on Wildlife*. Academic Press, New York.

German Standard DIN 4150-3. *Structural Vibration – Part 3: Effects of vibration on structures*, 1999.

Heggies. 2009. Caval Ridge Coal Mine Project.

Larkin, R.P., Pater, L.L. and Tazik, D.J. 1996. *Effects of military noise on wildlife: A literature review*. USACERL Technical Report 96/21, January 1996.

NT EPA. 2013. *Noise guidelines for development sites in the Northern Territory*. Northern Territory Environment Protection Authority.

PB. 2008. Wandoan Coal Project EIS.

Poole, G. 1982. *Sound Advice Poultry Notes*. NSW Department of Agriculture and Fisheries.

Rio Tinto. 2004. Clermont Coal Project EIS.

RTA. 2001. *Environmental Noise Management Manual*. Roads and Traffic Authority - Version 1.0, 2011

Wiss, J.F. 1981. *Construction vibrations: State-of-the-Art*. American Society of Civil Engineers, ASCE Journal of Geotechnical Engineering, Vol. 107, No. GT2, pp. 167-181.

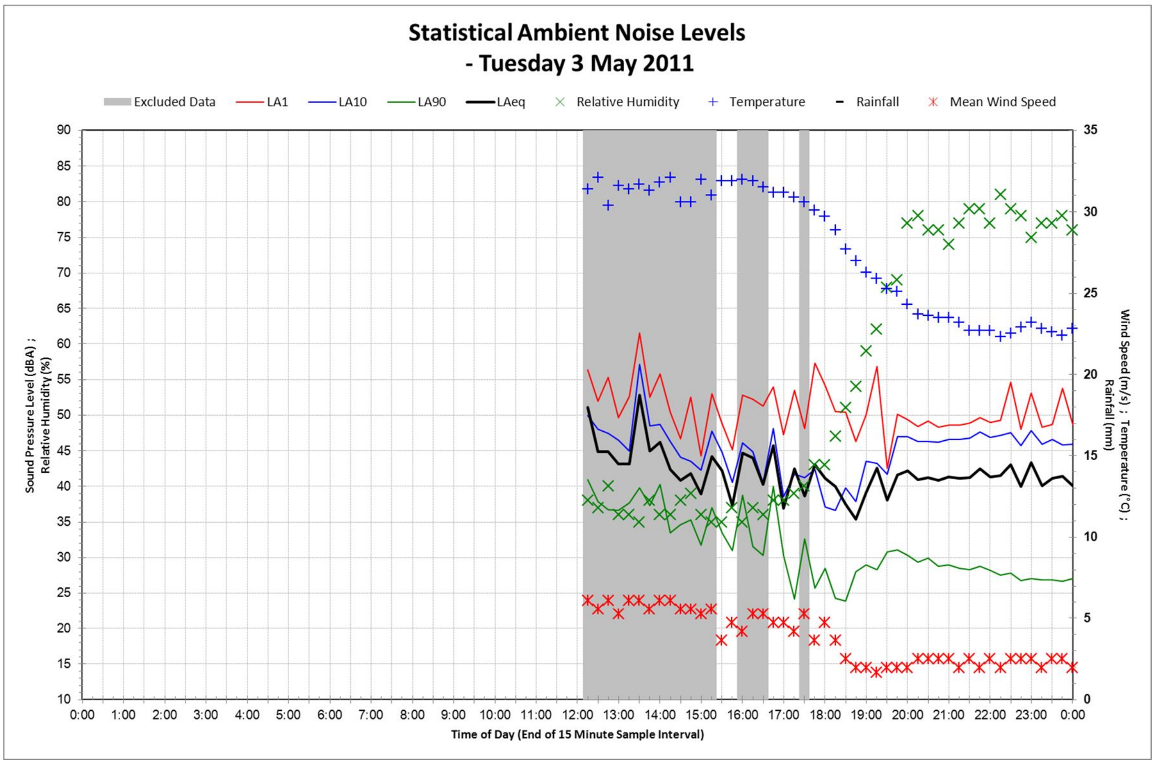
Appendix A

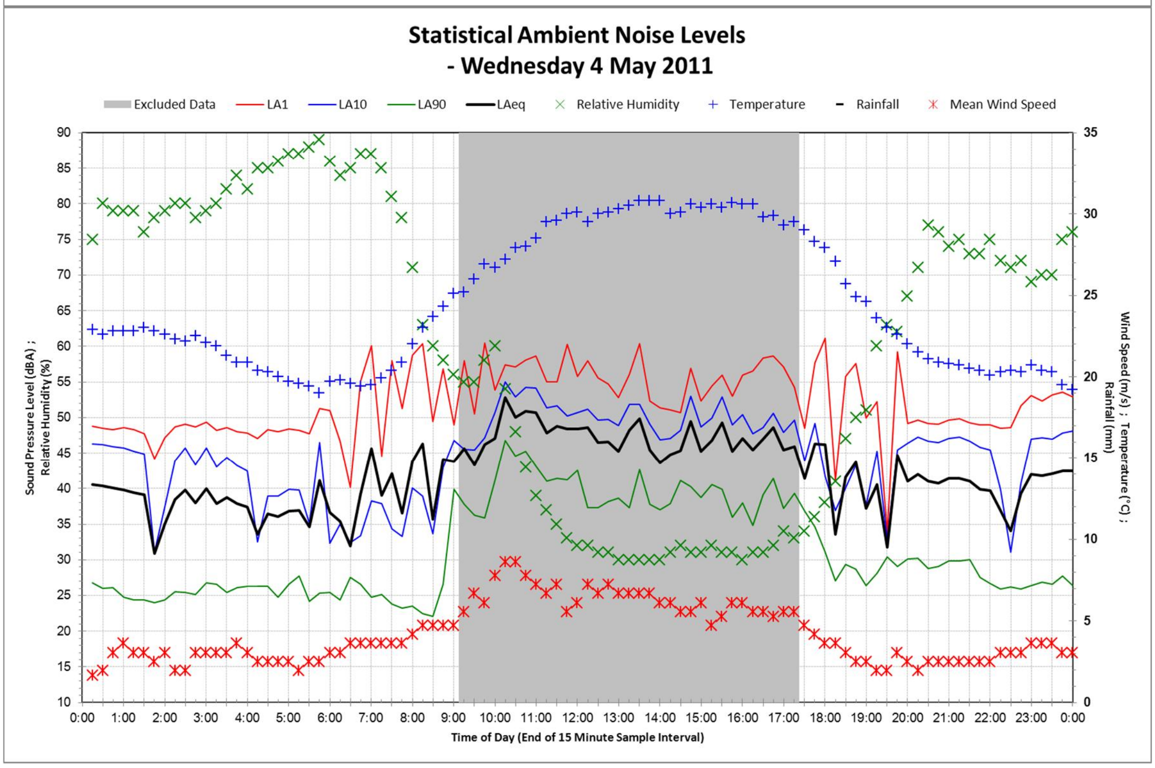
Noise Charts

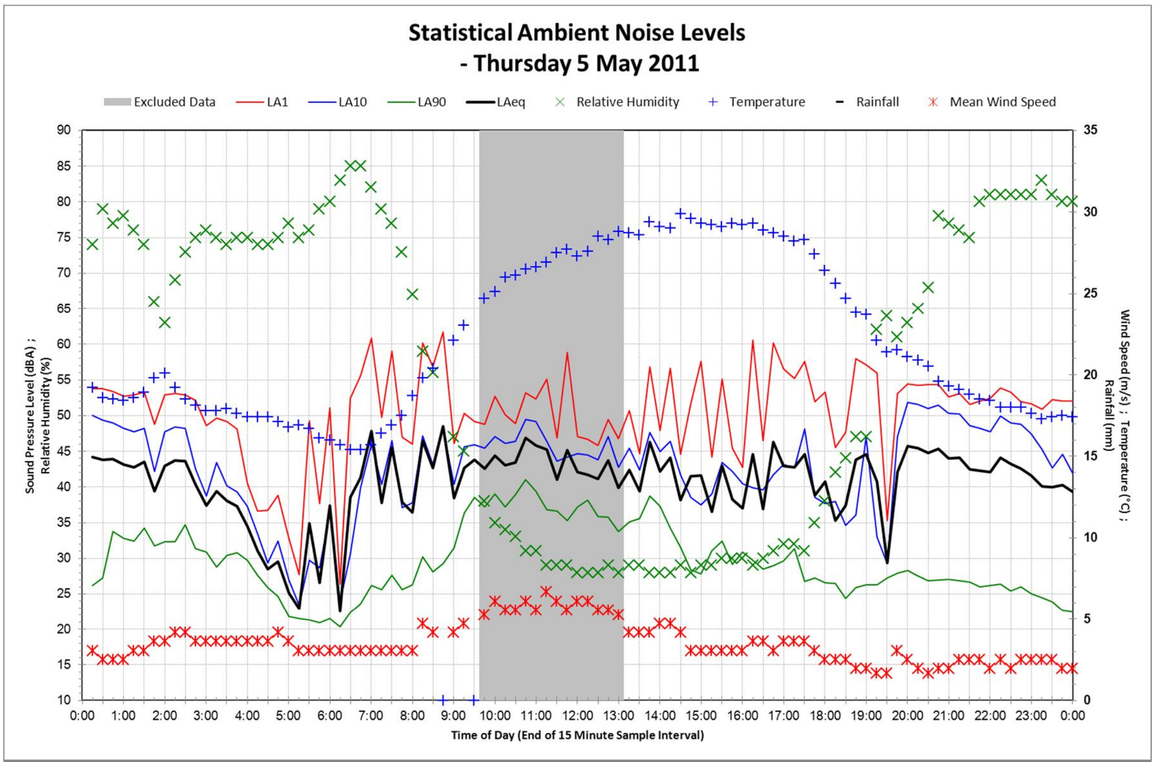
Logger 1

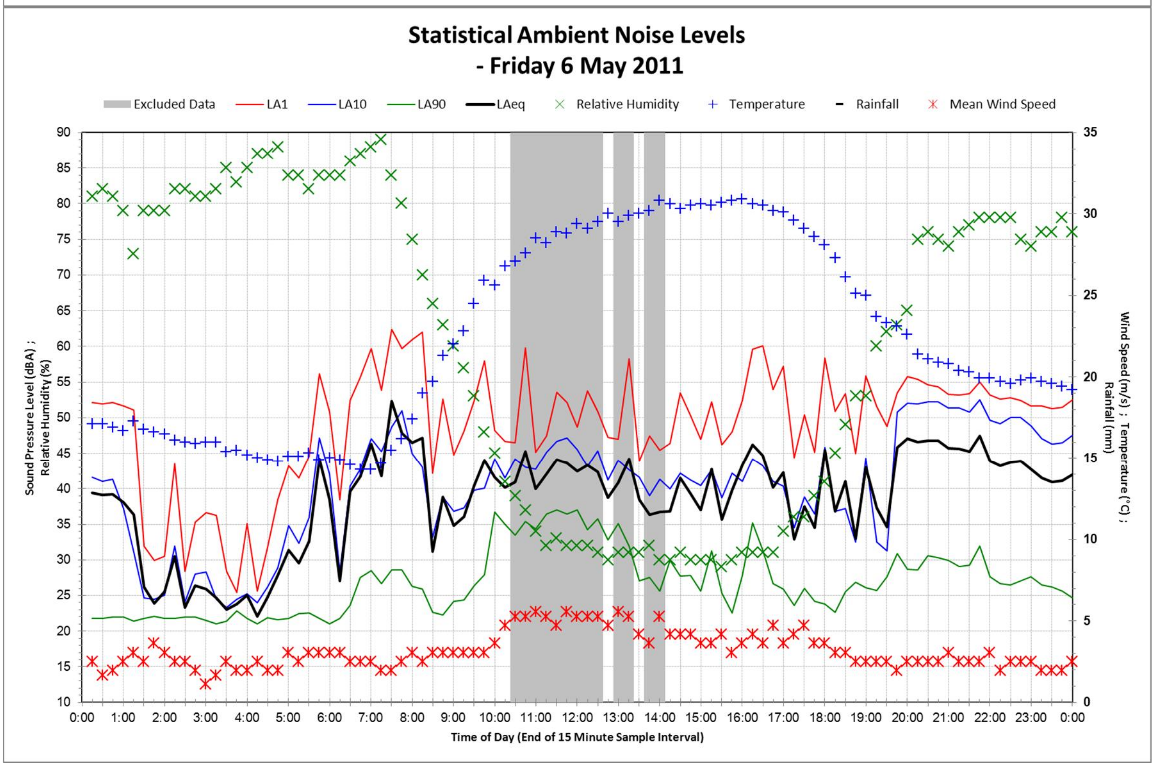
Logger 2

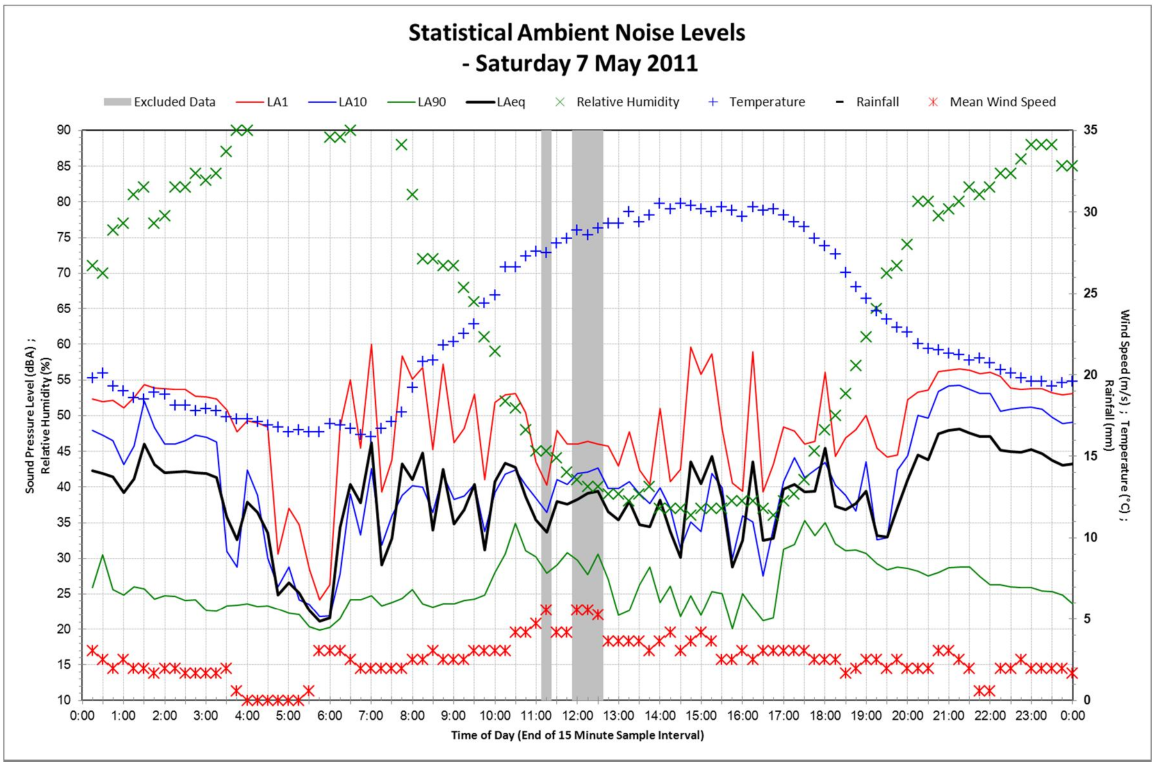
Logger 1

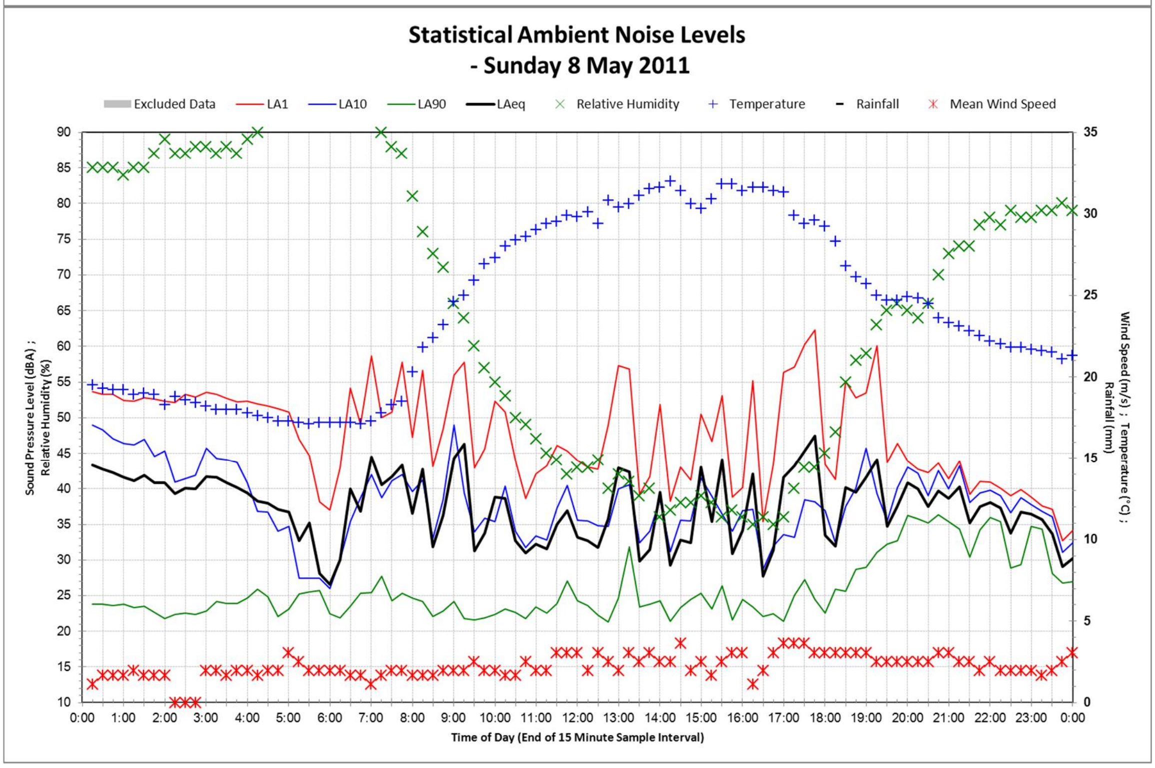

Statistical Ambient Noise Levels
- Tuesday 3 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ;
Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ;
Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
35
30
25
20
15
10
5
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00

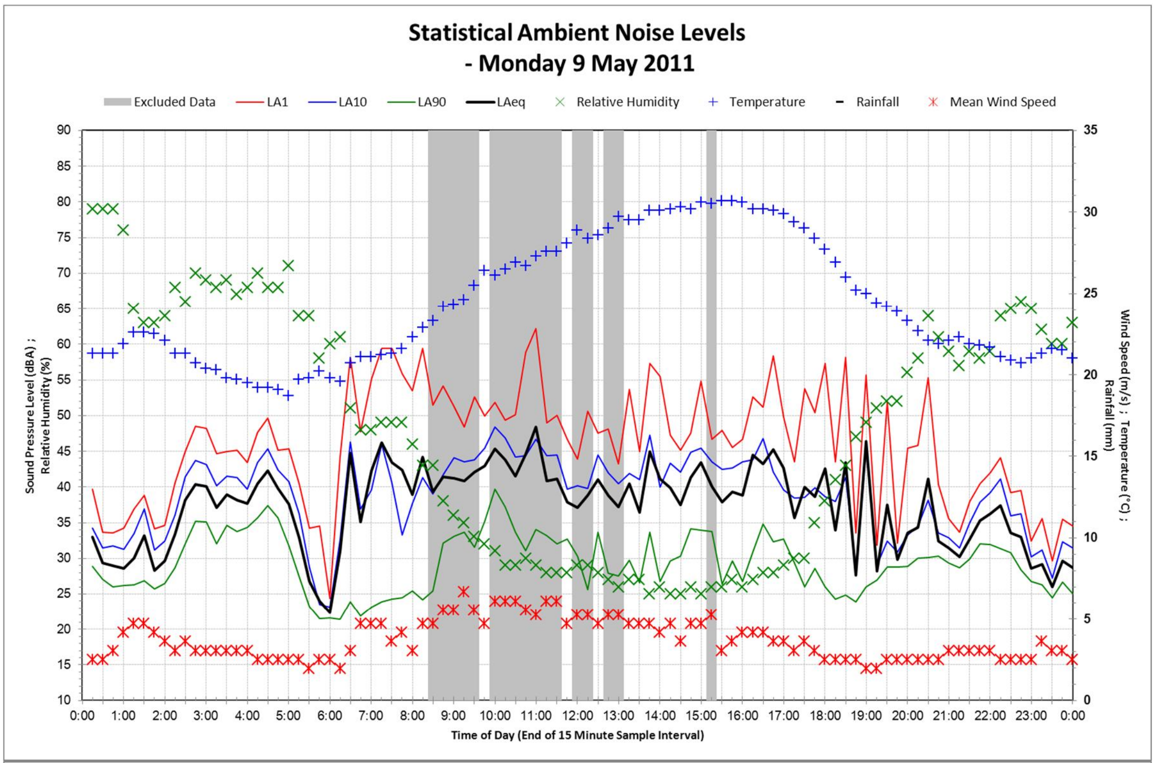

Statistical Ambient Noise Levels
- Wednesday 4 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ;
Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ;
Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
35
30
25
20
15
10
5
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00

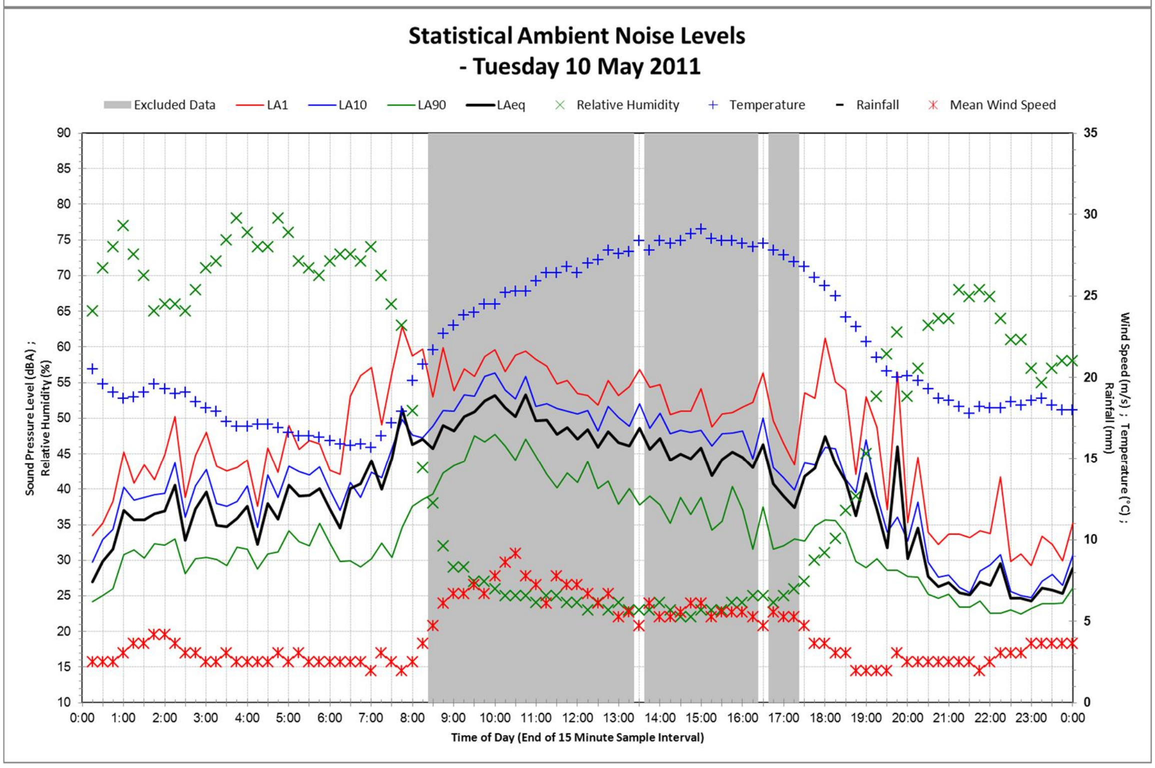

Statistical Ambient Noise Levels
- Thursday 5 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

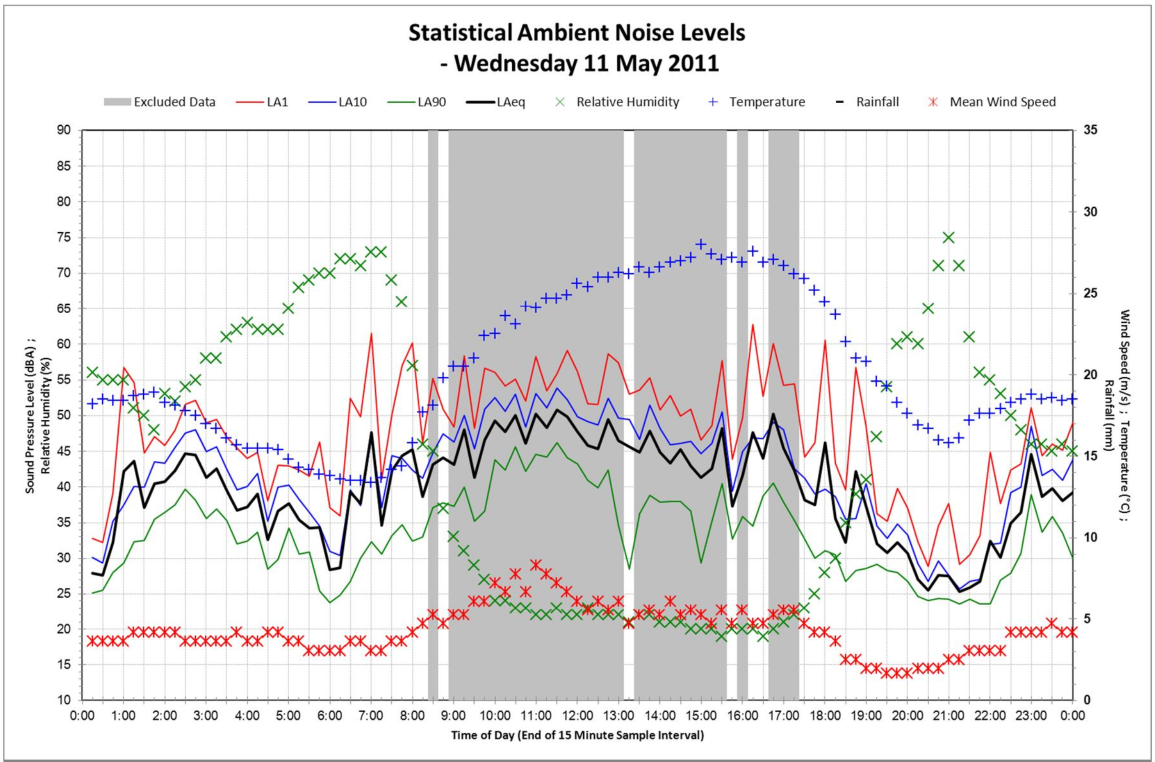

Statistical Ambient Noise Levels
- Friday 6 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

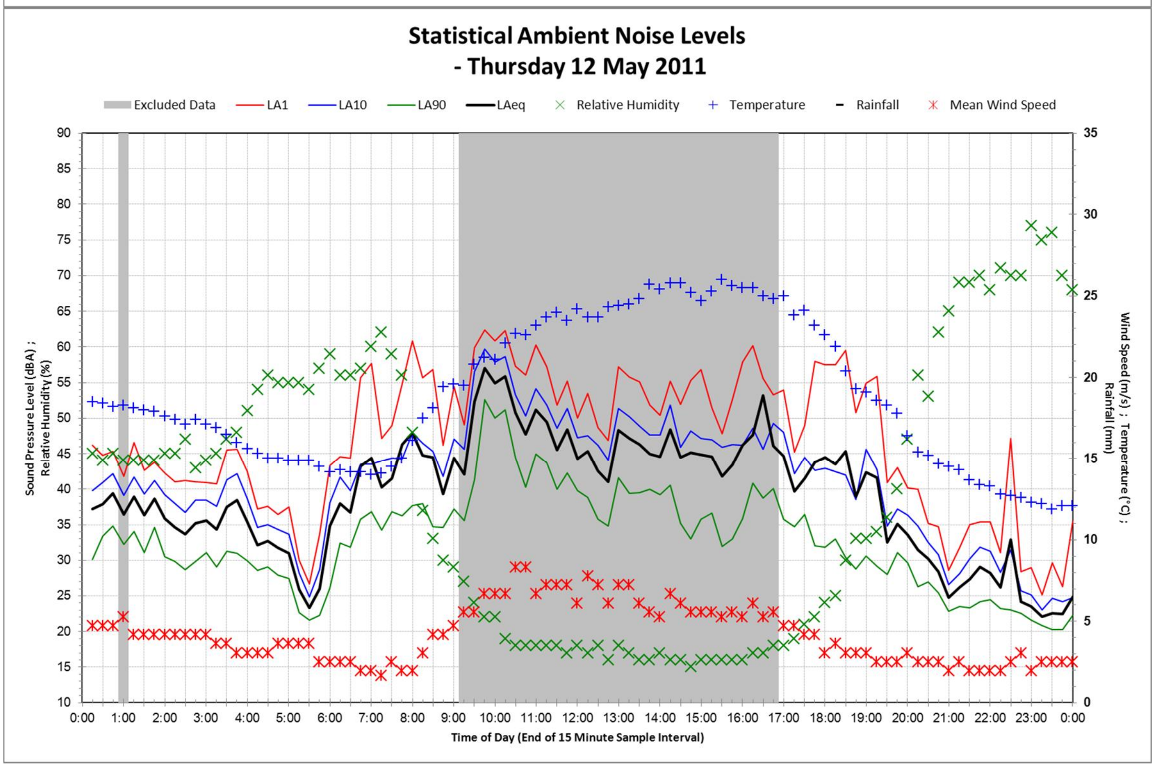

Statistical Ambient Noise Levels
- Saturday 7 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Sunday 8 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

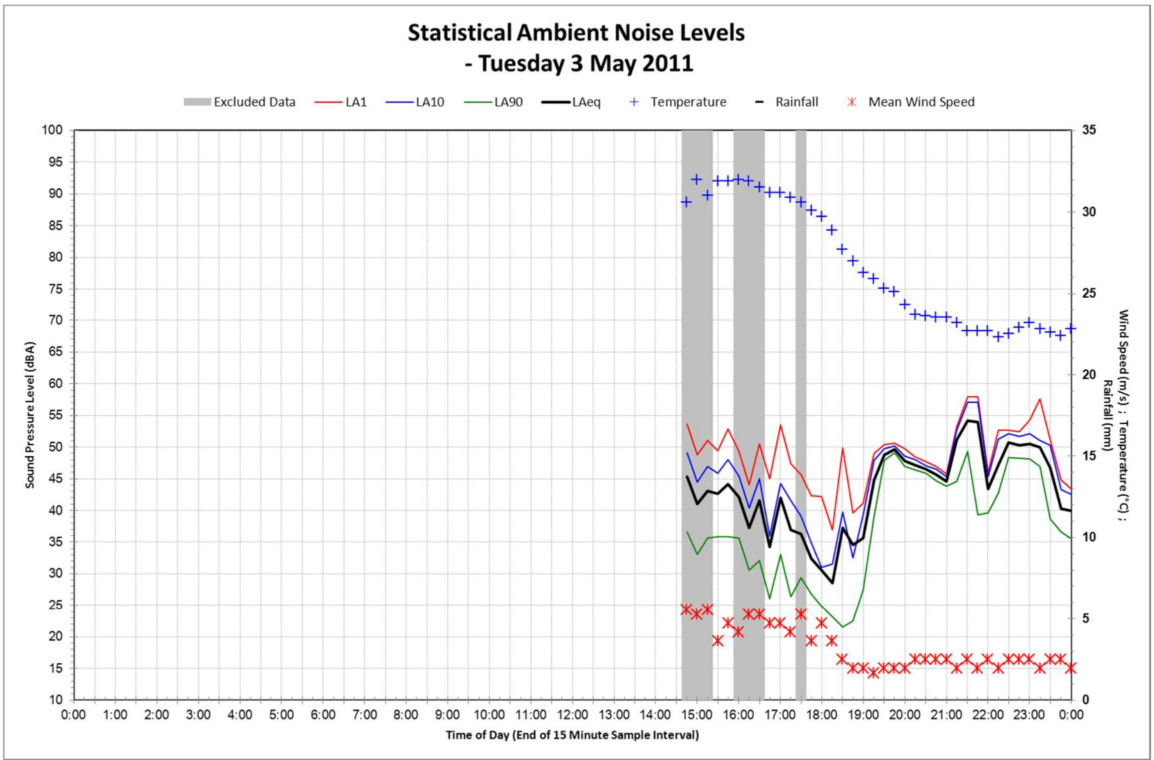

Statistical Ambient Noise Levels
- Monday 9 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Tuesday 10 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

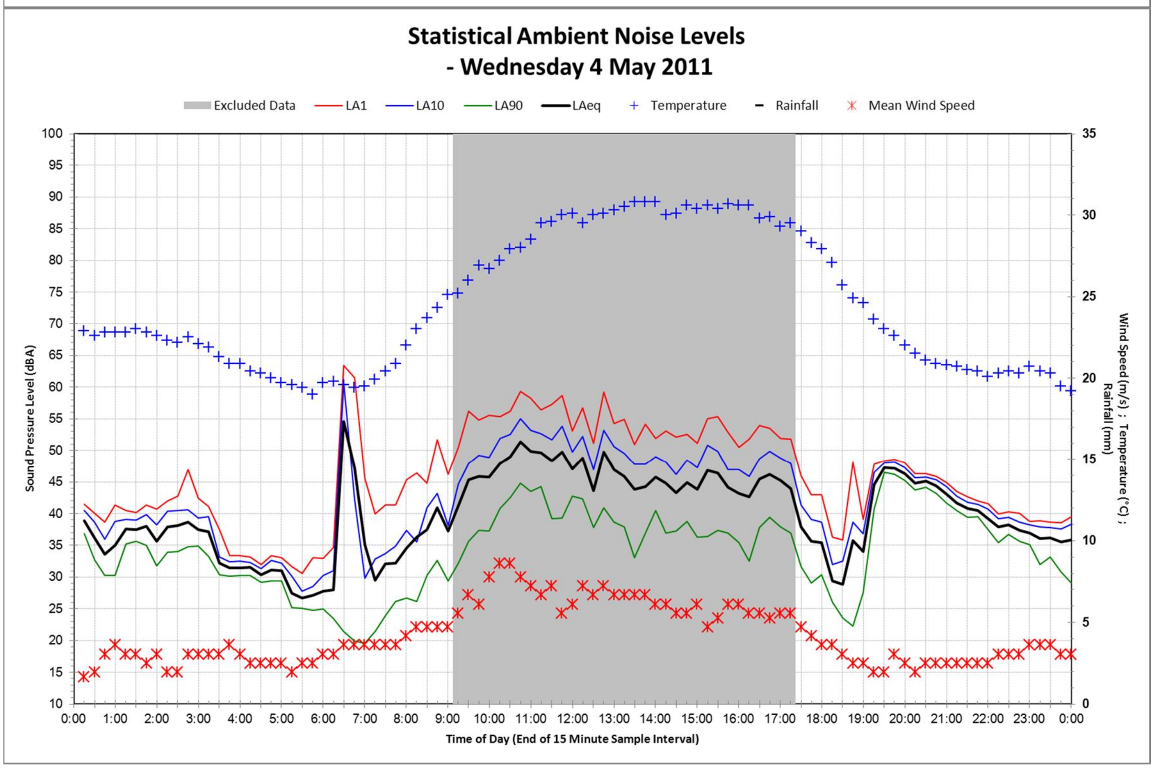

Statistical Ambient Noise Levels
- Wednesday 11 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Thursday 12 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

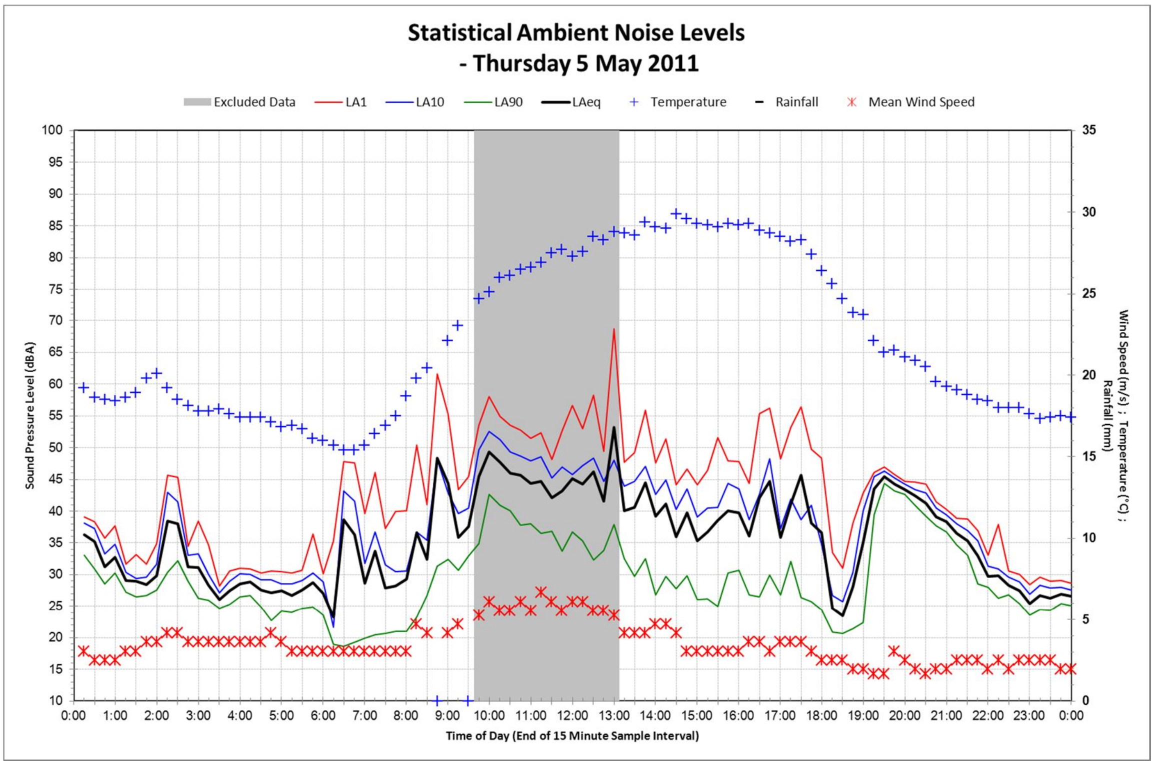
Logger 2

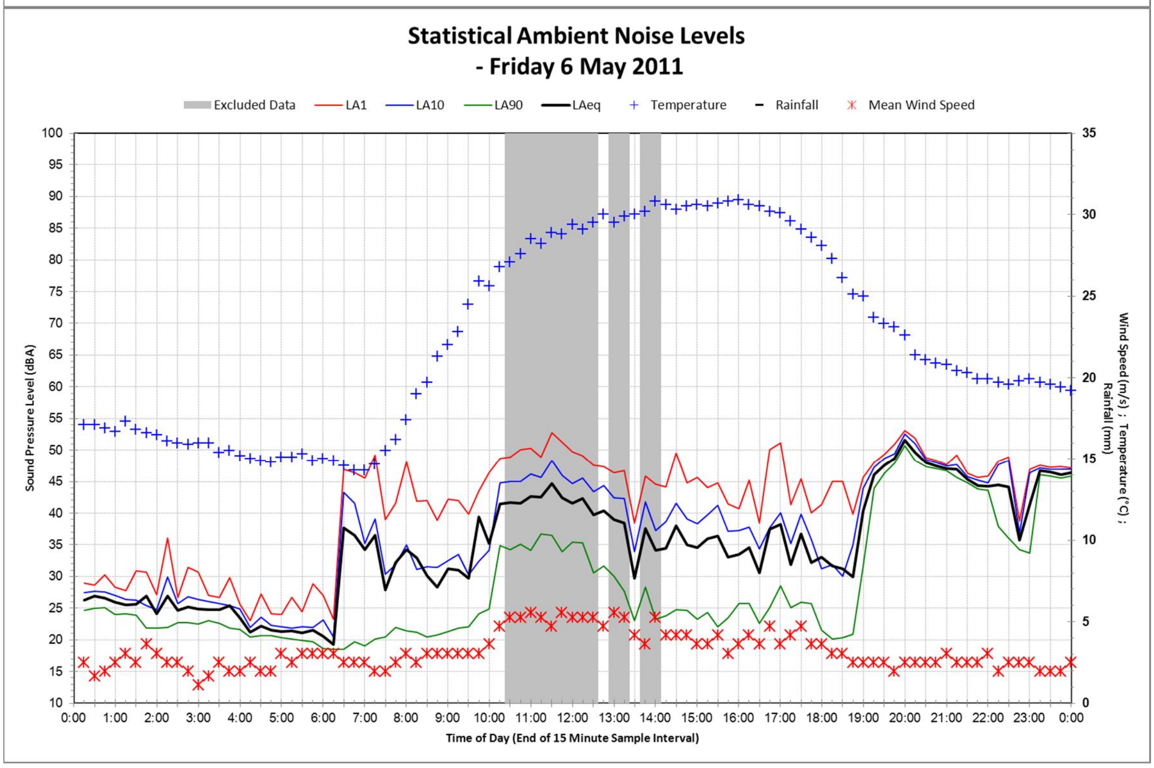


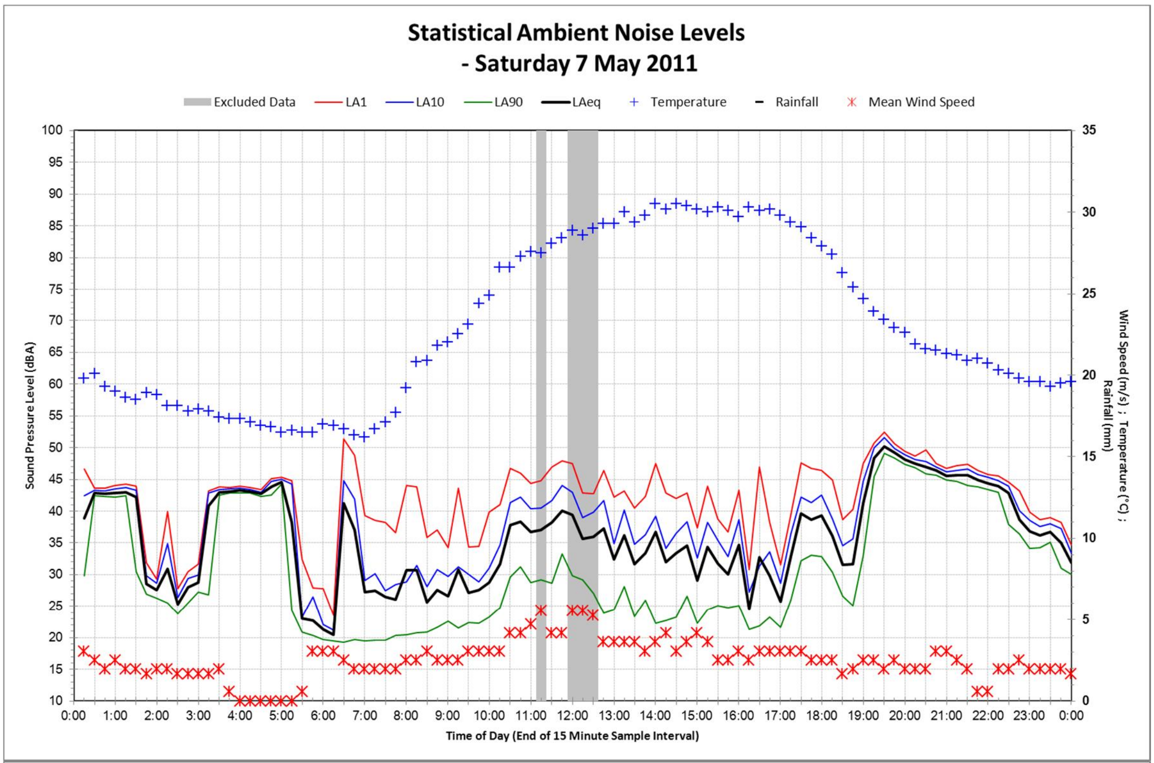
Statistical Ambient Noise Levels
- Tuesday 3 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

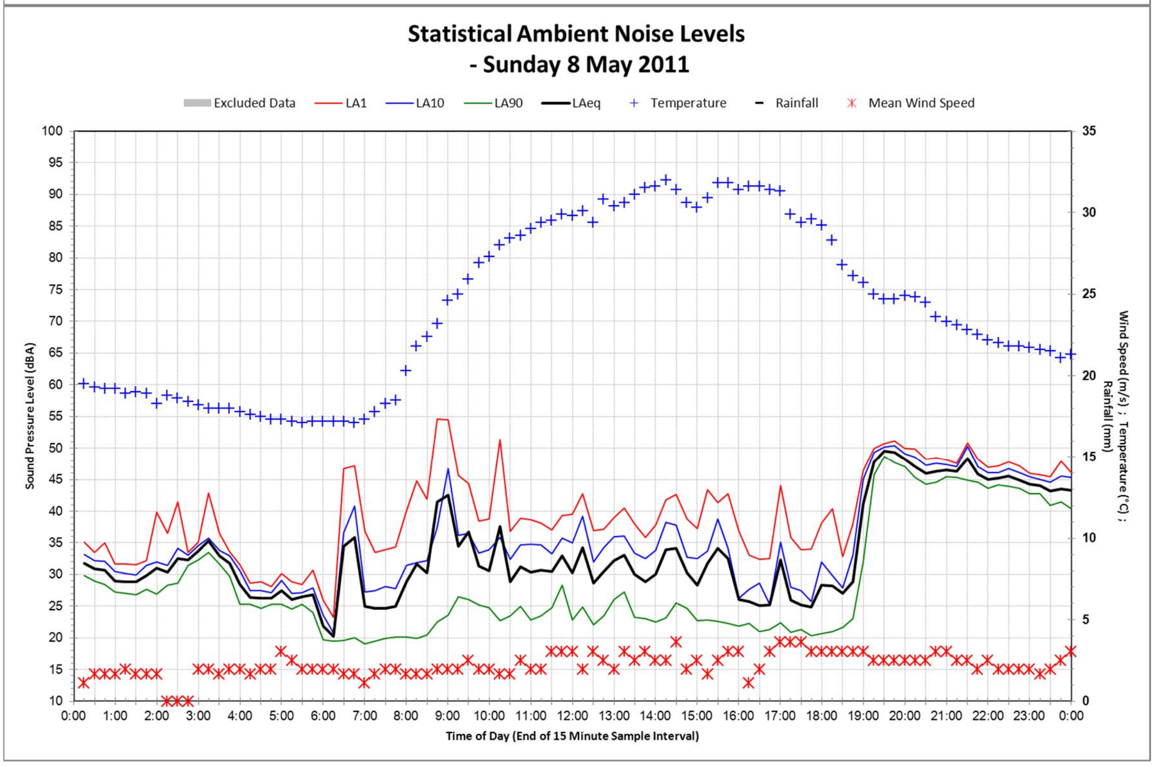


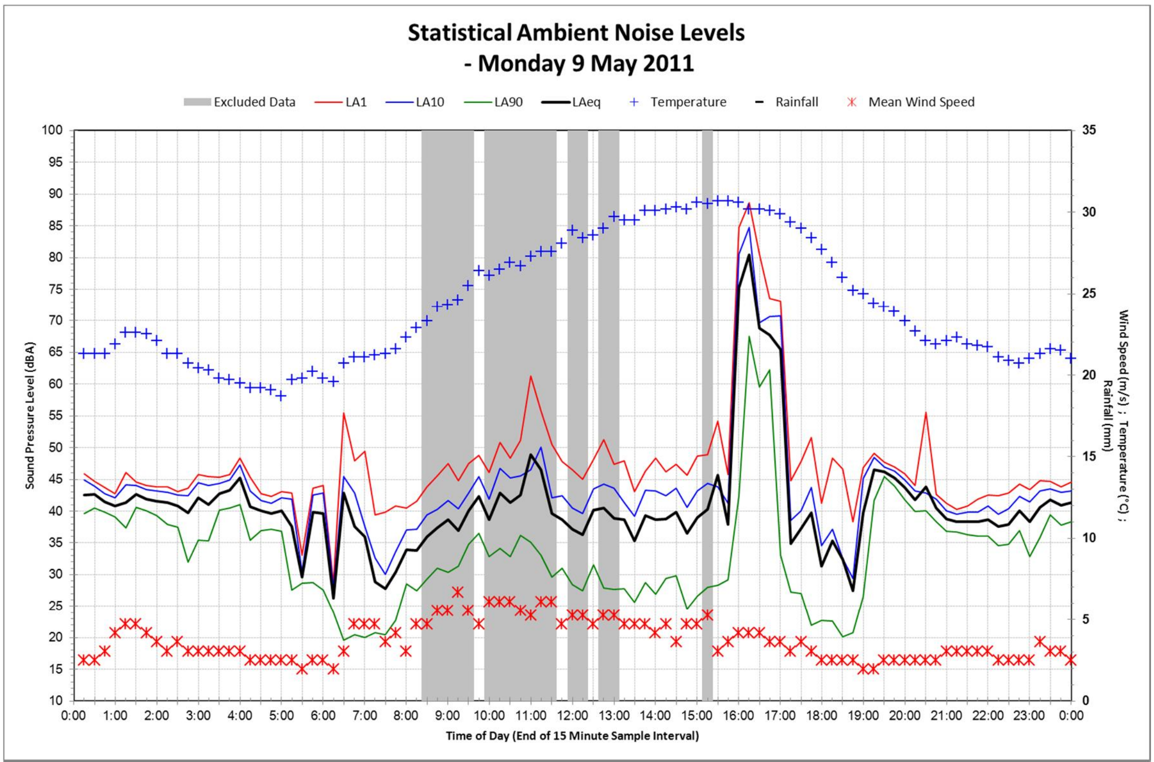
Statistical Ambient Noise Levels
- Wednesday 4 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Thursday 5 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

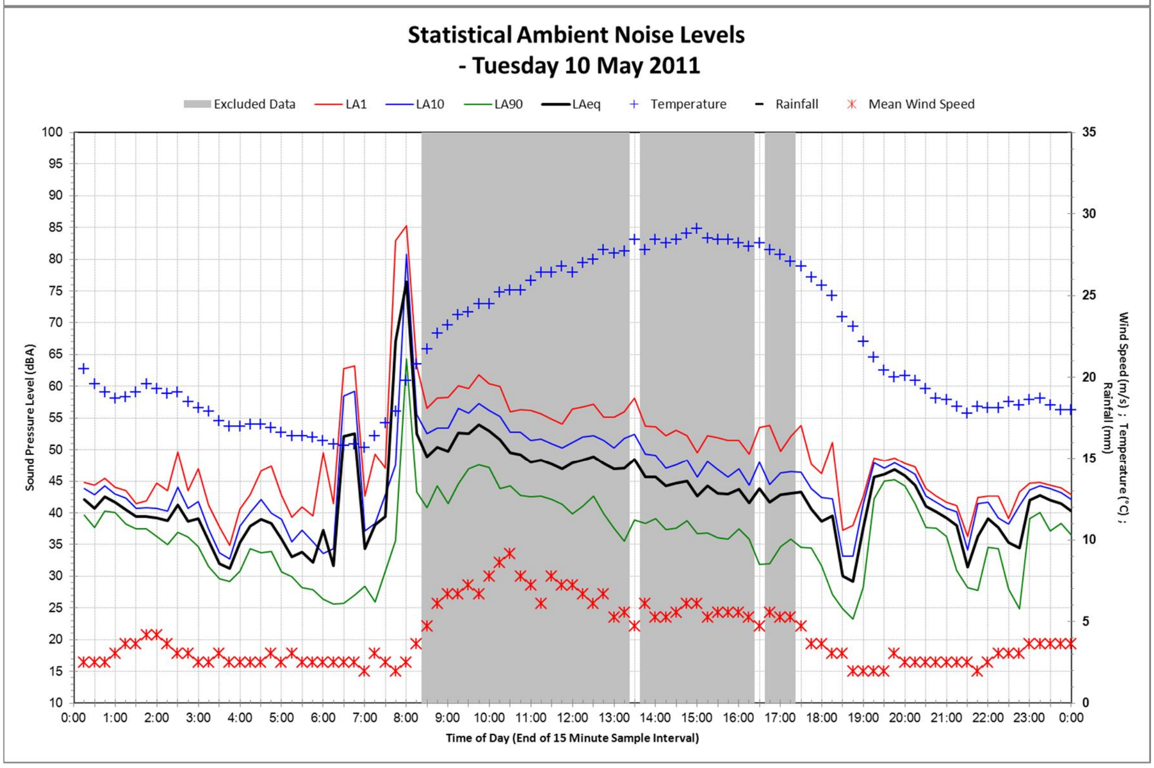

Statistical Ambient Noise Levels
- Friday 6 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Saturday 7 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

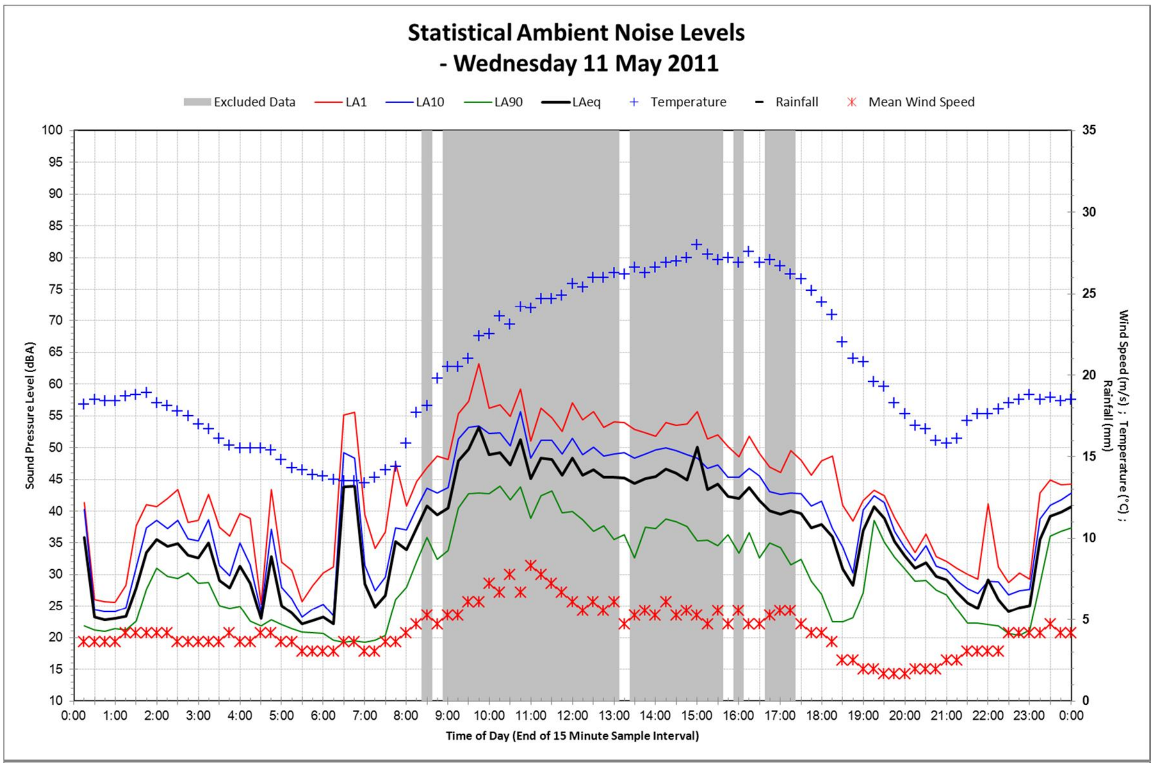

Statistical Ambient Noise Levels
- Sunday 8 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

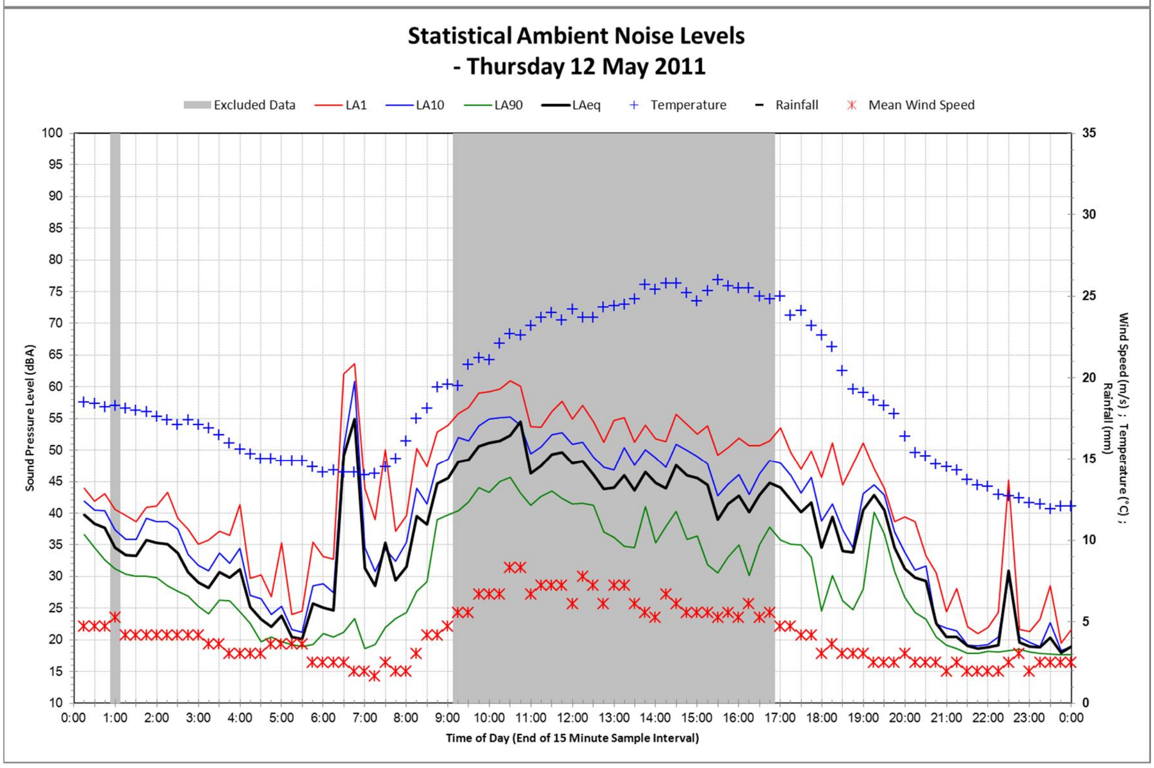


Statistical Ambient Noise Levels
- Monday 9 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)



Statistical Ambient Noise Levels
- Tuesday 10 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Wednesday 11 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Thursday 12 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

GHD

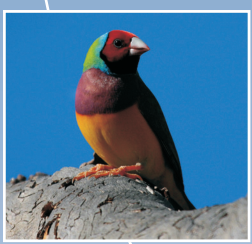
Level 5, 66 Smith Street
Darwin Northern Territory 0800
T: (03) 8687 8000   F: (03) 8687 8111   E: melmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	S Gunawan	V Chavand		I McCardle		6/6/2013

APPENDIX V

Traffic and Transport Assessment



CLIENTS | PEOPLE | PERFORMANCE

Vista Gold Australia Pty Ltd

Mt Todd Gold Project

Traffic and Transport Impact Assessment

June 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

This Traffic and Transport Assessment Report ("Report"):

1. *Has been prepared by GHD Pty Ltd ("GHD") for Vista Gold Australia Pty Ltd (Vista Gold); and*
2. *May only be used for the purpose of informing the Environment Impact Statement for the Mt Todd Gold Project (and must not be used for any other purpose).*

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in Section 3 Methodology.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report ("Assumptions"), as specified in Section 3 Methodology and throughout this Report.

GHD excludes liability for errors in, or omissions from, this Report arising from or in connection with any of the assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation. GHD has not, and accepts no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was signed.

Contents

Table Index

Figure Index

Glossary of Terms

Throughout this report the following terms or acronyms are referred to:

- *At-grade crossing* – A crossing of rail line and roadway at one level, without overpass or underpass.
- *Diverge taper* – A diverge taper is used on multi-lane carriageways when the number of traffic lanes is increased, i.e. from one lane into two lanes.
- Intersection treatment types:
  - *AUL* – Auxiliary left-turn treatment on the major road, i.e. additional short left-turn only lane;
  - *AUR* – Auxiliary right-turn treatment on the major road, i.e. shared through and right-turn lane and additional through-lane for overtaking vehicles;
  - *BAL* – Basic left-turn treatment on the major road, i.e. shared left-turn and through lane with minor widening of the shoulder;
  - *BAR* – Basic right-turn treatment on the major road, i.e. shared through and right-turn lane with minor widening of the shoulder;
  - *CHL* – Channelised left-turn treatment on the major road, i.e. additional short left-turn only lane separated from through traffic by painted chevrons and island; and
  - *CHR* – Channelised right-turn treatment on the major road, i.e. additional short right-turn only lane separated from through traffic by painted chevrons and island.
- *Merge taper* – A merge taper is used on multi-lane carriageways when the number of traffic lanes is reduced, i.e. from two lanes into one lane.
- *Priority control intersection* – The intersection of two or more roads with right of way for traffic managed by signage or line markings rather than traffic signals.
- vph – vehicles per hour.

Executive Summary

This document presents the Transport Assessment for the Draft Environmental Impact Statement (EIS) of the Mt Todd Gold Project. The scoping requirements for the EIS set out considerations regarding the potential transport impacts associated with the construction, operation and closure of the project. Potential impacts of the Project on capacity, intersection operations, safety and broader road network infrastructure for critical construction and operation phases are assessed.

The existing conditions of the transport network within the Project area are characterised by:

- Significant seasonal variation in traffic volumes on the Stuart Highway, with peak period dry season daily volumes observed to be up to 50% higher than daily average volumes for the year;
- Substantial spare capacity in the road network, with Stuart Highway and Edith Falls Road operating at the highest Level of Service standard;
- Relatively high proportion of heavy vehicles compared to typical arterial road network conditions;
- Duplicated and divided intersection of Stuart Highway and Edith Falls Road adequately providing for the separated movement of turning vehicles from through movement vehicles; and
- Road crash history with a high representation of single vehicle collisions, though not at any one location.

The construction of the project may have short-term adverse effects on the existing road network through the addition of construction related traffic. These impacts would be localised and short-term. The risks of these impacts are considered and could appropriately be mitigated through the implementation of measures, such as a Traffic Management Plan.

The traffic forecast to be generated by the operational phase of the Project is expected to have a negligible operational impact on the road network. No reduction in Level of Service or intersection performance is anticipated.

Additional risks and impacts associated with the operational phase of the Project will be manageable through the application of applicable minor localised infrastructure upgrades, management plans and management systems (including a Traffic Management Plan, Fatigue Management Plan and Incident Management Plan). Documentation will be produced in accordance with appropriate legislation and approved codes of practice.

.

1. Introduction

1.1 Background

GHD has been commissioned by Vista Gold Australia Pty Ltd (Vista Gold) to prepare a Draft Environmental Impact Statement (EIS) to assess the proposed re-establishment and operation of the Mt Todd Gold Mine.

The Mt Todd Gold Project (the Project) is located approximately 55 kilometres (km) northwest of Katherine, and approximately 250 km southeast of Darwin in the Northern Territory (Figure 1).

Pegasus Gold Australia Pty Ltd operated the Mt Todd mine from 1993 to 1999. The project closed as a result of technical difficulties and low gold prices. A joint venture, comprising Multiplex Resources Pty Ltd and General Gold Resources Ltd, bought the deeds to the mine in 1999 and operated it until July 2000. Vista Gold acquired concession rights in 2006. A Pre-feasibility Study for the Project is being completed by Vista Gold. Project information contained in this report has been supplied by Vista Gold from the Pre-feasibility Study.

This report has been prepared as part of the EIS and contains an assessment of the traffic and transport related issues relevant to the re-establishment of the Mt Todd Gold Mine.

1.2 Project Overview

This Project comprises the mining of gold ore from the existing Mt Todd Gold Mine – Batman Pit (previously mined and now in care and maintenance).

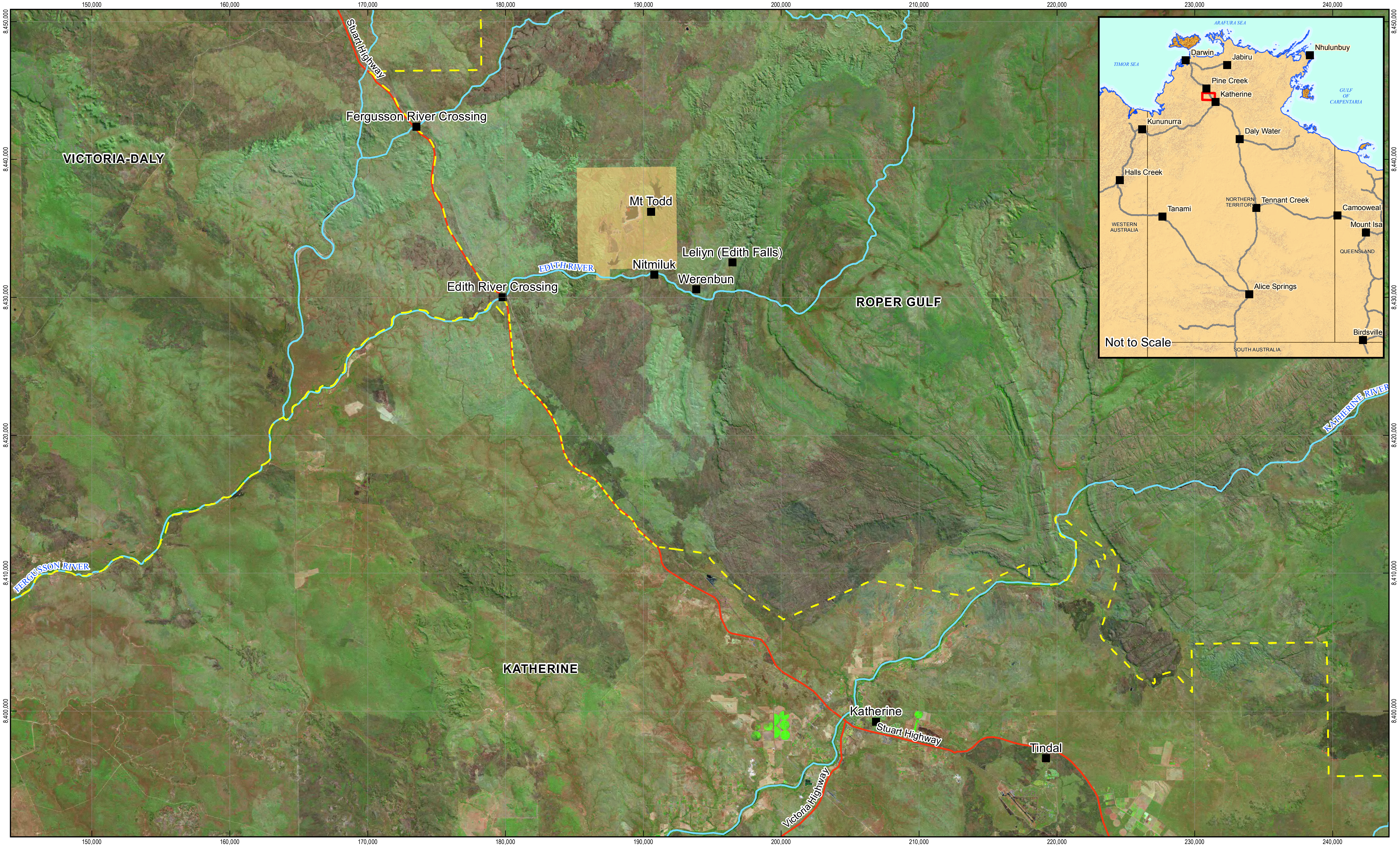
Mining will be an open-pit truck and shovel operation, using large haul trucks, hydraulic shovels and front end loaders to transport materials to the crusher, stockpiles, Run of Mine (ROM) pad and waste dump. Extracted ore, will be processed in an ore processing plant where it will be crushed, milled and then carbon in leach (CIL) leached followed by adsorption, desorption and recovery leading to gold dore (unrefined gold). Approximately 17.8 million tonnes per annum (Mtpa) of ore will be processed. Gold dore will be transported for onward secure shipment to a refinery.

Mine construction is will occur over a two year period (including pre-production operations during six months in construction year 2) and employ a workforce of up to 450. Transport associated with mine construction will include workforce transport to and from site by bus and light vehicle, and plant, equipment and construction materials transported to the site by a combination of standard and oversize heavy vehicles.

Mine production is expected to occur over a further 13 year period. Transport associated with mine operation and maintenance will include:

- Transport to and from site, primarily by bus, of a workforce that will peak at 350;
- Fuel, oil, chemicals and consumables transported to site by heavy vehicle; and
- Transport from site of gold dore by armoured vehicle.

Closure will occur over a four year period. Vehicle usage during this time will be low and significantly less than that occurring during the construction and production phases.



1:250,000 (at A3)

0 2.5 5 7.5 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

LEGEND

- Place Names
- LGA Boundaries
- Major Roads
- Mt Todd Mineral Leases
- Rivers

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	29 May 2013

Project Location

Figure 1

G:\43\21801\GIS\Maps 30000 TPA\TransportAssessment\4321801_501.mxd

Data source: NRETAS - Drainage (2011). Vista Gold - Mt Todd Mining Leases (2011). Geoscience Australia - Landsat Imagery (2007), Place Names, LGA Boundaries, States, Major Roads (2008). ESRI - SRTM (2009). Created by: CM

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

1.3 Scoping Requirements

Guidelines for the preparation of an EIS for the Mt Todd Gold Project were released by the NT EPA (formerly the Department of Natural Resources, Environment, the Arts and Sport (NRETAS)) in September 2011. Section 10.6 of the Guidelines stipulates that traffic and transport issues are to be addressed as follows:

- *Details of the existing transport infrastructure at locations likely to be impacted by the proposal;*
- *Description of transport systems and methods to convey all site traffic (including materials, workers and product) to and from the site (both during construction and operation) including:*
  - *Type, size and number of vehicles required during all phases of the proposal;*
  - *The estimated volumes, tonnage, composition, origin and destination of traffic generated by the proposal;*
  - *Estimated times of travel; and*
  - *Additional road infrastructure works required including site access and signage.*
- *Description of transport systems and methods to convey any product to proposed markets;*
- *Description of any proposed haul roads, including length, location, land requirements, tenure and acquisition requirements;*
- *Description of construction methods and timeframes for any proposed private and public haul roads;*
- *Description of how the project will, or has the potential to, impact on transport infrastructure during construction and operational phases. In addition, description of possible transport impacts as a result of the proposal including issues such as dust and road traffic noise;*
- *Describe proposed safeguards, management and monitoring strategies that will be implemented to minimise potential transport impacts during construction and operation including, but not limited to:*
  - *Methods for complying with any relevant road vehicle axle limits;*
  - *Methods for securing loads;*
  - *Measures to reduce any road traffic noise impacts;*
  - *Consultation with local communities affected by transport impacts;*
  - *Traffic management; and*
  - *Management of driver fatigue.*
- *Consultation undertaken with relevant regulatory agencies; and*
- *Necessary approvals required.*

In addition, points of consideration raised by the Road Network Division during the consultation process are also addressed. These comprise:

- Transport of dangerous goods;
- Increases in traffic on Stuart Highway and Edith Falls Road;
- The crossing of the Stuart Highway and Adelaide-Darwin railway line;
- Measures to address road safety in remote areas;
- Incident management; and
- Contributions by Vista Gold to the maintenance of roads used as haul routes.

2. Legislative Framework

2.1 Northern Territory Legislation

2.1.1 Control of Roads Act

The Control of Roads Act provides that, subject to the Planning Act and the Local Government Act, the control, care and management of all public roads in the Northern Territory vests with the Minister. This Act outlines the process by which public roads can be opened and closed. Any public or gazetted roads that are required to be opened or closed as a result of construction or operation of the mine would be required to follow the provisions of the Act.

2.1.2 Traffic Act

The objective of this Act is to regulate traffic, which includes provisions in relation to the erection and operation of traffic control devices. Traffic control devices refer to signals, signs or markings displayed for the purpose of regulating, warning or guiding traffic. Under the Act, consent from the applicable competent authority is required prior to the erection and operation of traffic control devices.

2.1.3 Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act, 2010

The object of this Act and associated regulations is to regulate the transport of dangerous goods on land in order to promote public safety and protect property and the environment, achieved within a nationally consistent context.

The provisions of this Regulation reflect, with minor modifications, the provisions of the Model Subordinate Law on the *Transport of Dangerous Goods by Road or Rail 2007* prepared by the National Transport Commission.

The Regulation establishes a system of standards and licensing for the transport of dangerous goods by road and rail and also applies the Australian Code for the Transport of Dangerous Goods by Road and Rail to such transport.

This Act makes provision for safety in the transport of dangerous goods by road and rail. Involvement in the transport of dangerous goods by road or rail includes, but is not limited to, being the consignee of dangerous goods, loading or unloading dangerous goods that have been transported or the importation or arrangement to import dangerous goods.

2.1.4 Work Health and Safety (National Uniform Legislation) Act 2011

The Northern Territory *Work Health and Safety (National Uniform Legislation) Act 2011* commenced on 1 March 2012, and represents a movement by state and territory governments towards harmonising work health and safety legislation across Australia. Under the Act, approved codes of practice provide practical guidance to meeting legislative obligations.

Of relevance to this transport assessment is the approved Northern Territory Code of Practice in Fatigue Management. It is a voluntary code of practice for fatigue management for road transport with the objective to provide operators with a basic set of key principles to be applied.

2.2 Northern Territory Policy

2.2.1 Traffic Management at Work Sites, Department of Planning and Infrastructure, 2009

The objective of this policy is to change the construction philosophy from closing roads and using detours to manage construction adjacent to the roadside under operating traffic conditions.

The policy states that all rehabilitation projects shall be constructed while the road is open to traffic. The requirements are to:

- Obtain all necessary approvals, clearances and permits (including material sources, water sources, camp grounds and turn around areas for construction traffic and nominate these areas in the specification);
- Provide public notification in advance of any works;
- Implement a Compliant Traffic Management Plan, including restricted working hours if necessary;
- Ensure regular auditing of project for compliance; and
- Consider environmental protection and preservation of sacred and heritage sites in all rehabilitation and other road work projects.

Vista Gold is not proposing to alter gazetted roads.

2.2.2 Road Traffic Noise on Northern Territory Government Controlled Roads, Department of Planning and Infrastructure, 2006

The objective of this policy is to achieve an appropriate balance between providing efficient road transport infrastructure and controlling the adverse effects of road traffic noise on adjacent land uses. The policy sets out target road traffic noise objectives for particular types of road situations for residential and noise-sensitive land uses adjacent to arterial roads. It is noted that for an existing arterial road with planned significant development (e.g. addition of regular heavy vehicles onto Stuart Highway), there is no target and no required action.

2.3 Northern Territory Strategies

2.3.1 Northern Territory Road Safety Strategy 2004 – 2010: Reduced Road Trauma

The NT Road Safety Strategy is aimed at reducing the number, severity and cost of road crashes in the NT. The Strategy aims to achieve a 40% reduction on current road fatalities, consistent with targets set nationally. The four key objectives designed to meet the challenge of reducing road trauma include:

- A safer road network, by ensuring planning, design, construction, development, maintenance and management of the road network enhances and supports good road safety principles and practices;
- Safer road users, by enhancing and legislating education, driver training and enforcement programs, as well as improving and supporting marketing activities to promote and influence long term community behavioural change with respect to speeding, alcohol and other drugs, fatigue, seatbelts and vulnerable road users. In addition to this, also ensuring adequate infrastructure to promote and enhance cycling as an alternative method of transportation and one which minimises the potential road safety risk;

- Safer vehicles, by advocating and supporting new technological features in vehicles to enhance, maximise and maintain protection for both vehicle occupant(s) and other road users in the event of a serious crash; and
- Effective emergency response, by enhancing communication skills and access to crash sites, particularly in remote locations, to enable timely first aid and care to the critically injured during the golden hour post-crash.

2.4 Road Permits

2.4.1 Permit to Work Within the Road Reserve, Department of Construction and Infrastructure, 2011

An application must be submitted to the Department of Construction and Infrastructure if works are to occur within an NT Government road reserve. This is expected to apply to any required upgrades of intersections on Stuart Highway. The application must be accompanied by a Traffic Management Plan and associated documents for approval.

2.4.2 Permit for Oversize and Overmass Vehicles, Department of Planning and Infrastructure, 2007

The Motor Vehicles Act and Motor Vehicles (Standards) Regulations specify maximum dimensional and mass limits for vehicles which may travel on public roads in the Northern Territory with permits required for exemptions to be granted. Over-dimensional and over-mass loads require consideration of the width, alignment and impact on the roads and bridges, traffic conditions and proximity of roadside and overhead obstacles. These conditions will vary widely throughout the NT and, therefore, so will the conditions imposed on the permit for travel.

3. Methodology

The following tasks have been undertaken to complete the traffic and transport assessment:

- Review of existing information, reports and investigations:
  - Visit to the project area on a typical day to establish the existing traffic conditions, identify any safety and accessibility issues along the route and identify any heavy vehicle facilities;
  - Review of legislation, reports and existing data related to the project including review of traffic data available for the project area;
  - Assessment of recent crash history for the project area; and
  - Review of other existing conditions information including public transport and local community information within the vicinity of the project area to inform the impact assessment.
- Consultation with the Department of Lands Planning and the Environment (DLPE) (formerly Department of Lands and Planning), Road Network Division, and with the community via public consultation processes;
- Estimates of traffic generation and distribution associated with the construction and operation of the Mt Todd mine:
  - Proposed transport activities associated with each stage of the project have been provided by Vista Gold.
- Undertake an impact assessment of the Project for construction, operation and closure. The assessment considers:
  - Assessment of staff transportation;
  - Impacts on road network capacity and impacts on key intersections;
  - Potential effects on road network infrastructure;
  - Assessment and potential impact identification of the proposed access routes; and
  - Impacts on a range of road safety issues.
- Following an assessment of the potential project traffic and transport impacts, recommendations for management and mitigation measures for identified impacts have been made.

4. Existing Conditions

4.1 Study Area

The Mt Todd Gold Project is located approximately 55 kilometres northwest of Katherine, and approximately 250 kilometres southeast of Darwin in the Northern Territory. The Mt Todd mine site is located approximately 10 kilometres east of Stuart Highway, off Edith Falls Road. The mine site access is via Jatbula Road, a restricted mine access road.

The extent of the study area for this traffic and transport assessment is shown in Figure 2. Key elements within the study area include:

- Stuart Highway;
- Edith Falls Road;
- Jatbula Road (private mine access road); and
- Adelaide – Darwin railway line.

4.2 Existing Road Network

4.2.1 Stuart Highway

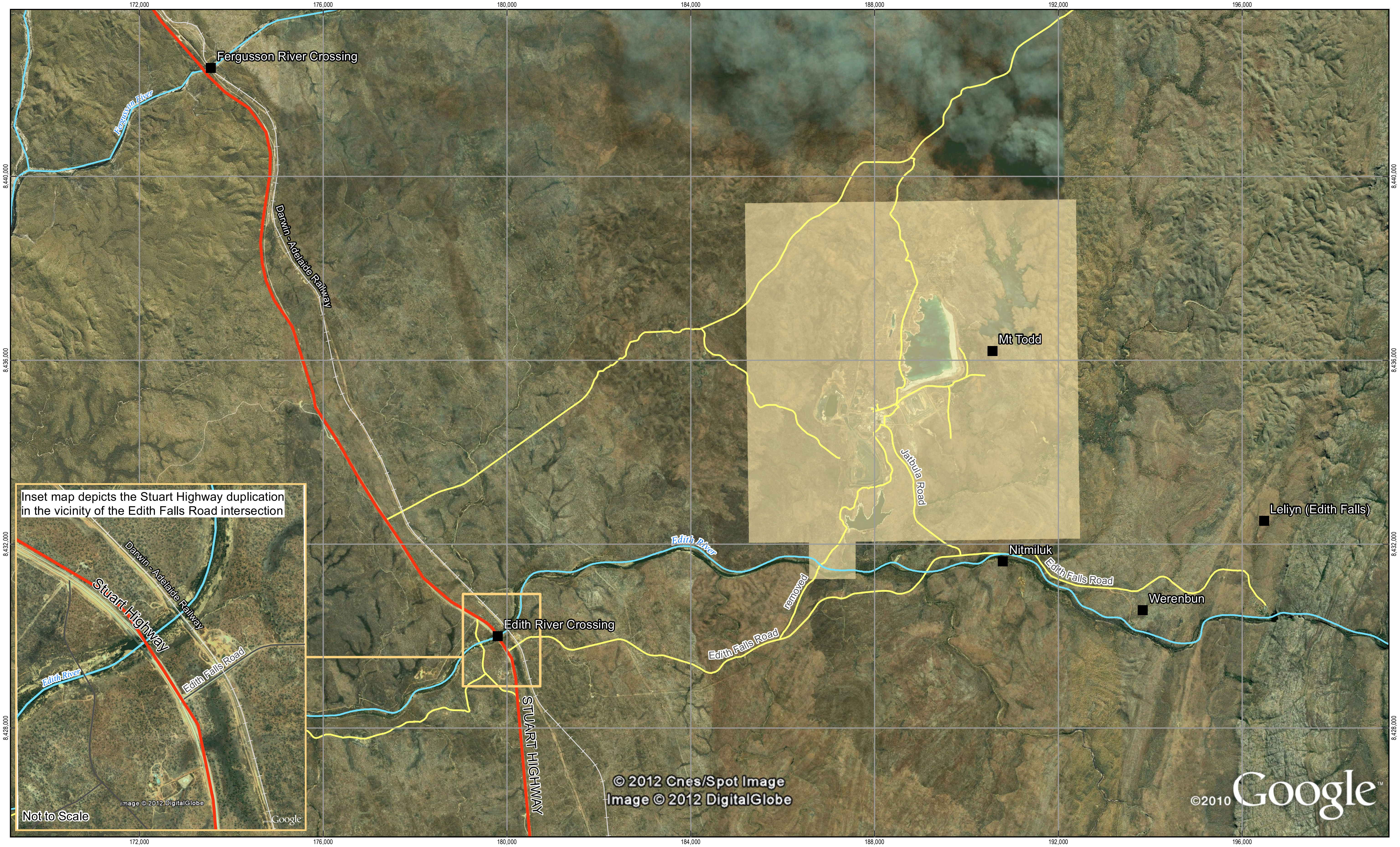
The Stuart Highway is a national highway extending approximately 2,700 kilometres from Darwin, NT to Port Augusta, SA. Within the study area, the Stuart Highway is a Declared Road controlled by DLPE. The Stuart Highway will provide connections from the major population centres to the mine.

The Highway has a 130km/h posted speed limit in the vicinity of the project and is generally a two-lane, two-way road with a seal width of 7 metres and unsealed or grassed shoulders varying between 2.5 and 5 metres in width. A typical cross section is shown in Figure 3. However in the vicinity of the intersection with Edith Falls Road, the Stuart Highway widens to a four-lane, two-way road which provides overtaking opportunities (Figure 4). In the vicinity of Edith Falls Road, the Highway has a 15 metre wide median with 3.5 metre wide right-turn and left-turn lanes. The road reserve at this location has a width of approximately 36 metres.

The dual carriageway section of Stuart Highway is approximately 3.25 kilometres long, extending about 750 metres to the south of the intersection and about 2.5 kilometres to the north of the intersection. The left-turn lane from the north into Edith Falls Road is approximately 180 metres long.

Sight distance along the Highway is good and typically exceeds one kilometre, with the exception of the Edith Falls Road intersection where sight distance is reduced to 850 metres to the south due to the horizontal curvature of the road (refer Section 4.3). This exceeds the Austroads desirable minimum stopping sight distance value of 257 metres for a 130km/h road.

There is no lighting provided along the road in the vicinity of the Edith Falls Road intersection; however, guide posts provide delineation for night time driving.



1:75,000 (at A3)

0 1 2 3 4

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

LEGEND

Place Names	Railway
Highway	Rivers
Pre-existing track	Mt Todd Mineral Leases

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	29 May 2013

Study Area Transport Network

Figure 2

G:\43\21801\GIS\Maps 30000 TPA\TransportAssessment\4321801_502.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: NRETAS - Rivers (2011). GA - Major Roads, Place Names (2011). Vista Gold - Mt Todd Mineral Lease, Railways (2011). Google Earth Pro - Imagery (Date Extracted: 09/05/2012). Created by: CM

Figure 3 Stuart Highway typical two-lane two-way cross section

Figure 4 Stuart Highway dual carriageway cross section at Edith Falls Road intersection, view to south

4.2.2 Edith Falls Road

Edith Falls Road is a two-way, two-lane road which connects the Stuart Highway with Edith Falls. Within the study area, Edith Falls Road is a Declared Road controlled by DLPE. The road is utilised mainly by local residents and tourists, and intersects with Jatbula Road (Mine Access Road), which is the main access road into the mine site. The road has a typical cross section width of 7 metres (2 x 3.5 metres lanes) and the shoulders are a mix of rocks, grass and crushed rock with a width between 2.0 metres and 2.5 metres. The posted speed limit along the road is 80km/h.

Roadside signage indicates that Edith Falls Road is subject to flooding, and alternative measures may need to be considered for emergency site access during a flood event. There is no lighting provided along the road, although guide posts provide delineation for night time driving. Cross sections of Edith Falls Road are shown in Figure 5 and Figure 6.

Figure 5 Edith Falls Road typical two-lane two-way cross section, creek crossing, view to west

Figure 6 Edith Falls Road typical two-lane two-way cross section, view to west

4.2.3 Jatbula Road (Mine Access Road)

Jatbula Road is a private access road and will provide the main point of access to the mine. Jatbula Road is a two-way road with no line marking and a speed limit of 80km/h. Seal widths along Jatbula Road vary from 7.5 to 8 metres and in most cases shoulder widths are less than 1 metre due to embankments on the side of the road, or the presence of rocks and debris. Pavement conditions along Jatbula Road vary, sections of the road are considered to be very poor, particularly in the area 1.2 kilometres north-west of Edith Falls Road. Roadside signage in this vicinity indicates that Jatbula Road is also subject to flooding. Figure 7 and Figure 8 present cross section images of Jatbula Road.

Figure 7 Jatbula Road (Mine Access Road) typical cross section, view to north

Figure 8 Jatbula Road (Mine Access Road) cross section – localised poor pavement condition, view to north

4.2.4 Internal Mine Roads

Jatbula Road (Mine Access Road) continues within the mine site as an internal road. Conditions along the internal mine roads vary, sections range between sealed and dirt roads. Figure 9 and Figure 10 present indicative existing conditions of the internal mine roads.

Figure 9 Internal Mine Roads, sealed section of roads

Figure 10 Internal Mine Roads, unsealed sections of roads

4.3 Intersections

4.3.1 Stuart Highway/Edith Falls Road

The Stuart Highway/Edith Falls Road intersection is a Give Way sign controlled T-intersection, where Stuart Highway is the major movement. At the intersection the Stuart Highway is a four-lane, two-way divided road with a median width of 15 metres. An Auxiliary Left Turn (AUL) treatment facilitates left turn movements from the northern approach of the highway and a Channelised Right Turn (CHR) treatment facilitates right turn movements from the highway at the southern approach. The separation of turning traffic from the through lanes on both the northbound and southbound carriageways makes provision for the deceleration of turning vehicles.

The width of the median of Stuart Highway allows for vehicles turning right from Edith Falls Road to perform a two-stage crossing of the intersection, i.e. waiting at the median after crossing the southbound carriageway before entering the northbound carriageway.

Sight distances to the south and north along the Stuart Highway from the intersection are shown in Figure 11 and Figure 12 respectively. Sight distances are observed to be approximately 850 metres in both directions on Stuart Highway. This is greater than the desirable minimum stopping sight distance value of 257 metres for a 130km/h road, as per Table 5.4 of Austroads Guide to Road Design Part 3: Geometric Design.

Figure 11 Sight distances at the Stuart Highway / Edith Falls Road intersection, view to south on Stuart Highway

Figure 12 Sight distances at the Stuart Highway / Edith Falls Road intersection, view to north on Stuart Highway

4.3.2 Edith Falls Road/Jatbula Road (Mine Access Road)

The Edith Falls Road / Jatbula Road (Mine Access Road) intersection is a Give Way sign controlled T-intersection, where Edith Falls Road is the major movement. A short Auxiliary Left Turn lane provides for left turn movements from Edith Falls Road into Jatbula Road (Mine Access Road) from the west and a basic right-turn treatment on the major road (BAR) provides for right turns from a shared right-turn and through lane from the east. A rural basic left turn treatment on the minor road (BAL) treatment provides for left and right turn movements exiting Jatbula Road (Mine Access Road).

Sight distances to the east and west along Edith Falls Road at the Jatbula Road (Mine Access Road) intersection are shown in Figure 13 and Figure 14. To the east from the intersection, sight distances are restricted to approximately 600 metres due to the horizontal curvature of the road. To the west from the intersection, sight distances are restricted to approximately 70 metres, limited by a dip in the road. This is less than the desirable minimum stopping sight distance value of 114 metres, as per Table 5.4 of Austroads Guide to Road Design Part 3: Geometric Design. There are existing warning signs on Edith Falls Road on the approach to the intersection.

Figure 13 Sight distances at the Edith Falls Road / Jatbula Road (Mine Access Road) intersection, view to east on Edith Falls Road

Figure 14 Sight distances at the Edith Falls Road / Jatbula Road (Mine Access Road) intersection, view to west on Edith Falls Road

4.3.3 Edith Falls Road Level Crossing

An at-grade level crossing of the single track Adelaide - Darwin Railway line is located on Edith Falls Road approximately 280 metres west of the Stuart Highway / Edith Falls Road intersection (see Figure 15 and Figure 16). The crossing is controlled by flashing lights.

Figure 15 Edith Falls Road level crossing, view to west

Figure 16 Edith Falls Road level crossing, view to east of flashing lights and on-road warning signage

4.4 Traffic Volumes

4.4.1 Recorded Traffic Volumes

Traffic volume information collected by the Road Network Division of DLPE has been provided for relevant observation locations to the project area for 2009, the most recently available full year of data. The records present daily average two-way volumes for each month. Significant seasonal variability of traffic volumes is observed, primarily due to the wet and dry seasons. For that reason, traffic volume data for Stuart Highway and Edith Falls Road in Table 1 lists the minimum, maximum and average daily two-way volumes. The maximum recorded daily volumes are considerably below typical capacity for a two-lane highway, which could be expected to carry up to 1,800 vehicles per hour (one way) in uninterrupted flow conditions.

Table 1 Traffic Volume Data (DLP 2009)

Road Name / Location	Minimum recorded daily traffic (two-way)	Maximum recorded daily traffic (two-way)	Average daily traffic (ADT) (two-way)	ADT Station
Stuart Highway / 2 km north of Kakadu Highway	668 (February 2009)	1,570 (July 2009)	1,070 (2009)	RDVDP005
Stuart Highway / 20 km north of Katherine River Bridge	907 (January 2009)	1,930 (July 2009)	1,312 (2009)	RKVDP001
Edith Falls Road / 2 km east of Stuart Highway	N/A	N/A	175 (2009)[1]	RKVDC033

[1] 2009 traffic volume data for ADT Station RKVDC033 only available for March – April

4.4.2 Percentage Heavy Vehicles

Classified vehicle counts are undertaken at fixed ADT stations for selected periods of the year. Heavy vehicle data obtained from the DLP indicates a relatively high proportion of heavy vehicles on Stuart Highway, as presented in Table 2. No further breakdown of heavy vehicles is available.

Table 2 Percentage Heavy Vehicles (DLP 2009)

Road Name / Location	Percentage LV (two-way)	Percentage HV (two-way)	Record Period (Days)	ADT Station
Stuart Highway / 2 km north of Kakadu Highway	74.3%	25.7%	November 2009 (14)	RDVDP005
Stuart Highway / 20 km north of Katherine River Bridge	84.0%	16.0%	March & April 2009 (28)	RKVDP001
Edith Falls Road / 2 km east of Stuart Highway	90.5%	9.5%	March & April 2009 (28)	RKVDC033

4.4.3 Background Traffic Growth Rates

Background traffic growth rates sourced from existing traffic count data are shown in Table 3. The low observed background traffic growth rates on the existing road network are likely due to the rural nature of the study area.

Table 3 Observed traffic growth rates (derived from DLP data, 2009)

Road Name / Location	Count Dates	Average Growth Rate (p.a.)	ADT Station
Stuart Highway / 2 km north of Kakadu Highway	2000 - 2009	0.8%	RDVDP005
Stuart Highway / 20 km north of Katherine River Bridge	2000 - 2009	2.7%	RKVDP001
Edith Falls Road / 2 km east of Stuart Highway	2001 - 2009	-1.7%[1]	RKVDC033

[1] Incomplete data for the comparison period

4.5 Casualty Crash History

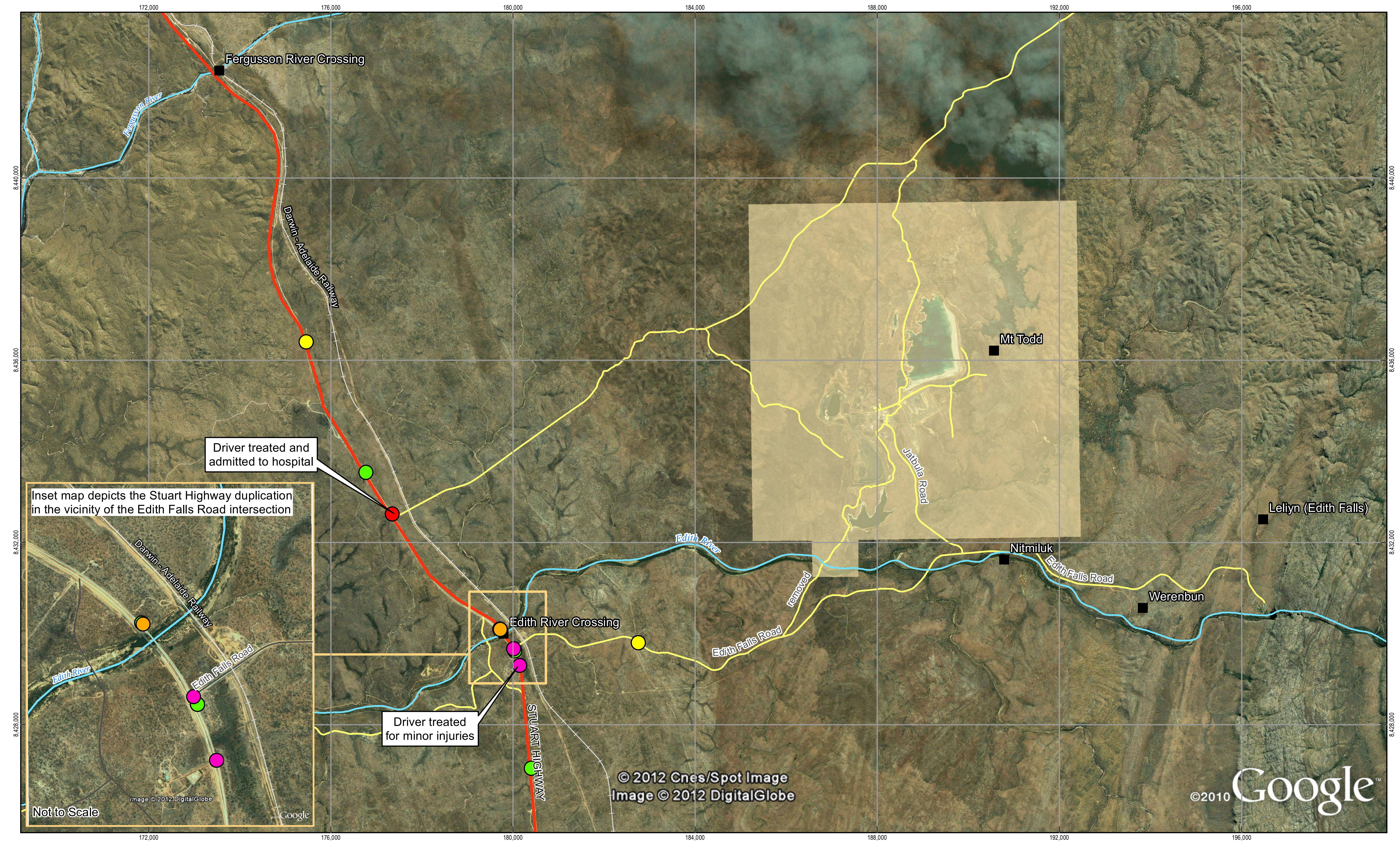
Crash data provides an indication of the road safety performance of an area, and can assist in determining existing road safety deficiencies.

A review of the crash history for the Stuart Highway and Edith Falls Road in the vicinity of the project area has been undertaken, from north and south of Edith Falls Road on Stuart Highway, to east of Jatbula Road (Mine Access Road) on Edith Falls Road. The crash history review has been collated for the five year period between June 2006 and June 2011 and was sourced from DLPE.

There have been nine crashes on Stuart Highway in the Project area, and 10 across the Project area. All recorded crashes have been single vehicle incidents. Of these, one crash resulted in hospital admission and another in minor medical treatment. No other injuries were recorded. Table 4 disaggregates the recorded accidents by accident type and Figure 17 depicts the location of crashes that have occurred on the Stuart Highway and Edith Falls Road.

Table 4 Recorded accidents by accident type (derived from DLP data, 2011)

Type	Stuart Highway	Edith Falls Road	Total
Overturned	4	-	4
Ran off road	2	-	2
Hit animal	2	1	3
Hit fixed object	1	-	1
Total	**9**	**1**	**10**



1:75,000 (at A3)

0 1 2 3 4

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

LEGEND

Place Names
Highway
Rivers
Railway
Pre-existing track
Mt Todd Mineral Leases

Vehicle Accident Type

HIT CATTLE/BUFFALO
HIT FIXED OBJECT
HIT OTHER ANIMAL
OVERTURNED
RAN OFF ROAD

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number 43-21801
Revision 1
Date 29 May 2013

Study Area Road Crashes

Figure 17

G:\43\21801\GIS\Maps 30000 TPA\TransportAssessment\4321801_503.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: NRETAS - Rivers (2011). GA - Major Roads, Place Names (2007). Vista Gold - Mt Todd Mineral Lease, Railways (2011). Google Earth Pro - Imagery (Date Extracted: 09/05/2012). GHD - Crash Data (2012). Created by: CM

The crash review for the Stuart Highway revealed ten crashes that occurred over the five-year period. The following summarises the ten crashes:

- Two ‘ran off road’ crashes occurred on the Stuart Highway, one near the Stuart Highway / Edith Falls Road intersection and one near Edith River (approximately 800 metres south of the Edith Falls Road intersection). Both crashes involved only one vehicle and occurred one year apart (in 2010 and 2011). The crash near Edith River resulted in a class 2 injury (treated and admitted to hospital). Both crashes occurred during daylight conditions;
- Four ‘overturned’ crashes occurred on the Stuart Highway within the assessed area. Specifically, these crashes occurred 20 metres north of the Edith River Bridge, 50 metres south of Edith Falls Road, approximately 18 kilometres north of Edith Falls Road and 2.6 kilometres south of Edith Falls Road. Two crashes involved northbound vehicles and two crashes occurred during both daylight and night conditions. No injuries were recorded;
- Two ‘hit animal’ crashes on Stuart Highway north of Edith Falls Road. One crash occurred in 2008 approximately 21 kilometres to the north. One crash occurred in 2010 approximately 17 kilometres to the north which resulted in minor injury requiring treatment. Both crashes occurred outside of daylight hours;
- One additional ‘hit other animal’ crash occurred in 2008 along Edith Falls Road. The vehicle was travelling eastbound and collided with the animal approximately 3 kilometres from the Stuart Highway / Edith Falls Road intersection. The accident occurred at night, no injuries were recorded; and
- One ‘hit fixed object’ crash occurred in 2007 north of the Edith River Bridge. The crash involved one vehicle and occurred during daylight hours. No injuries were recorded.

The crash history review indicates no pattern of specific road safety deficiencies in the Project area. However, the prevalence of single vehicle accidents highlights the concern regarding the potential influence of driver fatigue and decrease to alertness on road crashes.

Additionally, the crash history review has revealed no road crashes associated with the Darwin to Adelaide railway line crossing of Edith Falls Road.

4.6 Railway Line

The single track Darwin to Adelaide railway line runs parallel to the Stuart Highway within the Project area. Interstate passenger services and container and bulk freight services operate between Darwin and Adelaide along the line. Six services a week operate from Darwin to Adelaide, with additional bulk train services operating between regional mine sites and the Port of Darwin. The Ghan passenger service also operates two return services per week.

4.7 Public Transport

A key initiative of the NT Integrated Regional Transport Strategy is to “support passenger bus services in remote and regional areas, including services linking Growth Towns to major centres and outstations to Growth Towns” (DLP, 2010).

Regional bus services currently exist from the Katherine town centre to the communities of Beswick, Ngukurr and Lajamanu. The expansion of regional bus services is proposed over the next two years to include the communities of Numbulwar and Borroloola. An assessment of the feasibility of a town bus service for the greater Katherine area using existing public and private bus services is also proposed within the Integrated Regional Transport Strategy.

No current or proposed public transport routes exist within the Project area. Due to the rural nature of the Project area, public transport is not expected to be an influencing factor on Project generated traffic.

4.8 Truck Facilities

Parking for heavy vehicles is currently facilitated in the northbound direction on Stuart Highway, approximately five kilometers north of Edith Falls Road. The truck rest stop has a sealed surface, though does not provide for any amenities. The rest stop was constructed in 2009, and is considered to provide for adequate acceleration, deceleration and sight distances on approach and departure.

4.9 Local Community

4.9.1 Katherine

Katherine is the largest township within vicinity of the Mt Todd Gold Project. It is the fourth largest town in the Northern Territory, located approximately 312 kilometres south-east of Darwin on the Katherine River. The Katherine town council covers an area of 17.3 km^2 with a residential population of 6,094 in 2011.

4.9.2 Werenbun Community

Werenbun Community (also known as Barnjaru) is an outstation located approximately 60 kilometres by road from Katherine and along the Edith Falls Road. The community lies in the Roper Gulf Shire local government area and has a population of approximately 20-30 people. The outstation consists of permanent and semi-permanent residences with water and power supply. Road access to the outstation is via Edith Falls Road.

4.10 Existing Conditions Summary

This section has set out the existing conditions of the transport network within the Project area. Key findings of the existing conditions assessment include:

- Stuart Highway is typically a two-lane two-way road within the Project area, though increases to a four-lane two-way road for approximately 3.5 kilometres in the vicinity of Edith Falls Road, which is considered to provide additional highway capacity and overtaking opportunities;
- There is significant seasonal variation in traffic volumes on the Stuart Highway, with peak period dry season daily volumes observed to be approximately 50% higher than daily average volumes for the year. Heavy vehicles make up approximately 20% of total daily volumes, which is considered to be relatively high compared to typical arterial roads;
- The intersection of Stuart Highway and Edith Falls Road allows for the separation of turning traffic from the through lanes on both the northbound and southbound carriageways, hence makes provision for the deceleration of turning vehicles with adequate sight distance;
- On Edith Falls Road at the intersection with Jatbula Road (Mine Access Road) a short AUL treatment provides for left turn movements and a BAR treatment provides for right turns, providing for the deceleration of turning vehicles with adequate sight distance;
- In the five year analysis period, there have been 10 crashes across the Project area, including nine on Stuart Highway. Of these, one crash resulted in admission to hospital and one in minor treatment. All crashes were single vehicle collisions, including three accidents with animals;

- The Darwin-Adelaide rail line, which runs parallel to the highway within the Project area, has an at-grade crossing with Edith Falls Road. Flashing lights and associated signage are present at this location. No casualty crashes associated with the rail crossing have been observed in the past five years of available data; and
- No current or proposed public transport routes exist within the Project area. Due to the rural nature of the Project area, public transport is not expected to be an influencing factor on Project generated traffic.

5. Proposal

5.1 Overview

In order to assess the potential impact of the construction and operation of the Project, consideration of the traffic generation associated with these activities is required.

The Project includes two key infrastructure components: the Mt Todd mine site and the accommodation for construction and operation works, which is assumed to be located within 25km, and south of, the mine site.

Traffic generation for the construction of the Project will be dependent on the program of the construction contractor. For the purposes of undertaking this assessment, an understanding of the proposed transport activities associated with each stage of the Project has been established with Vista Gold.

The traffic volumes have been developed based on estimates and consideration of:

- Volume of plant and equipment required for construction of the Project;
- Volume of materials required for construction of the Project;
- Anticipated workforce numbers and daily fluctuations of movement of employees to and from site;
- Type and number of vehicles needed to transport plant, equipment, materials and employees to site;
- Likely routes for delivery of plant, equipment and materials; and
- Proposed construction schedule and timing of delivery of plant, equipment and materials.

For the mine site, consideration has been made to the construction, operating and decommissioning activities. The following provides an overview of the proposed development phases for the mine:

- Pre-mining site preparation such as reclamation of existing infrastructure and mine facilities;
- Construction of Ore Processing Plant, Water Treatment Plant, Power Station, and supporting infrastructure including sumps, decant towers, collection ditches, sludge disposal cell, equalisation pond and tailings storage facilities;
- Mining and processing of ore over a period of 13 years from the existing Batman Pit, LGO stockpile and Heap Leach; and
- Mine closure through rehabilitation of disturbed areas and ongoing treatment of acid and metalliferous drainage (AMD).

5.2 Workforce

The construction workforce is expected to peak at around 450. This workforce would be the responsibility of a construction contractor. Current understanding of construction works is that they will take place largely between 6am to 6pm, with construction workers working 12 hour shifts with rotating shift patterns based on 7 x 7 day roster. Administration and management personnel will work a standard 5 x 2 day roster.

The mine workforce including operations, maintenance, engineering, geological and support personnel, is expected to peak at around 350. This workforce will be employed by Vista Gold. It is assumed that mine operations will be 24 hour, split across two shifts (6:00am to 6:00pm and 6:00pm – 6:00am).

It is expected that around 40 personnel would be required for the decommissioning and closure phase of the Project.

5.3 Accommodation

The 450 construction personnel will be housed in a purpose built camp. The location of this camp is still to be determined but it is likely to be located within 25km of the mine on a site to be acquired by Vista Gold.

The operations workforce of 350 is expected to comprise 60 personnel drawn from the region with the remaining 290 personnel being new. Initial work indicates that these personnel could be accommodated as follows:

- 70 workers at the construction camp. This would accommodate mainly fly-in / fly-out (FIFO) and drive-in / drive-out (DIDO) personnel and provide an ability to quickly increase capacity to house overflow peak period personnel to meet mining needs or maintenance shut downs;
- 120 workers (family households with or without children) in a mixture of:
  - new three and four bedroom houses located on existing vacant Katherine and regional land;
  - existing (renovated if required) houses located in Katherine and regionally; and
  - small contained development on Katherine land, subject to real estate availability at the time of the arrangement.
- 100 workers located in a Katherine based single person accommodation facility.

The ultimate accommodation strategy adopted will be developed following further discussions with local and territory government agencies.

For the decommissioning and closure phase, the 40 workers would be housed in either the previous FIFO / DIDO accommodation or in the Katherine based single person accommodation.

In order to conservatively assess the impacts of generated traffic, it has been assumed that the above accommodation sites are located south of Edith Falls Road resulting in similar traffic movements to access the mine site.

5.4 Estimated Traffic Generation

Traffic generated by the Mt Todd mine site will relate initially to construction activity and then to the ongoing operation of the mine prior to decommissioning. The greatest traffic impact generated by the Project is expected to be associated with the construction phase of the Project, however construction activities are not expected to exceed 24 months' duration and accordingly; the construction traffic impact would be relatively short term. In contrast, the operational impact of ongoing traffic generated by the mine activity is relatively minor in the context of the existing road network traffic volumes, but it will extend for a further 15 years.

5.4.1 Construction and Commissioning

Actual traffic generated by the construction of the Project would principally be associated with the transport of construction machinery and equipment to site, import and disposal of materials by trucks and the removal of machinery post-construction. Traffic would also be generated by worksite contractors accessing the site across the workday.

The volume of traffic would ultimately depend on the program and staging of construction, where an increased rate of construction would result in higher traffic volumes on the network each day but over a shorter overall period.

The main construction and commissioning activities for the Mt Todd mine are anticipated to extend over 24 months and would comprise:

- Demolition and disposal of existing process plant and other facilities such as gate house;
- Construction of temporary facilities (i.e. lay down areas, offices, workshops, etc);
- Construction camp (located within 25km of the mine site but not on the mine site, and subject to separate approval);
- On site concrete batch plant;
- Administration and plant site buildings including:
  - Mine and plant workshops, warehouses and maintenance facilities;
  - Offices, medical facilities and training facilities;
  - Security gate house, weighbridge etc;
  - Crib room and ablutions; and
  - Laboratory.
- Ore processing plant;
- Power station;
- Water treatment plant (WTP);
- Sludge disposal cell and equalisation pond;
- Site roads;
- Pumps and pipelines; and
- New sumps, decant towers, decant ponds, collection ditches and diversions.

It is assumed that 90% of construction personnel will be transported to the site by bus and the remaining 10% will drive in private vehicles. This allows for the possibility that some workers will need to move around the site by light vehicle and are therefore likely to drive to site. It is also assumed that sufficient 30-seat buses will be available to transport workers to and from the site.

At peak construction, up to an additional fifty heavy vehicle deliveries per day are anticipated, delivering plant and associated materials. In addition to standard 19.5 metre rigid trucks, this would also include any oversize vehicles.

Based on the above, up to 127 heavy vehicle trips (of which 24 are personnel buses) and up to 60 light vehicle trips are anticipated per day during peak construction of the mine. Based on typical construction activities, it is assumed that 30% of personnel movements (light and heavy vehicles) and 10% of heavy vehicle delivery movements would occur in the typical peak hour.

5.4.2 Mining and Processing

Activities associated with the generation of traffic during the operation of the mine will principally be the transport of mine personnel, and the delivery of reagents, fuel and explosives.

It is assumed that mine operations will be 24 hour, split across two shifts (6:00am – 6:00pm and 6:00pm – 6:00am). It anticipated that mine personnel would be transported between accommodation and the mine site by 30 seat buses, transporting personnel by 12 bus trips (six buses in each direction per shift). It is assumed that around 7% of the workforce will require a light vehicle whilst on site and therefore will drive to and from the mine.

Diesel will be stored on-site for mining equipment and owner vehicles. Refuelling facilities will be provided in the heavy vehicle workshop area for the vehicles belonging to the operation. It is anticipated that up to 90,000L of diesel will be used daily. Diesel is assumed to be transported to the mine site by two deliveries per day via triple road tankers.

Various reagents for mixing and processing in the Ore Processing Plant and materials for use around the mine would also be transported to site. The following assumptions have been made in consultation with Vista Gold regarding transportation to site:

- Sodium cyanide, 13,668tpa, transported to site as a solid in a vendor bulk sparging unit by seven heavy vehicle deliveries per week;
- Sodium hydroxide, 710tpa, transported to site in 1t bags by four deliveries per week;
- Flocculant, 266tpa, transported to site as a solid powder by four heavy vehicle deliveries per week;
- Sodium metabisulfite, 12,958tpa, transported to site as powder in 20 foot containers by four heavy vehicle deliveries per week;
- Hydrochloric acid, 1,441tpa, transported to site in 1,150kg Intermediate Bulk Containers by four deliveries per week;
- Activated carbon, 355tpa, supplied to site in 500kg bulk bags by five deliveries per week;
- Lead nitrate, -1,775tpa, transported to site in 1t bags by two delivery per week;
- Quick lime, 16,153tpa, transported to site in in 20 foot containers by four deliveries per week;
- Fluxes, 3.6tpa, transported to site palletised to approximately 1t per pallet by one truck delivery per week;
- Waste oil would be stored and transported off site by two heavy vehicle collections per week;
- Blasting materials, 3000 tpa, transported to site by three heavy vehicle deliveries per week; and
- Mill balls, 16,901tpa, transported to site in 20 foot containers by six B-triple deliveries per week.

The dore product would be stored in a secure area on-site prior to transport to Darwin by one armoured truck delivery per week.

On the basis of the above, up to 47 light vehicle trips and 47 (including rounding of vehicle numbers) heavy vehicle trips are anticipated per day during peak operation of the mine site. Based on an understanding of the operational activities for the mine, it is assumed that during a typical peak hour 50% of bus trips (buses delivering staff to site at the beginning of a shift and also returning staff that have just completed their shift), 25% of light vehicle personnel trips and 10% of all other trips would occur.

5.4.3 Closure and Rehabilitation

A maximum of 40 personnel will be required for the rehabilitation and closure phase and the generation of traffic will consequently be less than that assessed for the construction and commissioning of the mine.

Consequently, the assessment of traffic impacts for rehabilitation and closure is considered to be adequately considered through the assessment for construction and commissioning of the mine.

5.4.4 Estimated Traffic Generation Summary

The traffic generation estimates for the construction and operation phases of the Mt Todd mine, as considered above, are listed in Table 5.

Table 5 Estimated Vehicle Trip Ends (VTE) per phase for Mt Todd Mine

	Trips per day		Trips per typical peak hour	
Phase	**Light Vehicles** (vte)	**Heavy Vehicles** (vte)	**Light Vehicles** (vte)	**Heavy Vehicles** (vte)
Construction and Commissioning	60	127	18	18
Mining and Processing Operation	47	47	12	14

5.5 Proposed Haulage Routes

It is highly likely that some of the mine equipment and process plant materials and equipment will arrive via the Port of Darwin. From the Port, they would be transported to site via the Stuart Highway.

During all phases of the mine, access to the mine site is proposed from Jatbula Road (Mine Access Road), via Edith Falls Road and Stuart Highway. Generated traffic is to be distributed across the network. Key origins and destinations for mine-associated traffic are anticipated to be Katherine to the south and the Darwin area to the north.

Approximate distances along each road to be used for haulage are as follows:

- Darwin to Edith Falls Road via Stuart Highway – approximately 275km;
- Katherine to Edith Falls Road via Stuart Highway – approximately 42km; and
- Stuart Highway to Jatbula Road via Edith Falls Road – approximately 11km.

It is not anticipated that any widening or land acquisition will be required along these roads, except for any localised improvements to mitigate impacts as identified in Section 6.

5.5.1 Construction and Commissioning

Plant, equipment and materials associated with construction are anticipated to be transported to the mine site from the north, including greater Darwin and the Port of Darwin. Additionally, 50% of the heavy vehicle VTEs for personnel are expected to be from the north. Accordingly, the remainder of trips, including light vehicle trips transporting personnel, are expected to be from the south at Katherine.

On this basis, at peak construction it is estimated that 114 heavy vehicle trips will have origins and destinations to the north and 14 heavy vehicle trips to the south. Two-way light vehicle trips are estimated to be up to 60 trips per day to the south of the mine site. The distribution of trips is summarised in Table 6.

Table 6 Estimated Construction Traffic Distribution for Mt Todd Mine

	Two-way movements per day		Two-way movements per typical peak hour	
Origin / Destination	**Light Vehicles** (vte)	**Heavy Vehicles** (vte)	**Light Vehicles** (vte)	**Heavy Vehicles** (vte)
North, including Darwin	-	114	-	14
South – Katherine	60	14	18	4
Total	**60**	**128**	**18**	**18**

5.5.2 Mining and Processing

It is proposed that mine personnel will be transported to site by bus from accommodation in Katherine and possibly Pine Creek. It is estimated that of the light vehicle trips transporting other personnel, 90% of trips will be to Katherine with the remainder to the north. All heavy vehicle deliveries and collections of the various reagents for mixing and processing, blasting materials, waste oils and dore product are assumed to be originating from or destined to the north.

On this basis, the distribution of light vehicles and heavy vehicles is estimated as listed in Table 7.

Table 7 Estimated Operation Traffic Distribution for Mt Todd Mine

	Trips per day		Trips per typical peak hour	
Origin / Destination	**Light Vehicles** (vte)	**Heavy Vehicles** (vte)	**Light Vehicles** (vte)	**Heavy Vehicles** (vte)
North, including Darwin	5	23	1	2
South – Katherine	42	24	11	12
Total	**47**	**47**	**12**	**14**

6. Potential Impacts

Following a review of the existing conditions and an understanding of the anticipated construction and operation traffic generation, an assessment of the Project impacts has been undertaken. This assessment includes road network capacity, key intersections, road network infrastructure, and road safety issues. As outlined in Section 5.4.3 the traffic generated during closure and rehabilitation will be significantly less than that experienced during construction. Accordingly, an assessment of the traffic impacts during construction is considered to be a conservative assessment of the 'worst case'.

Recommendations for management and mitigation measures for identified impacts are addressed in Section 7 of this report.

6.1 Cumulative Traffic Volumes

An overview of the origins and profile for total traffic generated by the construction and operation of the Mt Todd mine site is outlined in Section 5. This section identifies the cumulative traffic impact of both facilities in construction and operation. As the construction program would be determined by the Construction Contractor(s), it has conservatively been assumed that the peak construction activities and associated traffic movements would coincide for the Mt Todd mine site.

Given that the construction and operation activities have different areas of geographical impact and occur over different timeframes, the traffic volumes are described separately below.

6.1.1 Construction

Table 8 indicates that the majority of generated traffic is expected to be concentrated on Stuart Highway south of Edith Falls Road and on Edith Falls Road east of Stuart Highway. Most of this traffic is expected to be heavy vehicles.

Table 8 Estimated Cumulative Traffic Volumes (Construction)

	Peak Daily Traffic Generation		Typical Peak Hour Traffic Generation	
Location	Light Vehicles (vte)	Heavy Vehicles (vte)	Light Vehicles (vte)	Heavy Vehicles (vte)
Stuart Hwy, north of Edith Falls Rd	-	114	-	14
Stuart Hwy, south of Edith Falls Rd	60	14	18	4
Edith Falls Rd, east of Stuart Hwy	60	127	18	18

6.1.2 Operation

Table 9 indicates that, as for the construction phase, the majority of generated traffic is expected to be concentrated on Stuart Highway south of Edith Falls Road and on Edith Falls Road east of Stuart Highway. There is expected to be a fairly even split of light and heavy vehicles.

Table 9 Estimated Cumulative Traffic Volumes (Operation)

	Peak Daily Traffic Generation (two-way)		Typical Peak Hour Traffic Generation (two-way)	
Location	**Light Vehicles** (vte)	**Heavy Vehicles** (vte)	**Light Vehicles** (vte)	**Heavy Vehicles** (vte)
Stuart Hwy, north of Edith Falls Rd	5	23	1	2
Stuart Hwy, south of Edith Falls Rd	42	24	11	12
Edith Falls Rd, east of Stuart Hwy	47	47	12	14

6.2 Road Network Capacity Assessment

This section assesses the extent of impact that traffic volumes associated with the Project are expected to have on the operation of the arterial road network, i.e. reduction in the Level of Service. When the Project generated traffic is clear of intersections, it would be expected to behave in the same way as any other vehicle in the traffic stream. The exception to this is for vehicles carrying over dimensional loads, which are addressed in Section 6.4.1.

Level of Service (LOS) is a measure of operational conditions within a stream of traffic, where LOS A indicates free flowing travel. For this assessment, the approach outlined in the Highway Capacity Manual (Transportation Research Board, 2000) has been adopted. However, for a definition of LOS, Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis (2009) provides a description for each Level of Service, as outlined in Table 10. The actual traffic capacities associated with each Level of Service are dependent on a range of determinants including speed limits, terrain, geometry, lane widths and percentage of heavy vehicles.

It is considered appropriate to assess the Level of Service on Stuart Highway and Edith Falls Road to consider the potential capacity impacts.

6.2.1 Stuart Highway

The current Level of Service for Stuart Highway in the vicinity of the Project has been determined based on the traffic data, the assumptions outlined in Table 11 and the guidance provided in Highway Capacity Manual (Chapter 20).

Table 10 Level of Service descriptors (Austroads, 2009)

Level of Service	Descriptors
A	Is a condition of free flow in which individual drivers are virtually unaffected by the presence of other drivers. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.
B	Is in the stream of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than with Level of Service A.
C	Is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.
D	Is close to the limit of stable flow and is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.
E	Occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause break-down.
F	Is in the zone of forced flow. Flow break-downs occur, and queuing and delays result.

Table 11 Stuart Highway Level of Service factors

Determinant	
Traffic volume (ADT)	1,930
Peak hour percentage of ADT (assumption)	10%
Percentage of heavy vehicles	20%
Terrain (site observations)	Level
Directionality during typical peak hour (assumption)	Even directionality
Percentage of road with available sight distance less than 450 metres (site observations)	Up to 10%

Based on the above and in accordance with the assessment outlined in the Highway Capacity Manual (Chapter 20), it is considered that Stuart Highway currently operates at LOS A during the peak hour.

The additional traffic generated in the peak hour as estimated in Table 8 and Table 9 would apply to Stuart Highway. Table 12 outlines the anticipated change to peak period two-way traffic volumes on Stuart Highway as a result of the construction and operation of the Mt Todd mine. Subsequently, the impact on the operation of the arterial network from additional traffic associated with the Project can be considered through Level of Service.

Table 12 Traffic Capacity Assessment, Stuart Highway

		Stuart Highway / 2 km north of Kakadu Highway	Stuart Highway / north of Edith Falls Road	Stuart Highway / 20 km north of Katherine River Bridge
	Maximum recorded average daily traffic (ADT)	1,570 (July 2009)	< 1,900 [1]	1,930 (July 2009)
	Estimated peak hour volume	157	190	193
	Existing peak hour LOS	LOS A	LOS A	LOS A
Construction	Estimated maximum peak hour traffic generation	14	14	22
	Estimated resultant peak hour volumes	171	204	215
	Resultant peak hour LOS	LOS A	LOS A	LOS A
Operation	Estimated maximum peak hour traffic generation	2	2	22
	Estimated resultant peak hour volumes	160	193	215
	Resultant peak hour LOS	LOS A	LOS A	LOS A

[1] Due to absence of data at this location, two-way volumes have been conservatively extrapolated from existing network volume data in the vicinity

Summary

During the peak construction period, the results of the above analysis indicate that the Level of Service along Stuart Highway is expected to be maintained at LOS A both north and south of Edith Falls Road.

During the operation of the mine, the analysis indicates that the Level of Service on Stuart Highway is also expected to be maintained at LOS A. This represents unchanged peak period operational characteristics of the Highway, where LOS A indicates free flowing travel.

6.2.2 Edith Falls Road

The current Level of Service for Edith Falls Road in the vicinity of the Project has been determined based on the traffic data, the assumptions outlined in Table 13 and the guidance provided in the Highway Capacity Manual (Chapter 20).

Table 13 Edith Falls Road Level of Service factors

Determinant	Details
Traffic volume (ADT)	175
Peak hour percentage of ADT (assumption)	10%
Percentage of heavy vehicles	10%
Terrain (site observations)	Level
Directionality during typical peak hour (assumption)	Even directionality
Percentage of with available sight distance less than 450 metres (site observations)	Up to 20%

Based on the above and in accordance with the assessment outlined in the Highway Capacity Manual (Chapter 20), it is considered that Edith Falls Road currently operates at LOS A during the peak hour.

The additional traffic generated in the peak hour as estimated in Table 8 and Table 9 would apply to Edith Falls Road. Table 14 outlines the anticipated change to peak period two-way traffic volumes on Edith Falls Road as a result of the construction and operation of the Mt Todd mine. Subsequently, the impact on the operation of the arterial network from additional traffic associated with the Project can be considered through Level of Service.

Table 14 Traffic Capacity Assessment, Edith Falls Road

		Edith Falls Road / 2 km east of Stuart Highway
	Maximum recorded average daily traffic (ADT)	175 (2009)
	Estimated peak hour volume	18
	Existing peak hour LOS	LOS A
Construction	Estimated maximum peak hour traffic generation	36
	Estimated resultant peak hour volumes	54
	Resultant peak hour LOS	LOS A
Operation	Estimated maximum peak hour traffic generation	25
	Estimated resultant peak hour volumes	43
	Resultant peak hour LOS	LOS A

Summary

During the peak construction phase, the results of the analysis indicate that the Level of Service along Edith Falls Road is expected to be maintained at LOS A. The two-way roadway capacity for Edith Falls Road associated with LOS A is estimated to be 230 vehicles per hour (vph). Consequently, there is estimated to be significant capacity for Edith Falls Road to operate at free flowing travel.

During the operation phase, the analysis indicates that the Level of Service on Edith Falls Road is also expected to be maintained at LOS A. This represents unchanged peak period operational characteristics of the roadway, where LOS A indicates free flowing travel.

6.3 Intersection Assessments

The safety and operation of intersections is an important consideration for the Project. The operation and safety of an intersection has the potential to influence where the Project will generate additional traffic volumes for extended periods of time and where there is a significant change to the traffic composition of turning vehicles.

It is noted the Stuart Highway is a key national highway and has a posted speed limit of 130km/h in the vicinity of the Project. Accordingly, the introduction of turning heavy vehicles with slower rates of acceleration and deceleration onto Stuart Highway needs to be appropriately assessed and managed for efficient operations and road safety.

6.3.1 Stuart Highway / Edith Falls Road

At the intersection with Edith Falls Road, Stuart Highway is a four-lane, two-way divided road with a median width of 15 metres. An AUL treatment facilitates left turn movements from the north-west approach of the highway and a CHR treatment facilitates right turn movements from Stuart Highway at the south-west approach. Estimated turning volumes during construction and operation are shown in Table 15 and Table 16 respectively.

Table 15 Estimated Peak Turning Movements (Construction), Stuart Highway / Edith Falls Road

	Light vehicles	Heavy vehicles	Total vehicles
Construction			
Left turn from Stuart Highway	0	7	7
Right turn from Stuart Highway	18	4	22
Left turn from Edith Falls Road	0	0	0
Right turn from Edith Falls Road	0	7	7

Table 16 Estimated Peak Turning Movements (Operation), Stuart Highway / Edith Falls Road

	Light vehicles	Heavy vehicles	Total vehicles
Operation			
Left turn from Stuart Highway	1	1	2
Right turn from Stuart Highway	8	6	14
Left turn from Edith Falls Road	2	6	8
Right turn from Edith Falls Road	1	1	2

Existing conditions

This is a priority controlled T-intersection. Stuart Highway at this location is a dual carriageway with a 15m median. Turning lanes are provided for the left and right turns onto Edith Falls Road and these are approximately 180m and 270m long respectively. It is assumed these cater for deceleration from 130km/h, rather than for storage capacity.

Edith Falls Road is a two-lane two-way road. Although separate left and right turn lanes onto Stuart Highway are not provided, the throat of the intersection is probably wide enough to accommodate two vehicles side by side at the give way line. Street lighting is not provided at the intersection.

Sight distance and safety

Sight distances to the north and south along the Stuart Highway from the intersection are shown in Figure 11 and Figure 12. Sight distances are observed to be approximately 850 metres in both directions. Sight distance requirements are given in Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections. The required distances assuming a reaction time of 2.5 seconds are:

- Stopping Sight Distance (SSD) – 275m;
- Safe Intersection Sight Distance (SISD) – 383m;
- Approach Sight Distance (ASD – value for trucks has been used) – 275m; and
- Minimum Gap Sight Distance (MGSD) – 305m for a right turn (this is the maximum distance given in Austroads).

The available distances are all greater than these and are therefore acceptable.

Capacity

The width of the median on Stuart Highway at this location allows for vehicles less than 15 metres in length turning right from Edith Falls Road to perform a two-stage crossing of the intersection, i.e. waiting in the median after crossing the southbound carriageway before entering the northbound carriageway. For longer vehicles, such as the expected quad B-doubles, which are up to 25 metres long, right turns will have to be made in one movement and this is dependent on there being enough gaps in traffic on Stuart Highway.

As presented in Table 12, two-way traffic volumes on Stuart Highway are expected to be approximately 204vph in the peak hour. Assuming a uniform flow rate, this equates to approximately one vehicle every 17 seconds on average. In this location, the Stuart Highway is four lanes two-way with a wide median which will allow through vehicles to overtake vehicles accelerating up to the posted speed from the minor road. As such, a left turn vehicle turning from the minor road would require a 5 second gap to enter the traffic stream while a right turning vehicle would require an 8 second gap to enter the traffic stream due to the additional crossing distance. It is considered that 17 seconds is adequate to allow vehicles to turn onto the highway without experiencing undue delay.

Deceleration lanes

There are currently deceleration lanes for left and right turn movements into Edith Falls Road. The right turn lane is approximately 270m long, while the left turn lane is approximately 180m long.

Figure 4.9 of Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections provides guidance on the type of turning treatment required. For a major road flow of 204vph and a turning volume of 22vph (see Table 15 and Table 16) the figure indicates that BAL and BAR type treatments are required. As the existing treatments (CHL and CHR) are two steps higher than those required by Austroads, these are considered to be satisfactory.

6.3.2 Edith Falls Road / Jatbula Road (Mine Access Road)

Table 17 and Table 18 respectively show estimated turning volumes during construction and operation.

Table 17 Estimated Peak Turning Movements (Construction), Edith Falls Road / Jatbula Road (Mine Access Road)

	Light vehicles	Heavy vehicles	Total vehicles
Construction			
Left turn from Edith Falls Road	18	11	29
Right turn from Jatbula Road	0	7	7

Table 18 Estimated Peak Turning Movements (Operation), Edith Falls Road / Jatbula Road (Mine Access Road)

	Light vehicles	Heavy vehicles	Total vehicles
Operation			
Left turn from Edith Falls Road	9	7	16
Right turn from Jatbula Road	3	7	10

Existing conditions

This is a priority controlled T-intersection. Edith Falls Road at this location is a two-way two-lane single carriageway road. Left and right turn lanes are provided, although the right turn lane is a BAR type and therefore consists of widening on the left hand side to allow vehicles to pass stationary vehicles waiting to turn right from the through lane. The left turn is a CHL type and is approximately 100m long. Street lighting is not provided at the intersection.

Sight distance and safety

Visibility to the left from Jatbula Road is approximately 600m, limited by the horizontal curvature of Edith Falls Road. Visibility to the right is approximately 70m, limited by a dip in the road, which partially obscures approaching vehicles for a brief time. It is noted that visibility for truck drivers would be greater than these distances due to their higher ride height.

Sight distance requirements in Austroads guidelines are:

- Stopping Sight Distance (SSD) – 151m;
- Safe Intersection Sight Distance (SISD) – 226m;
- Approach Sight Distance (ASD) – 151m; and
- Minimum Gap Sight Distance (MGSD) – 250m for a right turn.

The available sight distance to the left satisfies all these criteria, but the sight distance to the right does not. Substandard visibility increases the potential for crashes and mitigation measures should be implemented to reduce the road safety risk. There are existing 'T-intersection' warning signs on Edith Falls Road on the approach to the intersection. Given the very low volumes on both roads, and the presence of warning signs on the approach to the intersection, it is considered that there are no other practical or cost-effective mitigation measures to physically improve visibility (i.e. such as regrading the road).

Capacity

As there is no median in which to wait when turning right, all turns onto Edith Falls Road must be made in one movement, which is dependent on there being enough gaps in traffic. As shown in Table 14, traffic volumes on Edith Falls Road are expected to be approximately 54vph in the peak hour. Assuming a uniform flow rate, this equates to approximately one vehicle every 67 seconds. For a right hand turn from a minor road, a 14 to 40-second gap is required for the turning vehicle not to interfere (i.e. slow) with the major road traffic. In addition, the guideline also states that a gap of 5 seconds is acceptable for a vehicle to turn right into a stream of traffic, however the approaching vehicle may be required to slow. It is considered that the average gap of 67 seconds is adequate to allow vehicles (including heavy vehicles) to turn onto the major road without experiencing undue delay.

Deceleration lanes

There is currently a channelised deceleration lane for the left turn movement into Jatbula Road which is approximately 100m long. The right turn lane is a BAR type treatment with widening on the left hand side of the road.

Figure 4.9 of Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections provides guidance on the type of turning treatment required. For a major road flow of 54vph and a turning volume of 29vph (Table 17 and Table 18) the figure indicates that BAL and BAR type treatments are required. As the existing left turn treatment is a CHL type and the right turn treatment is a BAR type, these are considered to be satisfactory.

6.4 Road Network Infrastructure

6.4.1 Over-dimensional loads

During the construction phase it is possible that over-dimensional vehicles will be used to deliver over-sized components to the mine. Where these loads are excessively wide, long, or restrict the haulage vehicle to speeds more than 20km/h lower than the posted speed limit, it is recommended that the vehicles be escorted. Additionally, consideration should be given to using traffic controllers to manage turning movements at intersections.

It is anticipated that this issue will be fully investigated in the Traffic Management Plan.

6.4.2 Rail crossing

As noted in the Existing Conditions, Section 4.6, an at-grade level crossing of the single track Darwin - Adelaide Railway line is located on Edith Falls Road approximately 280 metres east of the Stuart Highway / Edith Falls Road intersection. The crossing is controlled by flashing lights.

Construction and operation traffic associated with the Mt Todd mine would be expected to increase the exposure of vehicles to the rail crossing. While there would be an increase over existing crossing movements, it is considered that the existing flashing lights are adequate to control vehicles at the rail crossing.

6.4.3 Load sensitive assets

Load sensitive assets typically refer to bridges or culverts with lower load limits within the road network. The existing conditions review within the study area did not identify load sensitive assets. Confirmation of the absence of assets that could be impacted could be made through consultation with the DLPE prior to construction.

6.4.4 Pavement deterioration

Heavy vehicles contribute the greatest proportion of wear on road surfaces. The forecast increase in heavy vehicles (and, importantly, axle repetitions) is expected to increase the rate of deterioration of the road surface. However, the expected increase in vehicle volumes due to the development of the mine is low and the condition and age of the road surfaces (beyond a visual inspection) are unknown at this stage. It is therefore not possible to quantify the impacts of the increase in truck volumes on the road surface.

It is recommended that the existing condition of road pavements be established shortly before construction commences a programme of pavement monitoring and rehabilitation be developed to identify and deal with any significant deterioration.

6.5 Road Safety

6.5.1 Fatigue

Driver fatigue in NT is particularly important given the Territory's remote operating environment, the distances travelled, the remoteness and lack of facilities or services between major population centres, and climatic extremes (DLP, 2001).

As noted in Section 2.1.4, a new legal framework under the *Work Health and Safety (National Uniform Legislation) Act 2011* and associated Regulations and Codes of Practice came into effect on 1 March 2011. Under the Act, the Northern Territory Road Transport Fatigue Management Code of Practice is a voluntary code to provide a basic set of principles to be applied in the management of fatigue in the workplace.

Fatigue is a common problem in both short and long distance truck driving. This loss of alertness is accompanied by poor judgement, slower reactions to events, and decreased skill, such as in vehicle control. It affects the efficiency, effectiveness and safety of a driver's performance in carrying out the driving task.

The transportation of material associated with the construction and operation of the Mt Todd mine may expose drivers to fatigue. It is considered likely that Vista Gold would be directly responsible for a limited proportion of the transportation task during operation of the facilities. Notwithstanding, it is anticipated that as part of its operational health and safety obligations, a driver fatigue management plan will be developed to reduce the impacts of fatigue.

6.5.2 Haulage Routes

Vehicles that operate within legal size and mass limits are permitted to travel without special permission on any road in the Northern Territory. For vehicles which exceed these limits (including their load), special permits are required and pilot or escort vehicles may also be required. The permit would place limits on the roads a vehicle can use, depending on its size and mass.

A permit for the use of over-dimensional or over-mass vehicles will need to be sought from the NT Government prior to using them in either the construction or operational phases of the Project. It is anticipated that this issue will be investigated fully in the Traffic Management Plan.

6.5.3 Incidents

The management of incidents is generally the responsibility of the emergency services. See Section 7.5 for further details.

6.6 Potential Impacts Summary

The investigations detailed above indicate that the construction and use of the mine will have no adverse impacts on the road network in terms of safety or performance. The existing conditions of the road pavements should be established and a programme of road pavement monitoring and rehabilitation should be developed to mitigate the impacts on road surfaces of mining activities.

7. Management Measures

Following an assessment of the potential Project traffic and transport impacts in Section 6 of this report, this section outlines recommendations for management and mitigation measures for identified impacts.

7.1 Intersection Upgrades

It is considered that upgrades to existing intersections will not be required.

7.2 Traffic Management

A detailed Traffic Management Plan (TMP) should be prepared and approved prior to construction works taking place or to the operation of the mine. The TMP should address both the construction and operational phases.

7.2.1 Construction Traffic Management

The TMP should address:

- Haulage routes;
- Requirement for over-dimensional permits;
- Requirement for traffic controllers;
- Community consultation strategy; and
- Dates and times of construction.

7.2.2 Operations Traffic Management

The TMP should address:

- Haulage routes;
- Requirement for over-dimensional permits;
- Community consultation strategy; and
- Dates and times of operation.

7.3 Haulage Compliance Measures

7.3.1 Road Axle Limits

Road pavements are typically designed to withstand a certain number of axle repetitions, which are forecast for the design life of the road. Minor maintenance is required during this time. The number of axle repetitions is based on the number of heavy vehicle axles that are expected to pass over the road during its life; light vehicle axles are not counted as they typically cause negligible damage to a road surface compared to a heavy vehicle.

The additional number of heavy vehicles forecast to be generated by the mine is expected to increase the rate at which the road pavements wear. However, without knowing the current condition of the road pavement, nor its age, it is not possible to state what impact this increase in volume will have.

A pavement condition monitoring program could assist in identifying any deterioration to the pavement condition over the period of the mine operations. A baseline condition assessment prior to mine construction and commissioning could establish the existing condition of those public roads which are to form part of haulage routes.

7.3.2 Securing Loads

It is expected that loads being transported to and from the mine would be secured in accordance with the relevant legislation. All vehicles must be correctly licenced and compliant with relevant legislation.

7.3.3 Hazardous Goods

There are both international and local standards for the movement of cyanide and other hazardous substances. It is expected that the movement of these substances will be carried out in accordance with the relevant Northern Territory legislation. This issue will be dealt with in the Traffic Management Plan and should consider, but not be limited to, the following:

- Sensitive land uses (e.g. schools) on proposed haul routes;
- Times of day for haulage to minimise potential conflicts;
- Traffic volumes on proposed haul routes; and
- Sensitive infrastructure such as tunnels and bridges.

7.3.4 Tracking of Dirt

Measures to minimise the tracking of dirt off site will be implemented at access gates. The controls may include exit rumble grids or wheel wash facilities, sweeping of sealed roads to remove deposited material where applicable, and/or stabilisation of site roads/tracks with aggregate where appropriate.

7.4 Management of Driver Fatigue

The potential impacts of driver fatigue due to the transport of materials associated with the construction and operation of the Mt Todd mine could be managed through the appropriate implementation of a Fatigue Management System. This may be in accordance with the Northern Territory Road Transport Fatigue Management Code of Practice.

7.5 Incident Management

It is expected that adherence to relevant guidelines and legislation regarding the movement of hazardous substances and the securing of loads, along with the implementation of the engineering measures recommended in Section 6 of this report, will minimise the occurrence and severity of any incident that may occur.

Incidents, by their very nature, cannot be predicted. Despite the best efforts to reduce their occurrence, they can never be eliminated completely. In these circumstances it would be beneficial to refer to an agreed Incident Management Plan which sets out how to deal with various types of incidents. Often the emergency services will be responsible for dealing with incidents on the roads.

It is expected that an incident management plan will be prepared to set out the ways in which Vista Gold and the emergency services should respond to a variety of incident scenarios.

8. Conclusions and Recommendations

This study has assessed the impacts of the proposed gold mine north west of Katherine in the Northern Territory. In so doing, the study has considered:

- The existing conditions of the relevant road network for the purposes of establishing a bench mark against which to assess the impacts of the proposed development;
- The traffic generated by the proposed development and the impacts it will have on the operational and safety performance of relevant roads and intersections, and in particular the impact of large numbers of heavy and over-dimensional vehicles;
- The measures required to mitigate the identified impacts;
- The issues associated with the movement of hazardous substances;
- Traffic management measures during construction and operation; and
- Other miscellaneous issues.

8.1 Conclusions

The broad conclusions of this study are:

- The mine is expected to generate approximately 187 and 94 vehicles per day during the construction and operation phases respectively. This translates to approximately 36 and 26 vehicles in the peak hours during the construction and operation phases respectively;
- The traffic forecast to be generated by the proposed developments is expected to have a negligible impact on the road network, with no anticipated reduction in Level of Service or intersection performance;
- It is likely that the additional heavy vehicles generated by the proposed development will increase the rate of wear of road surfaces. However, due to the condition and age of these road surfaces being unknown at this stage it is not possible to estimate the impact that the generated traffic may have;
- Minor localised upgrades to road infrastructure will be required to mitigate the identified impacts;
- Road safety is not expected to suffer disproportionately as a result of the proposed developments;
- It is anticipated that traffic during the construction and operation phases can be adequately managed with the appropriate plans in place; and
- Any incidents that occur can be adequately managed with the appropriate plans in place.

8.2 Recommendations

The following recommendations to mitigate the identified impacts are made:

- Existing conditions of road pavements should be established prior to construction commencing and a programme of road pavement monitoring and rehabilitation should be developed; and
- Management plans for construction and operational traffic, incidents and driver fatigue should be developed through a Traffic Management Plan, Fatigue Management Plan and Incident Management Plan.

9. References

Austroads 2009, *Guide to Road Design Part 3: Geometric Design,* Austroads, Sydney.

Austroads 2009, *Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections*, Austroads, Sydney.

Austroads 2009, *Guide to Traffic Management Part 3: Traffic Studies and Analysis,* Austroads, Sydney.

Department of Infrastructure, Planning and Environment 2004, *Northern Territory Road Safety Strategy*, Department of Infrastructure, Planning and Environment, Darwin.

Department of Lands and Planning 1998, *Northern Territory Code of Practice in Fatigue Management*, Department of Lands and Planning, Darwin.

Department of Lands and Planning 2009, *Annual Traffic Report*, Department of Lands and Planning, Darwin.

Department of Lands and Planning 2010, *NT Integrated Regional Transport Strategy – Transport in our regions*, Department of Lands and Planning, Darwin.

GHD

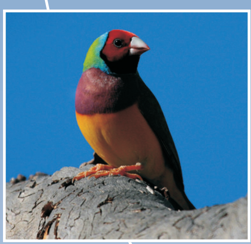
Level 5, 66 Smith Street
Darwin NT 0800
T: (08) 8982 0100 F: (08) 8981 1075 E: drwmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	M. Weir, T. Frodsham	K Fitzpatrick		I McCardle		4/6/2013

APPENDIX W

Economics



CLIENTS | PEOPLE | PERFORMANCE

Vista Gold Australia Pty Ltd

Mt Todd Gold Project

Economics

June 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Project overview

The Mt Todd Gold Project (the Project) is a brownfield gold mining project located approximately 55 kilometres northwest of Katherine and 250 kilometres south of Darwin.

The existing gold mine was acquired by Vista Gold Corp (Vista Gold) in 2006. Since then, Vista Gold has spent approximately $60 million on pre-feasibility activities including environmental rehabilitation activities on the brownfilled site.

Once operational, approximately 17.8 million tonnes per annum (Mtpa) of ore is expected to be processed. Based on current known data, the Project is expected to have a life of around 19 years inclusive of construction, operations and closure. Construction is anticipated to take two years, including 6 months for pre-production. The mine is scheduled to operate for a further 13 years. Closure and rehabilitation of the mine is expected to take four years.

1.2 Statutory requirements

The former Northern Territory Minister for Natural Resources, Environment, The Arts and Sport (NRETAS) determined that the Project requires formal assessment under the *Northern Territory Environmental Assessment Act* 1982 at the level of an Environmental Impact Statement. The proposal has also been referred to the Australian Government under the *Environment Protection and Biodiversity Conservation Act* 1999 and has been determined to be a controlled action.

This economic assessment has been prepared in accordance with Section 7.8.2 of the Guidelines for Preparation of an Environmental Impact Statement: Mt Todd Gold Project, Katherine Region NT (NRETAS, 2011).

1.3 Scope of report

This report addresses potential impacts on the local and regional economies that are expected to be affected (both positively and negatively).

The report:

- provides a snapshot of the demographic characteristics of the region;
- identifies trends in economic indicators, such as employment by sector and business entries and exits;
- describes the structure of the economy including identifying and describing trends in key industries such as mining, construction and agriculture;
- estimates the potential economic impacts (e.g. employment and economic output) of the Project on the local and regional economy; and
- outlines opportunities for local industry and employment opportunities for local people including Indigenous people.

2. Methodology

2.1 Study area

The study area for the purposes of the economic assessment includes the regions directly and indirectly affected by the Project. It is assumed that development of the Project will affect the economies of:

- the Katherine region[1] (comprising the Local Government Areas of Katherine, Victoria-Daly and Roper Gulf Shires); and
- the Northern Territory.

2.2 Data sources

Data was collected from a range of sources including:

- Australian Bureau of Statistics (ABS) 2011 Census of Population and Housing (ABS 2012a, 2012b, 2012c, 2012f).
- Australian Bureau of Statistics (ABS) 2011 Counts of Australian businesses (ABS 2012d).
- Australian Bureau of Statistics, Australian National Accounts, State Accounts (ABS 2012e).
- Australian Bureau of Statistics, National Regional Profile (ABS 2012e).
- Northern Territory Government, Katherine economic profile (NTG 2008).
- Northern Territory Government, Towards a Katherine Land Use Plan (NTG 2013).
- Vista Gold company data and information (Vista Gold 2013).

2.3 Desktop assessment

2.3.1 Economic baseline

The first step in undertaking an economic assessment is to establish the socio-economic baseline. This allows potential economic impacts (positive and negative) to be assessed against the baseline.

The economic baseline overview involves collection, analysis and presentation of data for the Katherine and Northern Territory regions - the regions where the mine and its infrastructure are expected to have the greatest impact. The economic baseline gives an indication to the region's general economic profile, conditions and trends.

The economic baseline gives a general overview of the Katherine region. More detailed, local-level analysis has been provided for the Katherine Local Government Area level in the Social Impact Assessment (Appendix F and Chapter 7).

2.3.2 Input-output analysis

The potential economic impacts of the Project on the regional economy and the Northern Territory economy have been assessed for the construction and operations phases of the Project.

1 The Katherine region is defined as the Katherine Statistical Area Level 3 as used by the Australian Bureau of Statistics (code: 70205). This statistical region includes the Local Government Areas of Katherine, Roper Gulf Shire and Victoria-Daly Shire. The Katherine region for the purposes of the economic assessment is therefore broader than the Katherine region profiled in the demographic profile presented in the social impact assessment (Appendix F).

The estimates of economic impact presented in this report were based on the use of the input-output (I-O) method. I-O analysis provides a comprehensive economic framework that is useful in the resource planning process. Broadly, there are two ways in which the method can be used.

First, the I-O transactions table provides a numerical picture of the size and shape of the economy and its essential features. It can be used to describe some of the important features of an economy, the interrelationships between sectors and the relative importance of the individual sectors.

Second, I-O analysis provides a standard approach for the estimation of the economic impact of a particular activity. The I-O model is used to calculate industry multipliers that can then be used to estimate economic impacts arising from some change in the local economy or the economic contribution of an existing industry.

The economic impact of the project is measured by the contribution of the project to:

- Gross Regional Product (GRP) [2] – a measure of the value of a region's outputs minus the cost of inputs. It is therefore able to measure the net contribution of the Project to the relevant economies (i.e. the Katherine region and Northern Territory).
- Employment - identifies the number of Full Time Equivalent (FTE) persons engaged in work within a region. In this assessment, employment is measured by place of remuneration rather than place of residence.

The impact of the Project on these indicators has been assessed at the regional level and for the Northern Territory.

2.4 Limitations

The assumptions underpinning the economic model are outlined in Appendix A.

[2] Gross Regional Product is a measure of the market value of all final good and services produced within a region in a given period of time.

3. Existing environment

3.1 Demographic profile

3.1.1 Population growth trend

The population of the Katherine region was 21,379 in 2011 (ABS 2012a). The population of the Katherine region increased from 20,458 persons in 2001 to reach 21,379 persons in 2011. This equates to an increase of 5 per cent in the period between 2001 and 2011 or an average annual growth rate of 0.5 per cent per annum (Figure 1).

For comparative purposes, the population of the Northern Territory has increased at an average rate of 1.1 per cent per annum between 2001 and 2011.

The town of Katherine is the key service hub for the Katherine region. In 2011, the ABS reported that the population of the Katherine Local Government Area was 10,698 (ABS 2012b).

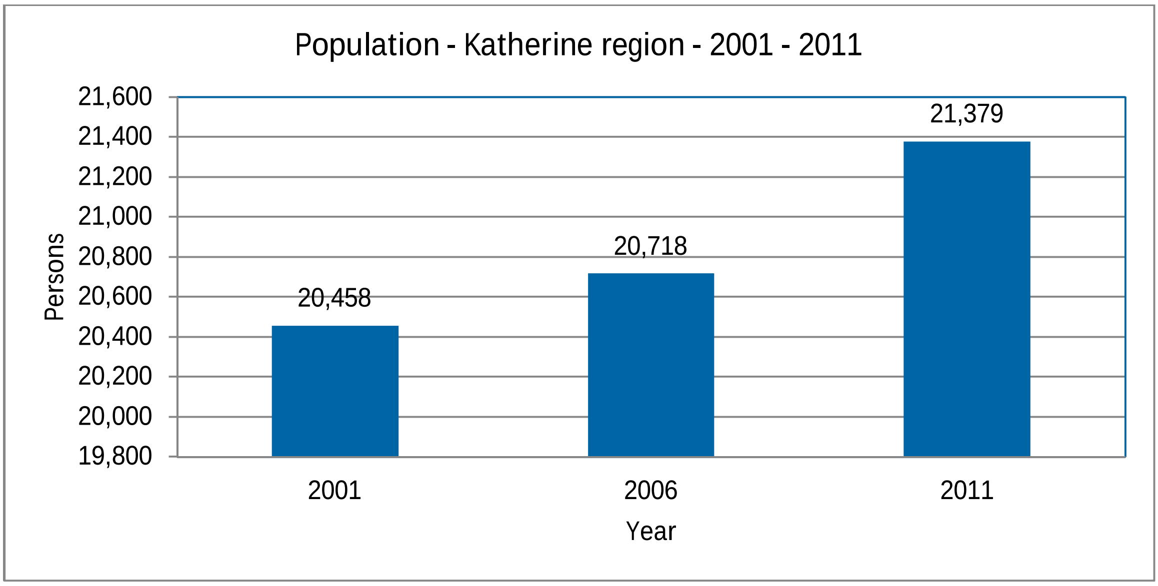


Figure 1: Katherine region historical population growth

Source: GHD analysis based on ABS (2012b)

3.1.2 Indigenous persons profile

The land surrounding the town of Katherine has been home to the Jawoyn people for thousands of years (NTG, 2013). The Katherine region is home to a comparatively high proportion of Indigenous persons. In 2011, 9,121 people identified themselves as being Aboriginal, Torres Strait Islander or both. This represents approximately 43 per cent of the total population (ABS 2012a). By comparison, in the same year, the proportion of people across the Northern Territory and the whole of Australia who identified themselves as being Aboriginal or Torres Strait Islander was approximately 25 per cent and 2.5 per cent respectively (ABS 2012e).

3.2 Labour market

3.2.1 Employment profile

In 2011, there was an estimated 8,035 persons working in the Katherine region (ABS 2012b). This is up from 7,522 in 2006. Between 2006 and 2011, the number of persons working within the Katherine region grew by 513.

The major employing industries in the Katherine region in 2011 were public administration and safety (24 per cent), health care and social assistance (11 per cent), agriculture, forestry and fishing (9 per cent), education and training (9 per cent) and retail trade (7 per cent) (Figure 2).

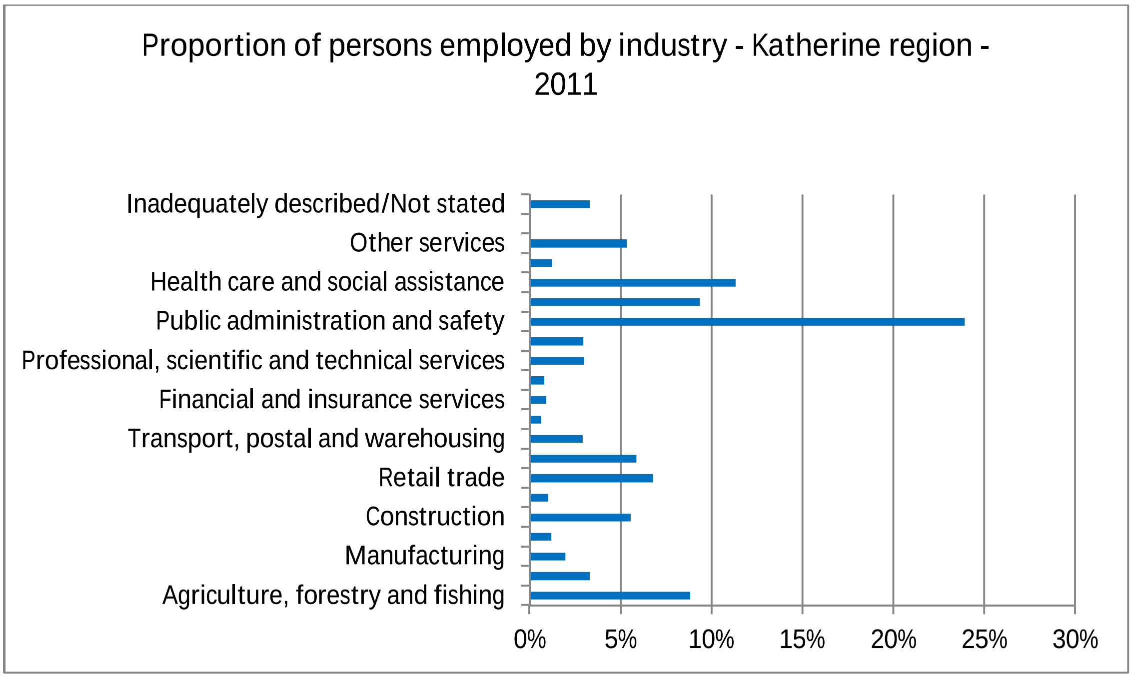


Figure 2: Proportion of people employed in the Katherine region

Source: ABS (2012b)

Figure 3 shows the dominance of the public administration and safety sector as an employer in the Katherine region although the total number of persons employed in the sector has declined between 2001 and 2006 and again between 2006 and 2011. The health care and social assistance sector is the second largest employing sector in the Katherine region. Persons employed in the education and training, and agriculture, forestry and fishing sectors has increased gradually between 2001 and 2006 and again between 2006 and 2011.

The accommodation and food services and retail trade sectors support a stable level of employment in the Katherine region. Katherine and surrounds are a popular destination for tourists who are drawn to the area due to its natural assets which include Katherine Gorge.

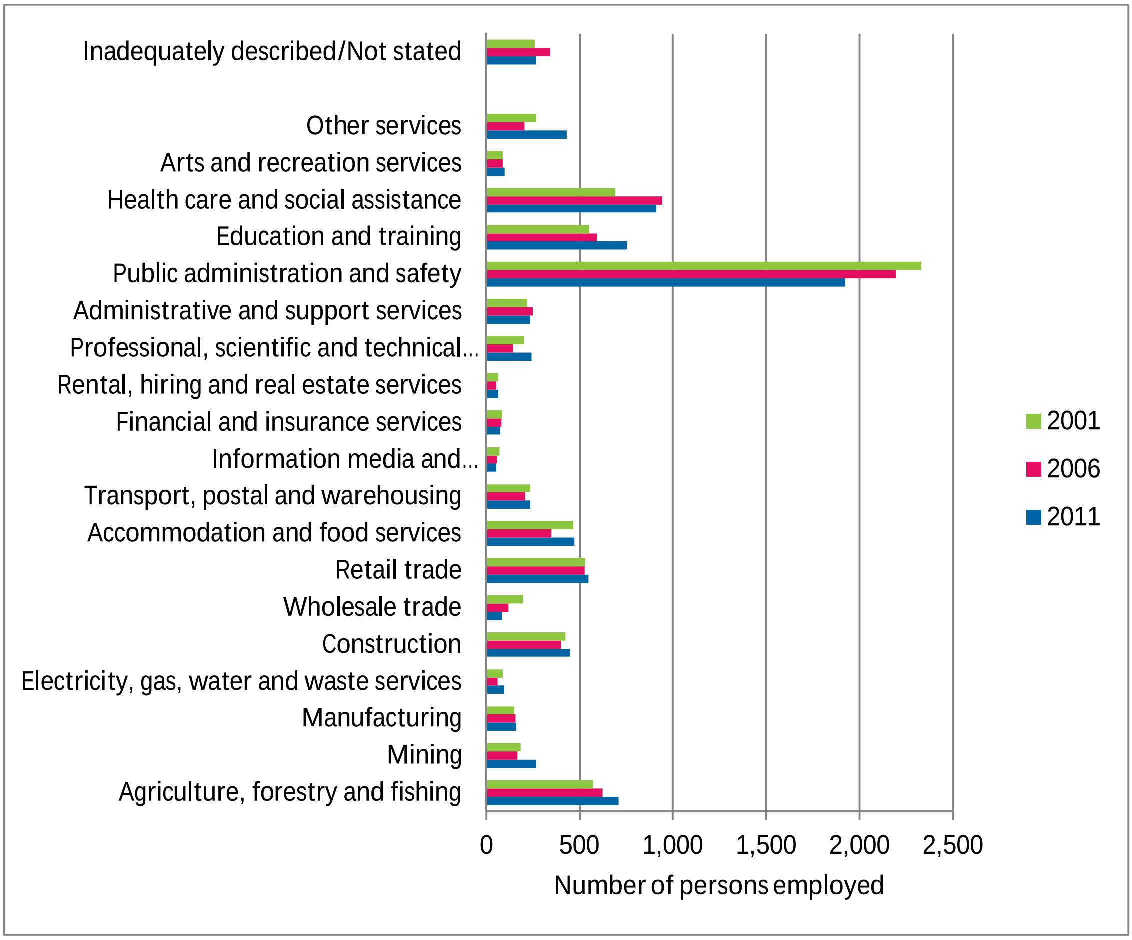


Figure 3: Employment by industry – Katherine region – 2001, 2006 and 2011

Source: ABS (2012b)

3.2.2 Unemployment profile

The unemployment rate in the Katherine region followed the general trend of the Northern Territory and declined between 2001 and 2006. Between 2006 and 2011, the unemployment rate in the Katherine region increased markedly from 5.3 per cent in 2006 to 8.7 per cent in 2011 (Figure 4). At 8.7 per cent, the unemployment rate in Katherine was higher than that of the Northern Territory (5.1 per cent) and Australia (5.6 per cent) in 2011 (ABS 2012a).

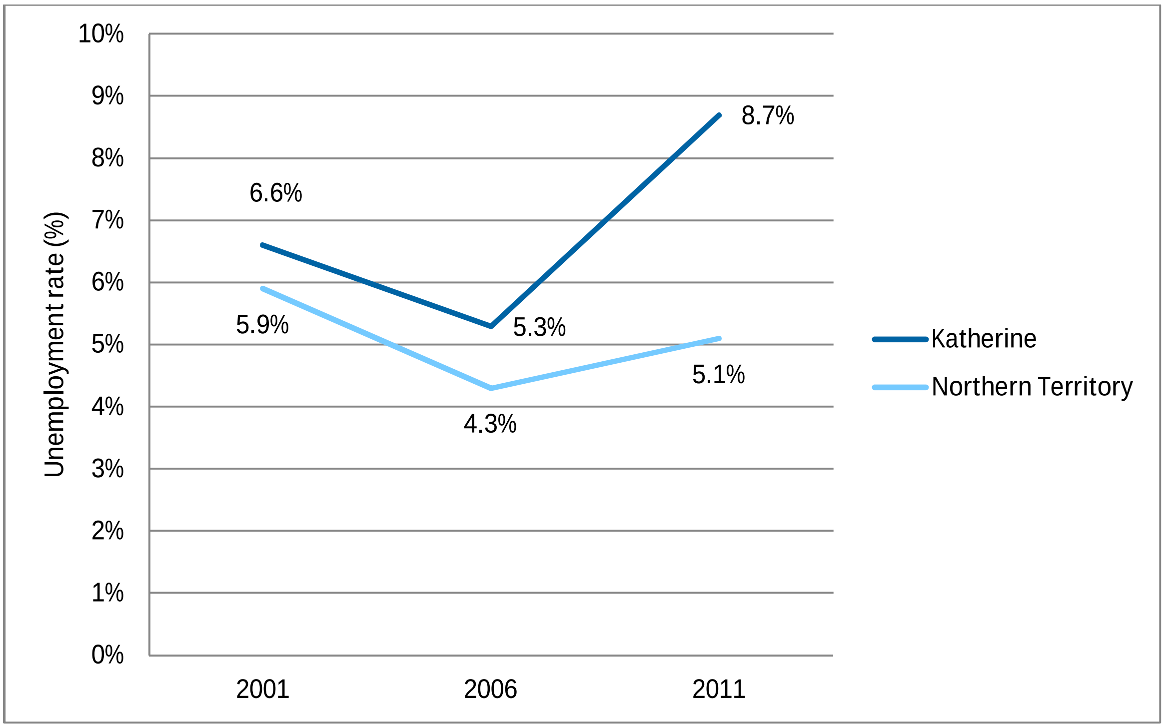


Figure 4: Unemployment rate – Katherine and Northern Territory – 2001 - 2011

Source: ABS (2012b)

3.2.3 Income profile

Median personal and household income levels have been rising at a steady rate in the Katherine region between 2001 and 2011. During this time, median personal incomes have risen at an average rate of 7 per cent per annum while median household incomes have risen at an average annual rate of 5 per cent per annum (Figure 5). By comparison, median personal and household income in the Northern Territory has increased at a rate of 7 per cent per annum between 2001 and 2011 (ABS 2012f).

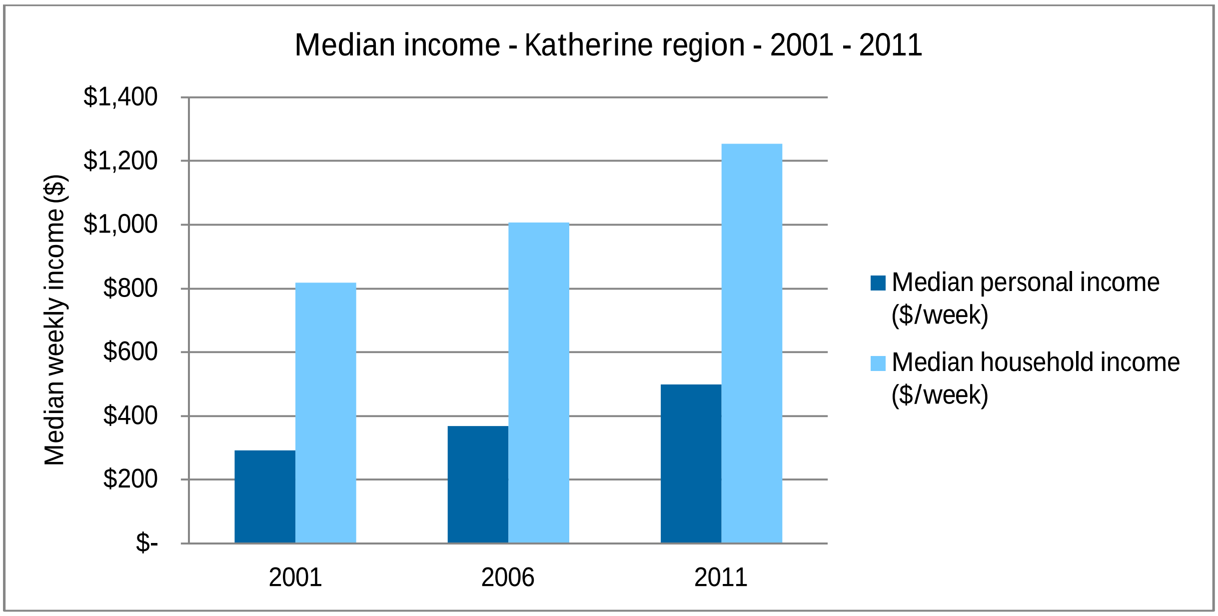


Figure 5: Median income - Katherine region - 2001 - 2011

Source: ABS (2012b)

3.3 Economic baseline

3.3.1 Economic output and industry trends – Katherine region

GRP is an indicator of regional economic performance and can be used to demonstrate the size and make-up of an economy. The Northern Territory Government reports that the GRP of the Katherine region in 2006 was $1.12 billion[3]. This represented 8.4 per cent of the total Gross State Product (GSP) of the Northern Territory in 2006 which was estimated at $13.4 billion (NTG 2008).

The top six sectors in terms of contribution to the GRP of the Katherine region in 2006 were:

- Mining ($270 million);
- Government administration and defence ($145 million);
- Agriculture, forestry and fishing ($73 million);
- Health and community services ($68 million);
- Construction ($57 million); and
- Education ($40 million) (NTG 2008).

In 2006, the mining industry was a key contributor to economic output in the Katherine region. At this time, the major mining operation operating in the Katherine region was the McArthur River zinc mine which is located 65 kilometres south-west of Borroloola. The mine commenced operations in 1995 and is estimated to continue to produce zinc and lead through to 2027 (McArthur River Mining 2013). The mine has an annual production capacity of 2.5 million tonnes. Other smaller mining operations operating in the Katherine region include limestone and gravel operations (NTG 2008).

The agriculture, forestry and fishing industry is also a major contributor to GRP in the Katherine region. Key primary industries include:

- Pastoral activity - predominantly cattle production however there is also some buffalo produced in the region (NTG 2008);
- Horticulture – including mangoes, melons, citrus and sandalwood (NTG 2013); and
- Dryland farming.

Residential and non-residential construction activity is also a key industry in terms of contribution to GRP and to employment. As outlined in section 3.3.3, the construction sector also accounts for the most number of businesses in the Katherine region.

3 This is the most recent data that was available.

3.3.2 Economic output – Northern Territory region

GSP for the Northern Territory has been increasing gradually since 2004 at an average annual rate of 4 per cent (Figure 6).

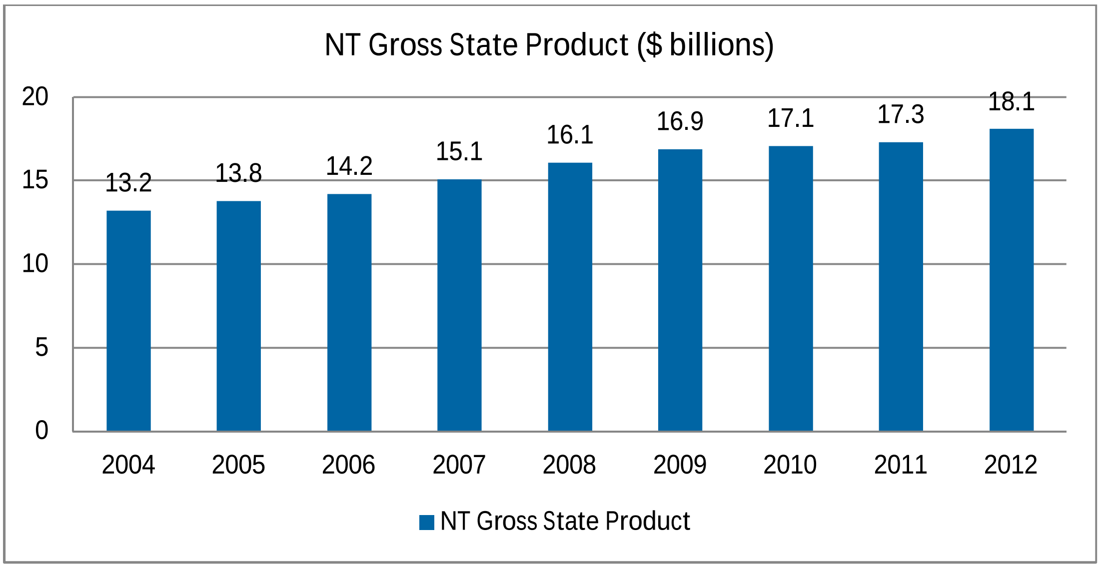


Figure 6: Northern Territory Gross State Product (2004 – 2012)

Source: ABS, 2012(d), Chain volume measures, denominated in 2011 dollars.

In 2012, key sectors in terms of contribution to the Northern Territory GSP were:

- Mining (19 per cent);
- Construction (12 per cent);
- Ownership of dwellings (11 per cent); and
- Public administration and safety (8 per cent) (ABS 2012e).

3.3.3 Business counts - Katherine

The construction and agriculture, forestry and fishing sectors were the dominant sectors in terms of businesses in Katherine in June 2011 (Figure 7).

The number of business entries (new businesses) in the Katherine region has been steady between 2008 and 2011. At the same time, the number of business exits in the Katherine region declined slightly between 2008 and 2011 (Figure 8). The net result is a slight increase in the number of businesses in the Katherine region between 2008 and 2011 from 864 to 911 (ABS 2012d).

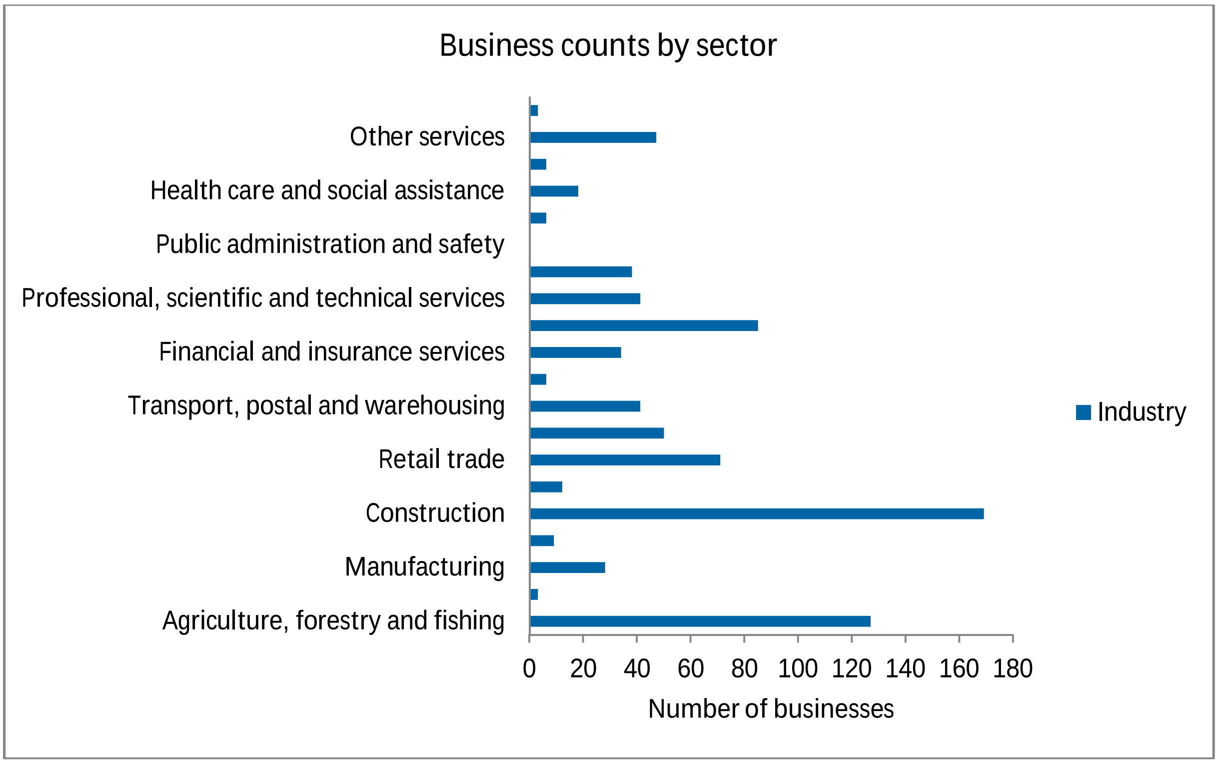


Figure 7: Business counts by sector – Katherine – June 2011

Source: ABS (2012c)

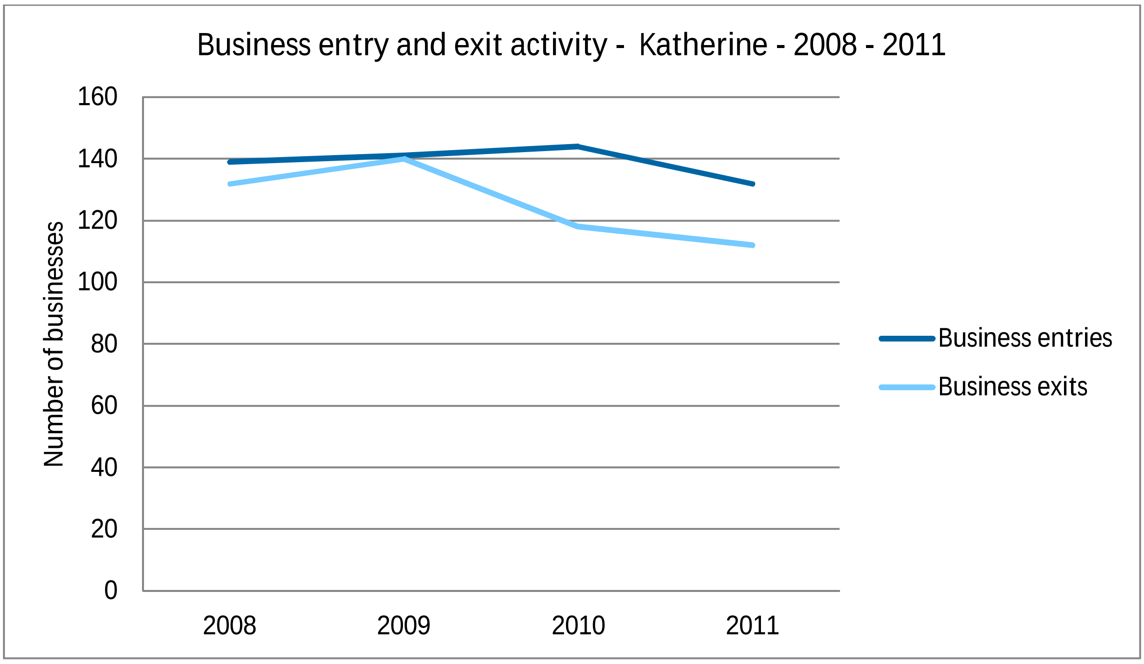


Figure 8: Business entries and exits – Katherine – 2008 - 2011

Source: ABS (2012d)

3.4 Property values

Median house values have risen by 22 per cent in Katherine in the four years between 2009 and 2013. Much of this rise occurred between early 2009 and mid-2010. Since mid-2010, the median house price in Katherine has been flat. Between February 2012 and February 2013, the median house price in Katherine fell 3.5 per cent (Property Observer 2013) (Figure 9).

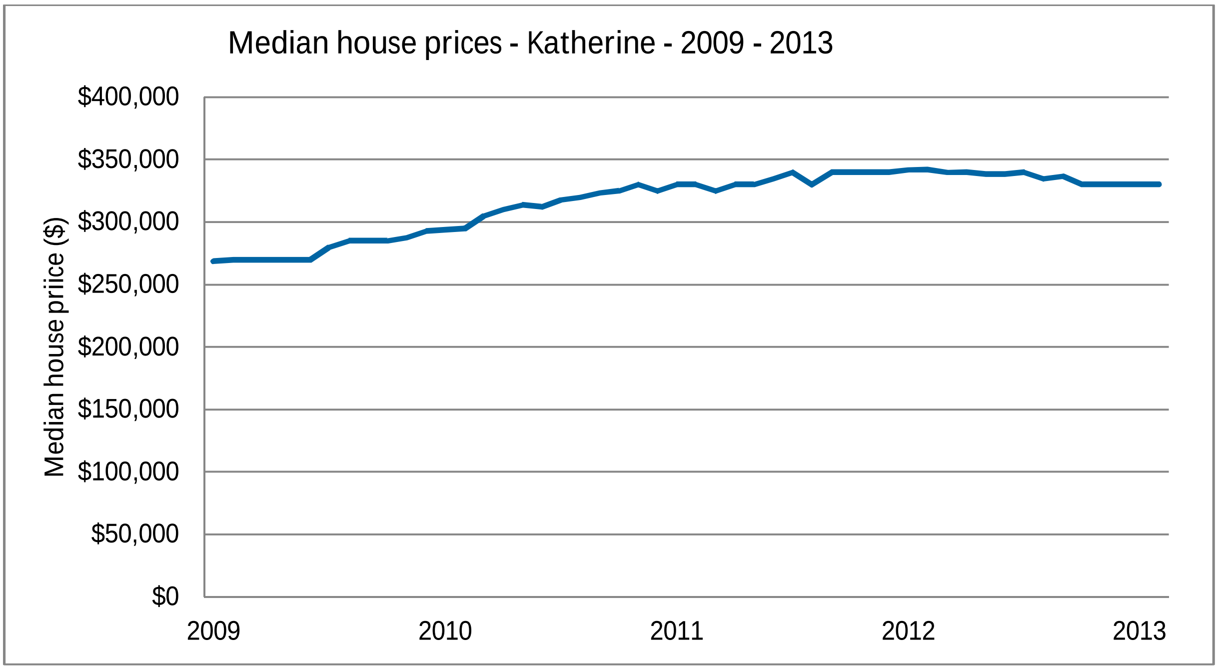


Figure 9: Median house prices – Katherine – 2009 – 2013

Source: Property Observer, 2013

4. Economic impact assessment

4.1 Potential economic impacts of the project

The potential economic impacts of the Project on the local/regional economy and the economy of the Northern Territory have been assessed for the construction and operations phases of the Project.

Subject to all necessary approvals being achieved, project construction is anticipated to take two years, including six months pre-production. The mine is scheduled to operate for a further 13 years followed by a four year closure and rehabilitation period.

As noted in section 2.3.2, estimates of economic impact are based on the use of an input-output (I-O) method. I-O analysis provides a comprehensive economic framework that provides a numerical picture of the size and shape of the economy and its essential features. The I-O model can then estimate economic impacts arising from a proposed project, including estimating industry multipliers and flow-on effects.

The economic impact of the Project is measured by the contribution of the Project to:

- Gross Regional Product (GRP) - a measure of the value of a region's outputs minus the cost of inputs. It is therefore able to measure the net contribution of the Project to the relevant economies (i.e. the Katherine region and the Northern Territory).
- Employment - identifies the number of Full Time Equivalent (FTE) persons engaged in work within a region. In this assessment, employment is measured by place of enumeration rather than place of residence.

Economic indicators, which provide a picture of economic activity in a region resulting from a specific activity, can be considered at two levels:

- Direct/initial impacts - identify the change in final demand or level of economic activity generated by the development;
- Indirect/flow-on impacts – are the total of:
  - Production induced impacts – purchasing goods and services from other industries and employment;
  - Consumption induced impacts – additional output and employment stemming from the consumption of additional goods and services by households that are the result of increased wages or employment in the development and associated activities; and
  - Offset consumption effects – the lost consumption by the local unemployed before they take a new job and the lost consumption of those who have lost a job before they start receiving welfare payments.

Direct and indirect flows into affected economies are summed in order to ascertain the total impact. Economic impacts (GRP and employment) are assessed at the regional and state levels during both the construction and operations phases of the mine.

The indirect (flow-on) impacts were calculated using the I-O models constructed for this Project and they measure the economic effects in other sectors of the economy generated by direct activities, that is, the multiplier effects. In addition to the assumptions embodied in the input-output model itself (Appendix A), it was necessary to make a number of other general assumptions in estimating the economic impacts:

- The impacts were measured using models that represent the structure of the regional and state economies for the year in which the most recent data are available (2011/12). However, over time there are likely to be improvements in primary factor productivity in these economies. To allow for these improvements, an across-the-board (all sectors) labour productivity improvement rate of 1 per cent per annum for subsequent years of the construction period has been incorporated into the modelling.
- When new jobs are created, it should be determined where the people come from to fill those jobs. In some cases, these jobs will be taken by previously unemployed locals or by someone who is currently employed locally but whose own job is taken by a previously unemployed local. In both cases, the impact of the newly created job and associated income is partially offset by the fact that someone who was previously receiving unemployment benefits is no longer doing so. To calculate this effect requires estimates of the parameter rho (Appendix A). Rho represents the proportion of new jobs that are likely to be filled by previously unemployed locals. For the construction phase, it was estimated to be 50 per cent for the local area and 60 per cent for the Northern Territory as a whole.

4.2 Economic impact – construction phase

The Project will involve capital expenditure of approximately $1.5 billion in total during the construction phase. Construction is anticipated to commence in the first quarter of 2014 and take two years, including six months pre-production. Some construction activity will continue throughout the course of the Project as indicated in Table 1. For presentation purposes, the years 2024 to 2029 have been omitted. Construction expenditure in these years gradually declines from the expenditure reported in 2023.

It was estimated that, over the life of the mine, 11 per cent of the capital investment for the construction of the mine will occur in the Katherine region and 32 per cent elsewhere in the Northern Territory. The remaining capital expenditure (58 per cent of the total) will occur outside the Northern Territory.

Table 1: Direct expenditure – construction phase ($m)

Year →	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023.....	2030	Total[4]
Katherine region	54.5	55.8	9.6	1.8	8.0	3.1	2.6	3.5	2.4	4.0	3.1	162.8
Elsewhere in the Northern Territory	164.1	168.1	28.9	5.3	24.0	9.2	7.9	10.6	7.1	12.0	9.3	489.9
Outside the Northern Territory	296.8	304.1	52.2	9.6	43.5	16.7	14.3	19.1	12.9	21.7	16.8	886.1
Total	515.4	528.0	90.7	16.7	75.5	28.9	24.8	33.2	22.4	37.7	29.2	1,538.8

[4] Does not include expenditure data years 2024-2029 – refer section 4.2

GRP and GSP are a measure of the net contribution of an activity or industry to the regional economy. They represent payments to the primary inputs of production (labour, capital and land) and are a regional/state level equivalent of gross domestic product. Estimates of GRP for the Katherine region and elsewhere in the Northern Territory and GSP for the Northern Territory as a whole during the construction period are provided in Table 2. For presentation purposes, the years 2024 to 2029 have been omitted.

During the construction phase, the direct and flow-on GRP in the Katherine region is expected to be around $27.1 million in 2014 and $27.8 million in 2015. Expenditure on mine construction is expected to continue until 2030 but at a significantly lower level from 2016 onwards. As such, the GRP total impact is expected to fall to $4.8 million in 2016 and gradually decline for the remainder of the construction phase. The Project is estimated to boost GRP in the Katherine region by around 2.9 per cent in 2015 (the peak year) based on current (2011/12) regional total GRP ($957 million).

For the Northern Territory, the Project is expected to generate GSP of $133 million in year 1 and $136 million in 2015. The GSP total impact is expected to fall to $23.4 million in 2016 and gradually decline for the remainder of the construction phase. In the context of the Northern Territory's GSP in 2011/12 ($18.6 billion) (ABS 2012b), the estimated GSP total impact in 2015 (the peak year) would represent an increase of 0.7 per cent.

Employment is an important indicator of both regional economic activity and the welfare of regional households. Table 3 shows total (direct plus flow-on) employment in the Katherine region, elsewhere in the Northern Territory and for the Northern Territory as a whole as a result of the construction phase of the Project. Employment numbers are expressed in Full Time Equivalent (FTE) terms. Table 3 shows that total (direct plus flow-on) employment in the Katherine region is expected to increase to 242 FTE in 2014 and 245 FTE in 2015. As a result of construction expenditure falling significantly in the remaining construction period post 2016, employment declines to 42 FTE in year 3 of construction and falls further in subsequent years. The direct plus flow-on employment in the peak year (2015) is 3.3 per cent of the estimated employment (FTE) for the Katherine region for 2011/12 (7,400 FTE).

For the Northern Territory, direct and indirect employment is expected to increase to 859 FTE in 2015, the peak year. This would represent a 0.8 per cent increase in employment over 2011/12 levels (112,000 FTE).

Table 2: Economic impact of the Mine – construction phase ($m)

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023……	2030
Katherine region GRP ($m)											
Direct	18.5	19.0	3.3	0.6	2.7	1.0	0.9	1.2	0.8	1.4	1.0
Flow-on	8.6	8.8	1.5	1.3	1.3	0.5	0.4	0.6	0.4	0.6	0.5
Total	27.1	27.8	4.8	0.9	4.0	1.5	1.3	1.8	1.2	2.0	1.5
Elsewhere in the Northern Territory GRP ($m)											
Direct	62.7	64.2	11.0	2.0	9.2	3.5	3.0	4.0	2.7	4.6	3.5
Flow-on	43.1	44.1	7.6	1.4	6.3	2.4	2.1	2.8	1.9	3.2	2.4
Total	105.8	108.4	18.6	3.4	15.5	5.9	5.1	6.8	4.6	7.7	5.9
Total Northern Territory GSP ($m)											
Direct	81.2	83.2	14.3	2.6	11.9	4.6	3.9	5.2	3.5	6.0	4.6
Flow-on	51.7	52.9	9.1	1.7	7.6	2.9	2.5	3.3	2.3	3.8	2.9
Total	132.9	136.1	23.4	4.3	19.5	7.4	6.4	8.6	5.8	9.8	7.4

Table 3: Employment impact of the Mine – construction phase ($m)

Year →	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023……	2030
Katherine region employment (FTE)											
Direct	174	177	30	5	25	9	8	10	7	12	8
Flow-on	67	68	12	2	9	4	3	5	3	4	3
Total	242	245	42	7	34	13	11	15	10	16	12
Elsewhere in the Northern Territory employment (FTE)											
Direct	380	385	66	12	53	20	17	23	15	25	18
Flow-on	225	229	39	7	32	12	10	14	9	15	11
Total	605	614	104	19	85	32	27	37	24	40	29
Total Northern Territory employment (FTE)											
Direct	554	562	96	17	78	30	25	33	22	37	27
Flow-on	293	297	51	9	41	16	13	19	12	19	14
Total	847	859	146	26	119	45	38	52	34	56	41

4.3 Economic impact –operations phase

The economic impact analysis of the operational expenditure of the mine was conducted using the operational expenditure profile presented in Table 4.

The operating phase will be characterised by the additional expenditure on mine operation, which will begin in 2016, increase until it reaches a maximum in 2020 (around $330 million) and gradually decline as production of the mine winds down. Total operational expenditure in 2020, once the mine is in full production, of around $330 million will comprise mining costs ($165 million), processing costs ($164 million) and water treatment plant costs ($1 million). There will be 20 per cent of operating expenditure spent in the Katherine region, 45 per cent will be spent elsewhere in the Northern Territory and 35 per cent will be spent outside the Northern Territory. For presentation purposes, the years 2024 to 2029 have been omitted.

In 2020, at full production of the mine, the direct and flow-on GRP in the Katherine region from the operation of the mine is expected to be $40.6 million, which represents 4.2 per cent of the current (2011/12) regional total GRP ($957 million). For the Northern Territory, the Project is expected to generate GSP of around $146 million in 2020. In the context of the Northern Territory's GSP in 2011/12 ($18.6 billion) (ABS 2012b), the estimated GSP total impact would represent an increase of 0.8 per cent.

In 2020, full production of the mine, total (direct plus flow-on) employment in the Katherine region is expected to be 139 FTE which represents 1.9 per cent of the estimated employment (FTE) for the Katherine region for 2011/12 (7,400 FTE). For the Northern Territory, direct and indirect employment is expected to be 426 FTE in 2020 which accounts for 0.4 per cent of total FTE employment in the Northern Territory for 2011/12.

Table 4: Mine operating expenditure profile ($m)

Year →	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025……	2030
Katherine region	53.1	58.5	65.5	65.9	66.0	65.3	62.8	59.7	61.5	60.8	0.3
Elsewhere in the Northern Territory	119.6	131.6	147.4	148.3	148.5	146.9	141.4	134.2	138.4	136.7	0.6
Outside the Northern Territory	93.0	102.4	114.6	115.4	115.5	114.3	110.0	104.4	107.6	106.3	0.4
Total	265.7	292.5	327.5	329.6	330.0	326.5	314.2	298.3	307.5	303.8	1.3

Table 5: Economic impact of the Mine – operating phase

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025……	2032
Katherine region GRP ($m)											
Direct	25.6	28.2	31.6	31.8	31.8	31.5	30.3	28.8	29.6	29.3	0.1
Flow-on	7.0	7.8	8.7	8.7	8.7	8.7	8.3	7.9	8.2	8.1	0.1
Total	32.7	36.0	40.3	40.5	40.6	40.1	38.6	36.7	37.8	37.3	0.2
Elsewhere in the Northern Territory GRP ($m)											
Direct	58.7	64.7	72.4	72.9	72.9	72.2	69.5	65.9	68.0	67.2	0.3
Flow-on	26.4	29.0	32.5	32.7	32.7	32.4	31.2	29.6	30.5	30.1	0.1
Total	85.1	93.7	104.9	105.6	105.7	104.5	100.6	95.5	98.5	97.3	0.4
Total Northern Territory GSP ($m)											
Direct	84.3	92.9	104.0	104.7	104.7	103.7	99.8	94.7	97.6	96.5	0.4
Flow-on	33.4	36.8	41.2	41.4	41.4	41.1	39.5	37.5	38.7	38.2	0.2
Total	117.7	129.7	145.2	146.1	146.2	144.8	139.3	132.2	136.3	134.7	0.6

Table 6: Employment impact of the Mine – operations phase

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025……	2032
Katherine region employment (FTE)											
Direct	61	67	74	74	73	72	68	64	65	64	0
Flow-on	56	61	67	67	66	65	62	58	59	58	0
Total	117	127	141	141	139	136	130	122	124	122	0
Elsewhere in the Northern Territory employment (FTE)											
Direct	102	111	123	123	122	119	114	106	108	106	0
Flow-on	138	151	167	167	165	162	154	144	147	144	1
Total	240	262	290	290	287	281	268	250	255	250	1
Total Northern Territory employment (FTE)											
Direct	163	178	197	197	195	191	182	170	173	170	0
Flow-on	194	212	234	234	231	227	216	202	206	202	1
Total	357	390	431	431	426	418	398	372	379	372	1

4.4 Value of production/exports

Vista Gold estimates total gold production of 4.81 million ounces over the course of the 13 year operation phase of the Project. This equates to an average production estimate of 370,000 ounces of gold per annum.

Assuming a gold price of $1,400 AUD per ounce, the value of this production is estimated at approximately $6.7 billion (undiscounted). At $1,300 AUD per ounce, the value of this production is estimated at $6.3 billion (undiscounted).

4.5 Royalties and taxes

It is estimated that the Project will generate the following taxes and royalty payments:

- $70 million in royalty payments to the local indigenous community (the Jawoyn people).
- $277 million in royalty payments to the Northern Territory Government.
- $469 million in taxation payments to the Australian Government.

Source: Vista Gold Corp, 2013.

4.6 Markets for gold produced at Mt Todd

It is proposed that gold dore bars will be produced on site at the mine. The gold dore bars will then be transported to Darwin where they will be shipped to a refinery where the dore bars will undergo a further purification process.

Major markets for Australian produced gold include Asia (particularly India) and the United Kingdom. The Australian Department of Foreign Affairs and Trade report that in 2010, India and the United Kingdom accounted for approximately 73 per cent of Australian gold exports (DFAT 2011). Other export destinations for Australian produced gold include Thailand, Singapore and Hong Kong.

Demand for gold includes:

- consumptive uses including use in jewellery, electronics and other industrial applications; and
- financial uses where central banks purchase and hold gold as part of a suite of assets that make up their reserves. Gold is often held by central banks together with foreign currency reserves. Gold provides diversification to reserve portfolios and is often seen as a safe haven during times of economic uncertainty and devaluation of more traditional reserve assets such as the US dollar and the euro (World Gold Council 2013).

4.7 Breakdown of skills/trades required and opportunities for skills development

A range of skills will be required during construction and operation of the mine including:

- a Construction Manager and other specialist mine managers;
- engineers;
- tradespeople (e.g. carpenters, electricians and boilermakers);
- civil construction personnel;
- machine operators;
- mobile plant operators;
- labourers;

- health, safety and environment personnel;
- accountants and administrative staff;
- mining Superintendent and support staff;
- mining engineers, geologists and surveyors;
- electrical superintendents and instrumentation technicians;
- truck drivers;
- stationary and mobile plant operators;
- mining labourers;
- specialist support staff including Human Resources personnel.

Vista Gold intends to develop training and employment policies and targets. It is intended that training will be done in collaboration with local and Northern Territory Government agencies where possible.

Any employment and training opportunities that the Project can provide to local residents should create an ongoing benefit to the local community in terms of improving the skill base of the local community. The extent to which this potential benefit is realised will depend on the extent to which local residents are employed either in the construction or operational phases of the Project and the extent to which these people remain in the Katherine region once the mine operations have been finalised.

4.8 Opportunities for local industry and indigenous workforce participation in the construction and operation phases

The I/O analysis estimates that the Project is expected to employ up to 554 direct workers during construction and up to 197 direct workers once the mine is operational.

The I/O analysis also estimates significant opportunities in flow-on employment with up to 293 flow-on jobs across the Northern Territory during construction and up to 234 during peak operations. Many of these opportunities will occur locally.

The Project is expected to require a range of skills and provide for a range of employment opportunities. Vista Gold has specified a preference for a local, residential workforce.

Vista Gold is aware of local and regional recruitment/employment agencies and will consult with them prior to the start of operations in order to facilitate local and regional employment opportunities.

Recruitment will commence approximately 6 months before the start of operations, and will be ongoing during operations as the workforce requirements evolve.

Vista Gold will develop human resource policies tailored for the residential workforce and to attract and retain local and regional employees.

4.9 Contribution to indigenous economic development and wider regional development

As outlined in section 3.1.2, approximately 43 per cent of the Katherine region population are Indigenous. The mine site and tenements are located on freehold land owned by the Jawoyn people. Vista Gold has an agreement in place to support local indigenous employment prior to and once the mine becomes operational (Vista Gold 2013). Vista Gold has also advised that they will develop an Indigenous employment strategy under the Jawoyn Partnership Agreement (Appendix F).

Vista Gold has been and will continue to be engaged in discussions with the local community - including the local business community. For example, in early June 2013, Vista Gold participated in the Katherine Regional Mining and Exploration Forum. The forum provided an opportunity to showcase the importance of the mining sector to the Katherine region. The forum also provided an opportunity for discussions between local business and staff of Vista Gold, with a focus on opportunities for possible joint ventures (Vista Gold 2013).

4.10 Negative impacts or potential synergies with exisiting land uses

The mine site has existing environmental and water quality issues that require ongoing management. Since acquiring the brownfield mine in 2006, Vista Gold has spent approximately $9 million on 'environmental stewardship' activities designed to treat water quality issues related to previous operations at the mine. This expenditure, and future environmental stewardship activities, provide a benefit to the local and regional community and the environment in the form of improved environmental outcomes and benefits to other land uses in the surrounding region. This includes the agricultural sector and for the nearby Werenbun Aboriginal community.

4.11 Socio-economic impacts upon local residents, communities and towns

Development of the Project is estimated to deliver considerable economic benefits to the region in the form of direct and indirect employment opportunities and expenditure. A detailed analysis of social impacts can be found in Appendix F.

4.12 Contribution to community benefit

Under the *Mineral Royalty Act* 1982, the Northern Territory Government collects royalty payments "in respect of the profit derived from minerals taken or produced" (Northern Territory Treasury 2013). The royalty scheme aims to encourage exploration and development of the Northern Territory's mineral resources whilst "compensating the Northern Territory community for allowing the private extraction of the Northern Territory's non-renewable resources" (Northern Territory Treasury 2013).

The Project is expected to generate approximately $277 million in royalty payments to the Northern Territory Government. Some of this revenue could fund community infrastructure across the Northern Territory.

Generation of employment and economic output in the Katherine region could in-turn lead to investment in new community infrastructure which has a lasting legacy in the local area.

Vista Gold is working with local and State Government to identify and address key infrastructure issues. For example, Vista Gold will encourage a 'whole of government' approach to develop a strategy to provide housing and accommodation options particularly during the operations phase.

4.13 Informing the local business community and workers of business and employment opportunities

Vista Gold will incorporate the following strategies to inform local businesses and residents of business and employment opportunities:

1. Advertise employment opportunities through a variety of media including local and regional print media (e.g. NT News, Katherine Times) and online (e.g. the Mt Todd gold mine website).
2. Continue dialogue with the local community and participate in local business development forums such as the recent Regional Mining and Exploration Forum held at Katherine.

4.14 Socio-economic parameters to be monitored

Development of the Project is expected to have a range of positive economic impacts for communities in the Katherine region and in the Northern Territory more broadly. Economic benefits include:

- Job creation;
- Increased income benefits; and
- Investment in residential and non-residential buildings.

Socio-economic indicators or parameters that should be monitored on an ongoing basis in order to gain an understanding of actual benefits include:

- Employment by industry – particularly in the mining sector but also in supporting sectors including the construction sector;
- Unemployment rates – it is expected that the unemployment rate in the Katherine region would decline as a result of job creation through the Project;
- Median personal and household income levels – a significant new industry in the Katherine region is expected to have a positive impact on income levels in the region;
- Value of residential and non-residential approvals – it is expected that the Project will generate direct and indirect expenditure in residential and non-residential property as income levels rise and unemployment falls.

5. References

Australian Bureau of Statistics (ABS) (2012a), 2011 Census of Population and Housing, Basic Community Profile, Katherine, Catalogue number 2001.0.

Australian Bureau of Statistics (ABS) (2012b), 2011 Census of Population and Housing, , Katherine, (T) (LGA), Catalogue number 2003.0.

Australian Bureau of Statistics (ABS) (2012c), 2011 Census of Population and Housing, Time Series Profile, Katherine, Catalogue number 2003.0.

Australian Bureau of Statistics (ABS) (2012d), Counts of Australian Businesses, including entries and exits, June 2007 to June 2011, Catalogue number 8165.0.

Australian Bureau of Statistics (ABS) (2012e), National regional profile: Katherine (Statistical Area Level 3), Available online at: http://www.abs.gov.au/AUSSTATS/abs@nrp.nsf/Latestproducts/70205Economy12007-2011?opendocument&tabname=Summary&prodno=70205&issue=2007-2011

Australian Bureau of Statistics (ABS) (2012f), 2011 Census of Population and Housing, Time Series Profile, Australia, Catalogue number 2003.0

Australian Bureau of Statistics, Australian National Accounts, State Accounts (ABS 2012e), Catalogue number 5220.

Australian Department of Foreign Affairs and Trade, 2011, Australia's gold industry: trade, production and outlook, Available online at: http://www.dfat.gov.au/publications/stats-pubs/australias-gold-industry-trade-production-and-outlook.pdf

Australian Taxation Office 2013, Taxation Statistics 2010/11, Table 3: Personal Tax, Selected items, by state/territory and postcode, for taxable individuals, 2010/11 income year.

EconSearch 2009, Input-Output Tables for South Australia and its Regions, 2006/07: Technical Report, report prepared for the Department of Trade and Economic Development, May.

EconSearch 2010a, Local Input-Output Modelling of Victorian Primary Industries, report prepared for the Department of Primary Industries (Victoria), June.

EconSearch 2010b, User Notes for the RISE Version 3.0 Impact Model, report prepared for the Department of Primary Industries (Victoria), June.

Jensen, R.C. 1980, 'The Concept of Accuracy in Input-Output Models', International Regional Science Review 5(2), 139-54.

Jensen, R.C. and West, G.R. 1986, Input-Output for Practitioners, Vol.1, Theory and Applications, Office of Local Government, Department of Local Government and Administrative Services, AGPS, Canberra.

Mangan, J. and Phibbs, P. 1989, Demo-Economic Input-Output Modelling with Special Reference to the Wollongong Economy, Australian Regional Developments 20, AGPS, Canberra.

McArthur River Mining, 2013, 'Mine at a glance', Available online at: http://www.mcarthurrivermine.com.au/EN/AboutUs/Pages/Ataglance.aspx

NRETAS 2011, *Guidelines for the preparation of an environmental impact statement*, *Mt Todd Gold Project Katherine Region, NT,* Department of Natural Resources, Environment, The Arts and Sport, Northern Territory Government.

Northern Territory Government, 2013, Consultation Paper, Towards a Katherine Land Use Plan, Availbale online at:
http://www.planningcommission.nt.gov.au/__data/assets/pdf_file/0013/35041/Katherine-Consultation-Paper.pdf

Northern Territory Government, 2008, Katherine Economic Profile, Available online at: http://www.drdia.nt.gov.au/__data/assets/pdf_file/0004/88465/KEPweb.pdf

Property Observer, 2013, Median house price data, Katherine, Northern Territory, Available online at: http://www.propertyobserver.com.au/data/suburb/katherine-nt

Tourism Research Australia 2012, Regional Tourism Profiles 2011/12, Canberra.

Vista Gold, 2013, 'Working with the Jawoyn community', Available online at: http://www.mttodd.com.au/jawoyn-community

Vista Gold, 2013, Community Update, 5 June, 2013, Available online at: http://www.mttodd.com.au/sites/default/files/files/MtToddCommunityUdate5June2013

West, G.R. 2009, IO9 Users' Guide and Reference, Part B (DRAFT), Department of Economics, University of Queensland, St Lucia.

World Gold Council, 2013, Central Bank diversification strategies: rebalancing from the dollar and euro, Available online at: http://www.gold.org/government_affairs/gold_reserve

Appendices

Appendix A - An overview of Economic Impact Analysis using the Input-Output method

Economic impact analysis based on an input-output (I-O) model provides a comprehensive economic framework that is extremely useful in the resource planning process. Broadly, there are two ways in which the I-O method can be used.

First, the I-O model provides a numerical picture of the size and shape of an economy and its essential features. The I-O model can be used to describe some of the important features of an economy, the interrelationships between sectors and the relative importance of the individual sectors.

Second, I-O analysis provides a standard approach for the estimation of the economic impact of a particular activity. The I-O model is used to calculate industry multipliers that can then be applied to various development or change scenarios.

The input-output database

Input-output analysis, as an accounting system of inter-industry transactions, is based on the notion that no industry exists in isolation. This assumes, within any economy, each firm depends on the existence of other firms to purchase inputs from, or sell products to, for further processing. The firms also depend on final consumers of the product and labour inputs to production. An I-O database is a convenient way to illustrate the purchases and sales of goods and services taking place in an economy at a given point in time.

As noted above, I-O models provide a numerical picture of the size and shape of the economy. Products produced in the economy are aggregated into a number of groups of industries and the transactions between them recorded in the transactions table. The rows and columns of the I-O table can be interpreted in the following way:

- The rows of the I-O table illustrate sales for intermediate usage (i.e. to other firms in the region) and for final demand (e.g. household consumption, exports or capital formation).
- The columns of the I-O table illustrate purchases of intermediate inputs (i.e. from other firms in the region), imported goods and services and purchases of primary inputs (i.e. labour, land and capital).
- Each item is shown as a purchase by one sector and a sale by another, thus constructing two sides of a double accounting schedule.

In summary, the I-O model can be used to describe some of the important features of a state or regional economy, the interrelationships between sectors and the relative importance of the individual sectors. The model is also used for the calculation of sector multipliers and the estimation of economic impacts arising from some change in the economy.

Using input-output analysis for estimation of economic impacts

The I-O model conceives the economy of the region as being divided up into a number of sectors and this allows the analyst to trace expenditure flows. To illustrate this, consider the example of a mine that, in the course of its operation, purchases goods and services from other sectors. These goods and services would include fuel, machinery and spare parts, transport services, and, of course, labour. The direct employment created by the vineyard is regarded in the model as an expenditure flow into the household sector, which is one of several non-industrial sectors recognised in the I-O model.

Upon receiving expenditure by the vineyard, the other sectors in the regional economy engage in their own expenditures. For example, as a consequence of winning a contract for work with vineyard, a spraying contractor buys materials from its suppliers and labour from its own employees. Suppliers and employees in turn engage in further expenditure, and so on. These indirect and induced (or flow-on) effects[5], as they are called, are part of the impact of the vineyard on the regional economy. They must be added to the direct effects (which are expenditures made in immediate support of the vineyard itself) in order to arrive at a measure of the total impact of the vineyard.

It may be thought that these flow-on effects (or impacts) go on indefinitely and that their amount adds up without limit. The presence of leakages, however, prevents this from occurring. In the context of the impact on a regional economy, an important leakage is expenditure on imports, that is, products or services that originate from outside the region, state or country (e.g. machinery).

Thus, some of the expenditure by the vineyard (i.e. expenditure on imports to the region) is lost to the regional economy. Consequently, the flow-on effects get smaller and smaller in successive expenditure rounds due to this and other leakages. Hence the total expenditure created in the regional economy is limited in amount, and so (in principle) it can be measured.

Using I-O analysis for estimation of regional economic impacts requires a great deal of information. The analyst needs to know the magnitude of various expenditures and where they occur. Also needed is information on how the sectors receiving this expenditure share their expenditures among the various sectors from whom they buy, and so on, for the further expenditure rounds.

In applying the I-O model to economic impact analysis, the standard procedure is to determine the direct or first-round expenditures only. No attempt is made to pursue such inquiries on expenditure in subsequent rounds, not even, for example, to trace the effects in the regional economy on household expenditures by vineyard employees on food, clothing, entertainment, and so on, as it is impracticable to measure these effects for an individual case, here the vineyard.

The I-O model is instead based on a set of assumptions about constant and uniform proportions of expenditure. If households in general in the regional economy spend, for example, 13.3 per cent of their income on food and non-alcoholic beverages, it is assumed that those working in vineyards do likewise. Indeed, the effects of all expenditure rounds after the first are calculated by using such standard proportions (i.e. multiplier calculations). Once a transactions table has been compiled, simple mathematical procedures can be applied to derive multipliers for each sector in the economy.

Input-output multipliers

Input-output multipliers are an indication of the strength of the linkages between a particular sector and the rest of the state or regional economy. As well, they can be used to estimate the impact of a change in that particular sector on the rest of the economy.

Detailed explanations on calculating I-O multipliers, including the underlying assumptions, are provided in any regional economics or I-O analysis textbook (see, for example, Jensen and West[6]). They are calculated through a routine set of mathematical operations based on coefficients derived from the I-O transactions model, as outlined below.

---

[5] A glossary of I-O terminology is provided in Appendix 2.

6 Jensen, R.C. and West, G.R. 1986, Input-Output for Practitioners, Vol.1, Theory and Applications, Office of Local Government, Department of Local Government and Administrative Services, AGPS, Canberra.

The transactions table may be represented by a series of equations thus:

$$X_1 = X_{11} + X_{12} + \dots\dots\dots\dots + X_{1n} + Y_1$$
$$X_2 = X_{21} + X_{22} + \dots\dots\dots\dots + X_{2n} + Y_2$$
$$X_n = X_{n1} + X_{n2} + \dots\dots\dots\dots + X_{nn} + Y_n$$

Where X_i = total output of intermediate sector *i* (row totals);

X_{ij} = output of sector *i* purchased by sector *j* (elements of the intermediate quadrant); and

Y_j = total final demand for the output of sector *i*.

It is possible, by dividing the elements of the columns of the transactions table by the respective column totals to derive coefficients, which represent more clearly the purchasing pattern of each sector. These coefficients, termed 'direct' or 'I-O' coefficients, are normally denoted as aij, and represent the direct or first round requirements from the output of each sector following an increase in output of any sector.

In equation terms the model becomes:

$$X_1 = a_{11}X_1 + a_{12}X_2 + \dots\dots\dots\dots + a_{1n}X_n + Y_1$$
$$X_2 = a_{21}X_1 + a_{22}X_2 + \dots\dots\dots\dots + a_{2n}X_n + Y_2$$
$$X_n = a_{n1}X_{11} + a_{n2}X_2 + \dots\dots\dots\dots + a_{nn}X_n + Y_n$$

Where a_{ij} (the direct coefficient) = X_{ij}/X_j. This may be represented in matrix terms:

$X = AX + Y$

Where A = $[a_{ij}]$, the matrix of direct coefficients.

The previous equation can be extended to:

$(I-A)X = Y$

Where $(I-A)$ is termed the Leontief matrix,

or $X = (I-A)^{-1}Y$

where $(I-A)^{-1}$ is termed the 'general solution', the 'Leontief inverse' or simply the inverse of the open model.

The general solution is often represented by:

$Z = (I-A)^{-1} = [z_{ij}]$

The I-O table can be 'closed' with respect to certain elements of the table. Closure involves the transfer of items from the exogenous portions of the table (final demand and primary input quadrants) to the endogenous section of the table (intermediate quadrant). This implies that the analyst considers that the transferred item is related more to the level of local activity than to external influences. Closure of I-O tables with respect to households is common and has been adopted in this project.

The 'closed' direct coefficients matrix may be referred to as A*. The inverse of the Leontief matrix formed from A* is given by:

$Z^* = (I- A^*)^{-1} = [z^*_{ij}]$

Z^* is referred to as the 'closed inverse' matrix.

A multiplier is essentially a measurement of the impact of an economic stimulus. In the case of I-O multipliers the stimulus is normally assumed to be an increase of one dollar in sales to final demand by a sector. The impact in terms of output, contribution to gross regional product, household income and employment can be identified in the categories discussed below.

(i) The initial impact: refers to the assumed dollar increase in sales. It is the stimulus or the cause of the impacts. It is the unity base of the output multiplier and provides the identity matrix of the Leontief matrix. Associated directly with this dollar increase in output is an own-sector increase in household income (wages and salaries, drawings by owner operators etc.) used in the production of that dollar. This is the household income coefficient hj. Household income, together with other value added (OVA), provide the total gross regional product from the production of that dollar of output. The gross regional product coefficient is denoted vj. Associated also will be an own-sector increase in employment, represented by the size of the employment coefficient. This employment coefficient ej represents an employment/output ratio and is usually calculated as 'employment per million dollars of output'.

(ii) The first round impact: refers to the effect of the first round of purchases by the sector providing the additional dollar of output. In the case of the output multiplier this is shown by the direct coefficients matrix [aij]. The disaggregated effects are given by individual aij coefficients and the total first-round effect by Σaij. First-round household income effects are calculated by multiplying the first-round output effects by the appropriate household income coefficient (hj). Similarly, the first-round gross regional product and employment effects are calculated by multiplying the first-round output effects by the appropriate gross regional product (vj) and employment (ej) coefficients.

(iii) Industrial-support impacts. This term is applied to 'second and subsequent round' effects as successive waves of output increases occur in the economy to provide industrial support, as a response to the original dollar increase in sales to final demand. The term excludes any increases caused by increased household consumption. Output effects are calculated from the open Z inverse, as a measure of industrial response to the first-round effects. The industrial-support output requirements are calculated as the elements of the columns of the Z inverse, less the initial dollar stimulus and the first-round effects. The industrial support household income, gross regional product and employment effects are defined as the output effects multiplied by the respective household income, gross regional product and employment coefficients. The first-round and industrial-support impacts are together termed the production-induced impacts.

(iv) Consumption-induced impacts: are defined as those induced by increased household income associated with the original dollar stimulus in output. The consumption-induced output effects are calculated in disaggregated form as the difference between the corresponding elements in the open and closed inverse (i.e. z*ij - zij, and in total as Σ(z*ij - zij). The consumption-induced household income, gross regional product and employment effects are simply the output effects multiplied by the respective household income, gross regional product and employment coefficients.

(v) Flow-on impacts: are calculated as total impact less the initial impact. This allows for the separation of 'cause and effect' factors in the multipliers. The cause of the impact is given by the initial impact (the original dollar increase in sales to final demand), and the effect is represented by the first-round, industrial-support and consumption-induced effects, which together constitute the flow-on effects.

Each of the five impacts are summarised in It should be noted that household income, gross regional product and employment multipliers are parallel concepts, differing only by their respective coefficients hj, vj and ej.

The output multipliers are calculated on a 'per unit of initial effect' basis (i.e. output responses to a one dollar change in output). Household income, gross regional product and employment multipliers, as described above, refer to changes in household income per initial change in output, changes to gross regional product per initial change in output and changes in employment per initial change in output. These multipliers are conventionally converted to ratios, expressing a 'per unit' measurement, and described as Type I and Type II ratios. For example, with respect to employment:

Type I employment ratio = [initial + first round + industrial support]/initial

and

Type II employment ratio = [initial + production induced[7] + consumption induced]/initial

7 Where (first round + industrial support) = production induced.

Table 7: The structure of input-output multipliers for sector i[8]

Impacts	General formula
Initial	1
First-round	$\Sigma_i a_{ij}$
Industrial-support	$\Sigma_i z_{ij}$-1-$\Sigma_i a_{ij}$
Consumption-induced	$\Sigma_i z^*_{ij}$-$\Sigma_i z_{ij}$
Total	$\Sigma_i z^*_{ij}$
Flow-on	$\Sigma_i z^*_{ij}$-1
Household income multipliers ($)	
Initial	h_j
First-round	$\Sigma_i a_{ij} h_i$
Industrial-support	$\Sigma_i z_{ij} h_i$- h_j-$\Sigma_i a_{ij} h_i$
Consumption-induced	$\Sigma_i z^*_{ij} h_i$-$\Sigma_i z_{ij} h_i$
Total	$\Sigma_i z^*_{ij} h_i$
Flow-on	$\Sigma_i z^*_{ij} h_i$-h_j
Gross Regional Product multipliers ($)	
Initial	v_j
First-round	$\Sigma_i a_{ij} v_i$
Industrial-support	$\Sigma_i z_{ij} v_i$- v_j-$\Sigma_i a_{ij} v_i$
Consumption-induced	$\Sigma_i z^*_{ij} v_i$-$\Sigma_i z_{ij} v_i$
Total	$\Sigma_i z^*_{ij} v_i$
Flow-on	$\Sigma_i z^*_{ij} v_i$-v_j
Employment multipliers (full time equivalents)	
Initial	e_j
First-round	$\Sigma_i a_{ij} e_i$
Industrial-support	$\Sigma_i z_{ij} e_i$- e_j-$\Sigma_i a_{ij} e_i$
Consumption-induced	$\Sigma_i z^*_{ij} e_i$-$\Sigma_i z_{ij} e_i$
Total	$\Sigma_i z^*_{ij} e_i$
Flow-on	$\Sigma_i z^*_{ij} e_i$-e_j

[8] In a DECON model, Z* (the 'closed inverse' matrix), includes a population and an unemployed row and column (see below for details).

Model assumptions

There are a number of important assumptions in the I-O model that are relevant in interpreting the analytical results.

Industries in the model have a linear production function, which implies constant returns to scale and fixed input proportions.

Another model assumption is that firms within a sector are homogeneous, which implies they produce a fixed set of products that are not produced by any other sector and that the input structure of the firms are the same. Thus it is preferable to have as many sectors as possible specified in the models and the standard models for this study were compiled with 66 sectors.

The model is a static model that does not take account of the dynamic processes involved in the adjustment to an external change, such as a permanent change in natural resources management.

Extending the standard economic impact model as a DECON model

Based on work undertaken by EconSearch (2009[9] and 2010a[10]) and consistent with Mangan and Phibbs[11], the I-O model developed for this project was extended as demographic-economic (DECON) model. The two key characteristics of the DECON model, when compared with a standard economic model, are as follows.

1. The introduction of a population 'sector' (or row and column in the model) makes it possible to estimate the impact on local population levels of employment growth or decline.
2. The introduction of an unemployed 'sector' makes it possible to account for the consumption-induced impact of the unemployed in response to economic growth or decline.

The population 'sector'

The introduction of a population 'sector' to the standard I-O model allows for the calculation of population multipliers. These multipliers measure the flow-on population impact resulting from an initial population change attributable to employment growth or decline in a particular sector of the regional economy.

Calculation of population multipliers is made possible by inclusion of a population row and column in the 'closed' direct coefficients matrix of the I-O model.

Population row: the population coefficient (pj) for sector j of the DECON model is represented as:

pj = -rhoj * ej * family sizej

where rhoj = the proportion of employees in sector j who remain in the region after they lose their job (negative employment impact) or the proportion of new jobs in sector j filled by previously unemployed locals (positive employment impact);

ej = the employment coefficient for sector j; and

family sizej = average family size for sector j.

9 EconSearch 2009, Input-Output Tables for South Australia and its Regions, 2006/07: Technical Report, report prepared for the Department of Trade and Economic Development, May.
10 EconSearch 2010a, Local Input-Output Modelling of Victorian Primary Industries, report prepared for the Department of Primary Industries (Victoria), June.
11 Mangan, J. and Phibbs, P. 1989, Demo-Economic Input-Output Modelling with Special Reference to the Wollongong Economy, Australian Regional Developments 20, AGPS, Canberra.

Population column: the population column of the DECON model is designed to account for growth or decline in those sectors of the economy that are primarily population-driven (i.e. influenced by the size of the population) rather than market-driven (i.e. dependent upon monetary transactions). Clearly, many of the services provided by the public sector fit this description and, for the purpose of this analysis, it was assumed that the following intermediate sectors were primarily population-driven:

- public administration and defence;
- education;
- health and community services; and
- cultural and recreational services.

Thus, the non-market coefficient for sector j of the DECON model is represented as expenditure on that non-market service (by governments) in $million per head of population.

The population multiplier for sector j is represented as: z*pj / ppj

where z*pj = coefficient of the 'closed inverse' matrix in the population row for sector j; and

ppj = coefficient of the direct coefficients matrix in the population row for sector j.

Sources of local data for the population sector of the DECON models used in this project included the following:

- rho: little or no published data are available to assist with estimation of this variable, particularly at a regional level. The DECON models have been constructed to enable the analyst to estimate this variable on the basis of the availability superior data or assumptions.
- Family size: in order to estimate average family size by industry, relevant data were extracted from the Australian Bureau of Statistics 2006 Census of Population and Housing using the TableBuilder database. These data were modified by the consultants in order to ensure consistency with the specification and conventions of the I-O models.

The unemployed 'sector'

As outlined above, the introduction of an unemployed 'sector' to the standard I-O model makes it possible to account for the consumption-induced impact of the unemployed in response to economic growth or decline.

Through the inclusion of an unemployed row and column in the 'closed' direct coefficients matrix of the standard I-O model it is possible to calculate Type III multipliers (for output, gross regional product, household income and employment).

The key point to note is that, in the situation where at least some of the unemployed remain in a region after losing their job (negative employment impact) or some of the new jobs in a region are filled by previously unemployed locals (positive employment impact), Type III multipliers will be smaller than the more frequently used Type II multipliers.

Unemployed row: the unemployed coefficient (uj) for sector j of the DECON model is represented as:

uj = -rhoj * (1-essj) * ej

where:

rhoj = the proportion of employees in sector j who remain in the region after they lose their job (negative employment impact) or the proportion of new jobs in sector j filled by previously unemployed locals (positive employment impact);

essj = the proportion of employed in sector j who are not eligible for welfare benefits when they lose their job; and

ej = the employment coefficient for sector j.

Unemployed column: the unemployed column of the DECON model is an approximation of total consumption expenditure and the consumption pattern of the unemployed. It is represented as dollars per unemployed person rather than $million for the region as a whole, as is the case for the household expenditure column in a standard I-O model.

Sources of local (i.e. state and regional) data for the unemployed sector of the DECON models used in this study included the following.

ess: in order to estimate the proportion of employed by industry who are not eligible for welfare benefits when they lose their job, relevant data were extracted from the Australian Bureau of Statistics 2006 Census of Population and Housing using the TableBuilder database. These data were modified by the consultants in order to ensure consistency with the specification and conventions of the I-O models.

Unemployed consumption: total consumption expenditure by the unemployed was based on an estimate of the Newstart Allowance whilst the pattern of consumption expenditure was derived from household income quintiles in the 2003/04 Household Expenditure Survey (ABS 2006).

Incorporating a tourism demand profile in the I-O model

Tourism expenditure is a measure of the value of sales of goods and services to visitors to the state or region. The following method and data sources were used to estimate tourism expenditure by industry sector for the region.

The primary data were sourced from Tourism Research Australia (TRA)[12].

Base datasets included total tourism expenditure by TRA tourism region and average expenditure profiles, by region, across a range of goods and services (e.g. food and drink, fuel, shopping, etc.).

Estimates were available for domestic day, domestic overnight and international visitor expenditure.

The first adjustment to the base data was the development of a concordance between the TRA tourism regions and I-O model regions and the allocation of these base data to the relevant I-O model region. These allocations were based, in turn, on an ABS concordance between TRA tourism regions and SLAs.

The second adjustment to the base data was the application of a more detailed expenditure breakdown from the ABS Australian National Accounts: Tourism Satellite Account for both domestic and international visitor expenditure.

The third adjustment to the base data was the conversion of tourism expenditure estimates from purchasers' to basic prices (i.e. reallocation of net taxes (taxes minus subsidies) and marketing and transport margins) to make the data consistent with accounting conventions used in the national, state and regional I-O models. Purchasers' to basic price ratios for tourism expenditure categories were derived from ABS data.

12 Tourism Research Australia 2012, Regional Tourism Profiles 2011/12, Canberra.

The final adjustment to the base data was the allocation of the tourism expenditure data in basic prices to the relevant input-output sectors (intermediate sectors, taxes less subsidies or imports) in which the expenditure occurred, thus compiling a profile of sales to final demand. This process was undertaken for each type of tourism expenditure (domestic day, domestic overnight and international visitor) and the results aggregated to form a single tourism demand profile. Profiles were developed at the state and regional levels.

Constructing a RISE v3.0 economic impact model

In the final model construction stage the data described above were incorporated into a Microsoft Excel spread sheet based economic impact model for the region and state (i.e. RISE v3.0)[13]. This model allows for description of the structure of the economy. It can also be used for the estimation of economic impacts over time in response to the introduction of a new industry or a change in the final demand for the output of one or many sectors. Model assumptions can be modified to account for:

Price changes between the model construction year (2009/10) and the base year for the analysis;

- labour productivity change over time (as above and for the subsequent years);
- the level of regional migration (e.g. for a positive employment impact, the proportion of new jobs filled by previously unemployed locals).

13 For further details on the use and application of this type of model see: EconSearch 2010b, User Notes for the RISE Version 3.0 Impact Model, report prepared for the Department of Primary Industries (Victoria), June.

Appendix B – Glossary of Input-Output terminology

Basic price is the price received for a good or service by the producer. It is also known as the producers' price. It excludes indirect taxes and transport, trade and other margins.

Changes in inventories (stocks) "consist of stocks of outputs that are held at the end of a period by the units that produced them prior to their being further processed, sold, delivered to other units or used in other ways and stocks of products acquired from other units that are intended to be used for intermediate consumption or for resale without further processing" (ABS 2008b).

Consumption-induced impacts are additional output and employment resulting from re-spending by households that receive income from employment in direct and indirect activities. Consumption-induced effects are sometimes referred to as 'induced effects'.

DECON model is a demographic-economic model based on a traditional input-output model. The introduction of a population 'sector' (or row and column in the model) makes it possible to estimate the impact on local population levels of employment growth or decline. The introduction of an unemployed 'sector' makes it possible to account for the consumption-induced impact of the unemployed in response to economic growth or decline.

Direct (or initial) impacts are an estimate of the change in final demand or level of economic activity that is the stimulus for the total impacts.

Employment is a measure of the number of working proprietors, managers, directors and other employees, in terms of the number of full-time equivalents and total (i.e. full-time and part-time) jobs. Employment is measured by place of remuneration rather than place of residence.

ess is an estimate of the proportion of employed who are not eligible for welfare benefits when they lose their job.

Exports (other) are a measure of the value of goods and services sold from the region/state of interest to consumers in other regions, interstate and overseas, net of sales to visitors to the region.

Final demand quadrant (components of) includes household and government consumption expenditure, gross fixed capital formation, changes in inventories (stocks), tourism expenditure and 'other' exports.

First-round impacts are estimates of the requirement for (or purchases of) goods and services from other sectors in the economy generated by the initial economic activity.

Flow-on impacts are the sum of production-induced impacts, consumption-induced impacts and offsetting consumption effects.

Government consumption expenditure includes "net expenditure on goods and services by public authorities, other than those classified as public corporations, which does not result in the creation of fixed assets or inventories or in the acquisition of land and existing buildings or second-hand assets. It comprises expenditure on compensation of employees (other than those charged to capital works, etc.), goods and services (other than fixed assets and inventories) and consumption of fixed capital. Expenditure on repair and maintenance of roads is included. Fees, etc., charged by general government bodies for goods sold and services rendered are offset against purchases. Net expenditure overseas by general government bodies and purchases from public corporations are included. Expenditure on defence assets that are used in a fashion similar to civilian assets is classified as gross fixed capital formation; expenditure on weapons of destruction and weapon delivery systems is classified as final consumption expenditure" (ABS 2008b).

Gross fixed capital formation (GFCF) includes government, private and public corporation expenditure on new fixed assets plus net expenditure on second-hand fixed assets, including both additions and replacements (see ABS 2008b for further detail).

Gross operating surplus and gross mixed income. Gross operating surplus (GOS) is a measure of the operating surplus accruing to all enterprises, except unincorporated enterprises. It is the excess of gross output over the sum of intermediate consumption, household income and taxes less subsidies on production and imports. Gross mixed income (GMI) is a measure of the surplus or deficit accruing from production by unincorporated enterprises (ABS 2008b). The National Accounts definition of this indicator, as specified in the 2004/05 National I-O table (ABS 2008a), includes drawings by owner operators (or managers). In the state model used in this project, drawings by owner operators have been included in household income.

Gross regional/state product (GRP/GSP) is a measure of the net contribution of an activity to the regional/state economy. GRP/GSP is measured as value of output less the cost of goods and services (including imports) used in producing the output. In other words, it can be measured as the sum of household income, 'gross operating surplus and gross mixed income net of payments to owner managers' and 'taxes less subsidies on products and production'. It represents payments to the primary inputs of production (labour, capital and land). Using GRP/GSP as a measure of economic impact avoids the problem of double counting that may arise from using value of output for this purpose.

Household consumption expenditure includes "net expenditure on goods and services by persons and expenditure of a current nature by private non-profit institutions serving households. This item excludes expenditures by unincorporated businesses and expenditures on assets by non-profit institutions (included in gross fixed capital formation). Also excluded is expenditure on maintenance of dwellings (treated as intermediate expenses of private enterprises), but personal expenditure on motor vehicles and other durable goods and the imputed rent of owner-occupied dwellings are included. The value of 'backyard' production (including food produced and consumed on farms) is included in household final consumption expenditure and the payment of wages and salaries in kind (e.g. food and lodging supplied free to employees) is counted in both household income and household final consumption expenditure" (ABS 2008b).

Household income is a component of GRP/GSP and is a measure of wages and salaries paid in cash and in-kind, drawings by owner operators and other payments to labour including overtime payments, employer’s superannuation contributions and income tax, but excluding payroll tax.

Imports are a measure of the value of goods and services purchased by intermediate sectors and by components of final demand in the region/state of interest from other regions, interstate and overseas.

Industrial-support impacts are output and employment resulting from second, third and subsequent rounds of spending by firms.

Input-output analysis is an accounting system of inter-industry transactions based on the notion that no industry exists in isolation.

Input-output model is a transactions table that illustrates and quantifies the purchases and sales of goods and services taking place in an economy at a given point in time. It provides a numerical picture of the size and shape of the economy and its essential features. Each item is shown as a purchase by one sector and a sale by another, thus constructing two sides of a double accounting schedule.

Multiplier is an index (ratio) indicating the overall change in the level of activity that results from an initial change in economic activity. They are an indication of the strength of the linkages between a particular sector and the rest of the state or regional economy. They can be used to estimate the impact of a change in that particular sector on the rest of the economy.

Offsetting consumption effects are 'lost' consumption expenditure by the local unemployed before taking a job or 'new' consumption expenditure of those losing a job as they shift to welfare payments.

Output (Value of) is a measure of the gross revenue of goods and services produced by commercial organisations (e.g. farm-gate value of production) and gross expenditure by government agencies. Total output needs to be used with care as it can include elements of double counting when the output of integrated industries is added together (e.g. the value of winery output includes the farm-gate value of grapes). For sectors where superior regional data are not available, value of output by industry is allocated across regions on an employment basis, rather than in terms of the location of other factors of production such as land and capital.

Purchasers' price is the price paid for a good or service paid by the purchaser. It includes indirect taxes and transport, trade and other margins.

Primary input quadrant (components of) includes household income, gross operating surplus and gross mixed income net of payments to owner managers, taxes less subsidies on products and production and imports.

Production-induced impacts are the sum of first-round and industrial support impacts. Production-induced impacts are sometimes referred to as 'indirect effects'.

rho is an estimate of the proportion of employees who remain in the region after they lose their job (negative employment impact) or the proportion of new jobs filled by previously unemployed locals (positive employment impact).

Taxes less subsidies on products and production (TLSPP) is defined as 'taxes on products' plus 'other taxes on production' less 'subsidies on products' less 'other subsidies on production'. Taxes on products are taxes payable per unit of some good or service. Other taxes on production consist of all taxes that enterprises incur as a result of engaging in production, except taxes on products. Subsidies on products are subsidies payable per unit of a good or service. Other subsidies on production consist of all subsidies, except subsidies on products, which resident enterprises may receive as a consequence of engaging in production (ABS 2008b).

Tourism expenditure is a measure of the value of sales of goods and services to visitors to the state or region.

Total impacts are the sum of initial (or direct) and flow-on impacts.

Type I multiplier is calculated as (direct effects + production-induced effects)/direct effects.

Type II multiplier is calculated as (direct effects + production-induced effects + consumption-induced effects)/direct effects.

Type III multiplier is a modified Type II multiplier, calculated by including a population and unemployed row and column in the 'closed' direct coefficients matrix of the standard I-O model. Calculated as (direct effects + production-induced effects + consumption-induced effects + offsetting consumption effects)/direct effects.

GHD

145 Ann Street

Brisbane

QLD 4000

T: 07 3316 3000 F: 07 3316 3204   E: bnemail@ghd.com

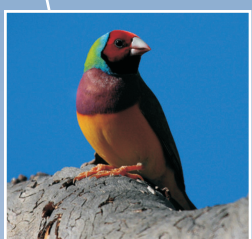
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	Rod Coulton	David Rolland	*D Rowland*	I McCardle	[illegible]	21/6/13

MT TODD

APPENDIX X

Greenhouse Gas Assessment



GHD

CLIENTS | PEOPLE | PERFORMANCE

Vista Gold Australia Pty Ltd

Mt Todd Gold Project

Greenhouse Gas Assessment

May 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

This Mt Todd Gold Project Greenhouse Gas Assessment ("Report"):

1. *has been prepared by GHD Pty Ltd (GHD) for Vista Gold Australia Pty Ltd (Vista Gold);*
2. *may only be used and relied on by Vista Gold;*
3. *must not be copied to, used by, or relied on by any person other than Vista Gold without the prior written consent of GHD;*
4. *may only be used for the purpose of estimating greenhouse gas emissions from the proposed construction and operation of Mt Todd gold mine (and must not be used for any other purpose).*

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Vista Gold arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- *were limited to those specifically detailed in section 1 of this Report;*
- *did not include estimating activity data or deriving emission factors.*

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report ("Assumptions"), including (but not limited to) assumptions listed in section 3 of this report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and may be relied on for 12 months, after which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

Contents

Table Index

Appendices

Executive Summary

Vista Gold Australia Pty Ltd (Vista Gold) proposes to re-establish and operate the Mt Todd Gold Mine, located 55km north of Katherine and 250km south of Darwin.

This greenhouse gas assessment has been undertaken by GHD on behalf of Vista Gold Australia Pty Ltd as part of the Draft Environmental Impact Statement for the Mt Todd Gold Project.

This report has been prepared to estimate the greenhouse gas emissions associated with construction, operations and mine closure, and to develop mitigation measures to minimise impacts.

Emissions have been separated into Scopes 1, 2 and 3 in accordance with the Greenhouse Gas Protocol (WRI et al 2004). These scopes are defined as follows:

1. Scope 1 emissions are greenhouse gas emissions created directly by a person or business from sources that are owned or controlled by that person or business.
2. Scope 2 emissions are greenhouse gas emissions created as a result of the generation of electricity, heating, cooling or steam that is purchased and consumed by a person or business. These are indirect emissions as they arise from sources that are not owned or controlled by the person or business who consumes the electricity.
3. Scope 3 emissions are greenhouse gas emissions that are generated in the wider economy as a consequence of a person's or business's activities. These are indirect emissions as they arise from sources that are not owned or controlled by that person or business but they exclude Scope 2.

The assessment was undertaken in accordance with the Northern Territory Environmental Impact Assessment Guide: Greenhouse Gas Emissions and Climate Change. The assessment results identified:

- average annual Scope 1, 2 and 3 greenhouse gas emissions is 0.50 Mt CO_2-e per annum;
- total Scope 1, 2 and 3 emissions over the project life is 10.5 Mt CO_2-e; and
- average annual greenhouse gas emissions for the Project are estimated to be approximately:
  - 2.9 percent of the Northern Territory's annual emissions;
  - 0.09 percent of Australia's annual emissions; and
  - 0.002 percent of the global annual emissions.

The feasibility of minimising greenhouse gas emissions from diesel consumption and electricity generation should be investigated during mine planning.

There are a number of legislative requirements for measuring, monitoring and reporting greenhouse gas emissions and energy consumption that are applicable to the Project. Monitoring and reporting of energy and greenhouse gas emissions will be required to comply with the *National Greenhouse and Energy Reporting Act 2007*, the *Clean Energy Act 2011* and the *Energy Efficiency Opportunities Act 2006*.

Glossary and Abbreviations

Abbreviation	Term
ANFO	Ammonium Nitrate Fuel Oil
CFI	Carbon Farming Initiative
CH_4	Methane
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent emissions (emissions of other greenhouse gases are multiplied by their Global Warming Potential so that their effects can be compared to emissions of carbon dioxide)
DCCEE	Department of Climate Change and Energy Efficiency
DEFRA	Department for Environment, Food and Region Affairs (UK)
dore	Gold in cast bars
EEO	Energy Efficiency Opportunities
EF	Emission Factor
Emission	The release of material into the environment (such as dust)
FullCAM	Full Carbon Accounting Model
GHG	Greenhouse gas
GJ	Gigajoule
Greenhouse Gases	Gases that accumulate within the earth's atmosphere (e.g.: primarily carbon dioxide and methane) which contribute to global climatic change/global warming (i.e. the 'greenhouse effect')
GWh	Gigawatt hour
GWP	Global Warming Potential
ha	Hectare
HFCs	Hydrofluorocarbons
J	Joule
kL	Kilolitre
km	Kilometre
kWh	Kilowatt hour

Abbreviation	Term
L	Litre
m	Metre
Mitigation	Limit the intensity of impacts or prevent impacts
MJ	Megajoule
MLN	Mineral Lease Number
mm	Millimetre
Mt	Million tonnes
N_2O	Nitrous oxide
NCAT	National Carbon Accounting Toolbox
NGA	National Greenhouse Accounts
NGERS	National Greenhouse and Energy Reporting Scheme
NT	Northern Territory
p	Passenger
PFCs	Perfluorocarbons
PJ	Petajoules
SF_6	Sulphur hexafluoride
t	Tonne
tdm	Tonnes of dry matter
TJ	Terajoules
Vista Gold	Vista Gold Australia Pty Ltd
XLPE	Cross-linked polyethylene

1. Introduction

1.1 Background

Vista Gold Australia Pty Ltd (Vista Gold) proposes to re-establish and operate the Mt Todd Gold Mine, located 55 kilometres (km) north of Katherine and 250km south of Darwin. The mine site is accessed via Jatbula Road, approximately 10km east of the Stuart Highway.

The Mt Todd Mine is a brownfield/disturbed site within an historical mining district. The site was most recently mined for gold in the late 1990s with operations ceasing in the early 2000s. Mining infrastructure such as pit, tailings dams, waste rock dump and remains of processing facilities remain onsite.

This report discusses the greenhouse gas (GHG) emissions associated with the construction, operation and the closure of the mine, identifies any potential impacts from GHG emissions, and documents necessary measures to manage identified potential impacts.

1.2 Level of Assessment

The assessment requirements are outlined in the Draft Environmental Impact Statement Guidelines for the Mt Todd Gold Project prepared by the NT EPA (formerly the Department of Natural Resources, Environment, The Arts and Sport (NRETAS)) in 2011). The draft guidelines refer to the *NT Environmental Impact Assessment Guide: Greenhouse Gas Emissions and Climate Change* (NRETAS 2010) for specific requirements for the GHG assessment. The GHG assessment is required to include:

- an estimate of the GHG emissions for the construction and operation phases:
  - in absolute and carbon dioxide equivalent terms;
  - identified on a gas by gas basis; and
  - by source, including on site and upstream sources.
- details of the project lifecycle GHG emissions and the greenhouse gas efficiency of the project;
- measures to minimise GHG emissions; and
- a comparison of estimated GHG emissions with NT, Australian and global annual GHG emissions.

1.3 Australian, Northern Territory and Global Greenhouse Gas Emissions

The Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) estimate annual greenhouse gas emissions for Australia to fulfil reporting requirements of the United Nations Framework Convention on Climate Change and the Kyoto Protocol. A breakdown of Australia's GHG emissions by state and territory are published by the DCCEE, the latest being for 2009/10 (DCCEE, 2012).

Australia's and the Northern Territories total GHG emissions for 2009/10 were estimated as 560.8 million tonnes of carbon dioxide equivalent (Mt CO_2-e) and 14.7 Mt CO_2-e respectively. The major emission sources for the NT were agriculture (primarily the burning of savannas) and fuel combustion for stationary energy purposes.

In 2010 global GHG emissions for Annex 1 Parties to the United Nations Framework Convention on Climate Change were 23 gigatons of carbon dioxide equivalent (Gt CO_2-e) (UNFCCC, 2013).

1.4 Project Overview

This Project comprises the mining of gold ore from the existing Mt Todd Gold Mine – Batman Pit (previously mined and now in care and maintenance).

Mining will be an open-pit truck and shovel operation, using large haul trucks, hydraulic shovels and front end loaders to transport materials to the crusher, stockpiles, Run of Mine (ROM) pad and waste dump. Extracted ore, will be processed in an ore processing plant where it will be crushed, milled and then carbon in leach (CIL) leached followed by adsorption, desorption and recovery leading to gold dore (unrefined gold). Approximately 17.8 million tonnes per annum (Mtpa) of ore will be processed. Gold dore will be transported for onward secure shipment to a refinery.

Mine construction will occur over a two year period (including pre-production operations during six months in construction year 2) and employ a workforce of up to 450. Mine production is expected to occur over a further 13 year period followed by a four year closure period.

2. Legislative Framework

Key Commonwealth legislation relevant to the Project and potential implications includes the following:

- *Clean Energy Act 2011*. The Clean Energy Future legislation will introduce a carbon pricing mechanism that has a broad coverage from commencement, encompassing the stationary energy sector, transport, industrial processes, non-legacy waste and fugitive emissions. The carbon pricing mechanism will commence on 1 July 2012, with a fixed price for the first three years, after which the carbon price will transition to a fully flexible price under an emissions trading scheme, with the price determined by the market. The mine site will exceed thresholds for participation in the carbon pricing mechanism. Participation will need to be determined based on actual annual greenhouse gas emissions.
- *National Greenhouse and Energy Reporting Act 2007*. In the 2011-2012 reporting year, the National Greenhouse and Energy Reporting Scheme (NGERS) applies to facilities that emit over 25,000t CO_2-e per year or consume more than 100TJ of energy or corporations that emit over 50,000t CO_2-e per year or consume more than 200TJ of energy. These thresholds relate to Scope 1 and Scope 2 emissions. Based on the estimated energy use during operations, the Project will trigger the facility and corporation thresholds. Participation will need to be determined based on actual annual greenhouse gas emissions and energy consumption.
- *Energy Efficiency Opportunities Act 2006*. The Energy Efficiency Opportunities (EEO) program requires businesses to identify, evaluate and publicly report cost effective energy saving opportunities. Participation in EEO is mandatory for corporations that use more than 0.5PJ of energy per year. As the Project will use more than 0.5PJ of energy per year at full production levels, it will be mandatory to report this under the EEO program. Participation will need to be assessed based on actual energy consumption to determine the first year the threshold is exceeded.
- *Carbon Credits (Carbon Farming Initiative) Act 2011*. The Carbon Farming Initiative (CFI) has been developed to give farmers, forest growers and landholders the ability to generate accredited domestic offsets for access to domestic voluntary and international carbon markets. It is unlikely that the Project will be able to generate offsets at the mine site unless it can be demonstrated that rehabilitation of the mine site is additional to legislative requirements and planning approval conditions. Any claims relating to 'carbon neutrality' for the Project (or part thereof) should give consideration to the use of offsets generated under the CFI.

3. Methodology

3.1 Overview

The greenhouse gas assessment was prepared in accordance with the general principles of:

- *The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition,* developed by the World Resource Institute and the World Business Council for Sustainable Development (GHG Protocol);
- The Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) *National Greenhouse Accounts* (NGA) Factors, July 2011 (DCCEE, 2011); and
- Australia's National Carbon Accounting System (DCCEE, 2005).

These are considered to represent current good practice in Australian greenhouse gas accounting.

3.2 Boundary of the Assessment

The assessment included emissions from the following activities:

- fuel combustion from construction, operation and mine closure;
- wastewater treatment during operation and mine closure;
- vegetation removal;
- explosive use during operations;
- embodied emissions (i.e. the emissions associated with the production) of major construction materials and plant;
- embodied emissions of major consumable materials during ore processing;
- transportation of materials to site during construction and operations;
- transportation of gold dore to Darwin during operations; and
- employee transportation during construction, operation and mine closure.

3.3 Greenhouse Gases Considered

The greenhouse gases and associated Global Warming Potential (GWP) considered in this assessment are listed in Table 1. The GWPs were sourced from the NGA Factors July 2012.

Table 1 Greenhouse gases and 100 year global warming potentials

Greenhouse gas	Global warming potential [1]
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	140 – 11,700
Perfluorocarbons (PFCs)	6,500 – 9,200
Sulphur hexafluoride (SF_6)	23,900

[1] GWP is a relative measure of how much heat a greenhouse gas traps in the atmosphere, eg: methane has 21 times the effect of carbon dioxide.

3.4 Emission Scopes

Emissions have been separated into Scopes 1, 2 and 3 in accordance with the GHG Protocol. These scopes are defined as follows:

1. Scope 1 emissions are greenhouse gas emissions created directly by a person or business from sources that are owned or controlled by that person or business;
2. Scope 2 emissions are greenhouse gas emissions created as a result of the generation of electricity, heating, cooling or steam that is purchased and consumed by a person or business. These are indirect emissions as they arise from sources that are not owned or controlled by the person or business who consumes the electricity; and
3. Scope 3 emissions are greenhouse gas emissions that are generated in the wider economy as a consequence of a person's or business's activities. These are indirect emissions as they arise from sources that are not owned or controlled by that person or business but they exclude Scope 2.

Scope 1 emissions are produced by the combustion of fuels such as diesel at the development site, and by vehicles and plant equipment which the proponent owns and has operational control over. Note that only the direct combustion of the fuels is considered as Scope 1 emissions.

Scope 2 emissions arise from the consumption of electricity at the development site, in plant and equipment that is owned and operated by the proponent.

Emissions arising from the extraction, processing and transportation and distribution of fuels and electricity are classified as Scope 3, since these activities are not within the operational control of the end user.

All other emissions associated with the Project are defined as Scope 3, since they are produced outside the development site, and the proponent does not have operational control of the facilities from which they originate. The proponent does not own or operate any of the vehicles that transport raw materials to the site. As such, emissions resulting from the combustion of fuels for this transportation are classified as Scope 3.

3.5 Data Collection and Calculation Procedures

Activity data used for the GHG assessment was provided by Vista Gold.

The calculation of greenhouse gas emissions for the Project was based on the methodology detailed in the *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* developed by the World Business Council for Sustainable Development and the World Resources Institute (GHG Protocol) and the relevant emission factors. The main sources of emission factors included:

- DCCEE NGA Factors July 2011; and
- SimaPro Australian and ecoinvent databases. These databases contain emission factors for scope 3 emission sources such as construction materials and transportation of materials to site.

To calculate Project emissions a spreadsheet model was specifically developed for the Project.

When data was unavailable, assumptions and approximations were made to obtain a reasonable estimate of activity levels or emission factors. All assumptions are detailed in Section 3.7.

All energy consumption and emissions data was converted into quantities of carbon dioxide equivalent. The emission values have been summed to reach an estimate of the total greenhouse gas emissions for the project.

Vegetation Clearing

Greenhouse gas emissions due to vegetation clearing were quantified using the National Carbon Accounting Toolbox (NCAT). The NCAT provides access to the Full Carbon Accounting Model (FullCAM) and supporting data (Richards and Evans, 2004). FullCAM is the method used to quantify emissions due to land clearing in Australia for the purposes of international reporting. The model estimates and predicts carbon stocks present in tree, debris and soil carbon pools and the transitions between different carbon pools in forest and agricultural systems.

In this assessment FullCAM was used to calculate the carbon stocks of mature vegetation at the Project site. It was assumed that the vegetation had reached maturity so that both the emissions from the removal of vegetation, as well as the lost sequestration potential of the vegetation, were taken into account. This is considered a conservative estimate of emissions from vegetation clearing as the current condition of the vegetation is not considered and the sequestration of carbon dioxide following site rehabilitation is not included in the assessment.

FullCAM requires information about the climatic and geophysical conditions in the area being modelled. This data was downloaded from the DCCEE Server for a specified location using FullCAM's Data Builder. A representative point at the project site (latitude: -14.141403; longitude: 132.111111) was chosen for which climatic, geophysical and maximum aboveground biomass values were downloaded. The maximum aboveground biomass is a value in FullCAM used to define a site's biomass potential. It provides an upper limit for the stock of trees and crops that can exist at a site (Richards *et al.* 2005). For the Project site the maximum aboveground biomass was 59.78 tonnes of dry matter per hectare (tdm/ha).

The FullCAM model was configured as a "Multilayer Forest System" over a period of 100 years. The initial conditions assumed that there was zero above ground vegetation at the start of the simulation. Vegetation growth was simulated as "natural regeneration" based on *Eucalyptus tintinnans*.

All FullCAM default settings were used for “Site”, “Trees” and “Soils” categories. An average year of climatic data (contained in FullCAM), based on records from 1968 – 2002, for the Project site was used. Kandosol and Tenosol soils were the available region soil types in FullCAM for the project location. Both soil types were modelled yielding the same result.

Except for the initial clearing event followed by natural regeneration, no fires, vegetation disturbances or vegetation management events (e.g. clearing, thinning, fertilising or pruning) in the vegetation’s history, were simulated. This provides a conservative calculation of carbon stocks at the site.

The mass of all carbon pools at the end of the 100 year simulation was used as the emission factor for vegetation removal.

3.6 Exclusions from the Assessment

Exclusions from the assessment included:

- electricity imported from the grid. Although the site will be able to import electricity from the grid it is assumed that electricity for the site will be supplied by the proposed gas turbine and any electricity imported from the grid during construction and operation will be negligible compared to the emissions over the life of the project;
- combustion of oils and greases in plant. These emissions were considered to be negligible compared with the emissions over the life of the project;
- emissions associated with the manufacture of minor consumables such as office supplies, cleaning products and personal protective equipment and the transportation of these consumables to site. These emissions were considered negligible compared to the overall emissions;
- miscellaneous construction materials were not included as part of this assessment as these components are considered minor, and are not considered as having considerable impact over the life of the project;
- emissions associated with the manufacture of sodium metabisulphite solution, activated carbon and lead nitrate. Emission factors for these consumables could not be identified and therefore were excluded from the assessment. It is unlikely that the exclusion of these consumables will be material to the overall emissions estimate;
- leakage of hydrofluorocarbons from air conditioning units and refrigeration. These emissions were considered to be negligible compared with the emissions over the life of the project;
- leakage of sulphur hexafluoride from electrical equipment. These emissions were considered to be negligible compared with the emissions over the life of the project;
- perfluorocarbons will not be generated or released during the project;
- scope 3 emissions from natural gas combustion (a Scope 3 emission factor is not provided for the Northern Territory in the NGA Factors July 2011 and was therefore excluded from the assessment);
- sequestration of carbon dioxide from revegetation of the site. The sequestration of carbon dioxide was excluded to provide a conservative estimate of emissions associated with vegetation removal and subsequent revegetation; and

- transportation of mine personnel by private vehicle. The majority of the mine workforce will be transported to site by bus and therefore emissions from private vehicle usage were considered to be negligible compared with the emissions over the life of the Project.

3.7 Assumptions

Assumptions used in estimating the activity levels and greenhouse gas emissions for the Project are listed in Table 2 for construction, Table 3 for operations and Table 4 for mine closure.

The assessment was based on emission factors available at the time of the assessment and future changes in emission factors were not considered.

Table 2 Construction assumptions

Parameter measured	Assumptions
Energy	
Diesel	Quantity of diesel for stationary and transport energy purposes estimated as 3,300 kL over the construction period. As per the methodology described in Section 3.5 Emission Factors (EFs) were sourced from the DCCEE NGA Factors July 2012 Tables 4 & 39 as transport EFs are greater than stationary EFs.
Materials	
Cables	Quantity estimated as 118 t based on 220,600 m of 50 mm^2 cross-linked polyethylene (XLPE) single copper core cable with a mass of 53.6 kg per 100 m. It was assumed that a 50 mm^2 cable was representative of all cables used during construction works. EF based on the mass percentage of XLPE (17%) and copper (83%) in a 50 mm^2 cable. EF for XLPE sourced from SimaPro Australian Database 2007 for polyethylene and EF for copper sourced from SimaPro Australian Database 2007.
Concrete	Quantity estimated as 24,500 t. EF sourced from the SimaPro Australian Database 2007 for concrete.
Geomembrane	Quantity estimated as 6,501 t based on 3,533,300 m^2 of geomembrane, a thickness of 2 mm and density of 0.92 t/m^3. EF sourced from SimaPro Australian Database 2007 for polyethylene.
Steel - major processing equipment	Mass of major processing equipment (crushers, mills and screens) estimated as 7,465 t. For the purpose of the assessment it was assumed that the major processing equipment was 100% steel. EF sourced from the SimaPro Australian Database 2007 for steel.
Steel - structural	Mass of structural steel estimated as 6,930 t. EF sourced from the SimaPro Australian Database 2007 for steel.

Parameter measured	Assumptions
Vegetation removal	
Vegetation removal	The area of vegetation to be removed was estimated as 575 ha as per the Flora and Vegetation Assessment (GHD 2013). A representative point at the Project site (latitude: -14.141403; longitude: 132.111111) was chosen for which climatic, geophysical and maximum aboveground biomass values were downloaded from the DCCEE server. It was assumed that data downloaded at this point was representative of conditions across the project site. In calculating existing carbon stocks on the site no fires, vegetation disturbance or vegetation management events (e.g. clearing, thinning, fertilising or pruning) in the vegetation's history were simulated. It was assumed that all carbon from the above ground vegetation, roots and soil carbon pools would be removed by the project and would not regrow following clearing. In the absence of FullCAM categories for each vegetation community identified at the site, it was assumed that the existing FullCAM tree species group "*Eucalyptus tintinnans*" represents the types of vegetation existing in the area.
Materials transportation	
Cables	It was assumed that cables will be sourced from manufacturers in Lilydale, Victoria and transported to site by road.
Concrete	It was assumed that the dry components of concrete (i.e. cement and aggregates) will be sourced from manufacturers in Darwin, Northern Territory and transported to site by road. Water for concrete will be sourced onsite. It was assumed that the dry components were 80% of the total concrete mass.
Diesel	It was assumed that diesel will be sourced from producers in Singapore, transported to Darwin by ship and transported to site by road. The density of diesel was assumed to be 0.83 t/kL.
Geomembrane	It was assumed geomembranes will be sourced from manufacturers in Malaga, Western Australia and transported to site by road.
Steel - major processing equipment	It was assumed major processing equipment will be sourced from manufacturers in South East Asia, transported to Darwin by ship and transported to site by road.
Steel - structural	It was assumed that steel will be sourced from manufacturers in Whyalla, South Australia and transported to site by road.

Parameter measured	Assumptions
***Employee transportation*[1]**	
Employee transportation – bus	Quantity of employee transportation estimated as 13,104,000 passenger kilometres (p.km) based on 410 construction personnel being transported from the construction camp by bus (50km round trip), 7 days per week, for a two year construction period. It was assumed that the remaining 40 construction personnel would travel by light vehicles and the fuel for these light vehicles is included in the diesel quantity for construction. EF sourced from 2012 Department for Environment, Food and Region Affairs (DEFRA) guidelines for coaches.
Wastewater treatment	
Wastewater treatment - septic system	Workforce population estimated as 450 construction personnel (based on 410 construction personnel and 40 senior construction staff) and a two year construction period. EF sourced from NGA Factors July 2012 Table 44 based on anaerobic treatment of both wastewater and sludge and default factors for chemical oxygen demand per person and methane emission factors.

Table 3 Operations assumptions

Parameter measured	Assumptions
Energy	
Diesel - stationary	Quantity of diesel for stationary energy purposes estimated as 32,850 kL per annum. EF sourced from NGA Factors July 2012 Tables 3 & 39 for post 2004 vehicles.
Diesel - transport	Total diesel consumption for road registered vehicles estimated as 4 kL per annum. EF sourced from NGA Factors July 2012 Tables 4 & 39.
Natural gas	Quantity of natural gas estimated as 8.9PJ per annum. EF sourced from NGA Factors July 2011 Tables 2 (Scope 1). EF for Scope 3 emissions not provided for the Northern Territory in the NGA Factors July 2011.

[1] Unless otherwise stated:

- road transportation emissions were based on a rigid truck emission factor sourced from SimaPro Australian Database 2007;
- shipping was based on an international shipping emissions factor sourced from SimaPro Australian Database 2007; and
- distances were estimated using Google Earth Pro.

Parameter measured	Assumptions
Materials	
Sodium hydroxide	Quantity of sodium hydroxide estimated as 710 t per annum. EF sourced from the SimaPro Australian Database 2007 for sodium hydroxide.
Explosives	Quantity of explosives estimated as 3,000 t per annum. Scope 1 EF sourced from NGA Factors 2008 for heavy ANFO and Scope 3 EF sourced from the SimaPro ecoinvent v1.3 database for ammonium nitrate.
Flocculent solution	Quantity of flocculent estimated as 266 t per annum. EF sourced from the SimaPro Australian Database 2007 for flocculent.
Hydrochloric acid	Quantity of hydrochloric acid estimated as 1,441 t per annum. EF sourced from ecoinvent database version 1.3 and was based on European data for 30% hydrochloric acid in water.
Lime	Quantity of lime estimated as 16,153 t per annum. EF sourced from ecoinvent database version 1.3 and was based on European data for packed quick lime.
Sodium cyanide	Quantity of sodium cyanide estimated as 13,668 t per annum. EF sourced from ecoinvent database version 1.3 and was based on European data for sodium cyanide tablets.
Steel - ball mills grinding media	Quantity of steel for ball mill grinding media estimated as 16,901 t per annum. EF sourced from the SimaPro Australian Database 2007 for steel.
Materials transportation[2]	
Caustic soda	It was assumed that caustic soda will be sourced from manufacturers in Yarwun, Queensland and transported to site by road.
Diesel	It was assumed that diesel will be sourced from producers in Singapore, transported to Darwin by ship and transported to site by road. The density of diesel was assumed to be 0.83 t/kL.
Explosives	It was assumed that explosives will be sourced from manufacturers in Port Hedland, Western Australia and transported to site by road.
Flocculent solution	It was assumed that flocculent will be sourced from manufacturers in Yarwun, Queensland and transported to site by road.

[2] Unless otherwise stated:

– road transportation emissions were based on a rigid truck emission factor sourced from SimaPro Australian Database 2007;
– shipping was based on an international shipping emissions factor sourced from SimaPro Australian Database 2007; and
– distances were estimated using Google Earth Pro.

Parameter measured	Assumptions
Hydrochloric acid	It was assumed that hydrochloric acid will be sourced from manufacturers in Yarwun, Queensland and transported to site by road.
Lime	It was assumed that lime will be sourced from manufacturers in Mataranka, Northern Territory and transported to site by road.
Sodium cyanide	It was assumed that sodium cyanide will be sourced from manufacturers in Yarwun, Queensland and transported to site by road.
Steel - ball mills grinding media	It was assumed that grind media will be sourced from producers in China, transported to Darwin by ship and transported to site by road.
Employee transportation	
Employee transportation - bus	Quantity of employee transportation estimated as 11,234,700 p.km per annum based on 320 operation personnel being bussed from Katherine (104 km round trip) and 365 days per year. EF sourced from 2012 DEFRA guidelines for coaches.
Wastewater treatment	
Wastewater treatment - septic system	Workforce population estimated as 350 people per year (based on 320 operation personnel and 30 senior staff). EF sourced from NGA Factors July 2012 Table 44 based on anaerobic treatment of both wastewater and sludge and default factors for chemical oxygen demand per person and methane emission factors.

Table 4 Mine closure assumptions

Parameter measured	Assumptions
Diesel - stationary	Quantity of diesel for stationary energy purposes estimated as 1,200 kL based on 300 kL per annum and a closure period of four years. EF sourced from NGA Factors July 2012 Tables 3 & 39.
Employee transportation - bus	Quantity of employee transportation estimated as 4,993,200 p.km based on 30 mine closure personnel being transported from Katherine (104 km round trip) for 365 days per year and a closure period of four years. EF sourced from 2012 DEFRA guidelines for coaches.
Wastewater treatment - septic system	Workforce population estimated as 40 people per year and a closure period of four years. EF sourced from NGA Factors July 2012 Table 44 based on anaerobic treatment of both wastewater and sludge and default factors for chemical oxygen demand per person and methane emission factors.

4. Greenhouse Gas Emissions

The greenhouse gas emissions for the project were calculated based on estimated energy usage during construction, operations and mine closure, embodied emissions in major construction and operation materials, vegetation removal, wastewater treatment, explosives usage and transportation of employees to site.

Scope 1, 2 and 3 emissions for the project are summarised in Table 5. Emissions were based on the mine and processing facility operating for 19 years (2 years for construction, 13 years operation and 4 years for mine closure). Total emissions for the Project are estimated at approximately 10.5 Mt CO_2-e. Scope 1 emissions over the life of the Project were estimated to be approximately 8.2 Mt CO_2-e, and Scope 3 emissions are estimated as approximately 2.3 Mt CO_2-e. It is anticipated that emissions associated with electricity imported from the grid will be negligible compared to the total emissions as the proposed gas turbine will provide electricity for the site. Therefore Scope 2 emissions have been reported as zero.

The operational phase of the project is estimated to contribute 98.8 percent of total project emissions. The construction phase is estimate to contribute 1.1 percent of total project emissions. Emissions associated with mine closure are estimated to contribute less than 0.1 percent of total project emissions.

Table 5 Summary of GHG emissions over the project life

Project Phase	Scope 1 emissions (t CO_2-e)	Scope 2 emissions (t CO_2-e)	Scope 3 emissions (t CO_2-e)	Total GHG emissions (t CO_2-e)	Percentage of project life emissions
Construction	58,718	0	59,661	118,379	1.1%
Operations	8,184,026	0	2,231,649	10,415,675	98.8%
Mine closure	3,259	0	419	3,678	<0.1%
Total	**8,246,003**	**0**	**2,291,728**	**10,537,731**	

Assuming a total project life of 19 years, the average annual greenhouse gas emissions for the project are estimated as approximately 0.50 Mt CO_2-e per annum. Compared with the Northern Territory's 2009/10 greenhouse gas emissions of approximately 17.4 Mt CO_2-e per annum (DCCEE, 2012), the average annual emissions for the Project are estimated to be approximately 2.9 percent of the Northern Territory's annual emissions. Compared with Australia's 2009/10 greenhouse gas emissions of approximately 560.8 Mt CO_2-e per annum, the average annual emissions for the project are estimated to be approximately 0.09 percent of Australia's annual emissions. The global greenhouse emissions for Annex 1 Parties to the UNFCCC in 2010 were 23 gigatons of carbon dioxide equivalent (Gt CO_2-e) (UNFCCC, 2013). The average annual emissions for the project are estimated to be approximately 0.002 percent of the global annual emissions.

The major source of emissions during operations was estimated as energy consumption (i.e. natural gas and diesel), contributing 79.5 percent of emissions. Energy consumption was followed by embodied emissions in materials (18 percent), transportation of materials to site (2.5 percent), employee transportation (0.1%) and wastewater treatment (<0.1%). The major individual emissions sources during operations were estimated as:

- natural gas combustion (65.8%);
- diesel combustion for stationary (i.e. non-transport) purposes (13.7%);
- embodied emissions in sodium cyanide (7.5%); and
- embodied emissions in grinding media (4.6%).

These four emission sources are estimated to contribute 91.6% of total GHG emissions during operations.

A breakdown of the annual Scope 1 greenhouse gas emissions during operation by gas is provided in Table 6. Carbon dioxide was the major greenhouse gas emitted (99.7% of total carbon dioxide equivalent emissions) followed by methane (0.2%) and nitrous oxide (0.1%). As discussed in Section 3.6, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride were not considered in the assessment.

Table 6 Annual operations Scope 1 greenhouse gas emissions by gas type

Greenhouse gas	Emissions (t)		Percentage of CO_2-e emissions
	(t)	(t CO2-e)	
Carbon dioxide[1]	543,977	543,977	99.7%
Methane	52.6	1,104	0.2%
Nitrous oxide	1.7	521	0.1%
Total carbon dioxide equivalent emissions		545,602	100%

1. Carbon dioxide emissions include emissions from explosive use as these emissions could not be separated by gas type.

2. Methane emissions include emissions from wastewater treatment.

The greenhouse gas inventories for construction, operations and mine closure are provided in Appendix A.

5. Potential Mitigation Measures

The management of adverse impacts arising from the Project has been addressed according to the hierarchy of avoidance, mitigation and offsetting of adverse impacts.

5.1 Avoidance of Impacts

Impacts of the Project on greenhouse gas emissions have been avoided or minimised where possible through the planning and design process.

The consumption of diesel is a necessary requirement of the Project, and currently accounts for approximately 14 percent of the greenhouse gas emissions from the Project. However, a reduction in the quantity of fuel consumed may be achievable through optimisation of operational activities and logistics. Optimisation of these activities may reduce the number of vehicles and/or trips required. This optimisation should be undertaken during the detailed project design and planning stage.

A small reduction in fuel consumption may be achieved through the use of more efficient plant and vehicles. Modern vehicle and plant models are typically more fuel efficient than the older models. The use of more recent vehicles and plant models would need to be part of a wider fuel management strategy that incorporates project planning, logistics, driver education and maintenance as any fuel reduction due to more efficient models may be outweighed by poor management in other areas.

Further mitigation and offset measures are described below with the aim to overcome these constraints.

5.2 Mitigation of Impacts

The majority of emissions for the Project are from the combustion of natural gas in a gas turbine to provide the project site with electricity. The gas fired turbine is estimated to produce 18,000 GWh of electricity over the project life. The Scope 1 greenhouse gas intensity of the onsite gas turbine is estimated to be 0.38 kg CO_2-e/kWh. Compared with the GHG intensity of grid electricity in the Northern Territory (0.67 kg CO_2-e/kWh), the onsite turbine significantly reduces emissions associated with the electricity demand for the Project site.

The most significant greenhouse gas mitigation option for fuel related emissions is likely to be the use of biodiesel. Biodiesel blends (diesel that has a percentage of the fuel replaced with biodiesel) may reduce greenhouse gas emissions due to fuel consumption, however, this is dependent on a number of factors including the origin of the biodiesel feedstock.

When sourced from appropriate feedstocks, the reduction in emissions is approximately equivalent to the percentage of biodiesel in the blend (for example diesel with 20 percent biodiesel will reduce greenhouse gas emissions by approximately 20 percent). Calculations to determine the reduction in GHG emissions when using biodiesel should consider the entire life cycle of the fuel.

There are a number of other factors that require consideration prior to the use of biodiesel for the Project. There is significant debate over the suitability and/or the percentage of biodiesel that can be used in vehicles and plant. Biodiesel may not be suitable for some vehicles without major modifications. Plant operators are also concerned that vehicle and plant warranties may be void if biodiesel or biodiesel blends are used in vehicles. Opportunities for the use of biodiesel may be further examined and used where possible on the Project.

5.3 Energy Efficiency

It is recognised that mining operations will result in the generation of greenhouse gas emissions. Through efficient and appropriate management of the operations, emissions can effectively be reduced. Identification of the significant energy consuming equipment and recognising opportunities to make this more efficient, including the application of technical efficiencies in plant and equipment as and when available, would provide more efficiency in operations.

Development and implementation of an energy efficiency review which would identify initiatives and available technologies, leading to implementation of processes to ensure energy efficiency opportunities are integrated into operations, may be undertaken. A monitoring process like this would ensure potential energy efficient concepts are recognised and considered through operations. This is further discussed in Section 5.4.

Best practice environmental management in the mining industry is generally governed and directed by the site specific environmental management plan. A well-defined management plan which outlines control, management and research strategies to ensure environmental conditions are considered during the operational and decommissioning phases of the mine will ensure targets and goals are achievable and best practice management is realised.

Through the environmental management plan, appropriate management would be integrated into all activities and processes and greenhouse gas emissions would be monitored. Through assessment and review, the Project will seek continuous improvement in compliance and emissions reduction.

5.4 Energy Management

Commitments to energy management would be developed as part of a detailed energy efficiency assessment. Monitoring and implementation of energy efficient improvements are also required under the EEO Act. Regular energy audits and reviews of mining operations may identify possible energy efficiency improvement opportunities which may be implemented to progressively improve operations and subsequent energy efficiency.

5.5 Offsets

The feasibility of generating carbon offsets at the Project site in accordance with the Carbon Farming Initiative should be investigated during Project planning. The feasibility study would need to consider legislative and development approval requirements in assessing whether the potential carbon offset projects comply with the additionality requirements (e.g. being able to demonstrate that rehabilitation of the mine site is additional to legislative requirements and planning approval) of the Carbon Farming Initiative.

The Project will exceed the threshold for participation in the carbon pricing mechanism. Therefore, a legislative price on the Scope 1 greenhouse gas emissions from the Project will apply. Voluntarily offsetting additional greenhouse gas emissions through the purchase of carbon offsets generated in Australia or overseas should be considered when assessing the Project’s liability under the carbon pricing mechanism.

5.6 Monitoring and Reporting

There are a number of legislative requirements for measuring, monitoring and reporting greenhouse gas emissions and energy consumption that are applicable to the Project for example under the *National Greenhouse and Energy Reporting Act 2007,* the *Clean Energy Act 2011* and the *Energy Efficiency Opportunities Act 2006*. The liable entity for NGERS reporting and the carbon pricing mechanism would need to be determined prior to the commencement of the construction phase. The Proponent will need to determine if it or the construction contractor(s) have operational control on the project site as defined in the *National Greenhouse and Energy Reporting Act 2007*.

Scope 1 and 2 emissions from the mining operations will be required to be measured or estimated as part of NGERS. The technical guidelines for NGERS outline the methods used for measuring and reporting Scope 1 and Scope 2 greenhouse gas emissions.

Measuring and monitoring Scope 1 emissions will be required as part of the carbon pricing mechanism.

Monitoring and reporting will also be mandatory under the EEO Act.

The legislative measuring and reporting requirements may be used to assist in the identification of greenhouse gas reduction opportunities and track performance throughout the mining operations.

6. References

Department of Climate Change and Energy Efficiency (2005) National Carbon Accounting Toolbox. http://www.climatechange.gov.au/.

Department of Climate Change and Energy Efficiency (2011). National Greenhouse Accounts (NGA) Factors July 2012, http://www.climatechange.gov.au/.

Department of Climate Change and Energy Efficiency (2012). Australian National Greenhouse Accounts: State and Territory Greenhouse Gas Inventories 2009-10, http://www.climatechange.gov.au/.

Department of Natural Resources, Environment, The Arts and Sport (2010). NT Environmental Impact Assessment Guide: Greenhouse Gas Emissions and Climate Change.

GHD (2013). Mt Todd Gold Project. Flora and Vegetation Assessment. Prepared for Vista Gold Australia Pty Ltd, 2013.

NTG (2012). TARGET Environment 2.5: *The Northern Territory contributes to the national target for greenhouse gas reduction*. Territory 2030, Viewed Online on June 2012 at <www.territory2030.nt.gov.au/documents/snapshots/pdf/EN2.5.pdf>. Northern Territory Government**.**

Richards, G. and Evans, D. (2004). 'Development of a carbon accounting model (FullCAM Vers. 1.0) for the Australian continent'. *Australian Forestry – The Journal of the Institute of Foresters of Australia,* Vol. 67, No. 4.

Richards, G. Evans, D. Reddin, A and Leitch, J. (2005). 'The *FullCAM* Carbon Accounting Model (version 3.0) User Manual'. National Carbon Accounting System, *Department of the Environment and Heritage Cataloguing-in-Publication.*

United Kingdom (UK) Department for Environment, Food and Region Affairs (2011) *2011 Guidelines to DEFRA / DECC's GHG Conversion Factors for Company Reporting.*

United Nations Framework Convention on Climate Change (2013). http://unfccc.int/2860.php, accessed 09/05/13

World Resource Institute and the World Business Council for Sustainable Development (2004). *The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition,* http://www.ghgprotocol.org/.

Appendix A

Greenhouse Gas Inventory

Table 7 GHG inventory for construction

Emission source category	Emission source	Value		CO_2 Emission Factor	CH_4 Emission Factor	N_2O Emission Factor	Scope 1 Emission Factor	Scope 2 Emission Factor	Scope 3 Emission Factor	Total Emission Factor		Method	CO_2 Emissions	CH_4 Emissions	N_2O Emissions	Scope 1 Emissions	Scope 2 Emissions	Scope 3 Emissions	Total Emissions	Proportion of Total Inventory
		(Q)	Units	t CO_2 / unit	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	Units		t CO_2	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	%
Energy	Diesel	3,300	kL	2.67	0.00772	0.01930	2.70	0	0.20	2.90	kL	Q x EF	8,815	25	64	8,904	0	675	9,579	8.1%
Materials	Cables	118	t	0	0	0	0	0	4.97	4.97	t	Q x EF	0	0	0	0	0	587	587	0.5%
	Concrete	24,500	t	0	0	0	0	0	0.14	0.14	t	Q x EF	0	0	0	0	0	3,455	3,455	2.9%
	Geomembrane	6,501	t	0	0	0	0	0	2.18	2.18	t	Q x EF	0	0	0	0	0	14,173	14,173	12.0%
	Steel - major processing equipment	7,465	t	0	0	0	0	0	1.91	1.91	t	Q x EF	0	0	0	0	0	14,258	14,258	12.0%
	Steel - structural	6,930	t	0	0	0	0	0	1.91	1.91	t	Q x EF	0	0	0	0	0	13,236	13,236	11.2%
Vegetation removal	Vegetation removal	575	ha	86	0	0	86	0	0	86	ha	Q x EF	49,591	0	0	49,591	0	0	49,591	41.9%
Materials transportation	Cables	118	t	0	0	0	0	0	0.876	0.876	t	Q x EF	0	0	0	0	0	104	104	0.1%
	Concrete	19,600	t	0	0	0	0	0	0.071	0.071	t	Q x EF	0	0	0	0	0	1,388	1,388	1.2%
	Diesel	2,739	t	0	0	0	0	0	0.089	0.089	t	Q x EF	0	0	0	0	0	244	244	0.2%
	Geomembrane	6,501	t	0	0	0	0	0	0.921	0.921	t	Q x EF	0	0	0	0	0	5,991	5,991	5.1%
	Steel - major processing equipment	7,465	t	0	0	0	0	0	0.098	0.098	t	Q x EF	0	0	0	0	0	729	729	0.6%
	Steel - structural	6,930	t	0	0	0	0	0	0.621	0.621	t	Q x EF	0	0	0	0	0	4,304	4,304	3.6%
Employee transportation	Employee transportation - bus	14,924,000	p.km	0	0	0	0	0	0.0000347	0.0000347	p.km	Q x EF	0	0	0	0	0	518	518	0.4%
Wastewater treatment	Wastewater treatment - septic system	900	p.years	-	-	-	0.24804	0	0.0000000	0.2480400	p.year	Q x EF	-	-	-	223	0	0	223	0.2%
Total GHG emissions (construction period)													58,406	25	64	58,718	0	59,661	118,379	

Table 8 GHG inventory for operations

Emission source category	Emission source	Value		CO_2 Emission Factor	CH_4 Emission Factor	N_2O Emission Factor	Scope 1 Emission Factor	Scope 2 Emission Factor	Scope 3 Emission Factor	Total Emission Factor		Method	CO_2 Emissions	CH_4 Emissions	N_2O Emissions	Scope 1 Emissions	Scope 2 Emissions	Scope 3 Emissions	Total Emissions	Proportion of Total Inventory
		(Q)	Units	t CO_2 / unit	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	Units		t CO_2	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	%
Energy	Diesel - stationary	32,850	kL	2.67	0.00386	0.00772	2.68	0	0.20	2.89	kL	Q x EF	87,746	127	254	88,127	0	6,720	94,847	13.7%
	Diesel - transport	4	kL	2.67	0.00039	0.02316	2.69	0	0.20	2.90	kL	Q x EF	11	0	0	11	0	1	12	0.0%
	Natural gas	8,900,000	GJ	0.05	0.00010	0.00003	0.05	0	0.00	0.05	GJ	Q x EF	455,680	890	267	456,837	0	0	456,837	65.8%
Materials	Sodium hydroxide	710	t	0.00	0.00000	0.00000	0.00	0	1.13	1.13	t	Q x EF	0	0	0	0	0	802	802	0.1%
	Explosives	3,000	t	-	-	-	0.18	0	8.60	8.78	t	Q x EF	-	-	-	540	0	25,800	26,340	3.8%
	Flocculent solution	266	t	0.00	0.00000	0.00000	0.00	0	1.18	1.18	t	Q x EF	0	0	0	0	0	314	314	0.0%
	Hydrochloric acid	1,441	t	0.00	0.00000	0.00000	0.00	0	0.76	0.76	t	Q x EF	0	0	0	0	0	1,091	1,091	0.2%
	Lime	16,153	t	0.00	0.00000	0.00000	0.00	0	0.75	0.75	t	Q x EF	0	0	0	0	0	12,050	12,050	1.7%
	Sodium cyanide	13,668	t	0.00	0.00000	0.00000	0.00	0	3.81	3.81	t	Q x EF	0	0	0	0	0	52,075	52,075	7.5%
	Steel - ball mills	16,901	t	0.00	0.00000	0.00000	0.00	0	1.91	1.91	t	Q x EF	0	0	0	0	0	32,281	32,281	4.6%
Materials transportation	Sodium hydroxide	710	t	0.00	0.00000	0.00000	0.00	0	0.68	0.68	t	Q x EF	0	0	0	0	0	480	480	0.1%
	Diesel	27,269	t	0.00	0.00000	0.00000	0.00	0	0.09	0.09	t	Q x EF	0	0	0	0	0	2,427	2,427	0.3%
	Explosives	3,000	t	0.00	0.00000	0.00000	0.00	0	0.53	0.53	t	Q x EF	0	0	0	0	0	1,585	1,585	0.2%
	Flocculent solution	266	t	0.00	0.00000	0.00000	0.00	0	0.68	0.68	t	Q x EF	0	0	0	0	0	180	180	0.0%
	Hydrochloric acid	1,441	t	0.00	0.00000	0.00000	0.00	0	0.68	0.68	t	Q x EF	0	0	0	0	0	974	974	0.1%
	Lime	16,153	t	0.00	0.00000	0.00000	0.00	0	0.04	0.04	t	Q x EF	0	0	0	0	0	645	645	0.1%
	Sodium cyanide	13,668	t	0.00	0.00000	0.00000	0.00	0	0.68	0.68	t	Q x EF	0	0	0	0	0	9,239	9,239	1.3%
	Steel - ball mills	16,901	t	0.00	0.00000	0.00000	0.00	0	0.10	0.10	t	Q x EF	0	0	0	0	0	1,650	1,650	0.2%
Employee transportation	Employee transportation - bus	13,315,200	p.km	0.00	0.00000	0.00000	0.00	0	0.000035	0.000035	p.km	Q x EF	0	0	0	0	0	462	462	0.1%
Wastewater treatment	Wastewater treatment - septic system	350	p	-	-	-	0.25	0	0.00	0.25	p.year	Q x EF	-	-	-	87	0	0	87	0.0%
Total GHG emissions for operation per annum													543,437	1,017	521	545,602	0	148,777	694,378	
Total GHG emissions for 15 years of operations													8,151,561	15,252	7,810	8,184,026	0	2,231,649	10,415,675	

Table 9 GHG inventory for mine closure

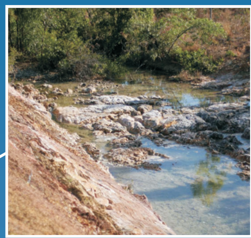
Emission source category	Emission source	Value		CO_2 Emission Factor	CH_4 Emission Factor	N_2O Emission Factor	Scope 1 Emission Factor	Scope 2 Emission Factor	Scope 3 Emission Factor	Total Emission Factor		Method	CO_2 Emissions	CH_4 Emissions	N_2O Emissions	Scope 1 Emissions	Scope 2 Emissions	Scope 3 Emissions	Total Emissions	Proportion of Total Inventory
		(Q)	Units	t CO_2 / unit	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	t CO_2-e / units	Units		t CO_2	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	(t CO_2-e)	%
	Diesel - stationary	1200	kL	2.67	0.00386	0.00772	2.68	0	0.20	2.89	kL	Q x EF	3,205	5	9	3,219	0	245	3,465	94.2%
	Employee transportation - bus	4993200	p.km	0.00	0.00000	0.00000	0.00	0	0.00	0.00	p.km	Q x EF	0	0	0	0	0	173	173	4.7%
	Wastewater treatment - septic system	160	p.years	-	-	-	0.25	0	0.00	0.25	p.year	Q x EF	-	-	-	40	0	0	40	1.1%
Total GHG emissions for decommissioning													3,205	5	9	3,259	0	419	3,678	

GHD

Level 5, 66 Smith Street
Darwin NT 0800
T: (08) 8982 0100   F: (08) 8981 1075   E: drwmail@ghd.com.au

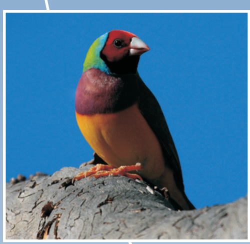
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	A Maddocks	S Trahair	Sue Trahair	I McCardle	I McCardle	30/05/13



APPENDIX Y

Reclamation Plan



Report to:

VISTA GOLD CORP.

7961 Shaffer Parkway, Suite 5, Littleton, CO 80127
Phone: 416-368-9080 Fax: 416-368-1963

Mt Todd Gold Project
Preliminary Feasibility Study
Reclamation Plan
Northern Territory, Australia

PROJECT NO. 114-311285

DATE: JUNE 2013

TETRA TECH

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS

ARD	Acid Rock Drainage
ARD/ML	Acid Rock Drainage and Metal-Laden Leachate
GCL	Geocomposite Clay Liner
H	Horizontal
HDPE	High Density Polyethylene
HLP	Heap Leach Pad
hr	hour
km	kilometer
LGO1	Existing low grade ore stockpile
LGO2	New low grade ore stockpile
LPM	low-permeability materials
m	meter
m^2	square meter
m^3	cubic meter
MDA	Mine Development Associates
Mt	Million tonnes
Mtpy	Million tonnes per year
MWH	Montgomery Watson and Harza
New WTP	Proposed WTP
NNP	Net Neutralizing Potential
NT	Northern Territory of Australia
O&M	Operations and Maintenance
PAG	Potentially Acid Generating
PEA	Preliminary Economic Analysis
Pegasus	Pegasus Gold Australia Pty Ltd
PFSRP	Preliminary Feasibility Study Reclamation Plan
PGM	Plant Growth Medium
PFS	Preliminary Feasibility Study NI 43-101 Technical Report
RP	Retention Pond
RP1	Waste Rock Dump Pond
RP2	LGO Stockpile Pond
RP3	Batman Pit Lake
RP4	Run-of-Mine Pond
RP5	Process Plant Runoff Pond
RP6	Process Plant Pond
RP7	TSF1 Pond
RUSLE	Revised Universal Soil Loss Equation
SWCC	Soil Water Characteristic Curve
TDR	Time-Domain Reflectometers
TPD	tonnes per day
TSF1	Existing Tailings Storage Facility
TSF2	New Tailings Storage Facility
Vista	Vista Gold Corp.
WEPP	Water Erosion Prediction Project
WRD	Waste Rock Dump
WRMP	Waste Rock Management Plan
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

Tetra Tech, Inc. (Tetra Tech) was retained by Vista Gold Corp. (Vista) to develop a Preliminary Feasibility Study Reclamation Plan (PFRP) for the Mt. Todd Project (Mt. Todd) 50,000 (50K) tonne per day (TPD) mine plan in support of the Preliminary Feasibility Study NI 43-101 Technical Report (PFS) for renewed mining operations. This PFSRP assesses select reclamation requirements and associated costs of resumed mining under the PFS mining plan, effective June, 2013.

Mt. Todd is located 56 kilometers (km) by road northwest of Katherine, and approximately 290 km southeast of Darwin in Northern Territory (NT), Australia. In March 2006, Vista gained the rights to explore and develop the mineral resources of Mt. Todd. In January 2007, Vista assumed the obligation to operate, care for and maintain assets held by the NT Government at Mt. Todd. The rights and responsibilities assumed by Vista in 2006 and 2007 continue as of the authoring of this report.

This report focuses on the reclamation earthworks associated with closing existing and future mine features during and following the completion of mining operations. The reclamation plan included in this report is based on the reclamation cover design presented in the Mt. Todd Project Preliminary Feasibility Closure Plan – Appendix J, Northern Territory, Australia, January 11, 2011, Tetra Tech. This report will be referred to here as the ‘January 2011 PFCP’. Vista is also conducting studies to address immediate environmental challenges for the Mt Todd site including management of acid rock drainage and metal-laden leachates (ARD/ML) currently contained in several water storage facilities. Current and future water treatment plans; sludge management; surface water management; facility decontamination, decommissioning, demolition and disposal; and baseline studies and permitting are not covered in this report, as they are discussed in detail elsewhere. The costs of selective handling of waste rock and the haulage of waste rock to the Tailings Storage Facility (TSF) 1 and 2 are not covered in this report, as they are discussed in detail elsewhere.

The major facilities that are included in this PFSRP are as follows:

- Batman Pit;
- Waste Rock Dump (WRD);
- Process Plant and Operations Area;
- Heap Leach Pad (HLP);
- Mine roads.
- Existing Tailings Storage Facility (TSF1);
- Proposed TSF (TSF 2);
- Low Grade Ore Stockpile (LGO1);
- Proposed LGO (LGO2) located north of the Process Plant Area; and
- Haul roads to all new and expanded facilities.

Plans and strategies for the reclamation of these existing and proposed facilities are provided in this report.

Purpose and Scope

The primary goals of this PFSRP are:

1. Advance previous closure and reclamation plans by defining reclamation approaches, strategies, and estimated costs at an overall ± 15 percent level of accuracy;
2. Update reclamation cost estimates to reflect utilization of mine employees and mine-owned equipment in reclamation activities;
3. Provide an estimate of the Security Cost for the project utilizing the Northern Territory's (NT) Security Cost estimate protocols;
4. Identify information and functional gaps pertaining to mine reclamation;
5. Summarize future investigations to address the information gaps identified; and
6. Recommend actions to address the functional gaps identified.

Approach

This PFSRP was developed based on input from Vista and their consultants; review of readily available data and information regarding Mt. Todd; and Tetra Tech's technical experts who are familiar with Mt. Todd mine and metallurgic planning. Additional technical support was provided by Tetra Tech geochemists, hydrogeologists, civil engineers, and vadose modeling experts.

Key issues and project drivers were identified during development of the January 2011 PFCP as well as a series of participatory meetings with Vista representatives, Mine Development Associates (MDA), and Tetra Tech staff. The concepts, strategies, and options developed and evaluated during these meetings and subsequent analyses were discussed with and endorsed by Vista and serve as the foundation for this PFSRP.

The reclamation store and release covers presented in the January 2011 PFCP were used as the basis for the store and release cover design in this PFSRP. This PFSRP was developed by modifying and updating the January 2011 PFCP according to the revised mining plan, recent findings and analyses from ongoing investigations, and design and planning efforts. These findings and analyses were incorporated to the extent possible to support specific portions of the PFSRP.

As noted earlier, this PFSRP does not include certain items addressed in the PFCP, such as surface water management, water treatment. These and other matters addressed in the PFCP are dealt with in other Appendices of the PFS.

The reclamation plans developed and their estimated costs are based on the following:

- 18 Million tonnes per year (Mtpy) mine plan and existing engineering and data presented in the PFS;
- Geochemical testing program and results (2013 Geochemistry Program);
- Mine-life (i.e., pre-production phase of two years, production phase of 13 years, reclamation phase of 2 years, and post-reclamation monitoring and maintenance phase of approximately 5 years);
- Estimates of environmental conditions throughout the mine-life;
- NT Government mine closure and environmental protection regulations and guidelines;
- Published unit costing, equipment specification and performance references;

- Australian cost estimates provided by Proteus, Tetra Tech, and Mt. Todd employees in Australia;
- Tetra Tech's recent mine closure costing experience; and
- Best professional judgment.

Goals and Important Project Drivers

The reclamation goals for Mt. Todd include:

1. Control acid-generating conditions;
2. Minimize erosion of facilities containing mine waste;
3. Reduce or eliminate the acid and metal loads of seepage and runoff water;
4. Minimize adverse impacts to the surface and ground water systems surrounding Mt. Todd;
5. Physical and chemical stabilization of mine waste and other mine-related surface disturbances;
6. Protect public safety; and
7. Comply with NT Government regulations governing mine development and closure.

The important project drivers by which the reclamation plan and strategies were developed are as follows:

1. Use standard reclamation practices with the knowledge that design details will be fine-tuned in the future;
2. Use previous investigations, studies, and available data and information;
3. Identify information gaps and future investigations necessary to improve the characterization of site conditions now and through reclamation;
4. Provide Vista with practical development and recommendations to facilitate:
    a. Future closure and design efforts, and
    b. Site-wide integration of closure designs;
5. Exploit 'Mine for Closure' opportunities by reclaiming mine components simultaneously with mining (i.e., concurrent reclamation);
6. Identify strategies to reduce acid/metal loading to water management structures and ground and surface water;
7. Handle materials and water efficiently; and
8. Emphasize low-maintenance or "walk away" reclamation where practical.

Major Reclamation Planning Results

The reclamation plans for each existing and proposed major facility at Mt. Todd are summarized in Table ES1.

Throughout the mine-life, Vista should anticipate, plan, design for, and implement effective plans for:

1. Identification of potentially acid-generating (PAG) and non-PAG materials, as well as materials that have the potential to leach constituents in concentrations above applicable water quality-based effluent standards (metaliferous);
2. Selective handling of PAG and non-PAG material and potentially direct treatment of PAG materials throughout the mine-life to prevent or reduce the generation of ARD/ML;
3. Separation of unimpacted surface and ground water from PAG and metalliferous materials and ARD/ML;
4. Short- and long-term hydrologic isolation of PAG and metalliferous materials from ground and surface water;
5. Facility and site-wide closure; and
6. Control of stormwater to prevent excessive erosion and sedimentation.

Tetra Tech recommends the following specific closure investigations necessary to address the information gaps:

1. Complete an analysis of waste and cover material hydraulic properties;
2. Complete a tailings trafficability study;
3. Complete a precipitation-watershed yield study;
4. Complete a tailings management plan;
5. Complete a site-wide soils, closure cover, and reclamation material inventory and characterization study; and
6. Complete a waste and closure cover erosion and sediment control study.

Tetra Tech estimated reclamation costs. Based on the costing approach discussed in this report, the PFS cost estimate for implementing this closure plan is **AU $154,812,000**. This cost estimate includes reclamation of major facilities at Mt. Todd, utilizes costs for performing reclamation activities with mine employees and mine-owned equipment, and includes indirect costs for an additional environmental supervisor to oversee reclamation activities.

TABLE ES1: RECLAMATION APPROACH

Task	Facility							
	Batman Pit	WRD	HLP	TSF1&2 Impounded Surface	TSF1&2 Dams	Process Plant and Pad	LGO 2	Mine Roads
Surface of Facility at Cessation of Production Composed of Non-PAG		x			x			
Final Overall Slopes > 3H:1V*	x				x			x
Final Overall Slopes < 3H:1V*		x	x	x		x	x	x
Benches Created During Construction	x	x			x			
Install 1.0 meter-Thick non-PAG Material		x		x				
Install 0.8 meter-Thick Store and Release Cover			x	x	x	x	x	x
Install 0.2 meter-Thick Plant Growth Medium (PGM) Cover		x	x	x	x	x	x	x
Revegetate with Native Seed Mix			x	x	x	x	x	x
Install GCL Liner (with under and overlayer of fines)		x						
Install Erosion and Sediment Controls		x	x	x	x	x	x	x
Construct Access Restriction Bund	x							
Additional Remedial Measures (as necessary)	x	x	x	x	x	x	x	x

* > and < indicates slopes are steeper and less steep, respectively.

1.0 INTRODUCTION

Tetra Tech was retained by Vista to develop a PFSRP for Mt. Todd 50K TPD in support of the PFS for renewed mining operations. This PFSRP evaluates the reclamation liabilities that will transfer to Vista should a decision be made to restart mining operations at Mt. Todd and is primarily supported by information and data provided in the 2013 Geochemistry Program, prepared by Tetra Tech. The primary goals of this PFSRP are:

1. Advance previous closure and reclamation plans by defining reclamation approaches, strategies, and cost estimates at an overall ± 15 percent level of accuracy;
2. Update reclamation estimates to reflect utilization of mine employees and mine-owned equipment in reclamation activity;
3. Develop the Northern Territory's (NT) Security Cost estimate;
4. Identify information and functional gaps pertaining to mine reclamation;
5. Summarize future investigations to address the information gaps identified; and
6. Recommend actions to address the functional gaps identified.

To achieve these goals, Tetra Tech developed plans and estimated quantities (e.g., facility dimension, material volumes, surface areas, and disturbance footprints) for the reclamation of major mine facilities at Mt. Todd. These plans and estimates were based on the following:

- 18 Mtpy mine plan;
- The January 2011 PFCP;
- Previously developed reclamation plans and strategies;
- Mine-life (i.e., pre-production phase of two years, production phase of 13 years, reclamation phase of 2 years, and post-reclamation monitoring and maintenance phase of approximately 5 years);
- Estimates of environmental conditions throughout the mine-life;
- NT Government mine closure and environmental protection regulations and guidelines; and
- Best professional judgment.

Vista is presently conducting studies to address immediate environmental challenges for Mt Todd including management of ARD/ML currently contained in several water storage facilities. Current and future water treatment plans; sludge management; surface water management; facility decontamination, decommissioning, demolition and disposal; and baseline studies and permitting are not are not covered in this report, as they are discussed in detail elsewhere. The costs of selective handling and the haulage of non-PAG waste rock to TSF 1 and 2 are not covered in this report, as they are discussed in detail elsewhere. This report focuses on the reclamation earthworks associated with closing existing and future mine features during and following the completion of mining operations. An emphasis in this reclamation plan has been placed on reclaiming features which contain PAG materials. PAG materials are currently located in the TSF1, WRD, Batman Pit, HLP, and other locations at Mt. Todd. Both PAG and non-PAG waste rock and tailings will be produced during the production phase of the project (See Geochemistry Program for additional discussions regarding existing and future waste rock and tailings quality). Tetra Tech believes that these current and anticipated waste management, closure, and water management challenges at Mt. Todd are significant but manageable. To manage these challenges, a concerted and well-coordinated effort will be necessary. This reclamation plan does not address water management issues or facilities removal and disposal, but rather focuses on the reclamation of facilities involving movement of earth and materials (e.g. TSF 1 and 2, WRD, HLP, roads, processing pad areas and LGO stockpile).

The reclamation plan for existing and proposed major facilities at Mt. Todd is summarized in Table 1 and includes:

1. General grading and capping designs and estimates of cut/fill and cover volumes for the reclamation of mine wastes, roads, the processing area, ponds no longer used at closure, and other mine-related surface disturbance; and
2. Analysis and preliminary numeric modeling of long-term store and release cover hydrologic performance

Throughout the mine-life, Vista should anticipate, design, plan, and implement effective plans for:

1. Identification of PAG and non-PAG materials, as well as materials that have the potential to leach metals in concentrations above applicable water quality-based standards;
2. Selective handling PAG and non-PAG material and potentially direct treatment of PAG materials to prevent the generation of ARD/ML;
3. Continuous collection, containment, and treatment of all ARD/ML prior to release;
4. Separation of unimpacted surface and ground water from ARD/ML;
5. Hydrologic isolation of acidic materials from ground and surface water; and
6. Control of stormwater to prevent excessive erosion and sedimentation.

Specific closure plans and strategies have not been developed in this document for the decommissioning, demolition, and removal of surface facilities. Geotechnical stability analyses of the closure grading and cover plans for the HLP and mine roads were not completed. Instead, the assumption was made that cut and fill slopes with a maximum overall slope gradient of 3 horizontal (H):1 vertical (V) is adequate to ensure long-term geotechnical stability. An evaluation of the geotechnical stability of the TSF1, TSF2, and WRD is provided in the applicable appendices to the PFS. Plans for the establishment of specific post-mining land uses and wildlife habitat were not completed for this PFSRP.

Descriptions of the existing environment at Mt. Todd, including the status of mining infrastructure, water management, and environmental monitoring and compliance are provided in the PEA (Gustavson, 2006) and the January 2011 PFCP.

The major facilities that currently exist on site or that will be constructed as part of the PFS mine plan that are included in this PFSRP are as follows:

- Batman Pit;
- WRD;
- Process Plant and Operations Area (including RP2, RP5 and the Equalization Pond);
- HLP;
- Mine roads;
- TSF 1;
- TSF 2;

- LGO1;
- LGO2 located north of the Process Plant Area; and
- Haul roads to all new and expanded facilities.

1.1 Report and Effective Date

All designs and costs used in the development of this reclamation plan are subject to variability. The reclamation plan enclosed in this report is effective as of June, 2012.

Additionally, the WRD Geosynthetic Clay Liner (GCL) Cover Vadose Model referenced in this report and included as Attachment A will be updated at a future date. The vadose modeling results discussed in the attached summary were completed in February 2012.

2.0 RECLAMATION PLAN ANALYSIS

This PFSRP was developed based on input from Vista and their consultants; review of readily available data and information regarding Mt. Todd; and Tetra Tech's technical experts who are familiar with Mt. Todd mining and mineral processing plans. Additional technical support was provided by Tetra Tech geochemists, hydrogeologists, civil engineers, and water balance modeling experts.

Key issues and project drivers were identified during development of the January 2011 PFCP as well as a series of participatory meetings with Vista representatives, MDA and Tetra Tech staff. The concepts, strategies, and options developed and evaluated during these meetings and subsequent analyses were discussed with and endorsed by Vista and serve as the foundation for this PFSRP. The January 2011 PFCP was used primarily as the basis for this PFSRP. This PFSRP was developed by modifying and updating the January 2011 PFCP according to the 50k TPD mining plan, recent findings and analyses from ongoing investigations, and design and planning efforts.

With the exception of matters such as surface water management, water treatment and other exclusions mentioned above and addressed in the PFCP (discussed in other Appendices of this PFS) these findings and analyses were incorporated to the extent possible to support specific portions of this PFSRP.

The reclamation plans for individual facilities of Mt. Todd were based on predictions of site conditions during the mine-life phases. Available information, numeric modeling, and best professional judgment were used to estimate site conditions such as ARD/ML sources and flow volumes, annual precipitation and runoff variability, extreme flood events, and the hydrologic and physicochemical properties of the mine, tailings, waste rock, and potential closure cover materials.

This section of the report includes a summary of the important elements and approaches used to develop reclamation plans and strategies.

2.1 Reclamation Planning Goals and Important Drivers

The reclamation goals for Mt. Todd include:

1. Control existing acid-generating conditions;
2. Minimize erosion of facilities containing mine waste;
3. Reduce or eliminate the acid and metal loads in seepage and runoff water;
4. Minimize adverse impacts to the surface and ground water systems surrounding Mt. Todd;
5. Physically and chemically stabilize mine waste and other mine-related surface disturbances;
6. Protect public safety; and
7. Comply with NT Government regulations governing mine development and reclamation.

The important project drivers by which reclamation plans and strategies were developed are as follows:

1. Use standard reclamation practices with the knowledge that design details will be fine-tuned in the future;
2. Use previous investigations, studies, and available data and information;
3. Identify information gaps and future investigations necessary to improve the characterization of site conditions now and through reclamation closure;
4. Provide Vista with practical development and reclamation recommendations to facilitate site-wide integration of reclamation designs.
5. Exploit 'Mine for Closure' opportunities by reclaiming mine facilities simultaneously with mining (i.e., concurrent reclamation);
6. Identify strategies to reduce acid/metal loading to water management structures and ground and surface water by emphasizing hydrologic isolation of acidic materials from ground and surface water where plausible.
7. Handle materials efficiently; and
8. Emphasize low-maintenance "walk away" reclamation where practical.

2.2 General Reclamation Planning Strategies

The general planning strategies used in the development of the reclamation plans provided in this PFSRP include the following:

1. Generate the lowest amount of ARD/ML feasible to minimize acid/metal loads that must be handled in the water conveyance and treatment system by:
    a. Isolating mine waste from precipitation and oxygen through the installation of store and release covers, GCLs, erosion control, rapid stormwater conveyance from the surface of graded and capped mine waste (surface water controls are not included in the scope of this reclamation plan, but are addressed in other Appendices), and prevention of surface water ponding;
2. Demolish and remove unnecessary mining facilities and structures, (decommissioning and demolition of facilities and structures are not included in the scope of this reclamation plan, but are addressed in other Appendices).
3. Create stable final configurations of features through regrading, placement of cover and installation of stormwater drainage systems at closure (stormwater drainage systems are not included in the scope of this reclamation plan, but are addressed in other Appendices).

2.3 Major Reclamation Assumptions

A summary of the major assumptions used for the development of this PFSRP is provided below. Estimated quantities (e.g., facility dimension, material volumes, surface areas, and disturbance footprints) used for the development of this PFSRP are discussed further in Sections 3 and 5, as well as in applicable sections of this PFSRP. Future work should be conducted to verify the assumptions presented below.

2.3.1 Reclamation Assumptions

- Sufficient quantities of non-PAG waste rock will be selectively handled during mining so as to be available for the reclamation of the LGO2, WRD, TSF1, TSF2, HLP, process plant pad area, roads, and other mine-related surface disturbance.
- Non-PAG waste rock in combination with low-permeability materials (LPM) will be suitable as a store and release cover material.
- LPM to be used in store and release covers will be imported from a source(s) within 40 to 60 kilometers of Mt Todd to compensate for a lack of such material on-site.
- Imported LPM will consist of non-expansive materials with a compacted hydraulic conductivity equal to or less than 1×10^{-6} cm/sec.
- Plant growth medium (PGM) will be available on-site in existing stockpiles and from material salvage from new disturbance (TSF 2, expanded WRD, etc.).
- Material salvage from construction and expansion of facilities will yield an average of 0.2 m depth of PGM, but no LPM material suitable for store and release covers.
- Supplemental PGM will be provided through crushing of non-PAG waste rock into fines.
- Soil amendments will not be required to facilitate plant growth on the crushed non-PAG waste rock.
- Applying a 1 m thick cover of non-PAG waste rock on the impounded surface of the TSF1 and TSF2 is adequate to bridge thixotropic tailings to permit the installation of the 0.8 m-thick store and release cover and 0.2 m thick PGM cover on the TSF1 and TSF2.
- Attaining final cut and fill slopes no steeper than approximately 3H:1V will be adequate to ensure long-term geotechnical stability of the TSF1, TSF2 and all other plant facilities, excluding the WRD.
- A GCL cover design in addition to placement of non-PAG waste rock around the perimeter of each bench will provide sufficient capping of the WRD to minimize seepage of ARD/ML.
- LGO1 will be eliminated as a result of the Batman Pit expansion, and will not require reclamation.
- The safety berm installed around the perimeter of the Batman Pit will be offset 30 m to account for the minimum 10 m buffer beyond an assumed 20 m “potentially unstable pit edge zone” per the requirements outlined in the guidelines for “Safety Bund Walls around Abandoned Open Pit Mines” from the Department of Industry and Resources in Western Australia.
- Vista will assume the responsibility to reclaim the HLP following the reprocessing of leached ore in the Mill.
- Leached ore in the HLP will be removed and re-processed in the Mill. The current high density polyethylene (HDPE)-liner will be removed and disposed of in TSF 2. The fill below the liner will be tested to determine presence and extent of contamination. Contaminated fill will be excavated and disposed of in TSF 2.
- Weak acid dissociable (WAD) cyanide levels in pore water and seepage from HLP and contaminated fill excavated from below the HLP are below maximum allowable concentration limits. Therefore, the liner or fill below the HLP will not require rinsing or

treatment with oxidants following the reprocessing of leached ore in the Mill and prior to grading and reclamation.

- The equipment fleet used for mining will be used to conduct reclamation activities.
- Mine-owned equipment and mine employees will be available during production to assist with concurrent reclamation activities.

Reclamation plans and strategies for each major facility at Mt. Todd are summarized in Section 3.0.

3.0 RECLAMATION PLAN

This section of the report includes a summary of the important elements of the PFSRP and our recommendations regarding the practical approaches to reclamation at Mt. Todd.

When mining is renewed at Mt. Todd, the plans and designs contained here must be refined based on changes in mine plans and site conditions, unforeseen circumstances, acquisition of additional data, and advancements in site knowledge and closure technologies. Vista personnel should continue to work closely with engineers, technical experts and specialists, scientists, and agencies to implement practical and effective closure, reclamation and water management programs at Mt. Todd. These same staff should work to improve the designs and analyses provided in this report as well the PFS. The success of closure, reclamation, liability reduction, and mine and asset development will depend on these future efforts.

The major facilities that currently exist on site or that will be constructed as part of the PFS mine plan that are included in this PFSRP are as follows:

- Batman Pit;
- WRD;
- Process Plant and Operations Area;
- HLP;
- Mine roads;
- TSF 1;
- TSF 2;
- LGO 1;
- LGO 2 located north of the Process Plant Area; and
- Haul roads to all new and expanded facilities.

Facilities not covered under this reclamation plan include:

- RP1 and pumping system;
- RP2 pumping system;
- RP3 and pumping system;
- RP4;
- RP5 pumping system;
- RP6;
- RP7;
- HLP Ponds and pumping system;
- Existing Water Treatment Plan (WTP) and sludge management facilities;
- New WTP and sludge management facilities; and
- Stormwater and surface water control facilities.

Reclamation approach and strategies for each major facility at Mt. Todd are discussed below and briefly summarized in Table 1. All recommendations for the advancement of reclamation to a design-level are provided in Section 4.0. The operational status and reclamation schedule of the Mt Todd facilities discussed within this plan is provided in Table 2.

3.1 Reclamation Materials

Limited materials suitable for reclamation are available on the Mt Todd project site. Reclamation materials utilized will include run-of mine non-PAG waste rock, imported LPM, existing PGM stockpiles, salvaged PGM from new facility construction, and crushed non-PAG waste rock as supplemental PGM.

The LPM is required for use in store and release reclamation covers. The requirements of this material are presented in Table 3. As sufficient quantities of suitable LPM have not been identified on-site, LPM material will be imported. A low permeability materials inventory was conducted in October and November 2012 and preliminarily identified potential sources of low permeability materials within 40 to 60 kilometers of the Project area. Samples of material within the potential sources of LPM were subject to laboratory testing to determine their physical properties. Based on preliminary evaluation of the lab and field inventory results the potential LPM source materials are non-expansive with compacted hydraulic conductivity equal to or less than 1×10^{-6} cm/sec and few coarse rock fragments. Additional investigations are necessary to confirm the quality and quantity of low-permeability materials within these and other potential sources of LPM. The LPM material will be used in the reclamation of the HLP, TSF1, TSF2, LGO2, mine roads and the process plant area.

PGM will be used as the top layer of reclamation covers for vegetation establishment. PGM will be obtained from existing stockpiles at the Mt Todd site, as well as through salvaging surficial soils within the footprints of new facility construction, including but not limited to TSF 2 and expansion areas of the WRD. An average of 0.2 m of suitable PGM is assumed to be present beneath the footprints of the salvage areas. PGM suitability guidelines are presented in Table 3. As needed, non-PAG waste rock will be crushed and used as supplemental PGM for revegetation. It is assumed that PGM from existing stockpiles, new salvage and crushed non-PAG waste rock will be of sufficient quality to facilitate plant growth and will not require any additional soil amendments. PGM will be used in the reclamation of the HLP, TSF1, TSF2, LGO2, the process plant and pad area, roads and other mine-related disturbances.

Run-of mine non-PAG waste rock will be used as bridging material over the tailings impoundments, erosion control material on the WRD, and mixed with LPM for store and release covers. Crushed non-PAG rock will be used as bedding and overlying material for the GCL cover on the WRD. Non-PAG waste rock will be handled during mining such that sufficient quantities will be available for concurrent reclamation of the HLP, WRD, TSF1, and TSF2. Additional non-PAG waste rock will be available at mine closure for final closure of the LGO2, WRD, TSF2, process plant and pad areas, roads and other mine-related disturbances.

3.2 Batman Pit

The Batman Pit will be significantly deepened and enlarged from its current depth of 114 m to a final planned depth of over 594 m below the pit rim elevation of 194 m. At closure the pit perimeter will be of approximately 4,500 m. Long term pit water treatment is not covered under this reclamation plan.

Scaling and blasting of select pit benches and walls will be completed during the production phase to reduce the potential of human injury due to rock fall and improve pit wall stability and aesthetics.

A pit safety bund will be constructed around the entire perimeter of the Batman Pit to impede human access to the pit. The pit safety bund will be constructed with a 5 m base and 2 m height with a 10 m offset from the potentially unstable pit edge zone to ensure berm longevity and safety. As such, the pit berm will be approximately 4,300 m in length and utilize nearly 43,000 m^3 of non-PAG material from the Batman Pit. Key reclamation quantities are presented in Table 4.

3.3 Waste Rock Dump

The existing WRD contains approximately 16 Mt of waste rock. The WRD will be significantly enlarged through the addition of approximately 562 Mt of waste rock. Based on the geochemical testing and analysis program conducted for the PFS (2013 Geochemistry Program), approximately 41 percent of the waste rock excavated during renewed mining activities will be non-PAG. As part of the PFS mine plan a Waste Rock Management Plan (WRMP) will be developed that specifies how waste rock is to be handled to minimize the potential for ARD/ML and maximize the beneficial use of non-PAG waste rock for closure. The WRMP will include:

- Routine waste rock testing procedures such as collecting monthly samples for analysis of carbon and sulfur that can be used to confirm data from the blast hole database;
- Staging dump construction to minimize the contact of PAG rock with air and water;
- Selective handling and isolation of the highest sulfide material or blending PAG and non-PAG waste rock;
- Contouring WRD surfaces to shed precipitation and runoff away from PAG materials during production and at closure; and
- Sequential closure of inactive dump areas and faces as mining progresses.

The results of this planning effort will include managing waste rock disposal so the outer layers of the WRD at closure are composed of non-PAG waste rock. The WRMP should also emphasize the implementation of operational techniques and dump designs that encourage clean water diversion, rapid internal surface runoff, and seepage control during operations and at closure.

From its current area of 69 hectares, the WRD will be constructed at an effective angle of 30 degrees with interbench slopes of 34 degrees and will expand to a planned 3D surface area, following closure, of approximately 241 hectares. Each lift will be constructed at 34 degrees with 8 m wide benches at 30 m vertical intervals on the face of the WRD. These benches will function as stormwater drainages and as access for reclamation cover installation, reclamation activities, and maintenance. The WRD will be built to final grade and configuration. Otherwise, the WRD will be benched appropriately to satisfy geotechnical stability constraints.

The WRD design was completed by MDA and is shown on Figures 1 and 2. This design:

- Avoids placing waste rock in RP1;
- Avoids grading of waste rock at the end of the mine-life;
- Incorporates concurrent reclamation throughout the life of the WRD;
- Results in reclamation of the entire WRD by the end of planning year 11; and
- Creates a ‘geomorphic’ final surface that includes:
    - Highly dissected, non-uniform and complex slopes;

- Opportunities for dispersing rather than concentrating runoff from the surface of the WRD; and
- Final WRD configuration similar to the surrounding undisturbed topography.

Concurrent installation of a GCL cover following attainment of final grades is proposed for the closure of the WRD. This cover design will include a 0.3 m thick bedding layer of crushed rock consisting of 750 mm particle size material, followed by placement of the GCL, and capped with a 0.3 m thick protecting layer of finely crushed rock placed over the GCL. The GCL will span approximately 52 m on top of each lift, covering the 8 m bench, and running below the subsequent lift. The GCL will be sloped at a 5 percent angle slopes toward the outside of the WRD. The GCL will be constructed with a 0.5 m berm made with 1:1 side slopes at the interior edge of the GCL layer. This cover will channel seepage toward the outer edge of the dump, toward the non-PAG material, mitigating generation of ARD/ML. A 1 m thick layer of non-PAG waste rock will be placed on the top of all surfaces of the WRD to aid in erosion control. The estimated volume of cover material necessary to close the WRD is approximately 585,000 m^3 of 750 mm particle size bedding material, and 585,000 m^3 of fines to be used as a protective layer over the GCL. Additionally, approximately 2.0 million m^2 of GCL will be applied to the WRD. Key reclamation quantities are presented in Table 4.

Seepage through the WRD with a similar cover configuration (25 m sections of GCL on each bench) has been modeled in the software program VADOSE (Attachment A). Initial modeling results indicate that the GCL cover will restrict seepage to such a degree as to allow for acceptable long-term passive water treatment. It is expected that implementation of 52 m GCL covers on each bench will reduce the quantity of seepage beyond what was established in the modeling of the 25 m sections of GCL. Additional information regarding the seepage modeling is included as Attachment A.

3.4 Tailings Storage Facilities

Approximately 62 and 146 Mt of slurry tailings will be disposed of in the TSF1 and TSF2, respectively. Thickened tailings will be produced at the Process Plant and disposed of in TSF1 and TSF2 as slurry with an average solids content of 50 percent by weight. The particle size of the tailings is anticipated to be fine, with 85 percent passing #100 mesh. Prior to construction of the tailings dam and inundation, PGM will be salvaged from approximately 0.2 m to 1.0 m throughout the footprint of TSF2. Based on this range of excavation depths, approximately 896,000 m3 of PGM will be salvaged from the TSF2 footprint. This salvaged material will be utilized in the closure of TSF1. Initiation of closure activities at TSF1 and TSF2 is anticipated to occur in Production Year 4 and 13, respectively.

Tetra Tech anticipates that the impounded tailings surface conditions in TSF1 and TSF2 at the end of tailings deposition activities will be similar to the current conditions. Currently, beach sands cover only a narrow strip near the inside crest of the existing TSF1 dam and slimes cover the remainder of the surface of TSF1. As such, Tetra Tech has assumed that at closure, the majority of the impounded surface of the TSF1 and TSF2 will be primarily composed of thixotropic tailings (thick like a solid but flows like a liquid when a sideways force is applied) that will maintain a high degree of saturation for many years unless they are actively dewatered and consolidated, covered with material (i.e., increase surcharge), or are chemically treated to increase their strength.

The final planned TSF1 surface area at closure will be approximately 239 hectares (which includes an impounded surface area of 214 hectares and TSF dam surface area of 25 hectares). The final planned TSF2 surface area at closure will be approximately 301 hectares (which includes an impounded surface area of 179 hectares and dam surface area of 122 hectares).

To close the impounded surfaces of TSF1 and TSF2, a 1 m-thick cover composed of non-PAG waste rock will be installed to bridge thixotropic tailings and allow equipment access for the installation of the 1 m-thick store and release and PGM cover. The estimated volume of non-PAG material necessary to bridge the thixotropic tailings on the impounded surface of TSF1 and TSF2 is approximately 2.1 and 1.8 million m3, respectively. This non-PAG sub-base will be covered with a 0.8 m thick store and release cover composed of 66% imported LPM and 34% non-PAG waste rock, requiring 1.7 and 1.4 million m3 of store and release material to cover the TSF1 and TSF2 impoundment surfaces, respectively. The store and release cover will be topped with a 0.2 m thick cover of PGM, requiring 0.4 million m3 of material each for TSF1 and TSF2 impoundment surfaces.

Tetra Tech assumes that the 2 m cover (Figure 3) would be placed on the entire impounded surface of TSF1 and TSF2.

On the outside slopes of the main dams of TSF1 and TSF2 the 0.8 m-thick store and release cover will be installed requiring approximately 0.2 and 1.0 million m3 of non-PAG waste rock mixed with LPM, respectively. This store and release cover will be capped with 0.2 m thick PGM. The embankment surfaces of TSF1 and TSF2 will require approximately 0.05 and 0.2 million m3 of PGM, respectively. Following capping with PGM, TSF1 and TSF2 will be revegetated with native seed to increase the erosion resistance of the store and release cover. To the degree practicable, the store and release cover will be installed concurrently on the TSF1 and TSF2 dams. A figure showing the TSF cover is included as Figure 3. Key reclamation quantities are presented in Table 4.

At closure, modifications will be made to the TSFs to manage seepage and precipitation. The spillways will be modified to suit the closure design, and seepage collection ditches installed, routing seepage to a modified sump that will collect seepage via gravity feed. The seepage collection ditches will be designed to receive and convey seepage in a lined ditch to a central sump. A pump and pipeline system will then be installed to route the collected water away from the TSF sump. In the case of TSF1, collected seepage will be routed to TSF2. At closure of TSF2, collected seepage from TSF2 (which includes seepage from TSF1) will be routed to the WTP or passive treatment system, depending on the year in question. Closure of TSF1 will also include modifications to the decant system to prevent short circuiting of fluids through the TSF at closure. Closure of TSF2 will include removal of tailings delivery line spigot piping and on-site disposal.

TSF2 will be reclaimed concurrently as opportunity allows, with the impoundment surface reclaimed in Production Year 14, following completion of all processing activities.

3.5 Process Plant and Pad Area

A new processing plant will be built at the current Process Plant and Pad Area. The current plant and pad area is approximately 35 hectares. This area encompasses the Process Plant structures, crushing stockpile, RP2, RP5 and ancillary facilities such as the ANFO storage location. Tetra Tech does not anticipate the area of disturbance will change significantly due to the construction of the new processing plant. Once mineral processing ceases the Process Plant will be decommissioned, decontaminated, demolished and any reusable equipment and materials will be salvaged and resold. Removal of foundations and reclamation of Process Plant areas will occur after the plant has been removed..

The current operating assumption is that the Process Plant (or portions thereof) will be demolished (disassembled), removed (salvaged) or hauled to a solid waste landfill or other suitable locations on-site, capped, and reclaimed. Some buildings will remain to support reclamation operations and maintenance.

Concrete foundations, walls, bridges and other non-reactive, non-combustive, non-corrosive and non-hazardous demolition waste will be broken up and either:

1. Placed in the WRD; and/or
2. Buried in-place or backfilled against cutbanks and highwalls throughout the Process Plant and Pad Area, as well as other areas that will be reclaimed at Mt. Todd.

The Process Plant and Pad Area will be graded to blend into the surrounding topography and drain towards Batman Creek. Closure grading will include pushing approximately 0.35 million m^3 of material. Stormwater drainage controls and erosion and sediment controls will be designed and constructed to minimize erosion and channel scour. The Process Plant Area and Pad will be covered with the 0.8 m-thick store and release cover (described previously) to prevent exposure to the non-reactive, non-combustive, non-corrosive and non-hazardous demolition waste. The store and release cover will be capped with 0.2 m of PGM and revegetated and protected from erosion as described previously. The estimated volume of material necessary to close the Process Plant Area is approximately 0.3 million m^3 of material for the store and release cover and 70,000 m^3 of PGM. Tetra Tech assumes that the Process Plant and Pad Area will no longer be a source of ARD/ML following closure. Key reclamation quantities are presented in Table 4.

Reclamation of the Process Plant vicinity will also include closure of RP2 and RP5 in Year 13. The closure of these retention ponds will include removal of sediments, cutting, folding and disposal of liners in place, and backfilling of the pond utilizing surrounding material. The pond surfaces will be covered and revegetated as described for the Process Plant area.

The Equalization Pond will be closed 5 years after production ceases, coinciding with the closure of the WTP. The equalization pond will be closed following the same methodology as described for RP2 and RP5.

The cost for Process Plant and Pad Area surface water management and Process Plant and WTP decontamination, decommissioning, demolition and disposal are not covered in this report, as these cost are addressed elsewhere.

3.6 Heap Leach Pad and Moat

The HLP covers an area of 39 hectares and is 20 to 25 m thick with side slopes as steep as 1H:1.6V in isolated areas. These slopes are dissected by a dense network of rills and gullies. Due to the extent of exposure to precipitation, Tetra Tech assumes the WAD cyanide concentration of HLP pore water and seepage meet applicable standards. Therefore, Tetra Tech assumes deliberate rinsing of the HLP or fill beneath the HDPE liner prior to initiation of re-processing of the leach ore is not required. While not confirmed by test results, the material in the HLP is likely PAG due to the acidic nature of surface water and seepage stored in the HLP Ponds. These assumptions must be verified prior to reprocessing and closure of the HLP.

Leached ore in the HLP will be removed and re-processed in the Mill in Production Years 12 and 13. Following removal of the leached ore the HDPE liner will be removed and disposed of in TSF 2. The fill below the liner will be tested to determine presence and extent of contamination. We have assumed a 0.5 m –thick layer of contaminated fill exists below the HDPE liner for a total of 195,000 m^3 . This contaminated fill will also be excavated and disposed of in TSF 2.

Approximately 156,000 m^3 of material will be graded to promote surface water drainage from the HLP area. Following grading, the HLP will receive the typical 0.8 m thick store and release cover and 0.2 m thick PGM cap. The estimated volume of material necessary to cap the HLP is approximately 0.3 million m^3 of store and release material and about 80,000 m^3 of PGM. The HLP area will then be revegetated with native seed. Key reclamation quantities are presented in Table 4. A figure showing the HLP reclamation and cover is included as Figure 4.

3.7 Low Grade Ore Stockpiles

LGO1 will be eliminated during the expansion of the Batman Pit. Consequently, it is assumed no reclamation is required for the closure of this facility.

The LGO2 will be located northeast of the Process Plant Area (see Figure 1). Closure of LGO2 will include removal of residual ore from the stockpile areas. Tetra Tech assumed that any remaining ore will be graded to a 3H:1V slope and covered. A nominal quantity of 100,000 m^3 to be regraded has been assumed for closure of the LGO2. In addition, stormwater drainage, erosion, and sediment controls will be designed and constructed to minimize erosion and channel scour. A 0.8 m thick store and release cover will be installed as described previously, topped with 0.2 m of PGM. The estimated total surface area of the LGO2 is approximately 51 hectares. The estimated volume of store and release cover material necessary to close the LGO2 is approximately 0.4 million m^3, which will be covered with approximately 0.1 million m^3 of PGM. The cover will be revegetated as described previously. A figure showing the LGO2 reclamation and cover is included as Figure 5. Key reclamation quantities are presented in Table 4.

We assume that the LGO2 will no longer be a source of ARD/ML following closure.

3.8 Mine Roads

Mine access roads will remain in place to provide post-closure access to the area. Haul roads were assumed to be 35 m wide throughout the site. All haul roads will be closed by grading into surrounding topography, ripping subgrade materials, placing 0.2 m of PGM, and revegetating the areas as described previously. Approximately 24 ha of haul roads area will require closure. A figure showing typical mine road reclamation and cover is included as Figure 6. Key reclamation quantities are presented in Table 4.

4.0 RECLAMATION RECOMMENDATIONS

Throughout the mine-life, Vista should anticipate, plan, design, and implement effective plans for:

1. Identification of PAG and non-PAG materials, as well as metaliferous materials;
2. Selective handling of PAG and non-PAG material and potentially direct treatment of PAG materials throughout the mine-life to prevent or reduce the generation of ARD/ML;
3. Short- and long-term hydrologic isolation of PAG and metaliferous materials from ground and surface water; and
4. Control of stormwater to prevent excessive erosion and sedimentation.

Specific recommendations are provided below to address information gaps and advance the feasibility study, as well as improve the function and performance of on-site water management.

4.1 Reclamation Recommendations

The following information is needed to progress reclamation planning to a design level. The recommended work should be performed strategically so that decisions about closure and reclamation can be made sequentially and at the appropriate phase of the project. The following work items are recommended for further study:

- Waste and cover material hydraulic properties characterization and analysis;
- Tailings trafficability testing;
- Improvement of the watershed hydrologic data collection system to enable an update of precipitation-yield characteristics of the site;
- Development of a Tailings Management Plan;
- Completion of the site-wide soils and closure cover materials inventory and characterization to identify material sources, properties, and balance; and
- Erosion and sediment control analysis.

4.1.1 Waste and Cover Material Hydraulic Properties Characterization and Analysis

The hydraulic properties of waste rock, tailings, and potential cover materials require additional characterization as part of the feasibility study. These results should be used to improve:

- Waste facility and site-wide water balance prediction; and
- Evaluation of closure cover design alternatives and performance.

Samples of waste rock, tailings, and potential cover materials should be collected and analyzed to determine particle size distribution. These particle size distribution data should be compared with available computational databases (e.g., SOILVISION) to estimate variably-saturated hydraulic properties (e.g. soil water characteristic curves [SWCC], saturated and unsaturated permeability). The SWCC describes the water content of a material as a function of soil suction or negative pore-water pressure. The particle size analyses and database query results should be used to select a wide range of samples for further empirical characterization of their saturated and unsaturated hydraulic properties.

Tetra Tech recommends that saturated hydraulic conductivity and SWCC of waste rock, tailings, and potential sources of soil cover materials be tested.

Samples should be collected as follows:

1. Waste Rock - 15 to 25 waste rock samples, each with a mass of 50 kilograms (kg), should be selected to represent the majority of the rock mass lithology anticipated to be deposited in WRDs. Samples should be collected from shallow trenches excavated in the existing waste rock facilities.
2. Tailings - Ten paired tailings material cores should be collected along transects from the tailings deposition zone to the far side of the impoundment or supernatant pond, as practicable. The cores should be collected using core barrels with clear plastic liners so that stratigraphy can be readily assessed. Cores should be collected to a minimum depth of 3 m. One of the paired cores should be used to visually assess stratigraphy. Areas of distinct sandy characteristics should be identified and evaluated for vertical continuity, with the goal of determining if there are large (e.g., greater than 0.5 m in depth) intervals composed solely of sandy material. Material from intervals of interest will be sampled and submitted to a laboratory for analysis (discussed below).

   The second paired core will be sealed to prevent atmospheric oxygen from entering the sample and archived for possible future chemical analysis, depending on whether the particle size analysis indicates a significant possibility that ARD generation could be an issue.
3. Cover Material - 15 to 25 samples of potential cover material sources, each with a mass of 50 kg, should be selected to represent the range of possible cover materials. Samples should be collected from shallow trenches in areas that are representative of the majority of cover material by mass.

Particle size distributions should be determined using the sieve and hydrometer method, in accordance with American Society for Testing and Materials (ASTM) D 422. Material classification should be conducted according to ASTM D 2487. Results will include percentages of cobbles, sand, silt and clay, and the material classification. Saturated hydraulic conductivity tests are most often completed using a triaxial permeameter. A falling head permeameter is more appropriate for coarse textured materials or for the determination of the saturated hydraulic conductivity of cover material following placement. SWCC tests are most often completed using a conventional or modified pressure plate apparatus.

Results of the field characterization should be incorporated into hydrologic models (e.g., GOLDSIM, VADOSE/W, SEEP/W, SOILCOVER, H-SAT, etc.) used to simulate the long-term water balance of tailings and waste rock facilities including the amount of meteoric water that infiltrates through closure covers. Detailed, stochastic models of waste facility and cover design alternatives should be developed using probabilistic analysis of precipitation to represent the range in wet, average, and dry year conditions.

Following the completion of the feasibility study, test plots and fills should be installed. These test plots and fills should be monitored to evaluate and confirm the performance of alternative grading, stormwater drainage and cover designs, and erosion control and revegetation treatments. Conclusions regarding the performance of closure alternatives tested should be used, in part, for the development of final closure plans and designs at Mt. Todd, and to validate vadose zone and water balance models to improve the prediction of long-term water treatment requirements and adverse impacts to surface and ground water in the vicinity of Mt. Todd.

4.1.2 Tailings Trafficability Testing

The minimum cover that will be needed to bridge the thixotropic tailings located on the impounded surface of TSF1 and TSF2 and the trafficability and stability of saturated and dewatered slimes requires study and should be investigated to adequately define capping techniques and the quantity of cover needed to successfully reclaim TSF1 and TSF2. A tailings consolidation and loading study would be developed to report these findings.

4.1.3 Development of a Tailings Management Plan

A Tailings Management Plan should be developed as part of the feasibility study to specify how tailings are to be handled to minimize the potential for ARD and metals leaching, and facilitate closure and rapid dewatering and consolidation of tailings.

4.1.4 Reclamation Material Inventory and Characterization

In order to maximize the use of on-site material over imported material for reclamation, Tetra Tech recommends that thorough site-wide inventories be conducted for reclamation materials. We recommend inventories (or continuance and completion of ongoing inventories) of the following materials:

- Non-PAG waste rock and other waste materials on site;
- LPM;
- Undisturbed or slightly disturbed soils, stockpiled soils, and regolith;
- Durable rock rip rap and gravels;
- Acid-resistant drain rock; and
- Organic wastes and other soil amendments.

These inventories should be followed by field-tests to determine the material suitability for the anticipated uses. The potential sources of closure materials at Mt. Todd include, but are not limited to:

- Production of waste covers, riprap, drain and low-permeability materials excavated from the pit during mining;
- Production of waste covers, riprap, drain and low-permeability materials excavated from the borrow areas;
- Production of organic soil amendments developed by composting organic waste such as feedlot manure, crop stubble, biosolids, wood waste from logging operations, etc.;
- Uncontaminated fill material in materials storage yards, roads, and ancillary facilities;
- Uncontaminated material excavated for creation of the WRD, RP1, TSF1, and TSF2 diversions; and
- Soil salvage from the footprint of TSF2 (and the expansion of the WRD and Pit).

Inventories should define the location, volume, properties, uniformity, retrievability, and where necessary acid-resistance of all potential sources of reclamation materials on or immediately adjacent to the site. Due to the significant cost associated with the excavation, processing (if necessary), transportation, and distribution of these reclamation materials, Vista should further evaluate approximate haul distance and road grades between each potential closure material source and major closure area. This process will eliminate some potential sources from further consideration.

When the properties, volume, and viability of closure material sources are determined based on site inventories, material balance and costs should be improved and the results should be integrated into the closure planning process. The suitability of many of the existing on-site sources of durable rock riprap and gravels, acid-resistant drain rock, low-permeability clays, and other material have already been evaluated by Vista and others. However, the scope of these inventories will likely need to be expanded to address the volumes of materials needed for closure.

Material testing discussed previously and standard test references should be used to guide the analysis to assess the suitability of potential sources of durable rock riprap and gravels, acid-resistant drain rock, LPM, and other materials (e.g., ASTM). Based on an initial assessment of materials contained in each potential cover source, representative material samples should be collected and the following material properties should be determined as appropriate for the intended use of the material.

Physical Parameters

- Particle size distribution (dry sieve and hydrometer for < 2 millimeter fraction);
- Atterberg limits;
- Specific gravity;
- Compaction curve (i.e., Proctor curve);
- Saturated hydraulic conductivity;
- Consolidation - saturated hydraulic conductivity tests; and
- SWCC (moisture release curves) tests.

Chemical Parameters

- pH (saturated paste and KCl);
- Electrical Conductivity (saturated paste extract);
- Bulk Density;
- Organic Carbon;
- Sodium absorption ratio;
- Cation (Anion) Exchange Capacity;
- Total Nitrogen;
- Nitrate-Nitrogen;
- Available Phosphorus;
- Soluble cations (K, Ca, Mg, Na);
- Exchangeable Bases (K, Ca, Mg, Na Fe, Mn, and Ti) and Aluminum; and
- Acid Base Accounting (additional analysis may be necessary if net neutralization potential [NNP] < + 20 tonnes $CaCO_3$ equivalent/1,000 tonnes material or NPR (acid net neutralization potential) < 2).

Phase I of the LPM inventory was completed in late October and early November, 2012 and included field work for the preliminary identification and characterization of LPM sources on-site and sources near Mt Todd. Tetra Tech recommends that Phase II field work and associated analyses be completed for completion of the DFS. Completion of Phase II would include estimates of the costs to deliver LPM to the mine and discussions regarding LPM material properties, estimate volume, factors influencing the feasibility of accessing each source and recommended LPM source selection.

4.1.5 Waste and Cover Material Erosion and Sedimentation Analysis

The erosion from tailings, waste rock, ancillary facility, and closure covers should be evaluated to:

- Predict soil loss from facilities during operations and following closure;
- Develop and evaluate erosion and sediment control options; and
- Predict the rate and magnitude of sediment loads to operational and closure stormwater drainage systems (ponds, channels, sumps, etc.).

Vegetation monitoring data should be collected for the existing (and future) reclamation test plots. These data and data from the characterization of waste and cover hydraulic properties should be used as inputs to empirical or process-based erosion and sedimentation prediction models (RUSLE, Water Erosion Prediction Project (WEPP), Erodibility Index Method, SEDCAD, and others) for the evaluation of facility drainage designs, sediment management plans, and erosion and sediment control alternatives.

5.0 ESTIMATED CLOSURE COSTS

The estimated quantities (e.g., facility dimension, material volumes, surface areas, disturbance footprints) for the reclamation of major facilities at Mt. Todd discussed above are summarized in Table 4. Reclamation costs were estimated at a ± 30 percent level of accuracy based on the following:

- 18 Mtpy mine plan and existing engineering and data presented in the PFS;
- Geochemical testing and analysis program;
- Estimates of environmental conditions throughout the mine-life;
- NT Government mine closure and environmental protection regulations and guidelines;
- Labor rates from The Hays Salary Guide, March 2011;
- Rawlinsons Australian Construction Handbook, Edition 30, 2012 (costs scaled based on location factors);
- Caterpillar Performance Handbook, Edition 40, January 2010;
- Equipment Rates developed by Mine Development Associates (MDA);
- Vendor quotes;
- Tetra Tech, Ausenco, and Tetra Tech - Proteus recent mine closure costing experience; and
- Best professional judgment.

Indirect costs were estimated to include reclamation oversight, monitoring test plots, monitoring concurrent reclamation, monitoring final reclamation, maintenance, and contingency. Maintenance was estimated to be 10 percent of the direct costs by year and includes such costs as maintenance and rehabilitation of reclamation covers and vegetation, weed control, installation of additional erosion control devices, and maintenance of site roads during closure, Contingency was estimated to be 15 percent of the total project cost.

Based on the costing approach described above, the cost estimate for implementing this plan is **AU$ 154,812,000**. As summarized in Table 5, this cost estimate includes closure of major facilities at Mt. Todd.

Table 6 includes the major unit costs used to estimate the closure costs that are provided in Table 5. Additional information used to develop this cost estimate is provided in Attachment B.

No costs were included for the following closure related items:

- Decontamination, demolition, removal and disposal of site infrastructure and structures (other than rubblization of foundations);
- Selective handling of waste rock and the haulage of waste rock to the TSF 1 and 2
- Construction of stormwater control structures;
- Baseline studies and permitting;
- Security cost fees;
- Water treatment (during operations or during closure and post-closure); and
- Amendment of PGM with additional organic matter.

As part of the PFSRP, an estimate was developed of the Security Cost required for the project. In the NT, the government requires that a Security Cost calculation be performed prior to issuing a mining authorization to commence mining. This Security Cost calculation is used to assist in establishing the level of security required to ensure liabilities incurred by mining activities will be addressed. The NT government has specified that the Security Cost calculation must follow the excel workbook developed by the NT government and which is posted on the NT government website. The Security that has been developed for the Mt Todd project has been developed in accordance with the NT Security workbook and associated guidance. The security calculation is reflective of the common mine site rehabilitation procedures and current rehabilitation costs included in the NT Security workbook as of the date of this document.

The Security Calculation addresses the future, end-of-mine state of the project and addresses activities required to close and rehabilitate each functioning facility planned for the Mt Todd project, including TSF1, TSF2, WRD, HLP, LGO2, Site Infrastructure and Process Plant area, Pit area, roads, decommissioning and post closure management and post closure water management. The Security Cost for the Mt Todd project was estimated at $158,000,000. Additional information regarding the Security Cost estimate can be found in Attachment C.

6.0 REFERENCES

GeoSlope Ltd., 2007. GEO-SLOPE International Ltd. VADOSE/W Calgary, Alberta Canada.

Guralnik, DB., editor. 1986. *Webster's New World Dictionary of the American Language*, Second College Edition. Prentice Hall Press.

Gustavson Associates, LLC, December 29, 2006. Preliminary Economic Assessment – Mt. Todd Gold Project – Northern Territory, Australia (NI 43-101 Report)

MWH Australia Pty Ltd, 2006a. Mt. Todd Environmental Management Services - Report 3: Mt. Todd Conceptual Closure Plan and Cost Estimate. December2006.

MWH Australia Pty Ltd, 2006b. Mt. Todd Environmental Management Services - Report 1: Environmental Assessment, December 2006.

MWH Australia Pty Ltd, 2006c. Mt. Todd Environmental Management Services - Report 2: Water Management, December 2006.

Munshower F. 1993. Planning, rehabilitation, and treatment of disturbed lands: Sixth Billings Symposium, March 21-27. Billings, Plaza Holiday Inn, Billings, Montana.

HydroGeoLogica, Inc. and Tetra Tech, 2010. Mount Todd Water Balance - Care and Maintenance Model Calibration and Forward Modeling Predictions, December 6, 2010

NR Environmental Consultants Pty. Ltd., 1992a. Mt. Todd Gold Project Draft Environmental Impact Statement, October 1992.

NR Environmental Consultants Pty. Ltd., 1992b. Mt. Todd Gold Project Supplement to the Draft Environmental Impact Statement, December 1992.

North Territory of Australia, Department of Regional Department, Primary Industry, Fisheries and Resources, Security Unit Costs, AP3-001 Minerals and Energy, August 2008.

Tetra Tech, 2010. MT. Todd Gold Project Prefeasibility Study, Northern Territory, Australia, Appendix J, October, 2010

Tetra Tech, 2011. Mt. Todd Project Preliminary Feasibility Study, Northern Territory, Australia, Appendix J, January, 2011.

Tetra Tech, 2012. Mt Todd Project Geochemistry Program, Northern Territory, Australia. March, 2012.

TABLE 1: RECLAMATION APPROACH
VISTA GOLD CORP. – MT TODD GOLD PROJECT
JUNE 2013

	Facility							
Task	Batman Pit	WRD	HLP	TSF1&2 Impounded Surface	TSF1&2 Dams	Process Plant and Pad	LGO 2	Mine Roads
Surface of Facility at Cessation of Production Composed of Non-PAG		x			x			
Final Overall Slopes > 3H:1V*	x				x			x
Final Overall Slopes < 3H:1V*		x	x	x		x	x	x
Benches Created During Construction	x	x			x			
Install 1.0 meter-Thick non-PAG Material		x		x				
Install 0.8 meter-Thick Store and Release Cover			x	x	x	x	x	x
Install 0.2 meter-Thick Plant Growth Medium (PGM) Cover		x	x	x	x	x	x	x
Revegetate with Native Seed Mix			x	x	x	x	x	x
Install GCL Liner (including underlayer and overlayer fines)		x						
Install Erosion and Sediment Controls		x	x	x	x	x	x	x
Construct Access Restriction Bund	x							
Additional Remedial Measures (as necessary)	x	x	x	x	x	x	x	x

* > and < indicates slopes are steeper and less steep, respectively.

TABLE 2: RECLAMATION FACILITY STATUS AND RECLAMATION SCHEDULE
VISTA GOLD CORP. – MT TODD GOLD PROJECT
June 2013

Facility	Pre-Production (Years -2 and -1)	Production (Years 1 through 13)	Closure Phase (Years 13 through 14)	Post-Closure Phase (Years 15 through 19)	Post-Closure Phase (Years >20)
TAILINGS STORAGE FACILITY 1 (TSF1)					
TSF1 Top (Area of Impounded Tailings)	Inactive	Active to Year 4 Drain/ Install Cover/ Reclaim in Year 5	Reclaim	Reclaimed	Reclaimed
TSF1 Dam Face	Inactive/Construct Dam Raise	Constructed Dam Raises / Reclaim as Practicable Final Reclamation Year 4	Reclaim	Reclaimed	Reclaimed
TAILINGS STORAGE FACILITY 2 (TSF2)					
TSF2 Top (Area of Impounded Tailings)	Nonexistent	Active in Year 4	Drain/ Install Cover/ Reclaim	Reclaimed	Reclaimed
TSF2 Dam Face	Nonexistent	Starting in Year 4 Constructed Dam Raises / Reclaim as Practicable, Final Reclamation in Year 13	Final Reclamation Years	Reclaimed	Reclaimed
HEAP					
Heap Leach Pad	Inactive	Leach Ore Re-Processed in Production Year 12 and 13	Reclaimed	Reclaimed	Reclaimed
PROCESSING PLANT AND PAD AREA					
Processing Plant	Constructed	Active	Demolish	Nonexistent	Nonexistent
Pad Area	Inactive / Upgraded	Active	Regrade / Install Cover / Reclaim	Reclaimed	Reclaimed
RP2 & RP5	Active	Active	Regrade / Install Cover / Reclaim	Reclaimed	Reclaimed
Water Treatment Plant & Equalization Pond	Constructed	Active	Active	Demolish / Reclaim	Reclaimed
BATMAN PIT					
Pit Access Berm	Nonexistent	Nonexistent	Construct	Active	Active
WASTE ROCK DUMP					
Waste Rock Dump	Inactive	Active/ Concurrently Install GCL Cover and Reclaim Final Cover Installation Begin Year 11	Complete Final Cover Installation and Reclaim /Seepage Routed to Passive Treatment System	Reclaimed	Reclaimed
LOW GRADE ORE STOCKPILE 2 (LGO2)					
Low Grade Ore Stockpile	Inactive	Active	Reclaimed	Reclaimed	Reclaimed
MINE ROADS					
Haul and Ancillary Roads	Inactive / Upgraded & Activated as Necessary	Active / Reclaim as Practicable	Reclaim	Reclaim	Reclaim

TABLE 3: PLANT GROWTH MEDIUM AND LOW PERMEABILITY MATERIAL SUITABILITY GUIDELINES[1]
VISTA GOLD CORP. – MT TODD GOLD PROJECT
JUNE 2013

Suitability Parameter	Suitability Rating and Criteria			
	Good (G)	**Fair (F)**	**Poor (P)**	**Unacceptable (U)**
Saturation %	25 to 55	≥56 to 80	<25, >80	
pH	6.5 to 8.1	6.0 to 6.4, 8.2-8.5	5.5 to 6.0, 8.6 to 9.0	<5.5, >9.0
EC (mS/cm 25^{0} C)	0 to 4	4 to 8	8 to 15	>15
SAR (Sodium Adsorption Ration)[a,b]	0 to 4	5 to 10	10 to 14	>14[a]
%$CaCO_3$	<15	15-30	>30	
Texture [c]	sl, l, sil, scl, sc, ls, lfs	cl, c, sicl, sc, ls, lfs	sic, s, sc, cos, fs, vfs	g, vcos
Total Organic Carbon	<10%			≥10%
Available Water Capacity[d]	>0.10, moderate	0.05 to 0.10, low	<0.05, very low	
K factor [e]	<0.37	0.37	>0.37	

[1] Utah Oil Gas and Mining, October, 2005. Guideline for Management of Topsoil and Overburden R645-301-200 Soils - Table 4

[a] For clay textured soils unacceptable SAR > 14. For sandy textured soils unacceptable is >20.

[b] For most Western soils, the SAR to ESP relationship is usually 1:1, up to ESP ≈ 20. If SAR> 20, then determine ESP (Evangelou, 2000).

[c] s=sand, l=loam, si=silt, c=clay, v=very, f=fine, co=coarse, g=gravel

[d] Available Water Capacity is adjusted for texture and SAR

[e] K factor recommendations from the USDA Soil Conservation Service, 1978. National Soils Handbook Notice 24 (3/31/78). NSH Part II-403.6 (a). For prime farmland soils, the K factor times the percent slope should be a value of five or less for minimal erosion hazard.

Low-Permeability Material Suitability Guidelines

Suitability Parameter	Suitability Criteria
Compacted Hydraulic Conductivity - $K_{(sat)}$	≤ 1 x 10^{-6} cm/second
Particles < 0.075 mm (i.e. very fine sand, silt and clay size particles)	> 20 percent by weight
Particles > 4.75 mm (i.e. gravel size particles)	< 10 percent by weight
Particles> 1 inch (i.e. coarse gravel size particles)	0 percent by weight

TABLE 4: MAJOR RECLAMATION QUANTITIES AND DIMENSIONS
VISTA GOLD CORP. – MT TODD GOLD PROJECT
JUNE 2013

Facility	Reclaimed Area (hectares)	Grading Volume (m^3)	Closure Cover Thickness (meters)	Total Closure Cover Volume (m^3)	Closure Cover LPM Volume (m^3)	Plant Growth Medium (PGM) (m^3)
TAILINGS STORAGE FACILITY 1 (TSF1)						
TSF1 Top (Area of Impounded Tailings)	214.2	0	2.0 meters (1 meter bridge, 0.8 meter store and release cover, 0.2 meter PGM)	1,714,000	1,131,000	428,000
TSF1 Dam Face	24.8	0	1.0 meter (0.8 meter store and release cover, 0.2 meter PGM)	198,000	131,000	50,000
TAILINGS STORAGE FACILITY 2 (TSF2)						
TSF2 Top (Area of Impounded Tailings)	178.7	0	2.0 meters (1 meter bridge, 0.8 meter store and release cover, 0.2 meter PGM)	1,430,000	944,000	357,000
TSF2 Dam Face	122.1	0	1.0 meter (0.8 meter store and release cover, 0.2 meter PGM)	980,000	645,000	244,000
HEAP						
Heap Leach Pad	39	156,000	1.0 meter (0.8 meter store and release cover, 0.2 meter PGM)	312,000	206,000	78,000
PROCESSING PLANT AND PAD AREA						
Processing Plant Pad Area	35.1	350,000	1.0 meter (0.8 meter store and release cover, 0.2 meter PGM)	281,000	185,000	70,000
RP2 and RP5		60,000				
BATMAN PIT						
Pit Access Berm	-	45,000	-	-	-	-
WASTE ROCK DUMP						
Waste Rock Dump	241	0	GCL cover (Bedding Layer, Protective Layer, Erosion Control Layer)	2,411,000	-	-
LOW GRADE ORE STOCKPILE 2 (LGO2)						
LGO 2	51	100,000	1.0 meter (0.8 meter store and release cover, 0.2 meter PGM)	409,000	270,000	102,000
MINE ROADS						
Haul and Ancillary Roads	24	48,000	0.2 m plant growth medium cover	-	-	48,000

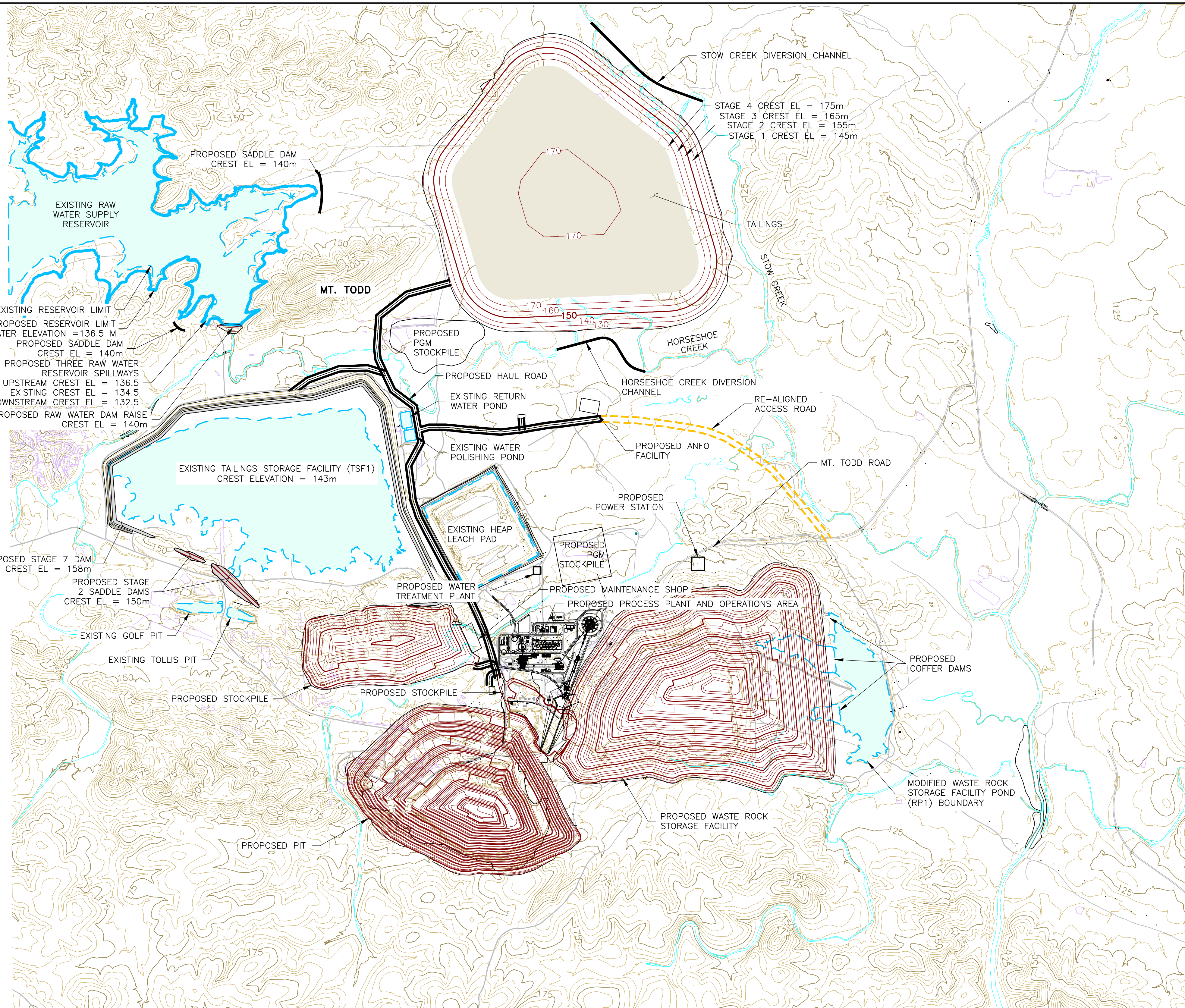
TABLE 5: RECLAMATION COST ESTIMATE
VISTA GOLD CORP. – MT TODD GOLD PROJECT
JUNE 2013

Area	Cost[1]
Tailings Storage Facility 1 (TSF1)	$24,028,000
Tailings Storage Facility 2 (TSF2)	$31,253,000
Heap	$4,777,000
Process Plant And Pad Area	$16,355,000
Batman Pit	$224,000
Waste Rock Dump	$35,038,000
Low Grade Ore Stockpile 2 (LGO2)	$4,883,000
Soil Stockpiles	$807,000
Mine Roads	$680,000
Total Direct Closure Cost	**$117,930,000**
Oversight, Maintenance, Contingency	$36,767,000
Total Indirect Cost [2]	**$36,767,000**
Total Closure Cost	**$154,812,000**
NT Government Security Cost	$158,000,000

[1] Cost rounded to nearest $1,000 in current $.
[2] Includes indirect costs associated with oversight of reclamation activities

TABLE 6: MAJOR RECLAMATION UNIT COSTS
VISTA GOLD CORP. – MT TODD GOLD PROJECT
JUNE 2013

Closure Activity or Material	Unit Cost[1]	Unit
Plant Growth Medium - Stockpile - 1km	$2.53	m3
Plant Growth Medium - Stockpile - 3km	$3.05	m3
Closure Cover and Reveg Test Plots	$250,000.00	LS
Spread / Grade	$0.34	m3
Revegetation	$9,500.00	ha
Erosion/Sediment Control-Fence	$23.13	m
Erosion/Sediment Control-Bales	$33.13	ea
Pit Safety Berm	$0.37	m3
Store and Release LPM - Import	$12.43	m3
Store and Release LPM Placement	$0.82	m3
Store and Release Blending	$0.73	m3
Plant Growth Medium Placement 1 km haul	$1.34	m3
Plant Growth Medium Placement 2 km haul	$1.60	m3
Plant Growth Medium Placement 3 km haul	$1.85	m3
Place Non-PAG Waste Rock	$0.82	m3
GCL Underlayer 750mm max particle size	$13.00	m3
GCL	$7.50	m2
GCL Overlayer - Fines	$16.00	m3
Excavate Seepage Collection Ditch	$0.67	m3
LLDPE Liner	$7.34	m2
Install Closure Spillway (TSF1 or TSF2)	$25,000.00	LS
Concrete	$196.50	m3
haul pipes to WRD	$2.11	m3
Concrete Foundation Rubblization and Haul to WRD	$600.00	m3
Cut and fold liner	$2.15	m2
Excavate Liner and Contaminated Material and Haul to TSF 2	$1.41	m3
Remove and dispose sediments	$2.11	m3
Backfill Pond	$0.34	m3
Environmental Supervisory Staff	$162,500.00	LS
Concurrent Monitoring	$50,000.00	LS
Closure Monitoring	$75,000.00	LS
Maintenance	10%	Of Direct Costs
Contingency	15%	



N

SCALE
150m 0 150m 300m
SCALE IN METERS
CONTOUR INTERVAL 5m

LEGEND:

150 EXISTING CONTOUR – MAJOR
EXISTING CONTOUR – MINOR
150 PROPOSED CONTOURS – MAJOR
PROPOSED CONTOURS – MINOR

Scale: As Shown
Designed by: AH
Drawn by: MJ
Checked by: AH
Approved by: RH

Issued for:
VISTA GOLD CORP.

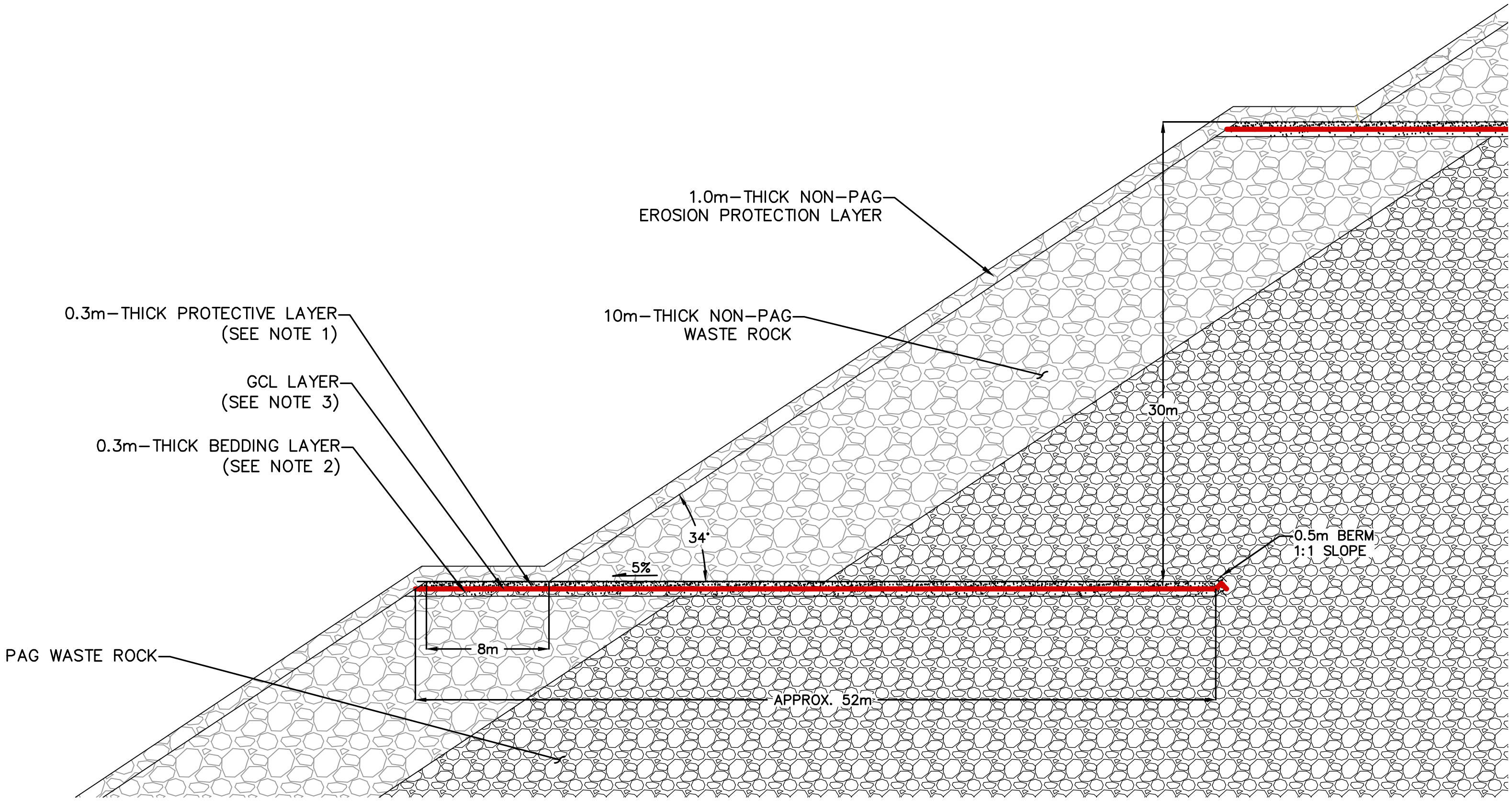
Issued by:
TETRA TECH
350 Indiana Street, Suite 500
Golden, Colorado 80401
(303) 217-5700 (303) 217-5705 fax

FIGURE 1
GENERAL FACILITY ARRANGEMENT

1
REVISION

Project: MT. TODD GOLD PROJECT FEASIBILITY STUDY
Project no.: 114-311285
Location: NORTHERN TERRITORY, AUSTRALIA
Date: 06/04/13
SHEET 1 OF 6

Johnson, Max – T:\Mining\Projects\VistaGold\VistaGold_MtTodd_114-311285\114-311285\904_PFS-Reclamation\C-GFA-ALT CASE-YEAR 12_MCJ0603213.dwg – 6/4/2013 4:31 PM



NOTES:
1. PROTECTIVE LAYER COMPOSED OF NON–PAG WASTE ROCK CRUSHED TO FINE PARTICLE SIZE

2. BEDDING LAYER COMPOSED OF NON–PAG WASTE ROCK CRUSHED TO 750mm PARTICLE SIZE

3. GCL MATERIAL PLACED ON EACH LIFT EXTENDING HORIZONTALLY TO A DISTANCE ADEQUATE TO REACH JUST BELOW THE OVERLYING BENCH.

NOT TO SCALE

Scale: As Shown
Designed by: AH
Drawn by: MJ
Checked by: AH
Approved by: HS

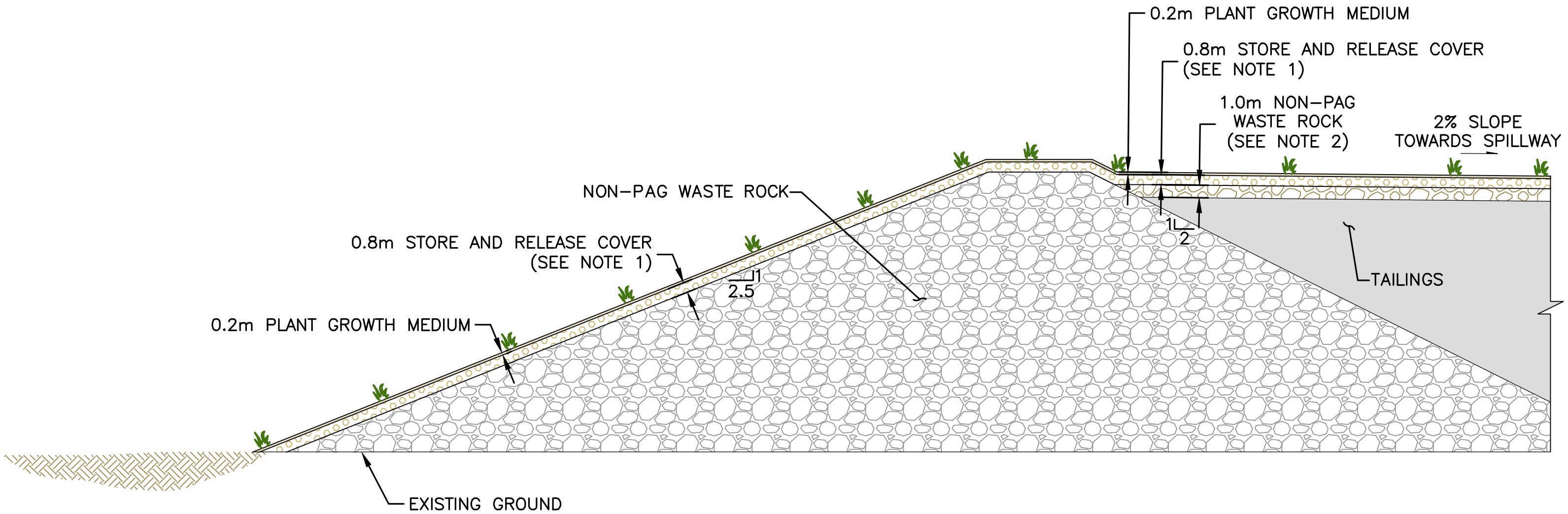
Issued for: VISTA GOLD CORP.

Issued by: TETRA TECH
350 Indiana Street, Suite 500
Golden, Colorado 80401
(303) 217-5700 (303) 217-5705 fax

FIGURE 2
WASTE ROCK DUMP GENERAL CLOSURE COVER DESIGN

REVISION 1

Project: MT. TODD GOLD PROJECT FEASIBILITY STUDY
Project no.: 114–311285
Location: NORTHERN TERRITORY, AUSTRALIA
Date: 06/04/13
SHEET 2 OF 6



NOT TO SCALE

NOTES:
1. STORE AND RELEASE COVER COMPRISED OF A MIXTURE OF 66% CLAY–LIKE MATERIAL AND 34% NON–PAG WASTE ROCK MATERIAL

2. NON–PAG WASTE ROCK PLACED TO BRIDGE TAILINGS MATERIAL

Scale: As Shown

Designed by: AH
Drawn by: MJ
Checked by: AH
Approved by: HS

Issued for:

VISTA GOLD CORP.

Issued by:

TETRA TECH

350 Indiana Street, Suite 500
Golden, Colorado 80401
(303) 217-5700 (303) 217-5705 fax

FIGURE 3
TAILINGS STORAGE FACILITY
GENERAL CLOSURE COVER DESIGN

1
REVISION

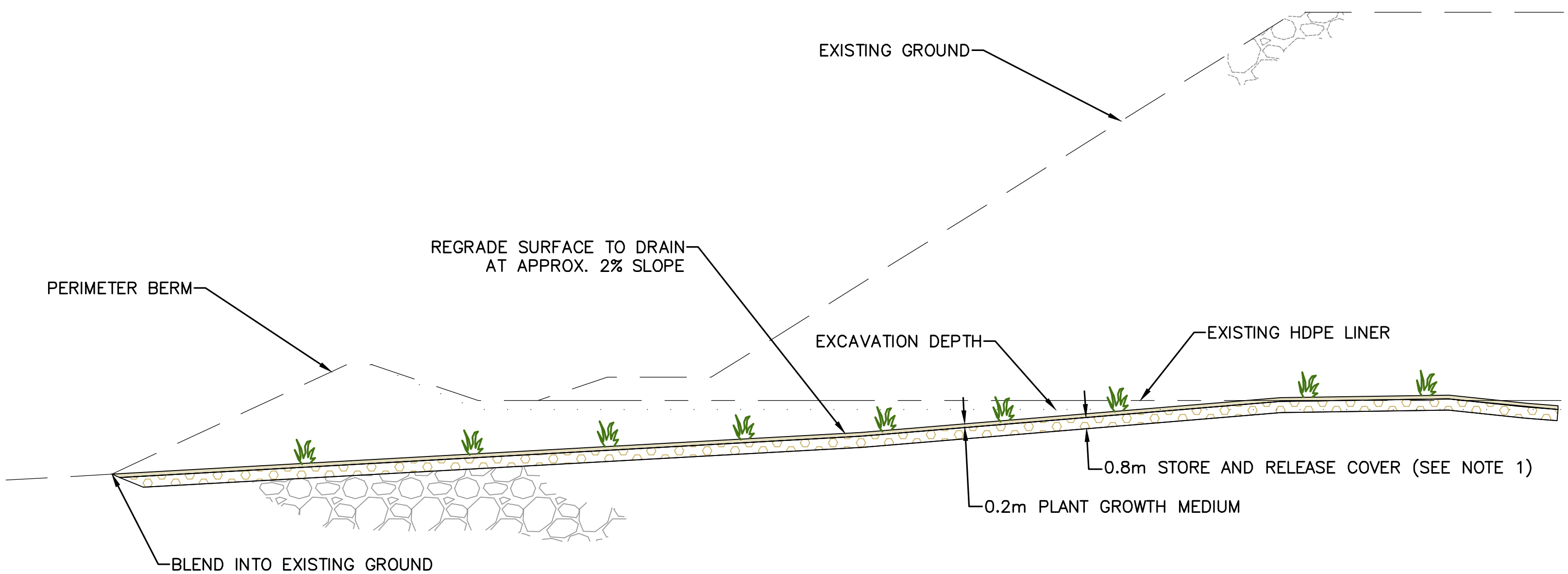
Project:
MT. TODD GOLD PROJECT
FEASIBILITY STUDY

Project no.:
114–311285

Location:
NORTHERN TERRITORY, AUSTRALIA

Date:
06/04/13

SHEET
3 OF 6



NOT TO SCALE

NOTES:
1. STORE AND RELEASE COVER COMPRISED OF A MIXTURE OF 66% CLAY-LIKE MATERIAL AND 34% NON-PAG WASTE ROCK MATERIAL.

2. IT IS ASSUMED THAT 4000 CU. M./HECTACRE OF FILL MATERIAL WILL BE NEEDED TO ACHIEVE AVERAGE REGRADED SURFACE SLOPE OF 2% TO ALLOW FOR WATER DRAINAGE.

Scale: As Shown
Designed by: AH
Drawn by: MJ
Checked by: AH
Approved by: HS

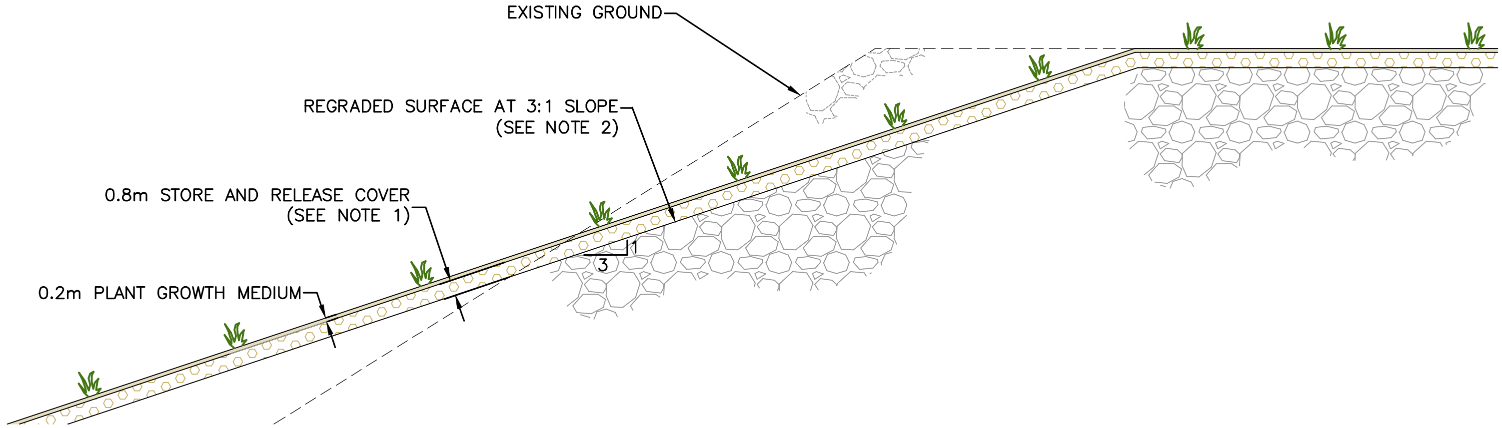
Issued for:
VISTA GOLD CORP.

Issued by:
TETRA TECH
350 Indiana Street, Suite 500
Golden, Colorado 80401
(303) 217-5700 (303) 217-5705 fax

FIGURE 4
HEAP LEACH PAD GRADING AND
GENERAL CLOSURE COVER DESIGN

1
REVISION

Project: MT. TODD GOLD PROJECT FEASIBILITY STUDY
Project no.: 114-311285
Location: NORTHERN TERRITORY, AUSTRALIA
Date: 06/04/13
SHEET 4 OF 6



NOT TO SCALE

NOTES:
1. STORE AND RELEASE COVER COMPRISED OF A MIXTURE OF 66% CLAY–LIKE MATERIAL AND 34% NON–PAG WASTE ROCK MATERIAL.

2. GRADING TO 3:1 SLOPE CAN BE ACHIEVED BY PUSHING MATERIAL DOWN–SLOPE TO ACHIEVE FINAL GRADE.

Scale: As Shown
Designed by: AH
Drawn by: MJ
Checked by: AH
Approved by: HS

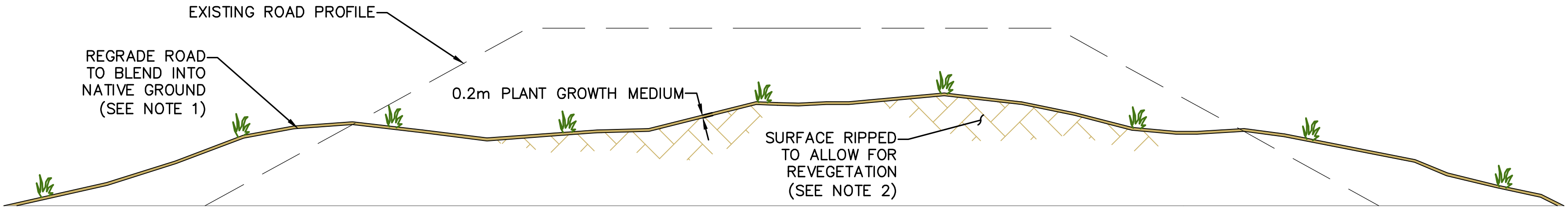
Issued for: VISTA GOLD CORP.

Issued by: TETRA TECH
350 Indiana Street, Suite 500
Golden, Colorado 80401
(303) 217-5700 (303) 217-5705 fax

FIGURE 5
LOW GRADE ORE PILE GRADING AND GENERAL CLOSURE COVER DESIGN

REVISION 1

Project: MT. TODD GOLD PROJECT FEASIBILITY STUDY
Project no.: 114–311285
Location: NORTHERN TERRITORY, AUSTRALIA
Date: 06/04/13



NOT TO SCALE

NOTES:
1. GRADING SHOWN REFLECTS ROAD CLOSURE IN PLACE. CUT SECTION AND FILL SECTION CLOSURES NOT SHOWN.

2. ROAD MATERIAL ASSUMED TO BE SUITABLE PLANT GROWTH MEDIUM FOLLOWING RIPPING OF MATERIAL TO REDUCE COMPACTION AND ENABLE ROOTING.

Scale: As Shown
Designed by: AH
Drawn by: MJ
Checked by: AH
Approved by: HS

Issued for:
VISTA GOLD CORP.

Issued by:
TETRA TECH
350 Indiana Street, Suite 500
Golden, Colorado 80401
(303) 217-5700 (303) 217-5705 fax

FIGURE 6
MINE ROADS GRADING AND GENERAL CLOSURE COVER DESIGN

REVISION 1

Project: MT. TODD GOLD PROJECT FEASIBILITY STUDY
Project no.: 114-311285
Location: NORTHERN TERRITORY, AUSTRALIA
Date: 06/04/13
SHEET 6 OF 6

ATTACHMENT A:
WRD GCL COVER VADOSE MODEL

Littleton Office
One Monarch Drive, Suite 101
Littleton, MA 01460
Tel 978.952.0120 Fax 978.952.0122
www.tetratech.com

Technical Memorandum

To:	John Rozelle	**From:**	Amy L. Hudson, REM and Patsy Moran, PhD
Company:	Vista Gold Corporation	**Date:**	February 1, 2012
Re:	Waste Rock Dump Design and Drainage Evaluation	**Doc #:**	
CC:	Reese Hastings, Jagrut Jathal (Tetra Tech)		

1.0 Introduction

Vista Gold is proposing a waste rock dump (WRD) with steeper slopes than those originally proposed in the Mt Todd Project Preliminary Feasibility Study (PFS) based on additional geotechnical work and review of other operating mines. As a result, a review of the proposed WRD drainage closure conditions was conducted to provide a technical basis for the revised WRD design.

As detailed in the PFS, the WRD included a store and release cover with 3H:1V slopes consisting of a 0.3 meter (m) clay capillary break, 0.6 m fine non-potentially acid generating (Non-PAG or NAG) rock mixed with clay cover, and a shallow layer of growth medium. The cover would be placed over a mantle of coarser crushed Non-PAG surrounding/covering a potentially acid generating (PAG) material core. The new WRD design under consideration has nine 30 m lifts with eight meter catch benches, a 34 degree interbench slope, and an overall slope of approximately 29 degrees. The proposed closure for the WRD is to place Geosynthetic Clay Liner (GCL) on top of each of the catch benches, and under the next lift. The total width of the GCL would be approximately 24 m, which corresponds to three rolls of the material laid side-by-side. A one foot layer of fines material will be placed on the GCL to provide confining pressure on the material, and to maintain the GCL's moisture content. A one meter layer of Non-PAG material will be placed over the fines layer to prevent erosion.

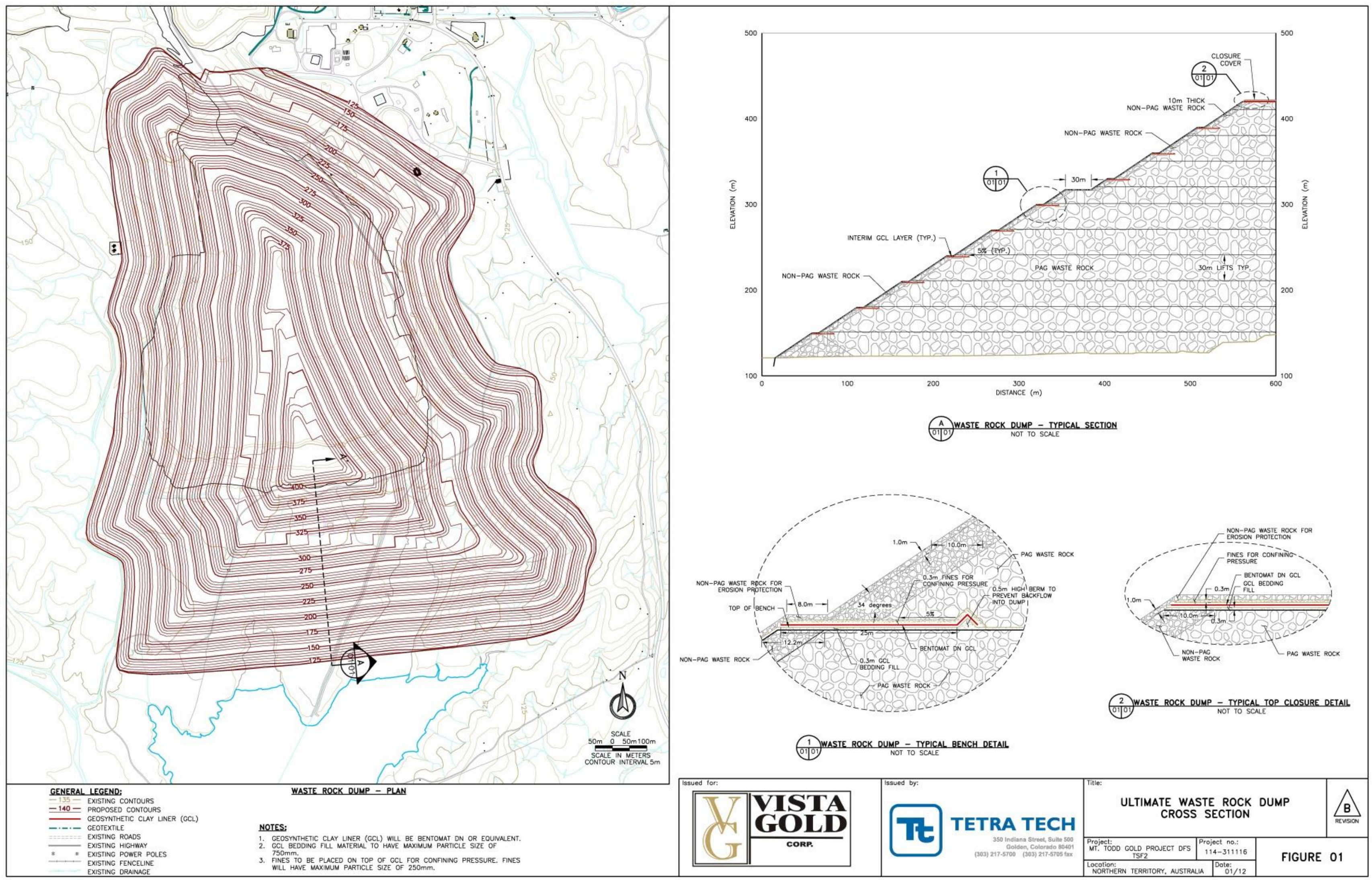
This Technical Memorandum presents the modeling used to assess the drainage conditions and resulting water quality that would likely exist during closure and post-closure periods. The drainage modeling was completed using the VADOSE/W program from the GeoStudio 2007 software package (GEO-SLOPE, 2007). Modeling was performed on cross-section A-A', which is oriented north-south and cuts through the south facing slope of the WRD (Figure 1). The focus of the modeling is on the interior flow dynamics that could affect the PAG material encapsulated within the interior portion of the facility, and the rate of seepage from the base of the WRD. The geochemical modeling was conducted using the computer code PHREEQC (Parkhurst and Appelo, 1999), a reaction path chemical equilibrium model supplied by the U.S. Geological Survey (USGS).

Proper closure of the WRD and seepage management is critical for preventing impacts to local waters, and to minimize long-term treatment and management costs. Acid rock drainage (ARD) commonly occurs in WRDs with sulphide-enriched mine waste through the oxidation of pyrite (or other sulphide minerals) as it is exposed to oxygen and water. The geochemical characterization program for Mt Todd has determined that 41% of the waste rock will be low sulphur and non-PAG, 18 % of the waste rock is in the uncertain acid generating category, and 41% will be PAG; however, it should be noted that the non-PAG material may not provide excess neutralization capacity. WRDs with significant PAG material and minimal neutralization require further management and control of water to prevent environmental impacts.

2.0 Conceptual Model

The conceptual model provided as Figure 2, shows the system water balance components of the WRD including precipitation, evaporation (from soil surface), runoff, infiltration, and seepage. Seepage includes continued draindown of the residual water trapped in the waste rock, as well as any infiltration that reaches the waste rock through the internal and closure cover material. The internal and top closure covers are composed of a thin Geosynthetic Clay Liner (GCL) layer covered by approximately 305 millimeters (mm) (12 inches) of fines material for confining pressure and moisture retention. Details of the GCL closure cover are shown as Figure 3. The internal covers will be placed on top of each the catch bench of each 30 m lift of waste rock to limit the flow of water into the encapsulated PAG waste rock. The GCL will be placed from the outer edge of the bench along the horizontal surface, and will be under the buttress of non-PAG material for the next lift. The waste rock will be graded to a five degree slope towards the outside of the WRD to ensure drainage of water away from the PAG waste rock material.

Modeling was performed to simulate closure of the facility. The transient conditions simulated the closure and post-closure conditions and include only the fully stacked facility with the cover placed over the top surface of the waste rock. No operational conditions were correlated.


WASTE ROCK DUMP – PLAN
GENERAL LEGEND:
135 EXISTING CONTOURS
140 PROPOSED CONTOURS
GEOSYNTHETIC CLAY LINER (GCL)
GEOTEXTILE
EXISTING ROADS
EXISTING HIGHWAY
EXISTING POWER POLES
EXISTING FENCELINE
EXISTING DRAINAGE
NOTES:
1. GEOSYNTHETIC CLAY LINER (GCL) WILL BE BENTOMAT DN OR EQUIVALENT.
2. GCL BEDDING FILL MATERIAL TO HAVE MAXIMUM PARTICLE SIZE OF 750mm.
3. FINES TO BE PLACED ON TOP OF GCL FOR CONFINING PRESSURE. FINES WILL HAVE MAXIMUM PARTICLE SIZE OF 250mm.
SCALE
50m 0 50m 100m
SCALE IN METERS
CONTOUR INTERVAL 5m
N
ELEVATION (m)
DISTANCE (m)
CLOSURE COVER
10m THICK NON-PAG WASTE ROCK
NON-PAG WASTE ROCK
30m
INTERIM GCL LAYER (TYP.)
5% (TYP.)
PAG WASTE ROCK
30m LIFTS TYP.
WASTE ROCK DUMP – TYPICAL SECTION
NOT TO SCALE
1.0m
10.0m
PAG WASTE ROCK
NON-PAG WASTE ROCK FOR EROSION PROTECTION
0.3m FINES FOR CONFINING PRESSURE
0.5m HIGH BERM TO PREVENT BACKFLOW INTO DUMP
TOP OF BENCH
8.0m
34 degrees
5%
25m
12.2m
BENTOMAT DN GCL
0.3m GCL BEDDING FILL
WASTE ROCK DUMP – TYPICAL BENCH DETAIL
NOT TO SCALE
NON-PAG WASTE ROCK FOR EROSION PROTECTION
FINES FOR CONFINING PRESSURE
BENTOMAT DN GCL
GCL BEDDING FILL
0.3m
NON-PAG WASTE ROCK
WASTE ROCK DUMP – TYPICAL TOP CLOSURE DETAIL
NOT TO SCALE
Issued for:
VISTA GOLD CORP.
Issued by:
TETRA TECH
350 Indiana Street, Suite 500
Golden, Colorado 80401
(303) 217-5700 (303) 217-5705 fax
Title:
ULTIMATE WASTE ROCK DUMP CROSS SECTION
B REVISION
Project: MT. TODD GOLD PROJECT DFS TSF2
Project no.: 114-311116
Location: NORTHERN TERRITORY, AUSTRALIA
Date: 01/12
FIGURE 01

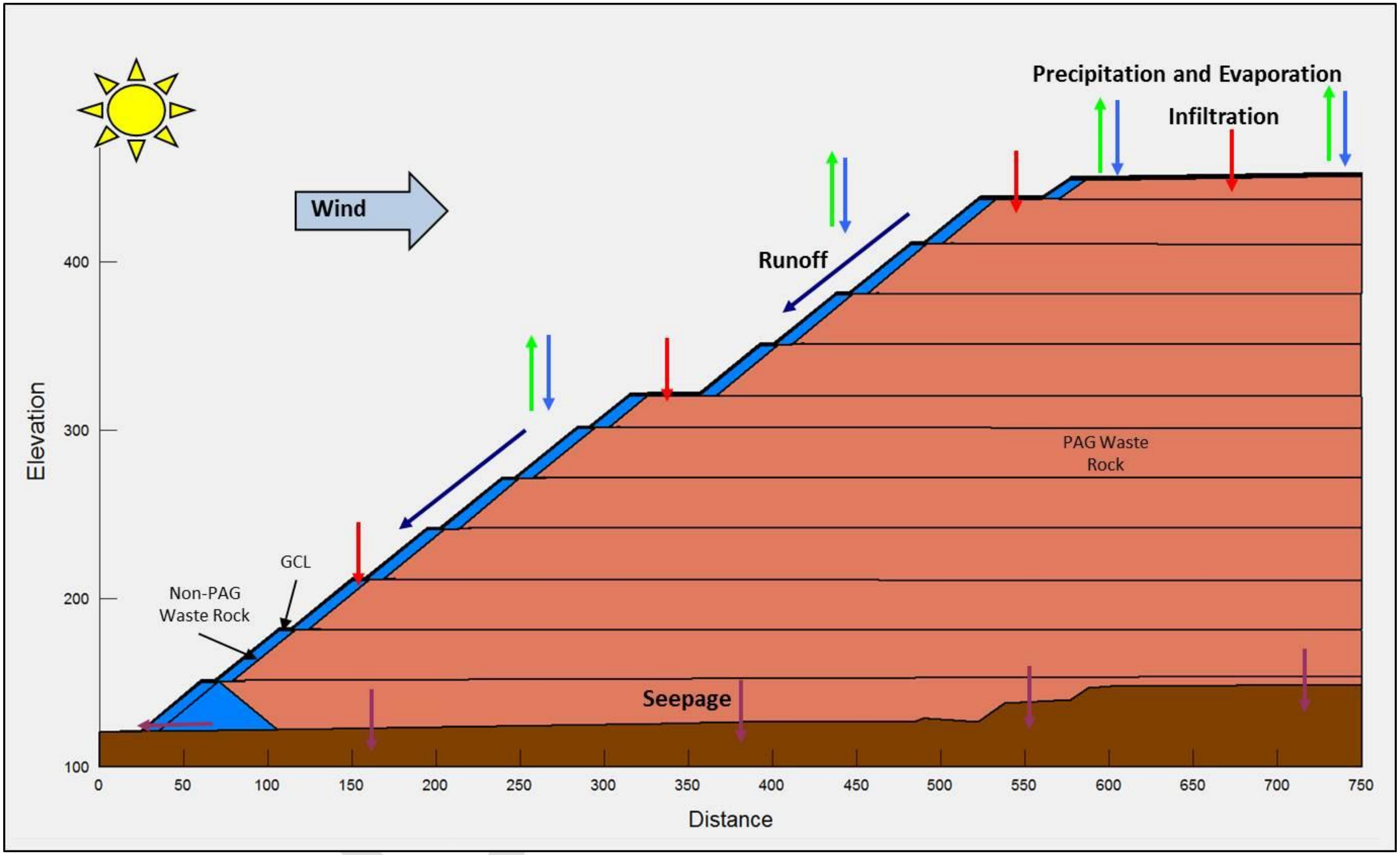


Figure 2 Waste Rock Dump Conceptual Model

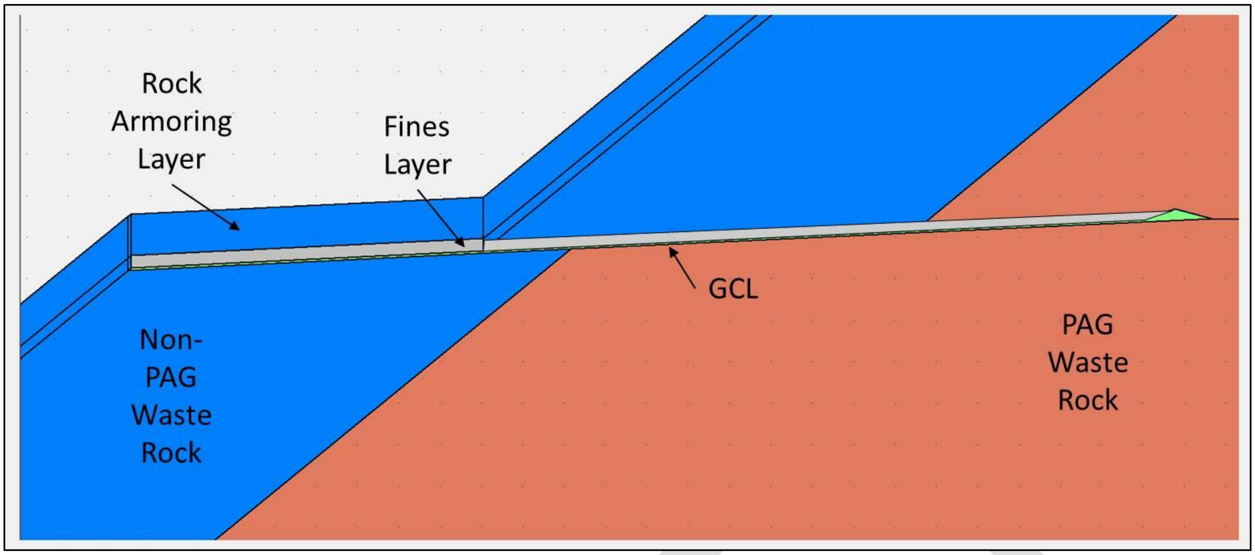


Figure 3 GCL and Fine Layer Details

2.1 Model Input Parameters

The following subsections present the data that was used in the seepage assessment.

2.1.1 Climate Data

Climate data from the Australian Government Bureau of Meteorology Katherine Aviation Museum meteorological station (http://www.bom.gov.au/climate/averages/tables/cw_014903_All.shtml) was used in the model to evaluate the infiltration of precipitation and seepage from the waste rock. The parameters in the climate data file included:

- Minimum and maximum daily temperature;
- Daily precipitation;
- Minimum and maximum daily humidity;
- Daily evaporation or net radiation; and
- Average daily wind speed.

The Katherine Aviation Museum meteorological station is located approximately 50 kilometers south of the mine. The dataset applied to the modeling utilizes the daily data from October 2010 to September 2011. By applying actual daily data versus average data, a more realistic distribution of precipitation events can be applied to the modeling, including the distinct wet and dry seasons of the site. The water balance for the site is net negative (more evaporation than precipitation). The climate file used for the modeling has precipitation of approximately 1,652 mm and an annual pan evaporation of approximately 2,104 mm. The average annual precipitation for this meteorological station is 1,131 mm and the highest rainfall measured for a one year period is 1,773 mm. The data used for this modeling is above average and provides a conservative evaluation of the behavior of the WRD when conditions are most ideal for the formation of potential wetting fronts within the waste rock material. The same model was run three times, back-to-back, to minimize the “noise” in the model results and to be able to consider three full wet and dry season cycles.

2.2 Material Properties

The most significant difference between saturated and unsaturated flow is the hydraulic conductivity. The hydraulic conductivity in saturated media is a function of the material type. In unsaturated flow, the hydraulic conductivity is a function of the material properties and the moisture content of the material. The equation used to calculate water flow within unsaturated media is:

$$q = -K(\theta)\nabla H$$

Where:

- q = water flow velocity (L^2/t)
- K(θ) = hydraulic conductivity as a function of soil (or rock) moisture content (L/t)
- ∇H = hydraulic head (L)

The relationship between moisture content and hydraulic conductivity is non-linear, which further complicates the flow dynamics. In saturated material, the physics of flow are relatively simple and are driven by Darcy’s Law where the flow is proportional to the saturated hydraulic conductivity, gravity, and pressure gradients. In simple terms, water flows downhill (downward pressure gradient) and flows faster through coarse material than fine material. However, in unsaturated flow, additional controlling forces include matric pressure (matric suction), absorption, and electrostatic forces.

Matric pressure (matric suction) is the suction created by capillary forces and the interaction of water, air, and solid surfaces. Matric pressure can be observed by placing a thin straw into a body of water. Driven by the surface tension forces, the water rises inside the straw, defying the force of gravity. The thinner the straw, the stronger the suction force will be and the higher the column of water will rise in the tube. The same process occurs in the voids between material particles in a WRD.

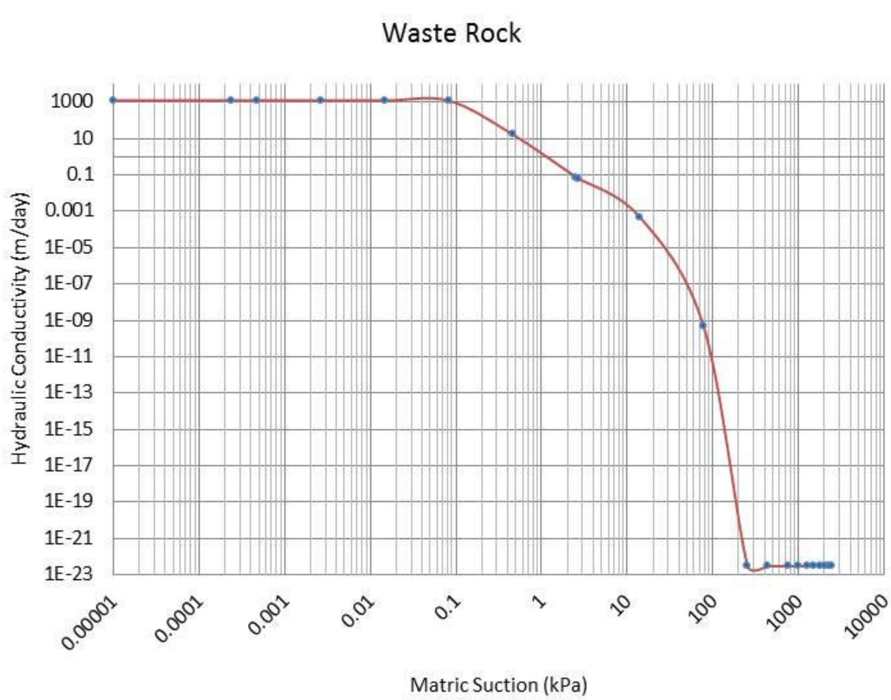
One of the most unusual properties of unsaturated zone flow is that different materials are preferentially conductive with varying moisture contents. Under high moisture conditions, pores are saturated and their suction decreases significantly. In this case, gravity is the strongest force and water will flow downhill from pore space to pore space. At low moisture conditions, the preferential flow changes, and the suction forces become stronger than gravitational forces. In this case, the tight materials are the most conductive with small voids that literally suck water through them. Under low moisture conditions, clay is more conductive than the sandy material.

The material properties used in the VADOSE/W (GEO-SLOPE, 2007) models were based on literature values and functions developed based on past experience of mined materials. The material property used to represent the waste rock was from a similar hard, competent waste rock with a limited amount of fine material. The GCL was simulated as a well graded high clay, and the fines layer was simulated as a uniform silt. Figure 4 presents the hydraulic conductivity functions of the waste rock, GCL, and fines layer materials. Figure 5 presents the water content functions of the same materials. The units used in these figures are those utilized by the modeling software.

The waste rock is expected to be very hard, competent material with a minimal amount of fines. This characterization is based on the current observations of an existing WRD for previous site operations. The function used to simulate this material has a saturated hydraulic conductivity of 4.2 centimeters per second (cm/sec) with a rapid, but smooth decrease with increased matrix suction. The hydraulic conductivity of the GCL layer was simulated as 10^{-6} cm/sec. This is higher than the specifications of this type of material, which is designed to be at 10^{-9} cm/sec. Work completed by Benson and Meer (2009) suggests that GCL that will be subjected to high levels of sodium and/or magnesium in solution will be subject to ion exchange processes. Their research showed that the GCL composition will be altered by exchanging sodium and/or magnesium for the calcium. When also subjected to multiple wetting and drying cycles, the hydraulic conductivity can increase by several orders of magnitude. The leachate from the non-PAG waste rock is estimated to have 20 milligrams per liter (mg/L) sodium (Na) and 200 mg/L magnesium (Mg). The saturated hydraulic conductivity value used in this modeling is higher than the design specs, but lower than the worst case observed by Benson and Meer (2009) and provides a conservative, but reasonable estimate of GCL conditions during closure and post-closure. For this modeling, the fines layer that will be placed over the GCL is assumed to be uniform silt with a saturated hydraulic conductivity of approximately 10^{-5} cm/sec.

2.2.1 Boundary Conditions

The boundary conditions used in this modeling were limited to a zero pressure boundary at the base of the model, initial moisture addition (establish non-zero starting conditions), and the climate file. A climate file was used in this modeling to ensure an evaluation of the long term behavior of the waste rock and the cover under actual climatic conditions.



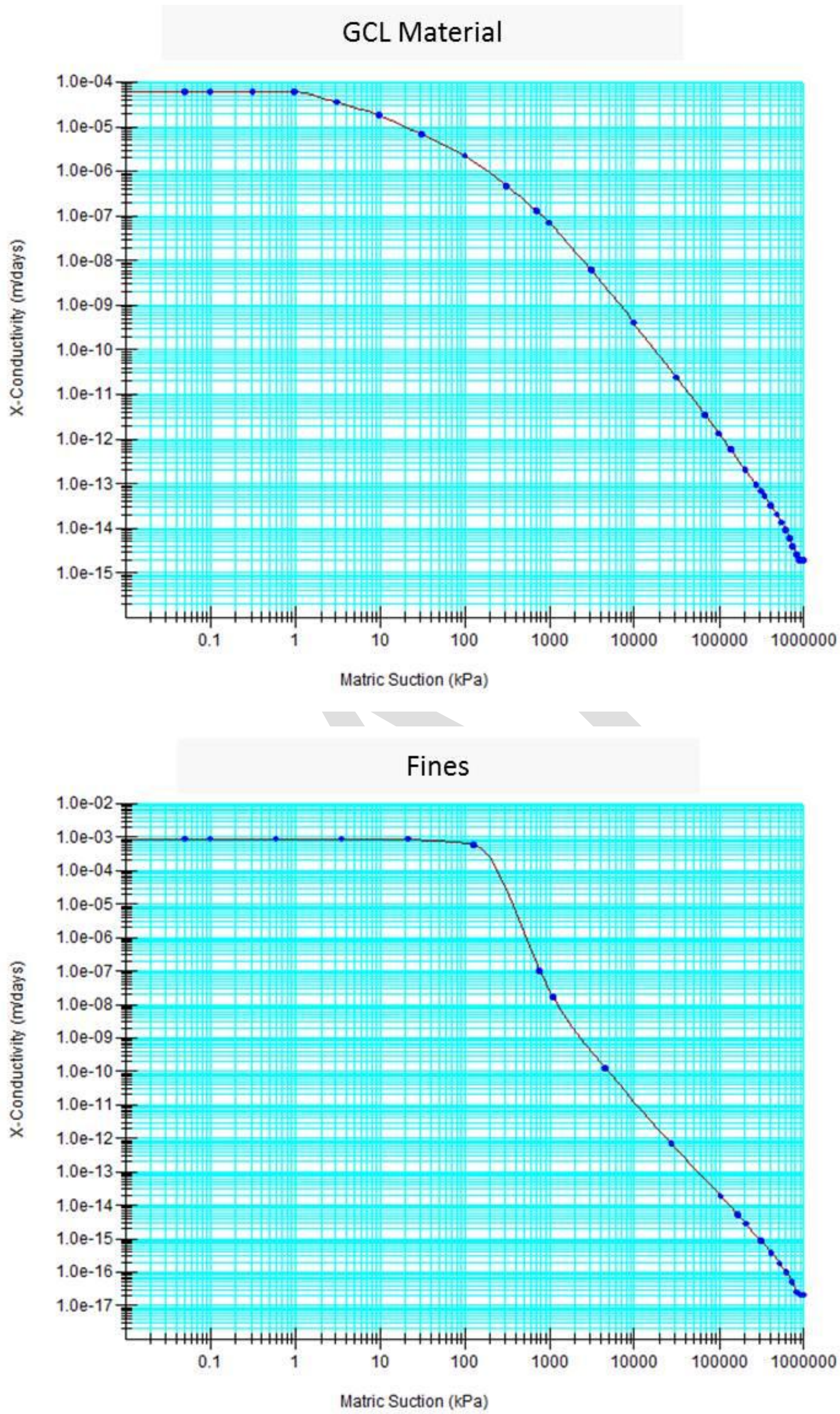
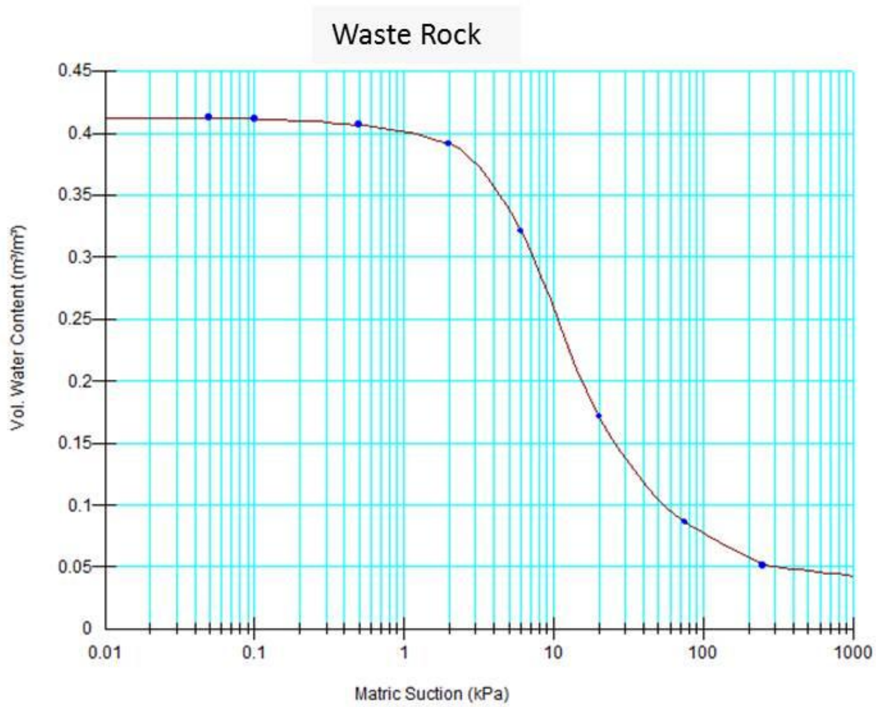
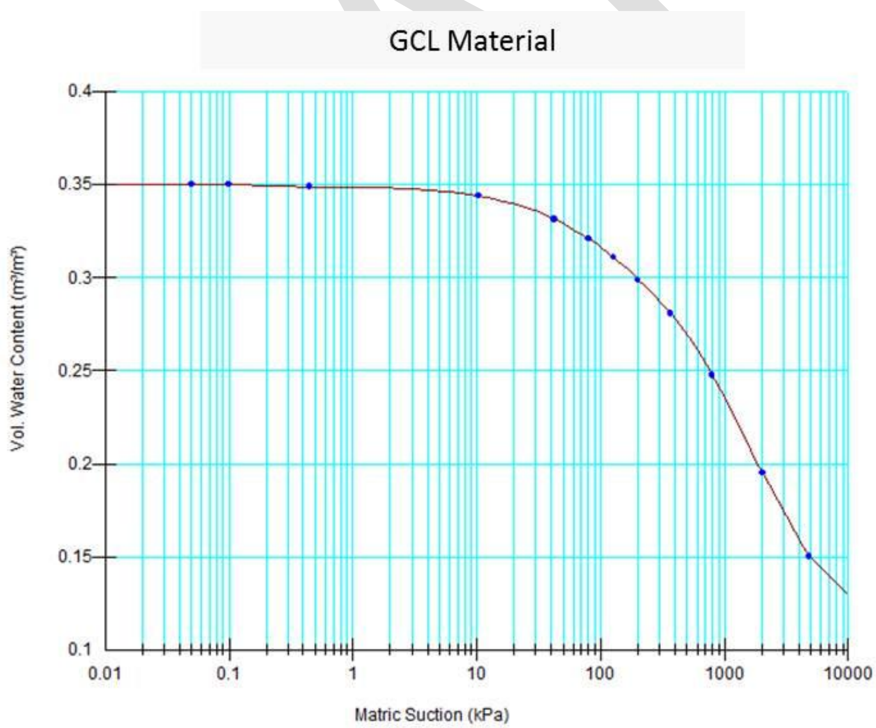


Figure 4 Hydraulic Conductivity Functions


Waste Rock
Vol. Water Content (m³/m³)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.01
0.1
1
10
100
1000
Matric Suction (kPa)


GCL Material
Vol. Water Content (m³/m³)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.01
0.1
1
10
100
1000
10000
Matric Suction (kPa)

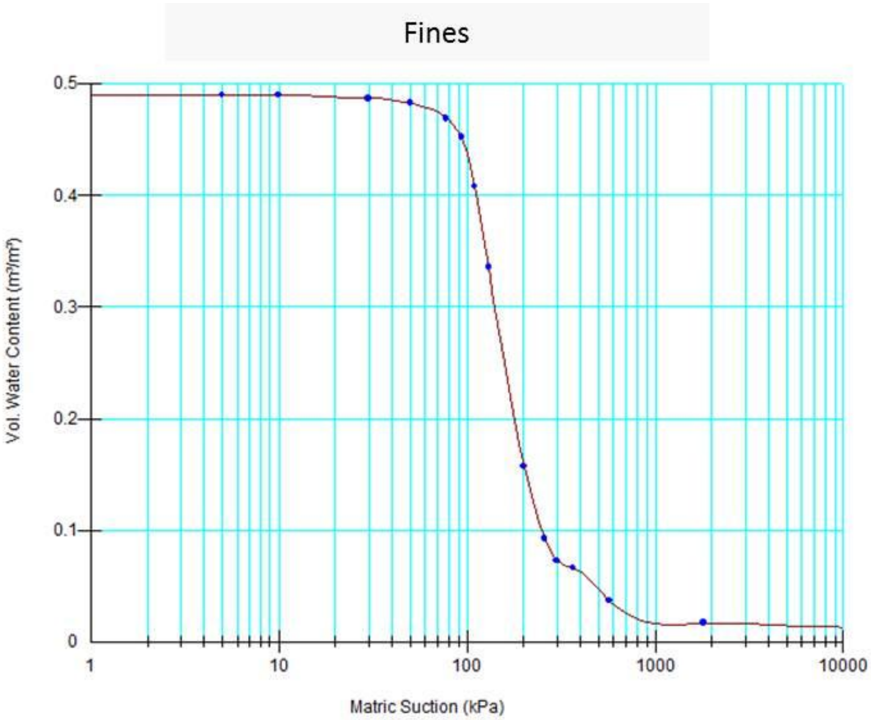


Figure 5 Soil Water Characteristic Curves

2.3 Modeling Technique

The modeling was completed as a steady state model followed by transient models to simulate the climate conditions.

2.3.1 Steady State Modeling

Steady state modeling is challenging when analyzing mining sites because the facilities change quickly and do not reach true steady state conditions until mine closure. To account for this, the WRD was modeled using an initial non-zero moisture condition to define the starting point of the facility at the completion of mining. The moisture content of the steady state model was in the range of 5% to 15% by volume. The results of the steady state model have been generally calibrated to site conditions (flow rates observed at Weirs 1, 2, and 3), but are only intended to offer non-zero starting values for the subsequent transient modeling scenarios and to evaluate the seepage rate from the waste rock.

2.3.2 Transient Modeling

Transient modeling provides a reasonable simulation of flow conditions within the WRD material. The upper most layer of these models is a surface region representing the top surface layer of the facility (the GCL, fines layer, and rock armor cover). It is in this part of the model that atmospheric conditions and soil come in contact, driving the water balance. The water within the facility then moves according to the rules of unsaturated flow physics through the waste rock material. Finally, and if applicable, the water reaches the base of the modeled region, where it moves to the model discharge point.

2.3.2.1 Transient Model Scenarios

This study focused on one transient scenario that represents the preferred construction and closure alternative. The preferred alternative details has interbench slopes of 34 degrees (overall slope of approximately 29 degrees) and the Petticoat cover option – GCL and fines layer on horizontal surfaces between the lifts of waste rock and on the top surface of the WRD.

2.3.2.2 Surface Layer

VADOSE/W (Geo-Slope, 2007) simulates the dynamics of the facility surface by considering climate and soil interactions. VADOSE/W (Geo-Slope, 2007) simulates precipitation using time increments with a maximum size of two (2) hours. The daily precipitation data is distributed according to a sinusoidal function that peaks at noon (normal distribution). This distribution pattern was compared with the constant averaged and the sloped averaged distribution patterns, and it was determined that the sinusoidal pattern resulted in the most mathematically stable calculation of the results. Potential evaporation or net radiation measurements are used to calculate the actual evaporation that is possible based on the conditions provided in the surface layer of the model. Evaporation is calculated from the following climate and soil factors:

- Air temperature;
- Soil temperature and thermal properties;
- Relative humidity;
- Solar intensity (from latitude);
- Soil temperature;
- Soil moisture content;
- Wind speed; and
- Measured pan evaporation.

The combination of the factors listed above provides a reasonable estimate of water lost from the system through evaporative processes. Infiltration is based on the unsaturated hydraulic conductivity of the material at a given time. Excess precipitation that has not evaporated, transpired, or infiltrated is tabulated as runoff. The surface region for the model was constructed with three layers to simulate the materials of the petticoat cover design.

2.3.2.3 Transient Flow within the Facilities

The transient flow dynamics within the tailings material are simulated over time and space. The model accounts for transitions between material types and produces the following data sets:

- Water flux within the model domain;
- Moisture content;
- Water flow velocity; and
- Seepage discharge, if applicable (out of the model domain).

The following sections present the infiltration and seepage model results.

3.0 Model Results

Table 1 presents the key components of the modeled facility water balance as a percentage of total annual precipitation. The petticoat closure cover limits the amount of precipitation that is able to infiltrate to approximately 25% of annual precipitation. The disadvantage with this design is that water infiltrates along the uncovered waste rock slopes. However, a closer investigation of the modeled results show that the precipitation that readily infiltrates into the waste rock slopes, is quickly evaporated back out of the WRD. Any water that infiltrates and is not quickly lost to evaporation travels vertically until it encounters the GCL and fines layer between the waste rock lifts. Once the infiltrated water reaches the GCL and fines layer, it travels laterally. Because the GCL layer is graded away from the center of the facility, the lateral flow is toward the outer edge of the facility and will prevent infiltration of some water into the PAG waste rock.

Table 1 Water Balance of Model Scenarios

	Cumulative Boundary Fluxes	Cumulative Runoff Mesh	Cumulative Water Balance	Cumulative Surface Evaporation
34 degree - Petticoat cover	25%	8%	2%	65%

The draindown rate of the WRD was also considered and is presented in Figure 6. Because the catch bench GCL layers do not overlap from lift to lift, there is some potential for water to travel vertically from the slopes to the base of the facility. The amount of water that will travel through the facility is minimal (reaches a steady state rate of four to five cubic meters per hour [m^3/hr] in year three after closure), and will be captured and treated through a passive engineered wetland system. This type of treatment design requires that some moisture flow into the engineered wetland system on a continuous basis to prevent the system from drying out and to help maintain a healthy bacterial population.

During the wet season, the WRD could have a significant amount of water flushed from the waste rock in response to large storm events. This is illustrated by the spike in flows in Year 1 and a slight increase in Year 2 presented in Figure 6. By Year 3 the facility has reach a steady state condition and does not show any response to the wet season or large storm events.

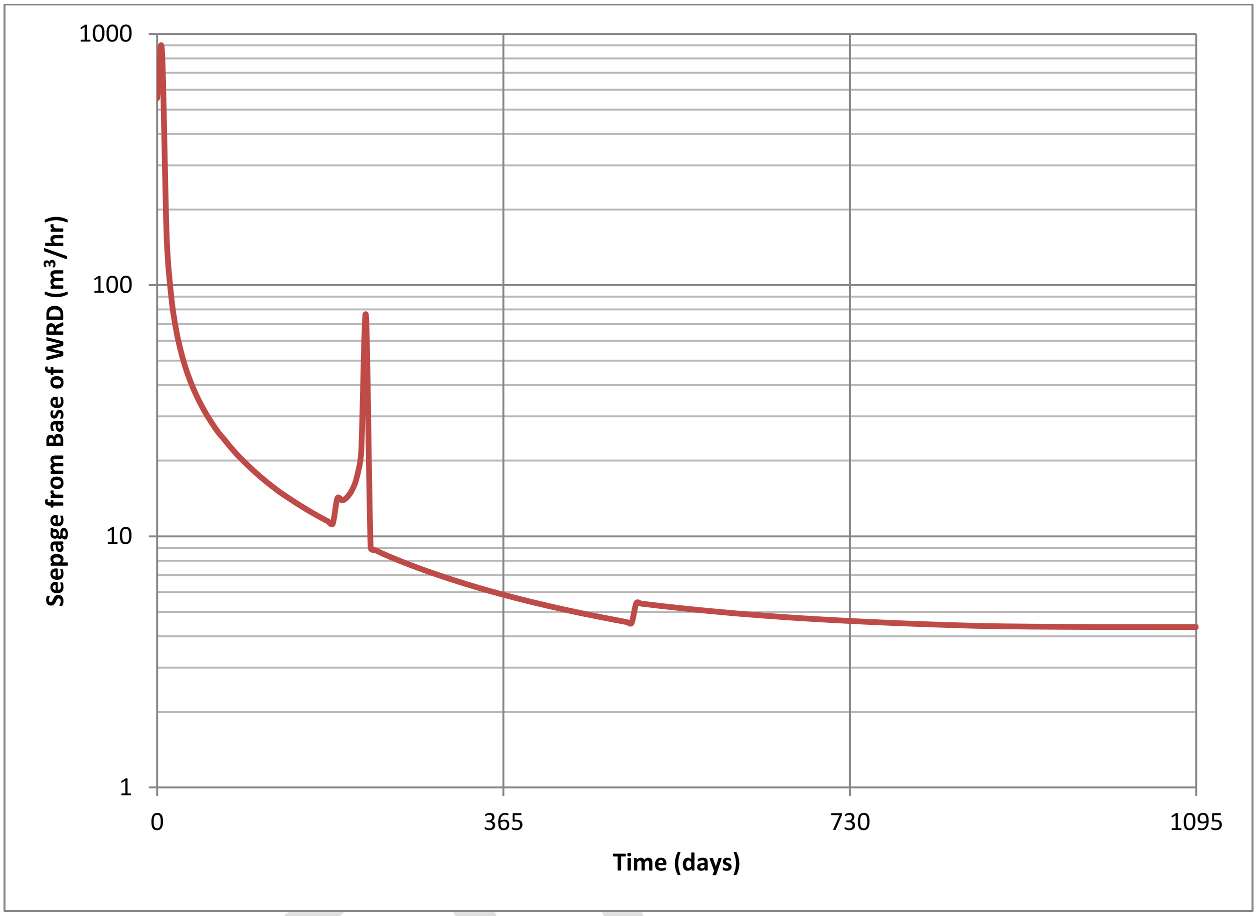


Figure 6 Draindown Flux Rate of WRD

Even though the waste rock material is quite hard and competent, the WRD will still be a dual porosity system. The primary porosity is the spaces between the pieces of rock. The secondary source of porosity is the fractures present in the rock that will “relax” and potentially open once the confining pressure of overlying rocks is removed. The secondary porosity is difficult to define and could allow ARD to happen in isolated fractures, that could be flushed by a passing wetting front, creating significantly impacted drainage water. These conditions need to be further defined as additional data is collected and site observations are made.

4.0 Water Quality Assessments

The water quality modeling approach and results are provided in the following subsections. Input parameters are summarized in Attachment 1.

4.1 Modeling Code and Database

The geochemical modeling was conducted using the computer code PHREEQC (Parkhurst and Appelo, 1999), a reaction path chemical equilibrium model supplied by the U.S. Geological Survey (USGS). PHREEQC is able to process multiple equilibria and mixing reactions to produce the final chemical speciation of a system. In addition to a computer code, geochemical modeling requires a database of the thermodynamic and kinetic parameters. For this study, the MINTEQ.V5 database (Allison et al, 1991) was chosen. However, this database does not include all of the relevant metals; therefore, to obtain a broad range of metals, data for Ti, Th, Bi were added from the Lawrence Livermore National Laboratory database (llnl.dat).

4.2 Geochemical Conceptual Model

The water quality estimates are based on three probable vertical flow paths that the infiltration water is likely to take within the WRD (Figure 6). In summary:

- Flow Path A represents the optimal scenario with regard to limiting ARD formation such as the scenario that could be envisioned for the outer portion of the lower most lift where water will contact non-PAG rock first (~50%), interact with PAG/uncertain rock within the core (~35%) and contact non-PAG rock again (~15%) before reporting to RP1.
- The horizontal flow induced by the petticoat option would be similar to Flow Path B, and would result in contact with non-PAG rock (~33.3%), followed by PAG/uncertain rock (66.6%).
- Flow Path C represents percolation through the GCL and into the PAG/uncertain rock core only. This worst case scenario represents a scenario without flow through a non-PAG cover.

4.3 Modeling Approach

The geochemical models were constructed as a series of mixing and reaction steps that represent the flow paths shown in Figure 7. The percentages of each waste rock type to be placed in the WRD and the associated potential to generate acid are based on the geochemical characterization program described in Tetra Tech (2011a) and the sulphur cutoffs based on the sulfur block model described in Tetra Tech (2011b).

Tonnages are based on the feasibility study ultimate pit design provided by the project mine planner (Tom Dyer). Micromine software was utilized to cut the pit into the 18 lithologic codes within the block model. Non-PAG, uncertain and PAG criteria were based on the total sulphur concentrations as follows:

- Non-PAG waste rock contains up to 0.25 wt. % total sulphur;
- Uncertain waste rock contains from 0.25 to 0.4 wt. % total sulphur; and
- PAG waste rock contains greater than 0.4 wt. % total sulphur.

TETRA TECH

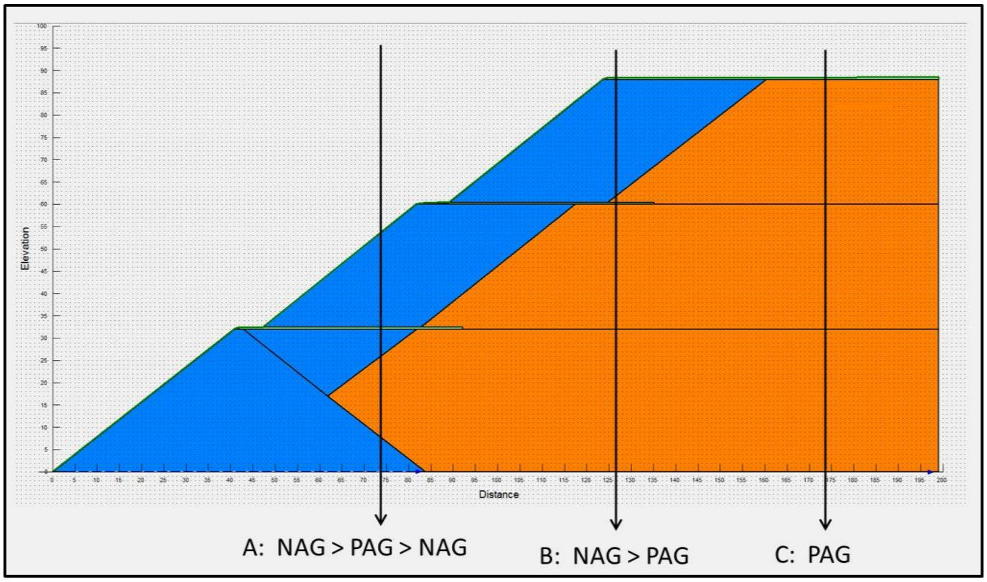


Figure 6 Expected Flow Paths and Material Contacts

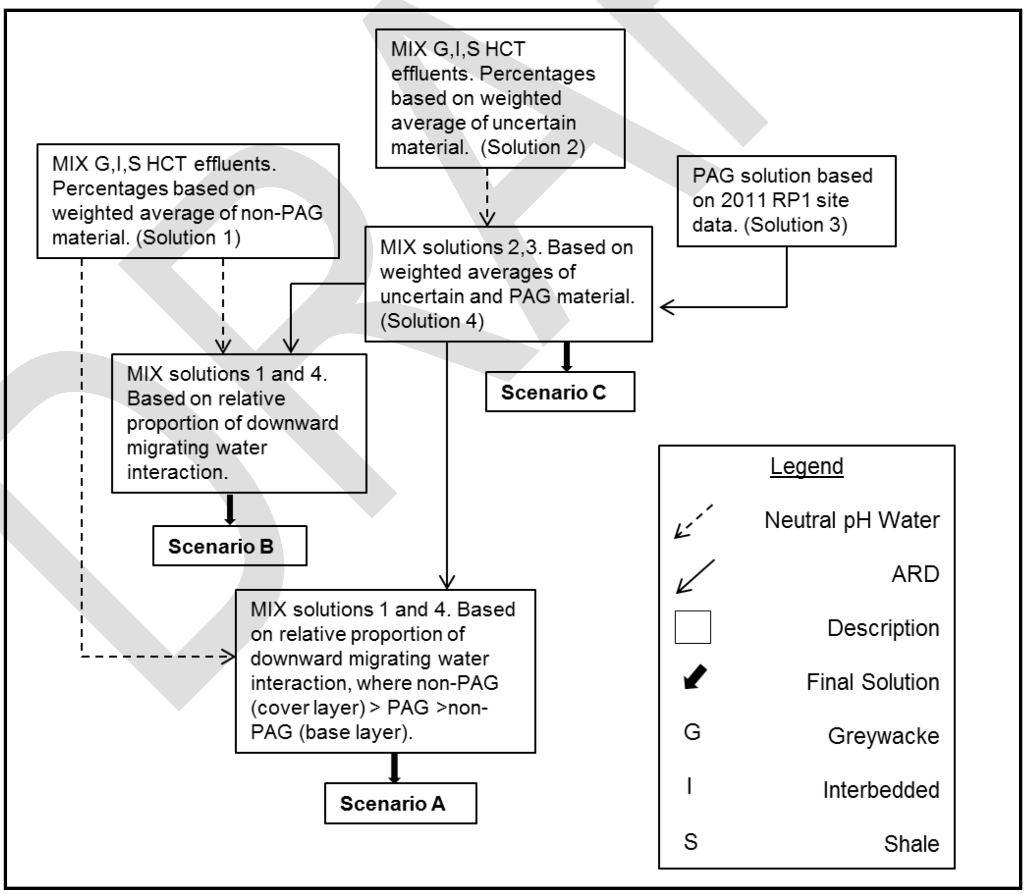


Figure 7 Geochemical Conceptual Model

Tonnages were obtained by querying all waste rock blocks (< 0.4 ppm Au) with 50% in or out of the topographic surface and ultimate pit surface. Tonnages of each rock type were initially compiled based on the 18 lithologic codes and then grouped into the three larger rock types defined as greywacke, interbedded and shale. Finally, the tonnages of non-PAG, uncertain and PAG waste rock from each rock types were determined (Attachment 1, Table A-1). Blocks identified as felsic tuff (~ 2% of the total tonnages) are also presented in Table A-1 but were not included in the geochemical modeling.

Initial solutions (Attachment 1, Table A-2) were based on kinetic humidity cell test (HCT) results including stable long-term concentrations associated with non-PAG and uncertain waste rock samples that generated neutral to alkaline pH for over one year and "first flush" concentrations from uncertain samples that also did not generate acid during the testing period. Alkalinity values less than 30 mg $CaCO_3$/L are commonplace in the HCT leachates. These initial solutions were mixed together based on the percentages of each rock type with the same acid-generating potential characteristics (Attachment 1, Table A-3). For example, stable concentrations from the non-PAG greywacke, shale and interbedded HCT leachates were mixed at a ratio of 0.4:0.18:0.42, to make solution 1. Likewise, solution 2 is comprised of first flush HCT concentrations of greywacke, shale and interbedded HCT leachates at a ratio of 0.35:0.15:0.5. Solution 3 was based on results from the November 2011 RP1 sampling event and represents ARD from PAG rock without consideration of rock type.

The seepage quality is based on stable long-term and first flush concentrations from the laboratory kinetic testing or ARD from RP1. Therefore, the model is considered to approximate water quality at the onset of the wet season when flushing of constituents will be the highest. The water quality predictions to be conducted for the water balance study will include kinetic oxidation of pyrite

4.4 Model Results

The geochemical model scenario results are summarized in Table 2. The results show that even partial encapsulation with non-PAG rock (scenario A) does not result in seepage with acceptable water quality as defined by the interim site specific trigger values (Table 3). The non-PAG rock primarily acts as a source of dilution of the regulated constituents. However, acidic pH remains because the alkalinity emanating from the non-PAG rock is insufficient to neutralize the acidity generated by the PAG rock. The model results show that acceptable pH (6 – 8) and associated decrease in constituent concentrations will require a source of neutralization potential (e.g., limestone).

5.0 Conclusions and Recommendations

The primary conclusions that can be drawn from this preliminary assessment of the drainage conditions and the water quality associated with different configurations of stacking and covering include:

- The petticoat option for both the 35° and 20° slopes limits the amount of precipitation that is able to infiltrate; however, water that infiltrates along the uncovered waste rock slopes interacts with the PAG waste rock unless the GCL layer is graded away from the center of the WRD.

- The beanie option performed the worst of the scenarios considered because only the top surface of the WRD is cover and the uncovered slopes and benches receive a significant amount of infiltration.
- The most protective option investigated is to fully cover the WRD; however, this option does not appear technically feasible for the 35° slopes.
- The non-PAG rock largely acts to dilute the ARD from the PAG rock because it does not contribute much to the regulated constituent load (e.g., metals, sulphate) but also is not a significant source of alkalinity.
- All three scenarios produce acidic pH solutions due to the minimal available alkalinity in the non-PAG rock to neutralize the acidity generated by the PAG rock. Addition of a neutralization potential source will be needed to prevent/minimize ARD.

Based on the findings of this study, the following recommendations should be considered to advance the current understanding of the drainage conditions associated with Vista Gold's preferred WRD closure configuration:

- Confirm that the WRD design chosen for the feasibility study is geotechnically stable.
- Confirm the composition and hydraulic properties of the fines material that will be placed to obtain the confining pressures.
- Quantify the concentrations of sodium and magnesium associated with the fines material and rainwater due to the potential for elevated sodium and magnesium concentrations to increase the GCL permeability these ions to impact the hydraulic permeability of the GCL. The heap leach pad residues have high sodium and magnesium concentrations compared to the non-PAG waste rock.
- Confirm the viability of an engineered wetland to treat ARD emanating from the WRD and prevent impacts to local waters.

Table 2 Summary of Model Results

Description	Scenario C	Scenario B	Scenario A
	PAG/Uncertain Only (100%)	Non-PAG>PAG/ Uncertain (33.3%, 66.6%)	Non-PAG>PAG>Non-PAG (50%, 37%, 13%)
pH	3.79	3.83	3.95
Sulphate	1220	816	448
Al	38.83	22.33	6.73
As	0.0119	0.0097	0.0078
Ca	77.4	52.9	31.0
Cd	0.107	0.071	0.039
Cl	9.21	7.64	6.24
Co	1.52	1.02	0.56
Cr	0.00079	0.00061	0.00045
Cu	8.38	5.59	3.10
Fe	0.000060	0.000040	0.000022
K	5.26	3.68	0.60
Mg	191	127	71
Mn	0.0067	0.0045	0.0022
Mo	0.00025	0.00018	0.00012
Na	22.9	15.8	9.4
Ni	12.9	8.64	4.79
Pb	0.053	0.036	0.020
Zn	25.13	16.76	9.30

TETRA TECH

Table 3 Proposed Interim Site Specific Trigger Values

Parameter	Units	Interim Trigger Values Edith River	Source (See GHD, 2011)
pH	pH Units	6 - 8	ANZECC & ARMCANZ Table 3.3.4
Electrical Conductivity	uS/cm	20-250	ANZECC & ARMCANZ Table 3.3.5
Magnesium	mg/L	2.5	Van Dam et al 2010 Environ Toxicol Chem 29(2):410-421
Sulphate	mg/L	129	Elphick et al 2011 Environ Toxicol Chem 30 (1):247-253
Aluminum	mg/L	0.149	Site derived 80th %ile
Cadmium	mg/L	0.2	High reliability TV ANZECC & ARMCANZ Table 3.4.1
Cobalt	mg/L	0.09	Moderate reliability TV ANZECC & ARMCANZ pg 8.3 - 118
Chromium(III)	mg/L	0.0033	Low reliability TV ANZECC & ARMCANZ pg 8.3 - 116
Chromium(VI)	mg/L	0.001	High reliability TV ANZECC & ARMCANZ Table 3.4.1
Copper	mg/L	0.0027	ERISS (2005) NOEC Value
Manganese	mg/L	1.9	Moderate reliability TV ANZECC & ARMCANZ Table 3.4.1
Nickel	mg/L	0.011	High reliability TV ANZECC & ARMCANZ Table 3.4.1
Lead	mg/L	0.0034	High reliability TV ANZECC & ARMCANZ Table 3.4.1
Iron	mg/L	0.3	Canadian Guideline ANZECC & ARMCANZ pg 8.3-123
Mercury	mg/L	0.0006	High reliability TV ANZECC & ARMCANZ Table 3.4.1
Zinc	mg/L	0.0095	ERISS (2005) NOEC Value

6.0 References

Allison JD, Brown DS, Novo-Gradac KJ. 1991. MINTEQA2/PROD-EFA2, A Geochemical Assessment Model for Environmental Systems: Version 3·0 Users' Manual. U.S. EPA, Athens, Georgia, EPA/600/3-91/021.

Benson, C. and S. Meer, 2009. Relative Abundance of Monovalent and Divalent Cations and the Impact of Desiccation on Geosynthetic Clay Liners. Journal of Geotechnical and Geoenvironmental Engineering 135:3 (349).

Allison JD, Brown DS, Novo-Gradac KJ., 1991. MINTEQA2/PROD-EFA2, A Geochemical Assessment Model for Environmental Systems: Version 3·0 Users' Manual. U.S. EPA, Athens, Georgia, EPA/600/3-91/021.

GEO-SLOPE International, Ltd. (GEO-SLOPE), 2007. *Vadose Zone Modeling with VADOSE/W 2007: An Engineering Methodology*. GEO-SLOPE International Ltd.: Calgary, Alberta, Canada.

GHD, 2011. Report for Mt Todd Gold Project Waste Discharge Licence 178 - Interim Site Specific Trigger Values. Prepared for Vista Gold Australia Pty Ltd. October 2011.

Parkhurst, David L. and Appelo, C.A.J., 1999. User's Guide to PHREEQC (Version 2) – A Computer Program for Speciation, Batch-Reaction, One-Dimensional Transport, and Inverse Geochemical Calculations. USGS WRIR 99-4259.

Tetra Tech, 2011a. 10.65 MTPY Preliminary Feasibility Study, NI 43-101 Technical Report, Mt Todd Gold Project, Northern Territory, Australia. Report with Appendices A- M. Prepared for Vista Gold Corp. January 28, 2011.

Tetra Tech, 2011b. Mt Todd Waste Rock Handling Criteria. Mt Todd Gold Project, Northern Territory, Australia. Prepared for Vista Gold Corp. September 26, 2011.

ATTACHMENT B:

RECLAMATION COST INFORMATION

Attachment B-1

Total Annual Costs by Facility

Vista Gold Corp. - Mt. Todd Project

	Total Closure Cost	Annual Total	Annual Total									
	AU$	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
Heap Leach Pad	$4,777,066	-	-	-	-	-	-	-	-	-	-	-
Low Grade Ore Stockpile	$4,883,311	-	$108,440	-	-	-	-	-	-	-	-	-
TSF 1	$24,028,056	-	-	$185,762	-	-	$2,254,062	$21,588,231	-	-	-	-
TSF 2	$31,252,760	-	-	-	-	$2,266,887	-	-	-	-	-	-
WRD (GCL Cover)	$35,037,758	-	-	$898,420	$3,395,312	$3,395,312	$3,395,312	$3,395,312	$3,395,312	$3,395,312	$3,395,312	$3,395,312
Process Plant Area	$16,354,568	-	-	-	-	-	-	-	-	-	-	-
Soil Stockpiles	$806,740	-	$28,702	$82,751	-	$217,467	$27,495	$131,377	-	-	-	-
Mine Roads	$680,357	-	-	-	-	-	-	-	-	-	-	-
Batman Pit	$224,154	-	-	$207,321	-	-	-	-	-	-	-	-
Indirect Costs	$36,767,489	$186,875	$223,218	$608,552	$1,144,133	$1,802,487	$1,748,745	$6,899,829	$1,144,133	$1,144,133	$1,144,133	$1,144,133
	$154,812,258	$186,875	$360,360	$1,982,806	$4,539,444	$7,682,153	$7,425,615	$32,014,749	$4,539,444	$4,539,444	$4,539,444	$4,539,444

		Annual Totals										
	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21
Heap Leach Pad	-	-	-	$4,777,066	-	-	-	-	-	-	-	-
Low Grade Ore Stockpile	-	-	$4,774,871	-	-	-	-	-	-	-	-	-
TSF 1	-	-	-	-	-	-	-	-	-	-	-	-
TSF 2	-	-	-	#########	$17,888,251	-	-	-	-	-	-	-
WRD (GCL Cover)	$3,395,312	$3,581,532	-	-	-	-	-	-	-	-	-	-
Process Plant Area	-	-	-	$30,410	$16,200,600	-	-	-	$123,558	-	-	-
Soil Stockpiles	-	-	$41,192	$104,654	$127,405	-	-	-	$14,589	$31,107	-	-
Mine Roads	-	-	-	-	-	-	-	-	-	$680,357	-	-
Batman Pit	-	$16,834	-	-	-	-	-	-	-	-	-	-
Indirect Costs	$1,144,133	$1,197,942	$1,520,631	$4,486,959	$9,311,683	$273,125	$273,125	$273,125	$309,734	$461,663	$162,500	$162,500
	$4,539,444	$4,796,307	$6,336,694	#########	$43,527,939	$273,125	$273,125	$273,125	$447,881	$1,173,127	$162,500	$162,500

Attachment B-2
Annual Equipment Use, Fuel Consumption, Equipment Costs, Labor Costs, and Non-Equipment Costs
Vista Gold Corp. - Mt. Todd Project

	Equipment Use	Annual Totals																						
	Hours	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21
D9 Dozer	*85,930*	-	470	3,276	972	10,747	2,775	22,985	972	972	972	972	972	988	3,943	12,558	21,708	-	-	-	174	472	-	-
994 Loader	*14,412*	-	42	296	237	1,119	481	4,510	237	237	237	237	237	281	503	1,780	3,912	-	-	-	18	47	-	-
180 Ton Haul Truck	*6,353*	-	84	711	-	1,763	98	843	-	-	-	-	-	-	302	1,419	934	-	-	-	57	142	-	-
Total Equipment Usage	*106,695*	*-*	*597*	*4,283*	*1,209*	*13,628*	*3,354*	*28,338*	*1,209*	*1,209*	*1,209*	*1,209*	*1,209*	*1,269*	*4,747*	*15,757*	*26,555*	*-*	*-*	*-*	*249*	*662*	*-*	*-*

Assume annual closure work is performed during the dry season.

	Fuel Consumption	Annual Totals																						
	Litres	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21
D9 Dozer	*3,866,862*	-	21,159	147,433	43,756	483,604	124,897	1,034,308	43,756	43,756	43,756	43,756	43,756	44,440	177,425	565,123	976,855	-	-	-	7,837	21,242	-	-
994 Loader	*2,161,809*	-	6,325	44,330	35,571	167,796	72,159	676,571	35,571	35,571	35,571	35,571	35,571	42,204	75,390	266,982	586,862	-	-	-	2,656	7,110	-	-
180 Ton Haul Truck	*698,829*	-	9,277	78,213	-	193,931	10,733	92,699	-	-	-	-	-	-	33,172	156,067	102,785	-	-	-	6,310	15,643	-	-
Total Fuel Consumption	*6,727,499*	*-*	*36,762*	*269,976*	*79,327*	*845,331*	*207,789*	*1,803,579*	*79,327*	*79,327*	*79,327*	*79,327*	*79,327*	*86,644*	*285,987*	*988,172*	*1,666,502*	*-*	*-*	*-*	*16,802*	*43,996*	*-*	*-*

Equipment Based Costs		Annual Totals																						
	Usage Based Totals	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21
D9 Dozer	*$7,746,484*	$0	$42,389	$295,352	$87,657	$968,805	$250,206	$2,072,030	$87,657	$87,657	$87,657	$87,657	$87,657	$89,027	$355,436	$1,132,112	$1,956,934	$0	$0	$0	$15,700	$42,555	$0	$0
994 Loader	*$4,603,226*	$0	$13,469	$94,393	$75,742	$357,295	$153,651	$1,440,651	$75,742	$75,742	$75,742	$75,742	$75,742	$89,866	$160,531	$568,495	$1,249,629	$0	$0	$0	$5,655	$15,141	$0	$0
180 Ton Haul Truck	*$1,279,299*	$0	$16,983	$143,180	$0	$355,016	$19,648	$169,698	$0	$0	$0	$0	$0	$0	$60,725	$285,702	$188,161	$0	$0	$0	$11,551	$28,636	$0	$0
Equipment Cost Totals	*$13,629,008*	*$0*	*$72,840*	*$532,925*	*$163,398*	*$1,681,115*	*$423,505*	*$3,682,379*	*$163,398*	*$163,398*	*$163,398*	*$163,398*	*$163,398*	*$178,893*	*$576,692*	*$1,986,308*	*$3,394,724*	*$0*	*$0*	*$0*	*$32,905*	*$86,332*	*$0*	*$0*

Labor Based Costs		Annual Totals																						
	Usage Based Totals	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21
D9 Dozer	*$5,265,334*	$0	$28,812	$200,753	$59,581	$658,503	$170,067	$1,408,372	$59,581	$59,581	$59,581	$59,581	$59,581	$60,512	$241,592	$769,503	$1,330,141	$0	$0	$0	$10,671	$28,925	$0	$0
994 Loader	*$883,092*	$0	$2,584	$18,109	$14,530	$68,544	$29,477	$276,377	$14,530	$14,530	$14,530	$14,530	$14,530	$17,240	$30,797	$109,061	$239,731	$0	$0	$0	$1,085	$2,905	$0	$0
180 Ton Haul Truck	*$389,276*	$0	$5,168	$43,568	$0	$108,027	$5,979	$51,637	$0	$0	$0	$0	$0	$0	$18,478	$86,936	$57,255	$0	$0	$0	$3,515	$8,714	$0	$0
Labor Cost Totals	*$6,537,702*	*$0*	*$36,563*	*$262,429*	*$74,111*	*$835,074*	*$205,522*	*$1,736,386*	*$74,111*	*$74,111*	*$74,111*	*$74,111*	*$74,111*	*$77,752*	*$290,867*	*$965,500*	*$1,627,127*	*$0*	*$0*	*$0*	*$15,271*	*$40,543*	*$0*	*$0*

Non-Equipment Based Costs		Annual Totals																						
	Task Based Totals	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21
Crushing-Fines-Ops	*$9,410,945*	$0	$0	$0	$935,645	$935,645	$935,645	$935,645	$935,645	$935,645	$935,645	$935,645	$935,645	$990,139	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Crushing-750mm-Ops	*$7,646,393*	$0	$0	$0	$760,212	$760,212	$760,212	$760,212	$760,212	$760,212	$760,212	$760,212	$760,212	$804,488	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Crushing-PostOps	*$0*	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
GCL Placement	*$14,704,602*	$0	$0	$0	$1,461,945	$1,461,945	$1,461,945	$1,461,945	$1,461,945	$1,461,945	$1,461,945	$1,461,945	$1,461,945	$1,547,093	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
LPM Import	*$43,691,470*	$0	$0	$0	$0	$0	$1,627,634	$14,058,032	$0	$0	$0	$0	$0	$0	$3,353,713	$10,573,057	$14,031,780	$0	$0	$0	$47,254	$0	$0	$0
Environmental Supervisor	*$3,737,500*	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500	$162,500
Revegetation	*$7,051,351*	$0	$13,538	$54,150	$0	$165,799	$245,290	$2,115,531	$0	$0	$0	$0	$0	$0	$504,213	$1,588,163	$2,113,465	$0	$0	$0	$6,840	$244,364	$0	$0
Maintenance	*$11,804,477*	$0	$13,714	$137,425	$339,531	$587,967	$567,687	$2,511,492	$339,531	$339,531	$339,531	$339,531	$339,531	$359,837	$481,606	$1,600,975	$3,421,626	$0	$0	$0	$13,815	$71,146	$0	$0
Contingency	*$20,150,512*	$24,375	$47,003	$258,627	$592,101	$1,002,020	$968,558	$4,175,837	$592,101	$592,101	$592,101	$592,101	$592,101	$625,605	$826,525	$2,673,484	$5,677,557	$35,625	$35,625	$35,625	$58,419	$153,017	$0	$0
Other Costs	*$16,448,297*	$0	$14,202	$574,749	$50,000	$89,876	$67,116	$414,790	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$140,577	$946,723	$13,099,161	$75,000	$75,000	$75,000	$110,877	$415,226	$0	$0
Non-Equip Cost Totals	*$134,645,547*	*$186,875*	*$250,957*	*$1,187,451*	*$4,301,935*	*$5,165,964*	*$6,796,588*	*$26,595,984*	*$4,301,935*	*$4,301,935*	*$4,301,935*	*$4,301,935*	*$4,301,935*	*$4,539,663*	*$5,469,135*	*$17,544,902*	*$38,506,088*	*$273,125*	*$273,125*	*$273,125*	*$399,705*	*$1,046,252*	*$162,500*	*$162,500*
Total Closure Cost	**$154,812,258**	**$186,875**	**$360,360**	**$1,982,806**	**$4,539,444**	**$7,682,153**	**$7,425,615**	**$32,014,749**	**$4,539,444**	**$4,539,444**	**$4,539,444**	**$4,539,444**	**$4,539,444**	**$4,796,307**	**$6,336,694**	**$20,496,710**	**$43,527,939**	**$273,125**	**$273,125**	**$273,125**	**$447,881**	**$1,173,127**	**$162,500**	**$162,500**

Attachment B-3
Reclamation Cost Estimate
Vista Gold Corp. - Mt. Todd Project

Feature to Reclaim	Area of Feature	Year	Year No.	Task	Unit	Quantity	Unit Cost	Cost	Details/Comments
Waste Rock Dump								**$35,037,758**	
Expansion Salvage									
Dump Salvage	Plant Growth	Y1	1	Plant Growth Medium - Stockpile - 1km	m3	157,519	$2.53	$398,420	Includes salvage of Soil Stockpile #9A located east of existing WRD
Dump Salvage	Test Plots	Y1	1	Closure Cover and Reveg Test Plots	LS	2	$250,000.00	$500,000	
Closure									
WRD Closure	Side	Y2	2	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	Will complete GCL cover concurrently, however detailed concurrent reclamation schedule not presently available, thus simply assume 10% conducted every year after the first year
WRD Closure	Side	Y2	2	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y2	2	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y2	2	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y2	2	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y2	2	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y3	3	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y3	3	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y3	3	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y3	3	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y3	3	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y3	3	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y4	4	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y4	4	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y4	4	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y4	4	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y4	4	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y4	4	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y5	5	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y5	5	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y5	5	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y5	5	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y5	5	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y5	5	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y6	6	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y6	6	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y6	6	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y6	6	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y6	6	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y6	6	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y7	7	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y7	7	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y7	7	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y7	7	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y7	7	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y7	7	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y8	8	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y8	8	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y8	8	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y8	8	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y8	8	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y8	8	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y9	9	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y9	9	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y9	9	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y9	9	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y9	9	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y9	9	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y10	10	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y10	10	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y10	10	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y10	10	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y10	10	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y10	10	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Side	Y11	11	GCL Underlayer 750mm max particle size	m3	58,478	$13.00	$760,212	
WRD Closure	Side	Y11	11	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y11	11	GCL	m2	194,926	$7.50	$1,461,945	
WRD Closure	Side	Y11	11	GCL Overlayer - Fines	m3	58,478	$16.00	$935,645	
WRD Closure	Side	Y11	11	Spread / Grade	m3	58,478	$0.34	$19,757	
WRD Closure	Side	Y11	11	Place Non-PAG Waste Rock	m3	241,100	$0.82	$197,996	
WRD Closure	Top	Y11	11	GCL Underlayer 750mm max particle size	m3	3,406	$13.00	$44,277	
WRD Closure	Top	Y11	11	Spread / Grade	m3	3,406	$0.34	$1,151	
WRD Closure	Top	Y11	11	GCL	m2	11,353	$7.50	$85,148	
WRD Closure	Top	Y11	11	GCL Overlayer - Fines	m3	3,406	$16.00	$54,494	
WRD Closure	Top	Y11	11	Spread / Grade	m3	3,406	$0.34	$1,151	
Tailings Storage Facility - 1								**$24,028,056**	
Salvage									
TSF1 Salvage	Salvage Footprint	Y1	1	Plant Growth Medium - Stockpile - 3km	m3	60,986	$3.05	$185,762	Salvaged with haul to Stockpile 10
Closure									
TSF1 Closure	Embankment	Y4	4	Place Non-PAG Waste Rock	m3	67,456	$0.82	$55,396	
TSF1 Closure	Embankment	Y4	4	Store and Release LPM - Import	m3	130,944	$12.43	$1,627,634	
TSF1 Closure	Embankment	Y4	4	Store and Release LPM Placement	m3	130,944	$0.82	$107,534	
TSF1 Closure	Embankment	Y4	4	Store and Release Blending	m3	198,400	$0.73	$144,782	
TSF1 Closure	Embankment	Y4	4	Plant Growth Medium Placement 1 km haul	m3	49,600	$1.34	$66,359	From Soil Stockpiles 1-9
TSF1 Closure	Embankment	Y4	4	Spread / Grade	m3	49,600	$0.34	$16,757	Erosion Control grading (i.e. dozer basins)
TSF1 Closure	Embankment	Y4	4	Revegetation	ha	24.80	$9,500.00	$235,600	
Impoundment Surface									
TSF1 Closure	Seepage Collection	Y5	5	Excavate Seepage Collection Ditch	m3	60,000	$0.67	$40,337	
TSF1 Closure	Seepage Collection	Y5	5	LLDPE Liner	m2	14,886	$7.34	$109,263	
TSF1 Closure	Modify for closure	Y5	5	Install Closure Spillway (TSF1 or TSF2)	LS	1	$25,000.00	$25,000	
TSF1 Closure	Decant closure	Y5	5	Excavate Seepage Collection Ditch	m3	750	$0.67	$504	modify sump pond
TSF1 Closure	Decant closure	Y5	5	LLDPE Liner	m2	750	$7.34	$5,505	line pond
TSF1 Closure	Decant closure	Y5	5	Concrete	m3	916	$196.50	$180,011	fill decant pipes with concrete
TSF1 Closure	Impoundment Surface	Y5	5	Place Non-PAG Waste Rock	m3	2,724,624	$0.82	$2,237,519	Cover impoundment to provide footing for equipment
TSF1 Closure	Impoundment Surface	Y5	5	Store and Release LPM - Import	m3	1,130,976	$12.43	$14,058,032	
TSF1 Closure	Impoundment Surface	Y5	5	Store and Release LPM Placement	m3	1,130,976	$0.82	$928,782	
TSF1 Closure	Impoundment Surface	Y5	5	Store and Release Blending	m3	1,713,600	$0.73	$1,250,499	
TSF1 Closure	Impoundment Surface	Y5	5	Plant Growth Medium Placement 1 km haul	m3	428,400	$1.34	$573,146	Material hauled from Stockpiles 1-9 with remaining material coming from Stockpile 11.
TSF1 Closure	Impoundment Surface	Y5	5	Spread / Grade	m3	428,400	$0.34	$144,734	
TSF1 Closure	Impoundment Surface	Y5	5	Revegetation	ha	214	$9,500.00	$2,034,900	
Tailings Storage Facility - 2								**$31,252,760**	
Salvage									
TSF2 Salvage	Salvage Footprint	Y3	3	Plant Growth Medium - Stockpile - 1km	m3	896,233	$2.53	$2,266,887	Salvaged with haul to Stockpile 11
Closure									
Embankment									
TSF2 Closure	Embankment	Y13	13	Place Non-PAG Waste Rock	m3	332,112	$0.82	$272,737	
TSF2 Closure	Embankment	Y13	13	Store and Release LPM - Import	m3	644,688	$12.43	$8,013,472	
TSF2 Closure	Embankment	Y13	13	Store and Release LPM Placement	m3	644,688	$0.82	$529,432	
TSF2 Closure	Embankment	Y13	13	Store and Release Blending	m3	976,800	$0.73	$712,819	
TSF2 Closure	Embankment	Y13	13	Plant Growth Medium Placement 1 km haul	m3	244,200	$1.34	$326,709	Material hauled from Stockpile 8 with remaining material coming from Stockpile 11.
TSF2 Closure	Embankment	Y13	13	Spread / Grade	m3	244,200	$0.34	$82,502	
TSF2 Closure	Embankment	Y13	13	Revegetation	ha	122	$9,500.00	$1,159,950	
Impoundment Surface									
TSF2 Closure	Pipeline Closure	Y14	14	haul pipes to WRD	m3	3,893	$2.11	$8,225	
TSF2 Closure	Sump Modification	Y14	14	Excavate Seepage Collection Ditch	m3	750	$0.67	$504	modify sump pond
TSF2 Closure	Sump Modification	Y14	14	LLDPE Liner	m2	750	$7.34	$5,505	line pond
TSF2 Closure	Seepage Collection	Y14	14	Excavate Seepage Collection Ditch	m3	48,150	$0.67	$32,371	
TSF2 Closure	Seepage Collection	Y14	14	LLDPE Liner	m2	11,946	$7.34	$87,683	
TSF2 Closure	Modify for closure	Y14	14	Install Closure Spillway (TSF1 or TSF2)	LS	1	$25,000.00	$25,000	
TSF2 Closure	Impoundment Surface	Y14	14	Place Non-PAG Waste Rock	m3	2,273,064	$0.82	$1,866,689	
TSF2 Closure	Impoundment Surface	Y14	14	Store and Release LPM - Import	m3	943,536	$12.43	$11,728,152	
TSF2 Closure	Impoundment Surface	Y14	14	Store and Release LPM Placement	m3	943,536	$0.82	$774,852	
TSF2 Closure	Impoundment Surface	Y14	14	Store and Release Blending	m3	1,429,600	$0.73	$1,043,250	
TSF2 Closure	Impoundment Surface	Y14	14	Plant Growth Medium Placement 1 km haul	m3	319,720	$1.34	$427,746	Material hauled from stockpile 11
TSF2 Closure	Impoundment Surface	Y14	14	Plant Growth Medium Placement 3 km haul	m3	37,680	$1.85	$69,878	Material hauled from stockpile 10
TSF2 Closure	Impoundment Surface	Y14	14	Spread / Grade	m3	357,400	$0.34	$120,747	Erosion Control grading (i.e. dozer basins)
TSF2 Closure	Impoundment Surface	Y14	14	Revegetation	ha	179	$9,500.00	$1,697,650	
Heap Leach Pad								**$4,777,066**	
Closure									
HLP Closure	All	Y13	13	Cut and fold liner	m2	390,000	$2.15	$839,280	
HLP Closure	All	Y13	13	Excavate Liner and Contaminated Material and Haul to T	m3	195,000	$1.41	$274,507	Assume portion of material below heap liner is contaminated. Excavate material and haul to TSF 2
HLP Closure	All	Y13	13	Spread / Grade	m3	195,000	$0.34	$65,880	Spread contaminated material and liner from HLP on TSF2
HLP Closure	All	Y13	13	Spread / Grade	m3	156,000	$0.34	$52,704	Grading to promote positive drainage
HLP Closure	All	Y13	13	Place Non-PAG Waste Rock	m3	106,080	$0.82	$87,115	
HLP Closure	All	Y13	13	Store and Release LPM - Import	m3	205,920	$12.43	$2,559,586	
HLP Closure	All	Y13	13	Store and Release LPM Placement	m3	205,920	$0.82	$169,106	
HLP Closure	All	Y13	13	Store and Release Blending	m3	312,000	$0.73	$227,682	
HLP Closure	All	Y13	13	Plant Growth Medium Placement 1 km haul	m3	78,000	$1.34	$104,354	70,000 From Stockpile 9B East of WRD - Less than 1 km; 8,000 from Stockpile 1&2, E of Pit - Less than 1 km
HLP Closure	All	Y13	13	Spread / Grade	m3	78,000	$0.34	$26,352	Erosion Control grading (i.e. dozer basins)
HLP Closure	All	Y13	13	Revegetation	ha	39	$9,500.00	$370,500	
Low Grade Ore Stockpile - 1				**Eliminate closure. LGO1 Area encompassed by expansion of Batman Pit**				**NA**	
Closure									
Low Grade Ore Stockpile - 2								**$4,883,311**	
Salvage									
LGO2 Salvage	Salvage Footprint	Y-1	-1	Plant Growth Medium - Stockpile - 1km	m3	42,873	$2.53	$108,440	Salvaged with haul to Stockpile 10
Closure									
LGO2 Closure	All	Y12	12	Spread / Grade	m3	102,200	$0.34	$34,528	Assume rough grading 0.2m thick over area
LGO2 Closure	All	Y12	12	Place Non-PAG Waste Rock	m3	138,992	$0.82	$114,143	
LGO2 Closure	All	Y12	12	Store and Release LPM - Import	m3	269,808	$12.43	$3,353,713	
LGO2 Closure	All	Y12	12	Store and Release LPM Placement	m3	269,808	$0.82	$221,572	
LGO2 Closure	All	Y12	12	Store and Release Blending	m3	408,800	$0.73	$298,322	
LGO2 Closure	All	Y12	12	Plant Growth Medium Placement 2 km haul	m3	102,200	$1.60	$163,132	
LGO2 Closure	All	Y12	12	Spread / Grade	m3	102,200	$0.34	$34,528	Erosion Control grading (i.e. dozer basins)
LGO2 Closure	All	Y12	12	Revegetation	ha	51.1	$9,500.00	$485,450	
LGO2 Closure	All	Y12	12	Erosion/Sediment Control-Fence	m	3,004	$23.13	$69,483	Accounted for in Process Plant Area Erosion Control

Attachment B-3
Reclamation Cost Estimate
Vista Gold Corp. - Mt. Todd Project

Feature to Reclaim	Area of Feature	Year	Year No.	Task	Unit	Quantity	Unit Cost	Cost	Details/Comments
Process Plant Area								**$16,354,568**	
Closure									
Plant Area Closure	Close RP2	Y13	13	Remove and dispose sediments	m3	1,562	$2.11	$3,300	
Plant Area Closure	Close RP2	Y13	13	Cut and fold liner	m2	2,996	$2.15	$6,446	
Plant Area Closure	Close RP2	Y13	13	Backfill Pond	m3	10,414	$0.34	$3,518	Reveg area included in overall process plant area
Plant Area Closure	Close RP5	Y13	13	Remove and dispose sediments	m3	2,058	$2.11	$4,349	
Plant Area Closure	Close RP5	Y13	13	Cut and fold liner	m2	3,792	$2.15	$8,160	
Plant Area Closure	Close RP5	Y13	13	Backfill Pond	m3	13,721	$0.34	$4,636	
Plant Area Closure	Foundations	Y14	14	Concrete Foundation Rubblization and Haul to WRD	m3	21,432	$600.00	$12,859,200	Rubblize Foundations - All except WTP
Plant Area Closure	Close Equalization Pond	Y18	18	Remove and dispose sediments	m3	10,800	$2.11	$22,819	
Plant Area Closure	Close Equalization Pond	Y18	18	Cut and fold liner	m2	9,900	$2.15	$21,305	
Plant Area Closure	Close Equalization Pond	Y18	18	Backfill Pond	m3	36,000	$0.34	$12,162	
Plant Area Closure	Close Equalization Pond	Y18	18	Spread / Grade	m3	4,320	$0.34	$1,459	Rip subgrade
Plant Area Closure	Close Equalization Pond	Y18	18	Place Non-PAG Waste Rock	m3	1,958	$0.82	$1,608	Place cover
Plant Area Closure	Close Equalization Pond	Y18	18	Store and Release LPM - Import	m3	3,802	$12.43	$47,254	Place cover
Plant Area Closure	Close Equalization Pond	Y18	18	Store and Release LPM Placement	m3	3,802	$0.82	$3,122	Place cover
Plant Area Closure	Close Equalization Pond	Y18	18	Store and Release Blending	m3	5,760	$0.73	$4,203	Place cover
Plant Area Closure	Close Equalization Pond	Y18	18	Plant Growth Medium Placement 2 km haul	m3	1,440	$1.60	$2,299	Place cover
Plant Area Closure	Close Equalization Pond	Y18	18	Spread / Grade	m3	1,440	$0.34	$486	Erosion Control grading (i.e. dozer basins)
Plant Area Closure	Close Equalization Pond	Y18	18	Revegetation	ha	0.7	$9,500.00	$6,840	
Plant Area Closure	All	Y14	14	Spread / Grade	m3	351,000	$0.34	$118,584	Grading to blend plant area into surrounding topography.
Plant Area Closure	All	Y14	14	Place Non-PAG Waste Rock	m3	95,472	$0.82	$78,404	
Plant Area Closure	All	Y14	14	Store and Release LPM - Import	m3	185,328	$12.43	$2,303,627	
Plant Area Closure	All	Y14	14	Store and Release LPM Placement	m3	185,328	$0.82	$152,195	
Plant Area Closure	All	Y14	14	Store and Release Blending	m3	280,800	$0.73	$204,914	
Plant Area Closure	All	Y14	14	Plant Growth Medium Placement 1 km haul	m3	70,200	$1.34	$93,919	
Plant Area Closure	All	Y14	14	Spread / Grade	m3	70,200	$0.34	$23,717	Erosion Control grading (i.e. dozer basins)
Plant Area Closure	All	Y14	14	Revegetation	ha	35.1	$9,500.00	$333,450	
Plant Area Closure	All	Y14	14	Erosion/Sediment Control-Fence	m	1,409	$23.13	$32,590	
Soil Stockpiles								**$806,740**	**NOTE - Costs for Stockpiles will be incurred during mine operations, however complete schedule of stockpile creation has not been developed at this level of design. Costs associated with stockpiles attributed to Y16 at this time.**
Closure									
Stockpiles	SS1-9	Y4	4	Erosion/Sediment Control-Fence	m	740	$23.13	$17,116	Soil Stockpile 1 footprint eliminated during salvage of LGO Stockpile 2 salvage
Stockpiles	SS1-9	Y4	4	Spread / Grade	m3	2,040	$0.34	$689	
Stockpiles	SS1-9	Y4	4	Revegetation	ha	1	$9,500.00	$9,690	
Stockpiles	SS1-9	Y5	5	Erosion/Sediment Control-Fence	m	604	$23.13	$13,971	Soil Stockpile 2 footprint eliminated during salvage of LGO Stockpile 2 salvage
Stockpiles	SS1-9	Y5	5	Spread / Grade	m3	4,560	$0.34	$1,541	
Stockpiles	SS1-9	Y5	5	Revegetation	ha	2	$9,500.00	$21,660	
Stockpiles	SS10	Y-1	-1	Erosion/Sediment Control-Fence	m	614	$23.13	$14,202	
Stockpiles	SS10	Y-1	-1	Spread / Grade	m3	2,850	$0.34	$963	grade out footprint for final reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS10	Y-1	-1	Revegetation	ha	1	$9,500.00	$13,538	
Stockpiles	SS10	Y1	1	Erosion/Sediment Control-Fence	m	1,070	$23.13	$24,749	
Stockpiles	SS10	Y1	1	Spread / Grade	m3	11,400	$0.34	$3,851	grade out footprint for final reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS10	Y1	1	Revegetation	ha	6	$9,500.00	$54,150	
Stockpiles	SS10	Y12	12	Erosion/Sediment Control-Fence	m	912	$23.13	$21,095	
Stockpiles	SS10	Y12	12	Spread / Grade	m3	3,950	$0.34	$1,334	grade out footprint for final reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS10	Y12	12	Revegetation	ha	2	$9,500.00	$18,763	
Stockpiles	SS10	Y13	13	Erosion/Sediment Control-Fence	m	790	$23.13	$18,273	
Stockpiles	SS10	Y13	13	Spread / Grade	m3	3,050	$0.34	$1,030	grade out footprint for final reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS10	Y13	13	Revegetation	ha	2	$9,500.00	$14,488	
Stockpiles	SS10	Y14	14	Erosion/Sediment Control-Fence	m	632	$23.13	$14,618	
Stockpiles	SS10	Y14	14	Spread / Grade	m3	3,950	$0.34	$1,334	grade out footprint for final reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS10	Y14	14	Revegetation	ha	2	$9,500.00	$18,763	
Stockpiles	SS10	Y18	18	Erosion/Sediment Control-Fence	m	630	$23.13	$14,572	
Stockpiles	SS10	Y18	18	Spread / Grade	m3	50	$0.34	$17	grade out footprint for final reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS10	Y18	18	Revegetation	ha	-	$9,500.00	$0	
Stockpiles	SS10	Y19	19	Erosion/Sediment Control-Fence	m	630	$23.13	$14,572	
Stockpiles	SS10	Y19	19	Spread / Grade	m3	3,250	$0.34	$1,098	grade out footprint for final reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS10	Y19	19	Revegetation	ha	2	$9,500.00	$15,438	
Stockpiles	SS11	Y3	3	Erosion/Sediment Control-Fence	m	1,724	$23.13	$39,876	Stockpile construction erosion control
Stockpiles	SS11	Y3	3	Spread / Grade	m3	34,905	$0.34	$11,793	
Stockpiles	SS11	Y3	3	Revegetation	ha	17	$9,500.00	$165,799	grade out disturbed footprint for interim reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS11	Y5	5	Erosion/Sediment Control-Fence	m	1,342	$23.13	$31,040	
Stockpiles	SS11	Y5	5	Spread / Grade	m3	12,415	$0.34	$4,194	grade out disturbed footprint for interim reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS11	Y5	5	Revegetation	ha	6	$9,500.00	$58,971	
Stockpiles	SS11	Y13	13	Erosion/Sediment Control-Fence	m	1,062	$23.13	$24,564	
Stockpiles	SS11	Y13	13	Spread / Grade	m3	9,100	$0.34	$3,074	grade out footprint for final reclamation - assume 0.2 m depth over footprint area
Stockpiles	SS11	Y13	13	Revegetation	ha	5	$9,500.00	$43,225	
Stockpiles	SS11	Y14	14	Erosion/Sediment Control-Fence	m	1,062	$23.13	$24,564	Stockpile construction erosion control
Stockpiles	SS11	Y14	14	Spread / Grade	m3	13,390	$0.34	$4,524	
Stockpiles	SS11	Y14	14	Revegetation	ha	7	$9,500.00	$63,603	grade out disturbed footprint for interim reclamation - assume 0.2 m depth over footprint area
Mine Roads								**$680,357**	
Closure									
Roads Closure	All	Y19	19	Spread / Grade	m3	48,195	$0.34	$16,283	Grade into surrounding topography
Roads Closure	All	Y19	19	Spread / Grade	m3	48,195	$0.34	$16,283	Rip material 0.2m deep prior to PGM placement
Roads Closure	All	Y19	19	Plant Growth Medium Placement 2 km haul	m3	48,195	$1.60	$76,929	
Roads Closure	All	Y19	19	Spread / Grade	m3	48,195	$0.34	$16,283	Erosion Control grading (i.e. dozer basins)
Roads Closure	All	Y19	19	Revegetation	ha	24.1	$9,500.00	$228,926	
Roads Closure	All	Y19	19	Erosion/Sediment Control-Bales	ea	720.0	$33.13	$23,854	
Roads Closure	All	Y19	19	Erosion/Sediment Control-Fence	m	13,048.0	$23.13	$301,800	
Batman Pit								**$224,154**	
Expansion									
Pit Expansion	Expansion	Y1	1	Plant Growth Medium - Stockpile - 1km	m3	81,966	$2.53	$207,321	
Closure									
Pit Closure	Pit Edge	Y11	11	Pit Safety Berm	m3	44,960	$0.37	$16,834	Berm material coming directly from pit. Assume haul costs covered by Pit/WRD Cost Estimate.
Indirect Costs								**$36,767,489**	
Indirect	Oversight	Y-2	-2	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y-1	-1	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y1	1	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y2	2	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y3	3	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y4	4	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y5	5	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y6	6	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y7	7	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y8	8	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y9	9	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y10	10	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y11	11	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y12	12	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y13	13	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y14	14	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y15	15	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y16	16	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y17	17	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y18	18	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y19	19	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y20	20	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
Indirect	Oversight	Y21	21	Environmental Supervisory Staff	LS	1	$162,500.00	$162,500	
	Concurrent Monitoring	Y1	1	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y2	2	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y3	3	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y4	4	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y5	5	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y6	6	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y7	7	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y8	8	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y9	9	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y10	10	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y11	11	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y12	12	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y13	13	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Concurrent Monitoring	Y14	14	Concurrent Monitoring	LS	1	$50,000.00	$50,000	
	Closure Monitoring	Y15	15	Closure Monitoring	LS	1	$75,000.00	$75,000	
	Closure Monitoring	Y16	16	Closure Monitoring	LS	1	$75,000.00	$75,000	
	Closure Monitoring	Y17	17	Closure Monitoring	LS	1	$75,000.00	$75,000	
	Closure Monitoring	Y18	18	Closure Monitoring	LS	1	$75,000.00	$75,000	
	Closure Monitoring	Y19	19	Closure Monitoring	LS	1	$75,000.00	$75,000	
	Maintenance	Y-2	-2	Maintenance	%	10%	$0.00	$0	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y-1	-1	Maintenance	%	10%	$137,142.34	$13,714	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y1	1	Maintenance	%	10%	$1,374,253.45	$137,425	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y2	2	Maintenance	%	10%	$3,395,311.75	$339,531	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y3	3	Maintenance	%	10%	$5,879,666.34	$587,967	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y4	4	Maintenance	%	10%	$5,676,869.53	$567,687	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y5	5	Maintenance	%	10%	$25,114,920.14	$2,511,492	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y6	6	Maintenance	%	10%	$3,395,311.75	$339,531	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y7	7	Maintenance	%	10%	$3,395,311.75	$339,531	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y8	8	Maintenance	%	10%	$3,395,311.75	$339,531	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y9	9	Maintenance	%	10%	$3,395,311.75	$339,531	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y10	10	Maintenance	%	10%	$3,395,311.75	$339,531	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y11	11	Maintenance	%	10%	$3,598,365.56	$359,837	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y12	12	Maintenance	%	10%	$4,816,062.23	$481,606	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y13	13	Maintenance	%	10%	$16,009,751.32	$1,600,975	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y14	14	Maintenance	%	10%	$34,216,256.39	$3,421,626	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y15	15	Maintenance	%	10%	$0.00	$0	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y16	16	Maintenance	%	10%	$0.00	$0	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y17	17	Maintenance	%	10%	$0.00	$0	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y18	18	Maintenance	%	10%	$138,146.96	$13,815	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Maintenance	Y19	19	Maintenance	%	10%	$711,464.10	$71,146	Assume maintenance required on reclamation activities performed during year (percentage based on direct costs only)
	Contingency	Y-2	-2	Contingency	%	15%	$162,500.00	$24,375	
	Contingency	Y-1	-1	Contingency	%	15%	$313,356.57	$47,003	
	Contingency	Y1	1	Contingency	%	15%	$1,724,178.80	$258,627	
	Contingency	Y2	2	Contingency	%	15%	$3,947,342.93	$592,101	
	Contingency	Y3	3	Contingency	%	15%	$6,680,132.98	$1,002,020	
	Contingency	Y4	4	Contingency	%	15%	$6,457,056.48	$968,558	
	Contingency	Y5	5	Contingency	%	15%	$27,838,912.16	$4,175,837	
	Contingency	Y6	6	Contingency	%	15%	$3,947,342.93	$592,101	
	Contingency	Y7	7	Contingency	%	15%	$3,947,342.93	$592,101	
	Contingency	Y8	8	Contingency	%	15%	$3,947,342.93	$592,101	
	Contingency	Y9	9	Contingency	%	15%	$3,947,342.93	$592,101	
	Contingency	Y10	10	Contingency	%	15%	$3,947,342.93	$592,101	
	Contingency	Y11	11	Contingency	%	15%	$4,170,702.12	$625,605	
	Contingency	Y12	12	Contingency	%	15%	$5,510,168.45	$826,525	
	Contingency	Y13	13	Contingency	%	15%	$17,823,226.45	$2,673,484	
	Contingency	Y14	14	Contingency	%	15%	$37,850,382.03	$5,677,557	
	Contingency	Y15	15	Contingency	%	15%	$237,500.00	$35,625	
	Contingency	Y16	16	Contingency	%	15%	$237,500.00	$35,625	
	Contingency	Y17	17	Contingency	%	15%	$237,500.00	$35,625	
	Contingency	Y18	18	Contingency	%	15%	$389,461.65	$58,419	
	Contingency	Y19	19	Contingency	%	15%	$1,020,110.51	$153,017	
							Total	**$154,812,258**	

Attachment B-4
Mine Equipment and Mine Labor Costs
Vista Gold Corp. - Mt. Todd Project

Mine Equipment

Primary Mining Equipment	Unit Cost	Freight	Assembly	Total	Source	Fuel l/hr	Fuel $/hr	Lube, Oil $/hr	Tires $/hr	Under-Carriage	R&M Parts	Special Wear Items	Total	Total AU$**
Atlas Copco PV235	$ 1,617,104	$ 91,960	$ 26,026	$ 1,735,090	EMG	70.40	$ 39.43	$ 11.58		$ 5.00	$ 36.24	$ 52.08	$ 144.33	$ 149.38
28m3 Hyd. Shovel (PC 5000)	$ 10,328,429	$ 598,259	$ 361,213	$ 11,287,901	EMG	350.00	$ 196.00	$ 48.48			$ 141.20	$ 13.52	$ 399.20	$ 413.17
18m3 Front End Loader (994)	$ 4,374,700	$ 132,130	$ 39,450	$ 4,546,280	EMG	150.00	$ 118.68	$ 29.29	$ 87.39		$ 71.45	$ 1.79	$ 308.60	$ 319.40
180t Haul Truck	$ 2,665,520	$ 151,580	$ 42,900	$ 2,860,000	EMG	110.00	$ 87.03	$ 21.59	$ 49.59		$ 36.35		$ 194.56	$ 201.37
Support Equipment														$ -
300 Kw Dozer (D9)	$ 869,155	$ 49,426	$ 13,989	$ 932,570	EMG	45.00	$ 35.60	$ 5.64		$ 12.51	$ 19.35	$ 14.00	$ 87.10	$ 90.15
230 Kw Dozer (D8)				$ 685,631		35.00	$ 19.60	$ 3.43		$ 9.38	$ 8.23	$ 10.61	$ 51.25	$ 53.05
4.9 m Motor Grader (16H)	$ 778,652	$ 44,280	$ 12,532	$ 835,464	EMG	21.00	$ 11.76	$ 4.14	$ 13.05		$ 18.83	$ 1.18	$ 48.96	$ 50.67
Water Truck - 70,000 Liter	$ 1,437,500	$ 53,681	$ 14,780	$ 1,505,961	EMG	60.00	$ 33.60	$ 8.28	$ 51.89		$ 32.77		$ 126.54	$ 130.97
RTD Dozer (834H)	$ 889,608	$ 50,589	$ 14,318	$ 954,515	EMG	40.00	$ 22.40	$ 4.57	$ 17.20		$ 18.88		$ 63.05	$ 65.26
Rock Breaker - Impact Hammer (691 Kg m)				$ 39,100	InfoMine	-	$ -	$ 0.22			$ 1.58	$ 0.63	$ 2.43	$ 2.52
Backhoe/Loader (1.5 cu m-446D)	$ 266,552	$ 15,158	$ 4,290	$ 286,000	EMG	15.00	$ 8.40	$ 2.05	$ 2.67		$ 8.70	$ 1.91	$ 23.73	$ 24.56
Pit Pumps (5299 lpm)				$ 25,500	InfoMine	6.46	$ 3.62	$ 0.28			$ 0.77		$ 4.67	$ 4.83
36 ton Crane	$ 298,240	$ 16,960	$ 4,800	$ 320,000	EMG	23.13	$ 12.95	$ 2.38	$ 1.33		$ 4.35		$ 21.02	$ 21.75
2 cm excavator (Cat 392)	$ 333,409	$ 18,164	$ 5,560	$ 177,345	EMG	30.00	$ 16.80	$ 2.78		$ 1.75	$ 14.34	$ 2.22	$ 37.89	$ 39.22
Low Boy	$ 864,000	$ 86,400	$ 43,200	$ 993,600	InfoMine - Gooseneck trailer w/ 60 ton truck	47.02	$ 26.33	$ 6.53	$ 12.99		$ 8.08	$ 0.30	$ 54.23	$ 56.13
Flatbed	$ 53,000	$ 2,650	$ -	$ 55,650	InfoMine	12.85	$ 7.19	$ 0.79	$ 0.80		$ 1.06	$ 0.30	$ 10.14	$ 10.50
Blasting														
Sanding/Stemming Truck					Infomine	24.00	$ 13.44	$ 0.90	$ 0.93		$ 1.51	$ 1.50	$ 18.28	$ 20.36
Explosives Truck	$ 157,110	$ 15,711	$ 7,856	$ 180,677	Tred (from Livengood Quote)	15.00	$ 8.40	$ 2.00	$ 1.12		$ 5.00	$ 0.30	$ 16.82	$ 18.73
Skid Loader	$ 47,800	$ 3,450	$ 3,145	$ 54,395	EMG	7.00	$ 3.92	$ 0.34	$ 1.60		$ 0.85		$ 6.71	$ 7.47
Mine Maintenance														
Lube/Fuel Truck				$ 192,610	EMG	10.00	$ 5.60	$ 0.50	$ 1.68		$ 3.50	$ 0.30	$ 11.58	$ 12.90
Mechanics Truck				$ 187,000	EMG	5.00	$ 2.80	$ 0.20	$ 1.68		$ 3.00	$ 0.30	$ 7.98	$ 8.89
Tire Truck				$ 137,000		3.00	$ 1.68	$ 0.60	$ 0.50		$ 3.00	$ 0.15	$ 5.93	$ 6.60
Other Mine Capital														
Light Plant	$ 12,302	$ 700	$ 198	$ 13,200	EMG	2.00	$ 1.12	$ 0.10	$ 0.12		$ 0.65		$ 1.99	$ 2.22

*Operating Costs updated per TT/MDA Equipment List, April 16, 2012

** AU$ based on factor of 1.035 to convert O&M rates from MDA to AU$

Mine Employees

Operator Hours

Hours per day	12
Days per year	170
Hours worked per Year	**2040**

*Developed based on assumption from Ausenco that operators work 4 day shifts of 12 hours with 4 days off, plus about two weeks of vacation/sick leave (January 9, 2012).

Operator Rates	Base Salary	On Cost	Total
Loader Operator	$100,000	$25,000	$125,000
Dozer Operator	$100,000	$25,000	$125,000
Truck Operator	$100,000	$25,000	$125,000

Environmental Supervision

	Base Salary (AU$)	On Cost	Total	
Environmental Supervisor	$110,000	$27,500	$137,500	
Environmental Vehicle			$25,000	Based on estimate from Proteus (1/5/2012)
		Total Cost	**$162,500**	

- **Operator & Supervisor Labor Rate Development:**
- Labor rates are based on values from TT cost model workbook, effective 4/18/2012.
- These rates replaced rates from Ausenco and the Hays Salary Guide

Unit Costs Development
Vista Gold Corp. - Mt. Todd Project

Mine Owned Equipment and Labor

Part 1: Cost, rates and dozers

Cost	UOM	Distance	Control Productivity (lcm/hr)	Unit Rate (AU$)	Equipment Cost ($/lcm)	Labor Cost ($/lcm)	Dozer (Salvage) Qnty	Dozer (Salvage) Productivity Rate	Dozer (Salvage) Total Productivity	Dozer (Salvage) Equipment Rate	Dozer (Salvage) Operator Wage	Dozer (Place) Qnty	Dozer (Place) Productivity Rate	Dozer (Place) Total Productivity	Dozer (Place) Equipment Rate	Dozer (Place) Operator Wage
Plant Growth Medium - Stockpile - 1km	m3	1 km	1017	**$ 2.53**	$ 1.69	$ 0.84	3	448	1345	$ 90.15	$61.27	8	134	1076	$ 90.15	$61.27
Plant Growth Medium - Stockpile - 2km	m3	2 km	1017	**$ 2.79**	$ 1.88	$ 0.90	3	448	1345	$ 90.15	$61.27	8	134	1076	$ 90.15	$61.27
Plant Growth Medium - Stockpile - 3km	m3	3 km	1017	**$ 3.05**	$ 2.08	$ 0.96	3	448	1345	$ 90.15	$61.27	8	134	1076	$ 90.15	$61.27
Plant Growth Medium - Stockpile - 5km	m3	5 km	1017	**$ 3.30**	$ 2.28	$ 1.02	3	448	1345	$ 90.15	$61.27	8	134	1076	$ 90.15	$61.27
Spread / Grade	m3		448	**$ 0.34**	$ 0.20	$ 0.14						1	448	448	$ 90.15	$61.27
Revegetation	ha			**$ 9,500**												
Erosion/Sediment Control-Fence	m			**$ 23.13**												
Erosion/Sediment Control-Bales	ea			**$ 33.13**												
Pit Safety Berm	m3		1017	**$ 0.37**	$ 0.31	$ 0.06										
Store and Release Blending	m3		208	**$ 0.73**	$ 0.43	$ 0.30						1	207.5	208	$ 90.15	$61.27
Plant Growth Medium Placement	m3		1017	**$ 0.82**	$ 0.58	$ 0.24						3	448	1345	$ 90.15	$61.27
Plant Growth Medium Placement 1 km haul	m3	1 km	1017	**$ 1.34**	$ 0.98	$ 0.36						3	448	1345	$ 90.15	$61.27
Plant Growth Medium Placement 2 km haul	m3	2 km	1017	**$ 1.60**	$ 1.17	$ 0.42						3	448	1345	$ 90.15	$61.27
Plant Growth Medium Placement 3 km haul	m3	3 km	1017	**$ 1.85**	$ 1.37	$ 0.48						3	448	1345	$ 90.15	$61.27
Plant Growth Medium Placement 5 km haul	m3	5 km	1017	**$ 2.11**	$ 1.57	$ 0.54						3	448	1345	$ 90.15	$61.27
Place Non-PAG Waste Rock	m3		1017	**$ 0.82**	$ 0.58	$ 0.24						3	448	1345	$ 90.15	$61.27
Store and Release LPM - Import	m3			**$ 12.43**												
Store and Release LPM Placement	m3		1017	**$ 0.82**	$0.58	$ 0.24						3	448	1345	$ 90.15	$61.27
Environmental Supervisory Staff	LS			**$ 162,500**												
Post Prod. Crushed PGM	m3	1 km	0	**$ 1.35**												
Crushed PGM	m3	1 km	0	**$ 16.00**												
Haul - 1 km	m3	1 km	511	**$0.51**	$0.39	$ 0.12										
Haul - 2 km	m3	2 km	395	**$0.66**	$0.51	$ 0.16										
Haul - 3 km	m3	3 km	322	**$0.82**	$0.63	$ 0.19										
Haul - 4 km	m3	4 km	272	**$0.97**	$0.74	$ 0.23										
Haul - 5 km	m3	5 km	235	**$1.12**	$0.86	$ 0.26										
Concurrent Monitoring	LS			**$ 50,000**												
Closure Monitoring	LS			**$ 75,000**												
Maintenance of Reclamation	LS			**$ 100,000**												
Cut and fold liner	m2			**$2.15**		$ 2.15										
Excavate Liner and Contaminated Material and Hau	m3	3 km	1017	**$ 1.41**	$ 1.11	$ 0.30										
Cut and fold Liner, dispose in place	m2			**$ 0.40**												
Characterize sediments in ponds	LS			**$ 10,000**												
Closure Cover and Reveg Test Plots	LS			**$ 250,000**												
Modify Decant Seepage Pump and Pipeline	LS			**$ 20,000**												
Install Closure Spillway (TSF1 or TSF2)	LS			**$ 25,000**												
Dewater HLP pond	LS			**$ 10,000**												
LLDPE Liner	m2			**$ 7.34**												
Concrete	m3			**$ 196.50**												
haul pipes to WRD	m3	5 km	1017	**$ 2.11**	$ 1.57	$ 0.54						3	448	1345	$ 90.15	$61.27
Decontaminate and Close HLP Moat	LS			**$ 25,000**												
Remove and dispose sediments	m3	5 km	1017	**$ 2.11**	$ 1.57	$ 0.54						3	448	1345	$ 90.15	$61.27
Backfill pond	m3		448	**$ 0.34**	$ 0.20	$ 0.14						1	448	448	$ 90.15	$61.27
Excavate Seepage Collection Ditch	m3		1017	**$ 0.67**	$ 0.49	$ 0.18						2	448	896	$ 90.15	$61.27
Concrete Foundation Rubblization and Haul to WRD	m3			**$ 600**												
GCL Underlayer 750mm max particle size	m3		0	**$ 13.00**												
GCL	m2			**$ 7.50**												
GCL Overlayer - Fines	m3		0	**$ 16.00**												

Part 2: Loader, truck, totals and comments

Cost	Loader Qnty	Loader Productivity Rate	Loader Total Productivity	Loader Equipment Rate	Loader Operator Wage	Truck Qnty	Truck Productivity Rate	Truck Total Productivity	Truck Equipment Rate	Truck Operator Wage	Totals: Total Hourly Equipment Cost	Totals: Total Hourly Labor Cost	Totals: Total Hourly Cost	Equipment Based Cost	Comments/Justification
Plant Growth Medium - Stockpile - 1km	1	1017	1017	$ 319.40	$61.27	2	511	1022	$ 201.37	$61.27	$ 1,713.77	$ 857.84	**$ 2,571.62**	equip	3 Dozer Excavating, 8 Dozer Placing/Grading up the stockpile, Loader to excavate and load truck, 2 Trucks to keep up with Loader productivity
Plant Growth Medium - Stockpile - 2km	1	1017	1017	$ 319.40	$61.27	3	395	1186	$ 201.37	$61.27	$ 1,915.14	$ 919.12	**$ 2,834.26**	equip	3 Dozer Excavating, 8 Dozer Placing/Grading up the stockpile, Loader to excavate and load truck, 3 Trucks to keep up with Loader productivity
Plant Growth Medium - Stockpile - 3km	1	1017	1017	$ 319.40	$61.27	4	322	1289	$ 201.37	$61.27	$ 2,116.51	$ 980.39	**$ 3,096.91**	equip	3 Dozer Excavating, 8 Dozer Placing/Grading up the stockpile, Loader to excavate and load truck, 4 Trucks to keep up with Loader productivity
Plant Growth Medium - Stockpile - 5km	1	1017	1017	$ 319.40	$61.27	5	235	1176	$ 201.37	$61.27	$ 2,317.88	$ 1,041.67	**$ 3,359.55**	equip	3 Dozer Excavating, 8 Dozer Placing/Grading up the stockpile, Loader to excavate and load truck, 5 Trucks to keep up with Loader productivity
Spread / Grade											$ 90.15	$ 61.27	**$ 151.42**	equip	1 Dozer spreading and distributing material to appropriate grade and depth
Revegetation													**$ -**		Cost based on revegetation cost estimate from Brian Iley and Keith Ashby in AU
Erosion/Sediment Control-Fence													**$ -**		Cost based on erosion control cost estimate from Brian Iley and Keith Ashby in AU
Erosion/Sediment Control-Bales													**$ -**		Cost based on erosion control cost estimate from Brian Iley and Keith Ashby in AU
Pit Safety Berm	1	1017	1017	$ 319.40	$61.27						$ 319.40	$ 61.27	**$ 380.68**	equip	1 Loader to move and place material from truck end-dump
Store and Release Blending											$ 90.15	$ 61.27	**$ 151.42**	equip	1 Dozer ripping store and release cover to blend material (single shank)
Plant Growth Medium Placement	1	1017	1017	$ 319.40	$61.27						$ 589.85	$ 245.10	**$ 834.94**	equip	Loader to load truck, 3 Dozers Placing/Grading at pace of loader
Plant Growth Medium Placement 1 km haul	1	1017	1017	$ 319.40	$61.27	2	511	1022	$ 201.37	$61.27	$ 992.59	$ 367.65	**$ 1,360.23**	equip	Loader to load truck, 2 Trucks to keep up with Loader productivity, 3 Dozers Placing/Grading at pace of trucks and loader, 1 Dozer Excavating
Plant Growth Medium Placement 2 km haul	1	1017	1017	$ 319.40	$61.27	3	395	1186	$ 201.37	$61.27	$ 1,193.96	$ 428.92	**$ 1,622.88**	equip	Loader to load truck, 3 Trucks to keep up with Loader productivity, 3 Dozers Placing/Grading at pace of trucks and loader, 1 Dozer Excavating
Plant Growth Medium Placement 3 km haul	1	1017	1017	$ 319.40	$61.27	4	322	1289	$ 201.37	$61.27	$ 1,395.32	$ 490.20	**$ 1,885.52**	equip	Loader to load truck, 4 Trucks to keep up with Loader productivity, 3 Dozers Placing/Grading at pace of trucks and loader, 1 Dozer Excavating
Plant Growth Medium Placement 5 km haul	1	1017	1017	$ 319.40	$61.27	5	235	1176	$ 201.37	$61.27	$ 1,596.69	$ 551.47	**$ 2,148.17**	equip	Loader to load truck, 5 Trucks to keep up with Loader productivity, 3 Dozers Placing/Grading at pace of trucks and loader, 1 Dozer Excavating
Place Non-PAG Waste Rock	1	1017	1017	$ 319.40	$61.27						$ 589.85	$ 245.10	**$ 834.94**	equip	1 Loader to pull material from local stockpile, 3 Dozers Placing/Grading at pace of loader
Store and Release LPM - Import															Costs Included in Low Permeability Material Cost Estimate
Store and Release LPM Placement	1	1017	1017	$ 319.40	$61.27						$ 589.85	$ 245.10	**$ 834.94**	equip	1 Loader to pull material from local stockpile, 3 Dozers Placing/Grading at pace of loader
Environmental Supervisory Staff															Based on cost for "Screen and Crush in Pit - to max 750mm particle size" and "Spread / Grade"
Post Prod. Crushed PGM											$ -	$ -	**$ -**		Based on $1.35 for Crushing to Fines
Crushed PGM											$ -	$ -	**$ -**		Based on $16 for Crushing to Fines
Haul - 1 km						1	511	511	$ 201.37	$61.27	$ 201.37	$ 61.27	**$ 262.64**	equip	Truck & Labor only costs
Haul - 2 km						1	395	395	$ 201.37	$61.27	$ 201.37	$ 61.27	**$ 262.64**	equip	Truck & Labor only costs
Haul - 3 km						1	322	322	$ 201.37	$61.27	$ 201.37	$ 61.27	**$ 262.64**	equip	Truck & Labor only costs
Haul - 4 km						1	272	272	$ 201.37	$61.27	$ 201.37	$ 61.27	**$ 262.64**	equip	Truck & Labor only costs
Haul - 5 km						1	235	235	$ 201.37	$61.27	$ 201.37	$ 61.27	**$ 262.64**	equip	Truck & Labor only costs
Concurrent Monitoring															Best Professional Judgement
Closure Monitoring															Best Professional Judgement
Maintenance of Reclamation															Best Professional Judgement
Cut and fold liner															Based on $0.10/SF cost to cut liner (vendor quote - Desert Engineering, Nevada, USA), assume 2 x cost to account for difference in labor between Nevada, USA and NT, Aus.
Excavate Liner and Contaminated Material and Hau	1	1017	1017	$ 319.40	$61.27	4	322	1289	$ 201.37	$61.27	$ 1,124.88	$ 306.37	**$ 1,431.25**	equip	1 Loader excavating contaminated soils, and 4 Trucks hauling soils to TSF2 for disposal
Cut and fold Liner, dispose in place															Best Professional Judgement
Characterize sediments in ponds															Best Professional Judgement
Closure Cover and Reveg Test Plots															Best Professional Judgement
Modify Decant Seepage Pump and Pipeline															From PFS - Best Professional Judgement, Assume pump and pipeline from Decant Ponds modified to convey TSF Decant and Moat seepage to the Water Treatment Plant. Maintain seepage collection system until long-term seepage from TSF1 = 0 or passive/semi-passive water treatment system installed.
Install Closure Spillway (TSF1 or TSF2)															From PFS - Best Professional Judgement- Assumes operational spillway will require modification at closure to safely pass a 200-year to probable maximum flood event.
Dewater HLP pond															Best Professional Judgement, assume can send water to Water Treatment Plant
LLDPE Liner															Consistent with Tailings Impoundment Estimate - 2012, Fabtech, Wingfield, South Australia
Concrete															2012 Rawlinsons - concrete delivered to site, 20 MPa, haul less than 15 km (p. 235), adjusted for Katherine location (p. 26)
haul pipes to WRD	1	1017	1017	$ 319.40	$61.27	5	235	1176	$ 201.37	$61.27	$ 1,596.69	$ 551.47	**$ 2,148.17**	equip	Loader to load truck, 5 Trucks to keep up with Loader productivity, 3 Dozers Placing/Grading at pace of trucks and loader, 1 Dozer Excavating
Decontaminate and Close HLP Moat															Best Professional Judgement
Remove and dispose sediments	1	1017	1017	$ 319.40	$61.27	5	235	1176	$ 201.37	$61.27	$ 1,596.69	$ 551.47	**$ 2,148.17**	equip	Loader to load truck, 5 Trucks to keep up with Loader productivity, 3 Dozers Placing/Grading at pace of trucks and loader, 1 Dozer Excavating
Backfill pond											$ 90.15	$ 61.27	**$ 151.42**	equip	1 Dozer spreading and distributing material to appropriate grade and depth
Excavate Seepage Collection Ditch	1	1017	1017	$ 319.40	$61.27						$ 499.70	$ 183.82	**$ 683.52**	equip	Assume 5m deep, 5m bottom width, 2:1 side slopes, waste material on downhill side
Concrete Foundation Rubblization and Haul to WRD															Based on cost quoted by Proteus - Nov. 2011
GCL Underlayer 750mm max particle size											$ -	$ -	**$ -**		Based on cost for "Screen and Crush in Pit - to max 750mm particle size" from Proteus and "Spread / Grade" unit cost
GCL															Vendor quote from Joe Kaul for Australia
GCL Overlayer - Fines											$ -	$ -	**$ -**		Based on cost for "Screen and Crush in Pit - to Fines" from Proteus and "Spread / Grade" unit cost

Number of dozers may not reflect actual operations. If the specified number of dozers are not available, fewer dozers may work more hours resulting in an equivalent total unit cost

Crushing During Years of Production with Separate Crusher

Screen and Crush in Pit - to Fines	$16.00	per m3	Max of costs quoted by Proteus for typical screen and crush cost
Screen and Crush in Pit - to max 750mm particle siz	$13.00	per m3	Min of costs quoted by Proteus for typical screen and crush cost

Crushing with Process Plant Crusher

Per Tonne Unit Cost =	$0.75	per tonne	Based on crushing cost estimate from Vista (e-mail, January 19, 2012)
Per m3 Unit Cost =	$1.35	per m3	

Concrete Foundation Rubblization and Haul to WRD

Per m3 unit cost=	$600.00	per m3	Based on cost quoted by Proteus - Nov. 2011

Concurrent Monitoring	$	50,000	Per Year	Best Professional Judgement	
Closure Monitoring	$	75,000	Per Year	Best Professional Judgement	
Maintenance of Reclamation	$	100,000	Per Year	Best Professional Judgement	
Cut and fold Liner, dispose in place	$	0.40	m2	Best Professional Judgement	For TSF Ponds and HLP ponds
Characterize sediments in ponds	$	10,000	Lump Sum	Best Professional Judgement	For TSF Ponds and HLP ponds
Closure Cover and Reveg Test Plots	$	250,000	Lump Sum	Best Professional Judgement	
Modify Decant Seepage Pump and Pipeline	$	20,000	Lump Sum	From PFS - Best Professional Judgement, Assume pump and pipeline from Decant Ponds modified to convey TSF Decant and Moat seepage to the Water Treatment Plant. Maintain seepage collection system until long-term seepage from TSF1 = 0 or passive/semi-passive water treatment system installed.	
Install Closure Spillway (TSF1 or TSF2)	$	25,000	Lump Sum	From PFS - Best Professional Judgement- Assumes operational spillway will require modification at closure to safely pass a 200-year to probable maximum flood event.	
Dewater HLP pond	$	10,000	Lump Sum	Best Professional Judgement	Send to WTP
LLDPE Liner	$	7.34	m2	Consistent with Tailings Impoundment Estimate - 2012, Fabtech, Wingfield, South Australia	
Concrete	$	196.50	m3	2012 Rawlinsons - adjusted for Katherine location (p. 26), concrete delivered to site, 20 MPa, haul less than 15 km (p. 235)	
haul pipes to WRD	$	2.11	m3	assume costs equivalent to loading and hauling topsoil 5km	
Decontaminate and Close HLP Moat	$	25,000.00	Lump Sum	Fold HDPE liner and cover.	
Remove and dispose sediments	$	2.11		assume costs equivalent to loading and hauling topsoil 5km	
Backfill pond	$	0.34	m3	spread/grade cost	
Low Permeability Material Import Cost - 2013 Unit (	$	12.43	m3	From TT Soils group, 2013 - unit cost for borrow development, importing, and borrow closure	

Attachment B-6
Equipment Productivity Rates
Vista Gold Corp. - Mt. Todd Project

Spread/Grade Flat
Equipment

Dozers	D9 Dozer - Flat	D9 Dozer - 3:1 Slope (down)	D9 Dozer - 3:1 Slope (up)	Source
Universal Blade, 45 m push (lm^3/hr)	675	675	675	Cat Handbook Volume 40, Chapter 1, p 47
50 min/hr	0.83	0.83	0.83	Cat Handbook Volume 40, Chapter 1, p 50
Dry, Non-cohesive soil	0.8	0.8	0.8	Cat Handbook Volume 40, Chapter 1, p 50
Slope Factor	1	1.6	0.3	Cat Handbook Volume 40, Chapter 1, p 50
Productivity (m^3/hr)	**448.2**	**717.12**	**134.46**	

Dozer - Ripping	D9 Dozer - Flat	Source
Multi- or Single Shank No. 9 Ripper		
Assumed Seismic Velocity (m/sec)	2300	Cat Handbook Volume 40, Seismic Velocity-D9 Ripper, Sedimentary Rock, Marginal Ripping Conditions; Chapter 1 P. 68
Handbook Productivity Rate, Single Shank (Bcm/hr)	250	Cat Handbook Volume 40, Seismic Velocity of 2300 m/sec, Chapter 1 P. 72
Handbook Productivity Rate, Multi Shank (Bcm/hr)	750	Multiplied Single shank productivity by three for ripping with three shanks
50 min/hr	0.83	
Productivity (m^3/hr)	**207.5**	Based on Single-Shank

Loaders	994 Loader - 18 m3	Source
Hydraulic Cycle Time (sec)	17.9	Cat Handbook Volume 40, Chapter 12, P. 8
Haul and Scoop Cycle Time (sec)	35	Assume 10 seconds to scoop + 20 seconds to haul + 5 seconds to position for dumping
Bucket Capacity (m^3)	18	Cat Handbook Volume 40, Chapter 12, P. 79; and Tom Dyer
50 min/hr	0.83	
Productivity (m^3/hr)	**1017**	

Trucks	789 Haul Truck - 1 km flat	789 Haul Truck - 2 km flat	789 Haul Truck - 3 km flat	789 Haul Truck - 4 km flat	789 Haul Truck - 5 km flat	Source
Haul	**1 km**	**2 km**	**3 km**	**4 km**	**5 km**	
Capacity (m^3)	105	105	105	105	105	Cat Handbook Volume 40 - Heaped Base Body Chapter 9 P. 7
50 min/hr	0.83	0.83	0.83	0.83	0.83	
Load Time (min)	5.4	5.4	5.4	5.4	5.4	From Tom Dyer
Dump Time (min)	1.5	1.5	1.5	1.5	1.5	From Tom Dyer
Haul Time Loaded (min)	1.71	3.21	4.71	6.21	7.71	Based on travel time calculations below, 1 km haul times provided by MDA w/ 2% Rolling Resistance (R.R. from Tom Dyer)
Haul Time Empty (min)	1.62	3.12	4.62	6.12	7.62	Based on travel time calculations below, 1 km haul times provided by MDA w/ 2% Rolling Resistance (R.R. from Tom Dyer)
Productivity (m^3/hr)	**511**	**395**	**322**	**272**	**235**	

Haul Time Development	**Truck Haul Times (E-mail from Tom Dyer, 1/5/2012)**		**Extrapolated Haul Times based on acceleration, constant speed and deceleration times from Tom Dyer's estimate for 1 km haul**							
100 m Haul Increments	1km - Loaded	1km - Empty	2km - Loaded	2km - Empty	3km - Loaded	3km - Empty	4km - Loaded	4km - Empty	5km - Loaded	5km - Empty
100	0.29	0.22	0.29	0.22	0.29	0.22	0.29	0.22	0.29	0.22
200	0.46	0.37	0.46	0.37	0.46	0.37	0.46	0.37	0.46	0.37
300	0.61	0.52	0.61	0.52	0.61	0.52	0.61	0.52	0.61	0.52
400	0.76	0.67	0.76	0.67	0.76	0.67	0.76	0.67	0.76	0.67
500	0.91	0.82	0.91	0.82	0.91	0.82	0.91	0.82	0.91	0.82
600	1.06	0.97	1.06	0.97	1.06	0.97	1.06	0.97	1.06	0.97
700	1.21	1.12	1.21	1.12	1.21	1.12	1.21	1.12	1.21	1.12
800	1.36	1.27	1.36	1.27	1.36	1.27	1.36	1.27	1.36	1.27
900	1.51	1.42	1.51	1.42	1.51	1.42	1.51	1.42	1.51	1.42
1000	**1.71**	**1.62**	1.66	1.57	1.66	1.57	1.66	1.57	1.66	1.57
1100			1.81	1.72	1.81	1.72	1.81	1.72	1.81	1.72
1200			1.96	1.87	1.96	1.87	1.96	1.87	1.96	1.87
1300			2.11	2.02	2.11	2.02	2.11	2.02	2.11	2.02
1400			2.26	2.17	2.26	2.17	2.26	2.17	2.26	2.17
1500			2.41	2.32	2.41	2.32	2.41	2.32	2.41	2.32
1600			2.56	2.47	2.56	2.47	2.56	2.47	2.56	2.47
1700			2.71	2.62	2.71	2.62	2.71	2.62	2.71	2.62
1800			2.86	2.77	2.86	2.77	2.86	2.77	2.86	2.77
1900			3.01	2.92	3.01	2.92	3.01	2.92	3.01	2.92
2000			**3.21**	**3.12**	3.16	3.07	3.16	3.07	3.16	3.07
2100					3.31	3.22	3.31	3.22	3.31	3.22
2200					3.46	3.37	3.46	3.37	3.46	3.37
2300					3.61	3.52	3.61	3.52	3.61	3.52
2400					3.76	3.67	3.76	3.67	3.76	3.67
2500					3.91	3.82	3.91	3.82	3.91	3.82
2600					4.06	3.97	4.06	3.97	4.06	3.97
2700					4.21	4.12	4.21	4.12	4.21	4.12
2800					4.36	4.27	4.36	4.27	4.36	4.27
2900					4.51	4.42	4.51	4.42	4.51	4.42
3000					**4.71**	**4.62**	4.66	4.57	4.66	4.57
3100							4.81	4.72	4.81	4.72
3200							4.96	4.87	4.96	4.87
3300							5.11	5.02	5.11	5.02
3400							5.26	5.17	5.26	5.17
3500							5.41	5.32	5.41	5.32
3600							5.56	5.47	5.56	5.47
3700							5.71	5.62	5.71	5.62
3800							5.86	5.77	5.86	5.77
3900							6.01	5.92	6.01	5.92
4000							**6.21**	**6.12**	6.16	6.07
4100									6.31	6.22
4200									6.46	6.37
4300									6.61	6.52
4400									6.76	6.67
4500									6.91	6.82
4600									7.06	6.97
4700									7.21	7.12
4800									7.36	7.27
4900									7.51	7.42
5000									**7.71**	**7.62**

Assumptions

General

Unless designs have been updated, the facility quantities reflect the designs in the Preliminary Feasibility Study
All closure activities will occur during the dry season each year

Contingency for PFS Level Costs =	**15%**
Exchange Rate	**1.035**

Cover Placement Quantities and Assumptions:

Store And Release Cover		
Plant Growth Medium Depth (m)	0.2	
Store And Release Cover Depth (m)	0.8	All facilities except WRD, Roads, HLP Footprint
Sub-base Material for Store and Release Cover Depth (m)	1	Bridging material for TSF Impoundment Surfaces
Store & Release Cover LPM Content	66%	
Store & Release Cover Non-PAG Waste Rock Content	34%	

Pit Berm Construction (Rock and Non-PAG Waste Rock)	
Width (m)	5
Height (m)	2
Length (m)	4,496

Heap Leach Pad	
Liner Area (m2)	390,000
Depth contam. mat. below liner (m)	0.5
Volume Contaminated Material (m3)	195,000

Areas and Borrow/Salvage/Reclamation Characteristics

Facility	Soil Unit	Area (ha)	Regrade Depth (m)	Regrade Volume (m3)	Volume (m3)	Primary Plant Growth Medium Depth (m)	Secondary Plant Growth Medium Depth (m)	Low-Permeability Material Haul Distance	
Waste Rock Dump - Coverage/Recl		208.1							Based on design from MDA, November 2012
Waste Rock Dump - Coverage/Recl - 3D area		241.1							Based on design from MDA, November 2012
Waste Rock Dump - Top Only		1.1							Based on design from MDA, November 2012
Waste Rock Dump - Expansion/Salvage	30C	67.64				0.18	0.00		Based on design from MDA, November 2012 and Soil Data from Henry Sauer, November 2012
Non-PAG Pit Run Waste Rock					111,111,111				200,000,000 tonnes/(1.8 t Based on estimate from MDA, November 2012
TSF 1 - Embankment Reclamation		24.8						4.5	Areas provided by TT Recl Group in Golden - December 2012
TSF 1 - Impoundment Reclamation		214.2						4.5	Areas provided by TT Recl Group in Golden - December 2012
TSF 1 - Salvage	30C	34.3				0.18	0.00		Soil Units from TT Soils Group - November 2012
TSF 2 - Embankment Salvage/Reclamation		122.1						5.5	Provided by TT in Golden, June 2013
TSF 2 - Impoundment Salvage/Reclamation		178.7						5.5	Provided by TT in Golden, June 2013
TSF 2 - Salvage 1	10A	38.9				0.30	0.65		Soil Units from TT Soils Group - November 2012
TSF 2 - Salvage 2	20A	54.7				0.30	0.00		Soil Units from TT Soils Group - November 2012
TSF 2 - Salvage 3	30C	201.4				0.18	0.00		Soil Units from TT Soils Group - November 2012
Heap Leach Pad & Moat		39	0.4	156,000				4.5	
LGO 1		14.6							Overtaken by Batman Pit expansion - no reclamation necessary
LGO 2		51.1	0.2	102,200				5.5	Based on design June 2013
LGO 2	30C	21.87				0.18	0.00		Soil Units from TT Soils Group - November 2012 - Not all of LGO 2 footprint salvaged
LGO 2	13A	3.14				0.13	0.00		Soil Units from TT Soils Group - November 2012 - Not all of LGO 2 footprint salvaged
Processing Plant and Pad Area		35.1	1	351,000				5.5	Includes process plant area, crushing stockpile, RP2 (LGO Pond), RP5 (Process Plant Pond), ANFO
Roads		24.1							Area based on road lay-out lengths with assumed width of 35 meters (12/10/12)
Pit - Salvage & Reclamation	30C	46.1				0.18	0.00		Soil unit data was only available to the extent of the base case pit perimeter.

Map Unit	Primary Limitations	Average Thickness of Salvageable Primary Plant Growth Medium[1]	Average Thickness of Salvageable Primary Plant Growth Medium[1]	Average Thickness of Salvageable Secondary Plant Growth Medium[3]	Salvaged Thickness of Secondary Plant Growth Medium[3]
ID #		inches	m	inches	m
10A	rock	12	0.30	73	1.85
11A	rock	11	0.28	29	0.74
12A	clay/rock	15	0.38	65	1.65
13A	rock	5	0.13	8	0.20
20A	ırated (cemented)	12	0.30	0	0.00
30C	rock	7	0.18	0	0.00

Erosion Control	Control Length (m)	
Roads - Fence	13,048	**Based on preliminary layout, both sides of road - 12/11/12**
Stockpile 1	224	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 2	480	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 3	420	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 4	220	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 5	318	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 6	534	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 7	346	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 8	412	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 9	-	**Removed during salvage and expansion of WRD & used for HLP reclamation**
Stockpile 10	740	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Stockpile 11	1,724	**Based on stockpile perimeter as preliminary estimate - 12/11/12**
Plant	1,409	**Based on plant area perimeter up to WRD and Pit as preliminary estimate - 12/11/12**
LGO2	3,004	**LGO2 based on MDA design - November 2012**
Roads - Bales	720	**18 Waterbody crossings counted on road layout - November 2012**

Assumptions:
16 meter offset for erosion control fence around plant, soil stockpiles, and LGO stockpiles
6 meter offset for erosion control fence and bales around roads
Erosion control bales replace fence at intersection of roads and surface water, extending to 10 meters either side of the waterbody centerline

WRD GCL Cover	
Underlayer Depth - 750mm particle size max (m)	0.3
GCL - Bentomat	NA
Overlayer Depth - Fines (m)	0.3

GCL Berm Construction **UPDATED WITH NEW BUILD OUT - 11/29/2012**

Slope =	1:1			
Berm Height =	0.5			
Berm Length=	1.41			
GCL Length each lift (not including berm)	Full (to just overlapping)	44.5 m	Horizontal Length each 30m lift at 34deg. (m)	

	Elevation	Length	Area	GCL Area on Lift	GCL Berm Area	
	m	*m*	*m2*	*m2*	*m2*	
Ground Level Lift 0	*134*	*5,873*	*2,080,616*	-	-	No GCL Placed under first lift of WRD
Lift 1	150	5,623	1,859,183	296,992	7,357	
Lift 2	180	5,202	1,562,191	276,867	6,790	
Lift 3	210	4,801	1,285,324	253,433	6,237	
Lift 4	240	4,410	1,031,891	233,221	5,402	
Lift 5	270	3,820	798,670	205,187	4,551	
Lift 6	300	3,218	593,483	172,662	3,874	
Lift 7	330	2,739	420,821	144,601	3,253	
Lift 8	360	2,300	276,220	127,920	2,390	
Lift 9	390	1,690	148,300	136,947	1,788	
Lift 10	420	1,264	59,123	59,123	668	
Cap	*440*	*472*	*11,353*	*11,353*	*Top*	GCL place over entirety of final 10 m lift - assumed final lift may contain PAG material

GCL Material Totals

Total (m2)	**1,960,614**
Total (ha)	**196.1**
Total Lift Area (ha)	**194.9**
Total Top Area (ha)	**1.1**

Costs Not Included For The Following:
Incorporation of organic matter into top lift of cover
Removal of sediments from ponds
Conducting minor grading around ponds to breach embankments
Water Treatment (Active or Passive)
Stormwater Control Structures
Decontamination, Decommissioning and Demolition of Site Facilities

Preliminary Costs Only Included For The Following:
Plugging of TSF1 decant pipes with concrete
Modification of TSF2 sumps to receive seepage from TSF2 foundation drains and TSF2 collection ditch via gravity
Modification of TSF1 operational spillway to safely convey surface runoff from TSF1 and TSF2 pools to Horseshoe Creek
Break up of concrete foundations/walls/bridges and place in the WRD
Construction of revegetation test plots on HLP following regrading and cover placement
Construction of closure cover (erosion) test plots on HLP following regrading
Seepage collection ditches at toe of TSF1 (lined with LLDPE or equivalent)

TSF 2 Pipe Removal

Distribution Pipe		Spigot Pipes	
Depth:	0.63 m	Depth:	0.315 m
Length:	9,250 m	Length:	4,625 m
Volume	2,883 m3	Volume	360 m3
bulking	20%	bulking	20%
total volume	3,460 m3	total volume	433 m3

Pipe diameters and lengths provided by J. Jathal, 2/23/12 via email
Bulking factor based on best professional judgement
Assume cost based on haul to WRD for on-site disposal

TSF 1 and 2 Seepage Collection Ditches

TSF 1 Impoundment Perimeter Length		8000 m	Based on June 2013 Design
TSF 2 Impoundment Perimeter Length		6420 m	Based on June 2013 Design
% of Perimeter requiring ditch		10%	
TSF 1 Seepage Ditch Length		800 m	Assume nominal length - length to be revised if seepage fronts identified during operation
TSF 2 Seepage Ditch Length		642 m	
Base width:		5 m	
Depth:		5 m	
Side Slopes	2H:1V		
Volume TSF 1 Ditch		60,000 m3	
Volume TSF 2 Ditch		48,150 m3	
Area Liner - TSF 1 Ditch		14,886 m2	assume only line bottom and downstream edge+15% for overlap/anchor
Area Liner - TSF 2 Ditch		11,946 m2	assume only line bottom and downstream edge+15% for overlap/anchor

Pond Closure

RP1 - No modifications required for closure, per conversation with Dwaine Edington, 2/23/12
RP2 - Closure to occur in dry season.

Volume:	10,414 m3	
Sediment Volume (15% of total)	1,562 m3	
Liner area:	2,996 m2	estimate based on square pond, with pond depth 5m

RP3 - No modification s for water management required for closure
RP5 - Closure to occur in dry season.

Volume:	13,721 m3	
Sediment Volume (15% of total)	2,058 m3	
Liner area:	3,792 m2	estimate based on square pond, with pond depth 5m

TSF1 Decant Pond

Modify volume	750 m3	Assumed breach dimesions: base width = 5m; depth = 5m; 2H:1V side slopes; length = 10 m. Maintain facility until decant pipes are sealed and long-term seepage from TSF1 = 0 or passive/semi-passive water treatment system installed.
Liner area:	750 m2	Assume 0.5*5*(5+25)*10
Decant pipe lenth	7,290 m	PFS
Decant pipe diameter	0.4 m	PFS
Decant pipe volume	916 m3	

Equalization Pond - Closure to occur with decommissioning of WTP.

Volume:	36,000 m3	
Area:	7,200 m2	
Length:	120 m	
Width:	60 m	
Depth:	5 m	
Liner area:	9,900 m2	Assume 10% extra for sloped sides
Sediment Volume (30% of total)	10,800 m3	

Process Plant Area Foundation Demolition

WTP Volume Concrete	294 m3	Accounted for in WTP estimate
All Other Structures Volume Concrete	21,432 m3	Assume decon, decommissioning, and demolition occurs year following end of production, removal of foundations in year following decon, decommissioning, and demolition.

Updated quantities not available at time of PFS Cost estimate - use 2011 volume estimate

Attachment B-8
Reclamation Cover Quantities
Vista Gold Corp. - Mt. Todd Project

Feature	Overall (million tonnes)	hectares (1 hectare = 10,000 m2)	Sub Base Non PAG Waste Rock Depth (m)	Sub Base Non PAG Waste Rock Volume (m^3)	Store and Release depth (m)	Store and Release LPM Volume (m^3)	Store and Release Non PAG Waste Rock Volume (m^3)	Total Store and Release (m3)	Plant Growth Medium Depth (m)	Plant Growth Medium Volume (m^3)	Total Material (m^3)	PFS Estimates	Comments
WRD	233	241.1	1	2,411,000		-	-	-		-	2,411,000	30% waste rock will be non PAG (30% of 233 MT = 69.9MT)	1-m thick erosion control layer
TSF1 - Embankment Stage 1		24.8		-	0.8	130,944	67,456	198,400	0.2	49,600	248,000	use salvaged soil from TSF2 instead of LPM	
TSF1 - Impoundment Surface	60	214.2	1	2,142,000	0.8	1,130,976	582,624	1,713,600	0.2	428,400	4,284,000	use salvaged soil from TSF2 instead of LPM	
TSF2 - Embankment Stage 1	NA	122.1		-	0.8	644,688	332,112	976,800	0.2	244,200	1,221,000		
TSF2 - Impoundment Surface	100	178.7	1	1,787,000	0.8	943,536	486,064	1,429,600	0.2	357,400	3,574,000		
Heap Leach Pad (HLP)		39		-	0.8	205,920	106,080	312,000	0.2	78,000	390,000		side slopes ~1H:2.5V grade to 3:1 - close immediately
LGO2		51.1		-	0.8	269,808	138,992	408,800	0.2	102,200	511,000		
Process Plant Area		35.1		-	0.8	185,328	95,472	280,800	0.2	70,200	351,000		
Equalization Pond		0.72			0.8	3,802	1,958	5,760	0.2	1,440	7,200		
Mine Roads		24.1		-	-	-	-	-	0.2	48,195	48,195		recontour and grade into existing topo
Pit Safety Berm				44,960		-	-	-		-	44,960		
Totals				**6,384,960**		**3,515,002**	**1,810,758**			**1,379,635**	**13,090,355**		

		Underlayer (m3)	Overlayer (m3)	GCL (m2)
Area of top covered by GCL (ha)	1.1	3,406	3,406	11,353
Area sides with GCL (ha)	195	584,778	584,778	1,949,261
TOTAL			**1,176,368**	**1,960,614**

TOTALS	Volume (m^3)	Mass (Tonnes)
Sub-Base Non-PAG Waste Rock	6,384,960	11,492,928
Store and Release LPM	3,515,002	6,327,003
Store and Release Waste Rock	1,810,758	3,259,365
Plant Growth Medium	1,379,635	2,483,343

TOTALS	Volume (m^3)	Mass (Tonnes)
Total LPM Needed	**3,515,002**	**6,327,003**
Total Non-PAG Waste Rock Needed	**8,195,718**	**14,752,293**
Total Plant Growth Medium Needed	**1,379,635**	**2,483,343**

Attachment B-9

Plant Growth Medium Salvage Quantities

Vista Gold Corp. - Mt. Todd Project

Feature	Area (ha)	Volume (m^3)	Primary Plant Growth Medium Depth (m)	Secondary Plant Growth Medium Depth (m)	Primary Plant Growth Medium Salvage (m^3)	Secondary Plant Growth Medium Salvage (m^3)	Total Plant Growth Medium (m^3)	Comments
WRD - Expansion	67.64		0.2	0.0	120,264	-	120,264	30C
Soil Stockpile - 9A (WRD Stockpile)		37,255	NA				37,255	Placed into Stockpile 10
TSF 1 - Salvage	34.3		0.2	0.0	60,986	-	60,986	30C
TSF 2 - Salvage	38.9		0.3	0.7	118,567	252,850	371,417	10A
TSF 2 - Salvage	54.7		0.3	0.0	166,726	-	166,726	20A
TSF 2 - Salvage	201.4		0.2	0.0	358,090	-	358,090	30C
LGO2	21.87		0.2	0.0	38,885	-	38,885	30C
LGO2	3.14		0.1	0.0	3,988	-	3,988	13A
Batman Pit Expansion - Surface Salvag	46.1		0.2	0.0	81,966	-	81,966	30C
Soil Stockpile - 1		2,283					2,283	
Soil Stockpile - 2		3,598					3,598	
Soil Stockpile - 2		3,673					3,673	
Soil Stockpile - 3		41,569					41,569	
Soil Stockpile - 4		7,233					7,233	
Soil Stockpile - 5		14,214					14,214	
Soil Stockpile - 6		38,494					38,494	
Soil Stockpile - 7		12,784					12,784	
Soil Stockpile - 8		21,839					21,839	
Soil Stockpile - 10 (WRD Expansion)			NA				-	Accounted for in Salvage Numbers
Soil Stockpile - 11			NA				-	Accounted for in Salvage Numbers
				TOTAL	949,472	252,850	1,385,263	

TOTAL SALVAGED MATERIAL	Volume (m^3)
Primary Plant Growth Medium	**949,472**
Secondary Plant Growth Medium	**252,850**
Total Plant Growth Medium	**1,202,322**

Attachment B-10
PGM Stockpiles
Vista Gold Corp. - Mt. Todd Project

Year	Salvaged Plant Growth Medium (m3)	Source	Stockpile	Stockpile Haul	SS10 Volume (m3)	SS1-9 & SS11 Volume (m3)	Placed Plant Growth Medium (m3)	Source	Destination	Haul	SS1-9 Area (m2)	SS10 Area (m2)	SS11 Area (m2)	SS1-9 Reclaim Area (ha)	SS10 Reclaim Area (ha)	SS11 Reclaim Area (ha)
Y-1	145,687	Existing Stockpiles	SS1-9		-	145,687	-									
Y-1	42,873	LGO2	SS10	1 km	42,873	145,687	-					14,250			1.43	
Y1	300,470	Pit, WRD, and TSF 1	SS10		343,343	145,687	-					57,000			5.70	
Y2	-				343,343	145,687	-									
Y3	896,233	TSF 2	SS11	1 km	343,343	1,041,920	-						174,525			17.45
Y4	-				343,343	992,320	49,600	SS1-9	TSF1 Embankment	1 km	10,200			1.02		
Y5	-				343,343	896,233	96,087	SS1-9	TSF1 Impoundment	1 km	22,800			2.28		
Y5	-				343,343	563,920	332,313	SS11	TSF1 Impoundment	1 km			62,075			6.21
Y6	-				343,343	563,920	-									
Y7	-				343,343	563,920	-									
Y8	-				343,343	563,920	-									
Y8	-				343,343	563,920	-									
Y9	-				343,343	563,920	-									
Y10	-				343,343	563,920	-									
Y11	-				343,343	563,920	-									
Y12	-				241,143	563,920	102,200	SS10	LGO2	1 km		19,750			1.98	
Y13	-				241,143	319,720	244,200	SS11	TSF 2 Embankment	1 km			45,500			4.55
Y13	-				163,143	319,720	78,000	SS10	HLP	2 km		15,250			1.53	
Y14	-				163,143	-	319,720	SS11	TSF2 Impoundment	1 km			66,950			6.70
Y14	-				125,463	-	37,680	SS10	TSF2 Impoundment	3 km						
Y14	-				55,263	-	70,200	SS10	Process Plant Pad	1 km		19,750			1.98	
Y15	-				55,263	-	-									
Y16	-				55,263	-	-									
Y17	-				55,263	-	-									
Y18	-				53,823	-	1,440	SS10	Equalization Pond	2 km		250			-	
Y19	-				5,628	-	48,195	SS10	Roads	2 km		16,250			1.63	
Y20	-				5,628	-	-									
Y21	-				5,628	-	-									
Y22	-				5,628	-	-									
Y23	-				5,628	-	-									
Y24	-				5,628	-	-									
Y25	-				5,628	-	-									
Total	*1,385,263*						*1,379,635*									

Attachment B-10
PGM Stockpiles
Vista Gold Corp. - Mt. Todd Project

Stockpile Name	Slope Ratio X(H):1(V)	Height (m)	Length (m)	Width (m)	Underlying Slope %	Swell Factor	Base Area (m2)	Bottom Perimeter (m)	Top Perimeter (m)	Top Length (m)	Top Width (m)	Top Area (m^2)	Gross Storage Capacity (m3)(1)	Less Storage Capacity for Underlying Slope Angle (m3)(2)	Net Storage Capacity (m3)(1)	Net Storage Volume (Accounting for Swell) (m3)
SS1-9	3	7.5	150	220	0%	1.30	33,000	740	560	105	175	18,375	189,999	0	189,999	146,153
SS1-9	3	7.5	150	152	0%	1.30	22,800	604	424	105	107	11,235	125,100	0	125,100	96,231
SSP #10	3	7.5	250	57	0%	1.30	14,250	614	434	205	12	2,460	56,577	0	56,577	43,521
SSP #10	3	7.5	250	285	0%	1.30	71,250	1,070	890	205	240	49,200	449,143	0	449,143	345,495
SSP #10	3	7.5	250	206	0%	1.30	51,500	912	732	205	161	33,005	314,333	0	314,333	241,794
SSP #10	3	7.5	250	145	0%	1.30	36,250	790	610	205	100	20,500	210,026	0	210,026	161,558
SSP #10	3	7.5	250	66	0%	1.30	16,500	632	452	205	21	4,305	73,083	0	73,083	56,217
SSP #10	3	7.5	250	65	0%	1.30	16,250	630	450	205	20	4,100	71,281	0	71,281	54,832
SSP #11	3	7.5	325	537	0%	1.30	174,525	1,724	1,544	280	492	137,760	1,168,354	0	1,168,354	898,734
SSP #11	3	7.5	325	346	0%	1.30	112,450	1,342	1,162	280	301	84,280	735,203	0	735,203	565,541
SSP #11	3	7.5	325	206	0%	1.30	66,950	1,062	882	280	161	45,080	417,418	0	417,418	321,091

Attachment B-11
Total Cost Summary by Facility
Vista Gold Corp. - Mt. Todd Project

Mt Todd Closure Material Salvage and Reclamation Costs

Facility	Cost	
Waste Rock Dump	$	35,037,758
Tailings Storage Facility - 1	$	24,028,056
Tailings Storage Facility - 2	$	31,252,760
Heap Leach Pad	$	4,777,066
Low Grade Ore Stockpile - 2	$	4,883,311
Process Plant Area	$	16,354,568
Soil Stockpiles	$	806,740
Mine Roads	$	680,357
Batman Pit	$	224,154
Indirect Costs	$	36,767,489
TOTAL	**$**	**154,812,258**

ATTACHMENT C:
NT SECURITY CALCULATION SUMMARY

Technical Memorandum

To:	John Rozelle	From:	April Hussey and Benjamin Stewart
Company:	Vista Gold, Corp.	Date:	June 4, 2013
Address:		Project No.:	114-311285
Re:	Security Cost Calculation - Summary		
CC:			

Security Summary

The following table presents a summary of the security calculation developed for the Mt Todd Project. This estimate is preliminary and will be updated and revised as Project planning progresses.

Domains	Calculated Cost
1: Site Infrastructure	$1,932,415.00
2: Extractive Workings - Sand, Clay & Gravel	$432,344.00
3: Hard Rock Pits & Quarries	$135,880.00
4: Underground Workings	$0.00
5: Tailings Storage Facilities and Dams	$85,674,000.00
6: Stockpiles & Waste Rock Dumps	$43,658,600.00
7: Exploration	$0.00
8: Access and Haul Roads	$433,072.50
9: River Diversions	$0.00
Decommissioning & Post Closure Management	$5,120,215.00
Sub-Total - All Domains	$137,386,526.50
CONTINGENCY @15%	$20,607,978.98
TOTAL COST	**$157,884,505.48**

The following sections of this memorandum present background information for the Security Calculation as well as pertinent assumptions used in the development of the security estimate.

Tetra Tech
4900 Pearl East Circle, Suite 300W, Boulder, CO , 80303
Tel 303.447.1823 Fax 303.447.1836 www. tetratech.com

Security Calculation Background

The Northern Territory (NT) government requires that a Security Cost calculation be performed prior to issuing a mining authorization to commence mining. This Security Cost calculation is used to assist in establishing the level of security required to ensure liabilities incurred by mining activities will be addressed. The NT government has specified that the Security Cost calculation must follow the excel workbook developed by the NT government and which is posted on the NT government website. The Security that has been developed for the Mt Todd project has been developed in accordance with the NT Security workbook and associated guidance. The security calculation is reflective of the common mine site rehabilitation procedures and current rehabilitation costs included in the NT Security workbook as of the date of this memorandum.

The Security Calculation addresses the future, end-of-mine state of the project and addresses activities required to close and rehabilitate each functioning facility planned for the Mt Todd project.

Security Requirements

The Security calculation must include a calculation for the cost to rehabilitate 100% of the known environmental liability associated with the life-of-mine plan approved under the mining Authorization. Progressive security development is not approved by the NT, and the security calculation covers all liabilities expected during the planned life-of-mine. The security calculation will be submitted to the NT Department of Resources (NT-DOR) in conjunction with the Mining Management Plan in support of an application for Authorization of a site, or to reflect a change in operational activities. Securities will be reviewed by the Security Assessment Board of the Department of Resources – Minerals and Energy, and adjusted to account for progress in rehabilitation as well as new or expanded facilities.

There is no specified time for re-calculation of securities; however a re-calculation can be triggered by:

- A request from Operator based on changes in potential lease liability
- Findings of periodic audits and inspections, which highlight deviations from an approved Mining Management Plan (MMP)
- Amendments to an approved MMP
- At the time of sale, transfer or mine closure.

Securities will be released when criteria specified in the approved mine closure plan have been met. These criteria include commitments to post closure monitoring and management of potential liabilities at the site. An application for a Certificate of Closure is submitted by the owner/operator to the Department of Resources, Minerals and Energy which triggers assessment of site closure, revocation of the mining authorisation and relinquishment of securities.

Security Calculation Summary

Security Cost Calculation Workbook Explanation:

The Security Cost calculation workbook includes sections to calculate the cost to rehabilitate various mine features. These sections include:

- Summary
- Key Information
- Infrastructure
- Extractive
- Pits
- Underground
- Tailings Storage Facilities (TSF) & Dams
- Waste Rock Dump (WRD)
- Exploration
- Roads
- River Diversion
- Post Closure
- Post Closure Water Worksheet

Portions of the NT Security Calculation workbook did not apply to the Mt Todd Project and were left blank in the Security Cost Calculation workbook. These sections include:

- Underground Workings
- Exploration
- River Diversions

The following discussion explains the assumptions and sources of information used in completing the NT Security Cost Calculation for the Mt Todd Definitive Feasibility Study (DFS). Unless otherwise stated, unit costs were provided by the NT-DOR and remained unchanged in this calculation.

Summary – Total Cost = approximately $157,995,000 (includes $20,608,000 contingency):

The summary tab compiles totals from each category of the Security Calculation. The sub-total from each category is presented, in addition to a 15% contingency multiplier and a final cost.

Key Information:

Footprint areas for all mine-site facilities were entered in the “Key Information” tab and were applied to the “Post Closure” tab for calculation of decommissioning and post-closure costs.

Site Infrastructure – Cost = $1,932,400:

Area-based demolition costs in the “Infrastructure” tab were based on building footprint areas provided by Jigar Sheth, of Vista Gold Corp., for the following structures:

- Administration and Gate House Buildings,
- Process Plant Office and Ablutions,
- Process Plant Control Room,
- Sample Preparation and Laboratory Space,
- Process Plant Workshop and Warehouse,
- Process Plant Reagents Store,
- Mining Office, and
- Mining Heavy Vehicle Workshop.

This section also includes optional costs for the closure of drinking or sewage water treatment plants on site, however as there are no such facilities at Mt Todd, these have been left blank.

Extractive Workings – Sand, Clay & Gravel – Cost: $432,300

The cost for rehabilitation associated with extractive workings is based on the low permeability material (LPM) borrow areas. Costs associated with these facilities are accounted for in the “Extractive” tab. Quantities were based on the largest cell size currently planned for the LPM borrow area. Rehabilitation activities were assumed to include ripping, revegetation, and fertilizer application. It was assumed that all sediment management structures and other surface water management would be constructed as part of the borrow area initial construction during operations, and would therefore not be required at closure.

Hard Rock Pits & Quarries – Cost = $135,900

The cost for rehabilitation associated with pits at the Mt Todd Site is accounted for in the “Pits” tab. The cost for rehabilitation of the Batman pit includes the installation of a safety bund installed to prevent human access and excess inflow of surface water to the pit. The length of the pit safety berm was estimated from AutoCAD drawings of the proposed pit expansion with an additional offset of 30 m. A 30 m offset was determined based on an assumption of a 20 m “potentially unstable pit edge zone”, with a minimum additional 10 m offset per Guidelines for “Safety Bund Walls around Abandoned Pit Mines” from the Department of Industry and Resources in Western Australia.

Tailings Storage Facilities and Dams – Cost = $85,674,000

Costs for the rehabilitation of TSF1 and TSF2 were calculated in the “TSF & Dams” tab. Material volumes were based on footprint areas derived from AutoCAD drawings developed by Tetra Tech and the following proposed cover design:

- 1 m thick Non-PAG waste rock sub-base over the thixotropic tailings on the impoundment surfaces of both TSF1 and TSF2;
- 0.8 m thick store and release cover composed of 66% low permeability material (imported) and 34% non-PAG waste rock over the impoundment and embankment surfaces;
- 0.2 m thick plant growth medium cap on impoundment and embankment surfaces; and
- Revegetation by direct seeding.

The following activities account for the majority of the closure costs for TSF1 and TSF2:

- Importing Low Permeability Material makes up 41% of the closure costs for TSF1 and TSF2, based on importing 2.85 million m^3 of low permeability material at a unit cost of $12.43/$m^3$. This results in a total cost of $35.4 million.

- "Source cart and spread suitable material for capping" makes up 34% of the closure costs for TSF1 and TSF2, based on hauling about 3.9 million m^3 of non-PAG sub-base material to the impoundment surface, and about 4.3 million m^3 of store and release cover to the impoundment and embankment surfaces. At a unit cost of $3.50 per m^3, hauling and spreading closure material results in a total cost of $28.9 million.

- "Apply capping design treatment as required e.g. 'store and release'" accounts for 16% of closure costs at TSF1 and TSF2. The NT-DOR provided a unit cost of $36,500 per hectare based on an assumption of a 2 m-thick store and release cover. Because the proposed cover design calls for a 0.8 m-thick store and release layer, a unit cost of $25,000 per ha, the lowest unit cost provided in the suggested range, was utilized. Based on a unit cost of $25,000 per hectare to apply the store and release cover over the 540 ha of impoundment and embankment surfaces of TSF1 and TSF2, the total cost for the store and release cover is about $13.5 million.

- The remaining 9% of closure costs at TSF1 and TSF2 account for placement of plant growth medium, ripping/blending of material, and revegetation by direct seeding, totaling $7.9 million

Stockpiles & Waste Rock Dumps – Cost = $43,659,000

Reclamation activities of the Heap Leach Pad (HLP) and Low Grade Ore stockpile (LGO2) were accounted for in the "Oxide waste rock dumps and extractive product stockpiles" section of the "WRD" tab. Footprint areas of the HLP and LGO2 were based on the existing site-map for Mt. Todd and the proposed design from Tom Dyer of MDA, respectively. Closure material volumes were calculated based on removing an average of 0.5 meter from the footprint of the HLP to TSF2, and the proposed store and release, plant growth medium, and revegetation covers to be placed on both the HLP and LGO2 footprints, discussed above for TSF1 and TSF2. Total closure costs for the HLP and LGO2 were estimated at $5 million.

Closure of the proposed WRD is accounted for in the "Waste rock dumps with AMD or metals" section of the "WRD" tab. The WRD rehabilitation will include a geo-synthetic clay liner (GCL) cover rather than a store and release cover based on a design developed collaboratively by Tetra Tech, MDA, and Vista. The estimated GCL cover cost accounts for material quantities of GCL cover and the GCL bedding and protective layers made up of crushed non-PAG waste rock. Quantities of these materials were based on a footprint area of the WRD from AutoCAD drawings supplied by Tom Dyer of MDA. The following items present a breakdown of the WRD closure activities and costs:

- "Unshaped requiring minor earthworks" – At a unit cost of $1,600 per ha for minor reshaping of the entire surface area of 241 ha, this activity accounts for placement of 1 m of non-PAG waste rock for erosion prevention, and amounts to approximately $386,000.
- "Source cart and spread suitable material for capping" – To account for the haul costs of the specified bedding and protective layers for the GCL cover, the NT-DOR unit cost of \$5 per m^3 was applied to the total volume of material, for a total cost of $5.9 million.
- "Apply capping design treatment e.g. 'store and release'" – This category reflects costs associated with placement of the GCL over 196 ha. This placement area reflects coverage of the entirety of each 30 m lift. To account for the increased costs associated with placing a GCL rather than a store and release cover, the unit cost was increased from the standard $36,500 per ha to $75,000 per ha to reflect the vendor-quoted cost of \$7.50/m^2 for GCL. The GCL cover over results in a total cost of $14.7 million, accounting for nearly 70% of the total costs associated with closure of the HLP, LGO2, and WRD.
- The estimated security cost for closure of the WRD is lower than the estimated cost in the closure plan. This discrepancy is due to the fact that crushing of non-PAG waste rock for the bedding and protective layer will be completed with the process plant crusher in the case of the security cost, but will be completed with a secondary crushing unit in the proposed closure plan. Thus, unit costs for placing the bedding and protective layers in the security cost calculation are considerably lower than in the proposed closure plan.

The cost for treatment of seepage from the WRD was accounted for in the "WRD" tab. Technologies for seepage treatment listed in this tab include wetland treatment or active recovery and treatment. As wetlands will be developed approximately 5-years after closure, seepage treatment was assumed to be conducted by active recovery and treatment for the first five years, and costs were included for the construction of a new wetland treatment system. Although the cost for active seepage treatment listed in the security workbook is presented as a lump sum ranging from of $20,000 to $200,000, discussion with Tetra Tech engineers designing the water treatment system indicated that operating costs for the plant would run approximately $470,000/year. The cost to construct the new wetland treatment system was based on the cost estimated in the 2011 PFS.

Access and Haul Roads – Cost = $433,000

All activities for closure of haul roads were accounted for in the "Roads" tab. Closure of haul roads involves scarification and revegetation of the roads. Total haul road areas were calculated from AutoCAD plans assuming a 16 m width on all haul roads. Rehabilitation of the main access road was not included in the cost calculations as the main access road will remain in place after closure of the mine per the request of the Jawoyn Association Aboriginal Corporation.

Decommissioning & Post Closure Management – Cost = $5,120,000

The "Post Closure" tab accounts for activities such as mobilization/demobilization, contaminated site assessments, pest and weed management, and earthwork maintenance. Area-based costs developed here are based on the areas input in the "Key Information" tab discussed previously. Mobilization and demobilization costs assume haul to and from Darwin, NT, located 290 km from the mine-site.

Post Closure Water Worksheet – Cost Included in Decommissioning & Post Closure Management

Information in the water monitoring worksheet was provided by Andrew Sawicki, of Vista Gold Corp. The number of wells listed at each location represents the wells that presently exist at the mine. The total cost developed in this worksheet is accounted for in the "Decommissioning & Post Closure Management" cost.

The following comments and assumptions came from Andrew Sawicki (circa 2011) regarding water monitoring on-site:

- Groundwater Monitoring at Mine Site Structures:
    - Discrete infrastructure areas – Currently one well exists near the infrastructure area. Up to four more wells may be installed later.
    - Pit voids/declines – The number entered denotes sampling of bores adjacent to structures. Currently two wells exist. An estimated three extra may be necessary to the east and SSE as the pit expands.
    - Waste Rock Dump - Mixed or sulfide – There are two wells currently in place, with an estimated four to six more as the dump progresses.
    - Tailings dam / residue disposal ponds – 15 wells currently in place at TSF1, some of which need repairs or replacement. The operator will need to establish up to 16 more when the new TSF is constructed.
    - Water containment / retention ponds –
        - Existing bores at RP1 are in need of repair or replacement. Estimate another four will be required after deepening of RP1.
        - Drainage arrangements to be put in place for RP2 and RP5 will require approximately three more bores.
        - Vista will need sufficient bores to monitor the final infrastructure area. May need two to four additional bores to monitor infrastructure area.
    - Four monitoring wells are located up and down gradient of the site for background monitoring
    - Four monitoring wells are located around Quigleys, North of TSF1, that need to be maintained.

- Surface Water Monitoring:
    - Water Retaining Structures with no Discharge – There are currently two monitoring sites at Batman Pit. There may be one more at Quigleys.
    - Water Retaining Structures with Possible Discharge – One monitoring site exists at RP1. RP2 and RP5 currently discharge without monitoring structures. This should be addressed before operation of the mine.

- Perennial Streams Discharging from Site – There are three sites monitoring discharge from the Edith River
- Ephemeral Streams Discharging from Site – There are a total of 12 monitoring sites with three on each of the following streams:
  - Western Creek (to Edith River),
  - Batman Creek (to Stow Creek),
  - Horseshoe Creek (to Stow Creek), and
  - Stow Creek (to Edith River).

- Water Quality Interpretation and Reporting:
  - Other Reporting – The Mt. Todd Reference Group, a group of stakeholders who meet annually and compile an annual report on the condition of the area, will most likely require reporting on water quality at Mt Todd. This organization will likely exist post-closure.

Vista Gold Corp. - Mt. Todd

Security Calculation

Security Summary

Details			
Contact Name	John Rozelle	**Authorisation #**	
Project	Vista Gold - Mt Todd PFS	**Date**	12/13/2012
MMP			

NOTE: Operators may use DME Cost per Unit Of Measure as a guide or insert their own cost and UOM - adjust form as necessary. Justification of changes to UOM and cost should be provided if DME units area not used

New Authorisation	MMP Renewal/amendment	Audit Finding	Client Request
X	X	X	X

Domains	Calculated Cost
1: Site Infrastructure	$1,932,415.00
2: Extractive Workings - Sand, Clay & Gravel	$432,344.00
3: Hard Rock Pits & Quarries	$135,880.00
4: Underground Workings	$0.00
5: Tailings Storage Facilities and Dams	$85,674,000.00
6: Stockpiles & Waste Rock Dumps	$43,658,600.00
7: Exploration	$0.00
8: Access and Haul Roads	$433,072.50
9: River Diversions	$0.00
Decommissioning & Post Closure Management	$5,120,215.00
Sub-Total - All Domains	**$137,386,526.50**
CONTINGENCY @15%	**$20,607,978.98**
TOTAL COST	**$157,994,505.48**

DISTURBANCE AREA INVENTORY			
Whole of site summary	**Total Area (ha)**	**Progressively rehabilitated area**	**Remaining area**
Lease surface area			
Disturbed operational area			
Above grade landforms			
Waste rock dump #1	90		
Waste rock dump #2	241		
Waste rock dump #3			
Waste rock dump #4			
Waste rock dump #5			
Tailings Dam #1	540		
Tailings Dam #2			
Tailings Dam #3			
Tailings Dam #4			
Mining area #1			
Mining area #2			
Mining area #3			
Mining area #4			
Mining area #5			
Mining area #6			
Extractive areas	115.60		
haul roads	24		
access roads			
water ponds/dams			
Area of infrastructure	35		
camp area			
area of drill pads and sumps			
costeans/pits			
tracks/roads			
other			
TOTAL	**1045.7**		

Quantities and costs based on June 2013 Update to Mt Todd Project

Domain 1: Infrastructure

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Process Plant, Mill, Crusher area	disconnect and terminate services	@	10000-27500	26700.00	1	26700.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.	
	demolish and remove small buildings	m^2	70-90	90.00	254	22860.00	enter the total area of small buildings and offices in the area, including demountables. It does not include workshops.	Process Plant Offices and Control Room
	demolish and remove industrial workshops and sheds	m^2	160-210	210.00	1413	296730.00	enter the total area of workshop facilities in the area.	Workshop, Warehouse, and Reagents Storage
	demolish remove conveyor system	m	100-250	140.00		0.00	Enter the total length of conveyors	
	demolish/remove crusher, process plant and mills	m^2	160-210	210.00	343	72030.00	enter the total surface area of process plant and mills etc. If multi-story the area should be the sum of the surface area of all floors.	Sample Prep and Laboratory
	remove concrete pads and footings	m^2	10-30	15.00	2010	30150.00	enter the total area of buildings, workshops etc. Cost dependent on thickness. Assume $10/m2 for <300mm thick, $30/m2 for >300mm thick. (default $15 if unknown)	Entire Process Plant area
	remove mobile plant	hr	140-300	200.00		0.00	consider distance to remove all mobile plant to the nearest centre or to Darwin.	
	remove contaminated material	m^3	3.00-5.00	5.00		0.00	enter volume of spillage and other contamination for removal to pit or WRD.	
	deconstruct and remove large tanks - eg leach	@	35000-165000	35000.00		0.00	enter the number of tanks	
	deconstruct and remove small tanks	@	10000-30000	10000.00		0.00	enter the number of tanks	
						448470.00		
Main Workshop and Stores area	disconnect and terminate services	@	5000-5500	5000.00	2	10000.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.	Process Plant Workshop and Mining Are
	demolish and remove small buildings	m^2	70-90	90.00	396	35640.00	enter the total area of small buildings and offices in the area, including demountables. It does not include workshops.	Mining Area Office
	demolish and remove industrial workshops and sheds	m^2	160-210	210.00	4039	848190.00	enter the total area of workshop facilities in the area. Are there any remote or field based workshops to include	Mining Area Workshop
	remove concrete pads and footings	m^2	10-30	10.00	4435	44350.00	enter the total area of workshops and buildings. Include any areas of carpark and washdown pads, bulk fuel bunding and refuelling areas.	Mining Area Workshop and Office
	remove contaminated material	m^3	3.00-5.00	5.00		0.00	enter volume of spillage and other contamination for removal to pit or WRD.	
	underground tank removal - large hydrocarbon (>5000L)	@	48000-82500	60000.00		0.00	removal of underground tank and all pipework, bunds and any contamination	
	underground tank removal - small hydrocarbon (up to 5000L)	@	20000-21000	20000.00		0.00	removal of underground tank and all pipework, bunds and any contamination	
	above ground tank removal - hydrocarbon	@	200.00	200.00		0.00	enter number of tanks	
	remove hydrocarbon contamination	m^3	3.00-5.00	5.00		0.00	enter the volume to be removed to pit void for appropriate rehabilitation. If the volume is not known assume a volume of 3000m3 per fuel storage facility.	

Domain 1: Infrastructure

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
	remediation on site of hydrocarbon contamination	m^3	30-55	40.00		0.00	enter the volume of material requiring onsite remediation. If the volume is not known assume a volume of 3000m3 per fuel storage facility.	
						938180.00		
Administration	disconnect and terminate services	item	5000-5500	5000.00	2	10000.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.	Admin Building and Gatehouse
	demolish and remove small buildings	m^2	70-90	75.00	483	36225.00	enter the total area of small buildings and offices in the area, including demountables. It does not include workshops.	Admin Building and Gatehouse
	demolish and remove industrial workshops and sheds	m^2	160-210	210.00		0.00	enter the total area of workshop facilities in the area.	
	remove bitumen from sealed carparks etc	m^2	12.00-17.00	17.00		0.00	enter total area of carparks. Includes removal offsite to appropriate facility	
	remove concrete pads, footings	m^2	10-30	10.00	483	4830.00	enter the total area of workshops and buildings. (concrete <300mm @ $10/m2, concrete >300mm @ $30/m2)	Admin Building and Gatehouse
	waste disposal offsite	@	650	650.00		0.00	assumes removal offsite to a waste disposal facility. Adjust if disposing at onsite facility	
						51055.00		
Sewerage/Water treatment plant	disconnect and terminate services	item	2500-5000	2500.00		0.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.	
	demolish and remove small buildings	m^2	70-90	75.00		0.00	enter the total area of small buildings and tanks.	
	remove contaminated soil	m^3	3.00-5.00	5.00		0.00	removal to pit void for appropriate rehabilitation	
						0.00		
Accommodation Camp	disconnect and terminate services	item	5000-5500	5000.00		0.00	This item includes disconnecting all services such as power, water and sewer. This is a 'one off' cost for the area.	
	demolish and remove small buildings	m^2	70-90	75.00		0.00	enter the total area of small buildings and tanks.	
						0.00		
Airstrip, borefields, other	remove concrete pads footings and bitumen	m^2	10-30	10.00		0.00	enter total area (concrete <300mm @ $10/m2, concrete >300mm @ $30/m2)	
	demolish and remove sheds and storage tanks	m^2	70-90	75.00		0.00	enter area of sheds and tanks	
	production/dewatering bore closure	@	2000-3300	2000.00		0.00	sealing and rehabilitation	
	observation bore closure	@	500	500.00		0.00	includes sealing and rehabilitation to make safe.	
						0.00		
Revegetation Activities - all infrastructure areas	Deep rip	ha	550-1100	1100.00	35	38610.00	Enter all areas disturbed by infrasturcture from above, including laydown areas Assume highly disturbed and compacted areas - see assumptions.	Entire Process Plant area

Domain 1: Infrastructure

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
	source cart and spread topsoil	m^3	2.50-5.50	5.50	70200	386100.00	assume minimum of 10cm depth	0.2 m depth of PGM
	revegetation by tubestock	ha	6000/ha (or 5/ea)	6000.00		0.00	enter total area for revegetation by tubestock. (or enter quantity of tubestock required (<15cm), and density/ha)	
	revegetation by direct seeding	ha	1200-2000	2000.00	35	70000.00	this rate includes acquiring a mix of native tree and shrub species appropriate for the area, mixing and treating the seed and applying by hand at a rate of 4-10kg/ha	
	feriliser application	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program - see assumptions	
						494710.00		
Other	remove powerlines	km	9800-15000	15000.00		0.00	include dismantling and removal of lines and poles from the site	
	remove pipelines	km	1400-1800	1400.00		0.00	remove polypipe >300mm diameter. Assumes removal by 3 persons via truck to nearest location.	
						0.00		
DOMAIN 1 TOTAL						$1,932,415.00		

Domain 2: Extractive Workings - Sand, Clay & Gravel

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Pits	Scaling, battering for stabilisation	m^2	1.21-3.00	3.00		0.00	this includes the area requiring reshaping for stabilisation and preparation for revegetation	
	backfilling of pits	m^3	4.00-5.00	5.00		0.00	enter volume of material to be backfilled into pit	
	abandonment bund and pit access closed	m	20.00-63.25	50.00		0.00	required where final pit includes steep faces. Includes bund around pit and closure of ramp. Bund assumed to be 2m high and 5m wide at base	
	structural works for drainage	ha	700-1500	1500.00		0.00	earthworks for banks and drains to manage surface water .	
	source cart and spread topsoil or growth medium	m^3	2.50-5.50	5.50		0.00	required if it has not been demonstrated that pit material is suitable as a growth medium	
	final trim, deep rip	ha	550-1600	1600.00	115.60	184960.00	to enhance vegetation program as required, dependent on material to be ripped eg sand, gravel, clay. Assume low to medium level disturbance - see assumtpions	Low Permeability Borrow area - largest cell size. Area will be ripped, amended and seeded.
	revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation by direct seeding	ha	1200-2000	2000.00	115.6	231200.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	Low Permeability Borrow area - largest cell size. Area will be ripped, amended and seeded.
	fertiliser application	ha	140-744	140.00	115.6	16184.00	includes a single application of fertiliser during the initial seeding program - see assumptions	Low Permeability Borrow area - largest cell size. Area will be ripped, amended and seeded. No cost item for soil amendment - use fertilization as surrogate.
	signage	@	50	50		0.00	enter number of warning signs as approriate	
						432344.00		
Sediment Management	sediment traps/dams	m^3	2.50-2.90	2.90		0.00	enter volume of dam required for sediment traps	
	Rocks or coarse material lined sediment trap	m^3	1.00-5.00	5.00		0.00	condsider distance to cart material	
Other						0.00		
						0.00		
DOMAIN 2 TOTAL						$432,344.00		

Domain 3: Hard Rock Pits and Quarries

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Stabilisation of Pits	Drill and blast faces to make safe OR	m^3	1.20-1.60	1.60		0.00	Volume is worked out be multiplying length of bench by width and height to reduce angle to make it safe.	
	scaling, battering, pushing walls	m^3	1.21-3.00	3.00		0.00	volume requiring reshaping	
	abandonment bund and pit access closed	m	19.00-63.25	30.00	4496	134880.00	required where final pit includes steep faces (>18o). Includes bund (2m high , 5m base) around pit and closure of ramp	30 m offset from Batman Pit perimeter
	final trim, deep rip	ha	550-1600	1600.00		0.00	to enhance vegetation program around pit and pit floors as required	
	structural works for drainage	ha	700-1540	1200.00		0.00	earthworks for banks and drains to manage surface water .	
	source cart and spread topsoil if appropriate	m^3	2.50-5.50	5.50		0.00	includes min of 10cm of topsoil to assist revegetation program.	
	revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation by direct seeding	ha	1200-2000	2000.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	
	fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program	
	fencing	m	10.0-30.0	30.00		0.00	construct a standard stock fence around the site	
	signage	@	50	50	20	1000.00	enter number of warning signs as appropriate	Assumed value
						135880.00		
Infill of pits	infill with tailings or waste rock	m^3	2.00-4.00	4.00		0.00	haul and dump of waste rock or tailings. Distance needs to be considered.	
	shaping or levelling	ha	550-1100	700.00		0.00	area requiring minor reshaping prior to deep ripping	
	source cart and spread suitable material for growth medium	m^3	2.00-5.00	5.00		0.00	required if it has not been demonstrated that infill material is suitable as a growth medium and only if does not require egineered capping design for ARD/metals mitigation. Assume min thickness of 0.5m	
	source cart and spread topsoil if appropriate	m^3	2.50-5.50	5.50		0.00	includes min of 10cm of topsoil to assist revegetation program.	
	final trim, deep rip	ha	550-1600	1600.00		0.00	to enhance vegetation program over infilled pit as required	
	structural works for drainage	ha	700-1540	1200.00		0.00	earthworks for banks and drains to manage surface water on top of capped pit area if required.	
	revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation by direct seeding	ha	1200-2000	2000.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	
	fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program - see assumptions	
						0.00		

Sediment Management	sediment traps/dams	m^3	2.5-2.9	2.90		0.00	enter volume of dam required for sediment traps	
	Rocks or coarse material lined sediment trap	m^3	1.00-5.00	5.00		0.00	condsider distance to cart material	
Other						0.00		
						0.00		
DOMAIN 3 TOTAL						$135,880.00		

Domain 4: Underground Workings

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Portals, Declines and Shafts	barricading portal/declines/adits	@	1500-2500	2500.00		0.00	barricading of portal with steel grill to make safe and ensure access cnnot be gained but will allow movement of bats	
	sealing portal/decline	@	15000-25000	25000.00		0.00	OR sealing portal with concrete and backfill to make safe and ensure access cannot be gained	
	capping/sealing shafts	@	10000-25000	10000.00		0.00	cap shafts using reinforced concrete slab. Dependent on size	
	shaft infilling	m^3	8.00-20.0	10.00		0.00	filling of shafts using onsite material	
	seal ventilation fans	@	27500	27500.00		0.00	seal and rehab ventilation fans to make safe.	
	final trim, deep rip	ha	550-1600	1600.00		0.00	to enhance vegetation program in area as required	
	revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation by direct seeding	ha	1200-2000	2000.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	
	fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program - see assumptions	
						0.00		
DOMAIN 4 TOTAL						$0.00		

Domain 5: Tailings Storage Facilities and Dams

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Water Dams, Ponds	clean water dams - stabilise and make safe	@	2000-2200	2000.00		0.00	minor earthworks	
	or backfill to natural surface	m^3	2.00-5.00	5.00		0.00	backfilled with onsite material. Haul distance sliding scale from $2/m3 for up to 1km, up to $5/m3 for up to 5km or greater.	
	dirty water dams - drain and remove sediment	m^3	5.00-7.50	7.50		0.00	includes draining the dam to the pit or other appropriate place, removing 500mm of potentially contaminated sediments to be buried in the pit or other disposal area. Must consider the distance from dam to disposal area.	
	shaping or levelling	ha	550-1100	700.00		0.00	area requiring minor reshaping prior to deep ripping	
	source cart and spread suitable material for capping/growth medium	m^3	2.00-5.00	5.00		0.00	required if it has not been demonstrated that infill material is suitable as a growth medium Assume min thickness of 0.5m	
	source cart and spread topsoil if appropriate	m^3	2.50-5.50	5.50		0.00	includes min of 10cm of topsoil to assist revegetation program.	
	final trim, deep rip	ha	550-1600	1600.00		0.00	to enhance vegetation program over infilled pit as required	
	structural works for drainage	ha	700-1540	1500.00		0.00	earthworks for banks and drains to manage surface water on top of capped dam area if required.	
	revegetation by tubestock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation be direct seeding	ha	1200-2000	2000.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	
	fertiliser application	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program	
						0.00		
Tailings Dams	source cart and spread suitable material for capping	m^3	2.00-5.00	3.50	8247000	28,864,500	volume of suitable material for capping the TSF. Must have appropriate chemical and physical properites. Required whether for engineered design or growth medium.	All Non-PAG sub-base, and Non-PAG and LPM in Store & Release Cover, used average of costs in range
	apply capping design treatment as required eg 'store and release'	ha	25000-49500	25000.00	540	13,500,000	required to manage AMD or metals leachate from TSF. Capping layer assumed to be no less than 2m thick.	Entire area of both TSF1 and TSF2 (rounded)
	source cart and spread topsoil if appropriate	m^3	2.50-5.50	5.50	1080000	5,940,000	includes min of 10cm of topsoil to assist revegetation program.	All PGM on both TSF1 and TSF2
	reshape walls and surrounds	ha	1400-5500	1400.00		0.00	area requiring stabilisation and reshaping works around the walls of the emplacement	
	fianl trim, deep rip	ha	550-1600	1600.00	540	864,000	to enhance vegetation program over infilled pit as required	Entire area of both TSF1 and TSF2 (rounded)
	structural works for drainage	ha	700-1540	1500.00		0.00	earthworks for banks and drains to manage surface water on top of capped dam area if required.	

	revegetation by tubestock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation be direct seeding	ha	1200-2000	2000.00	540	1,080,000	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	Entire area of both TSF1 and TSF2 (rounded)
	fertiliser application	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program - see assumptions	
	seepage management - recovery and treatment	@	20000-200000	20000.00		0.00	where seepage is at unacceptable levels and no wetland filter is in place and company has committed to recovery and treatment of seepage. Depends on size.	
	seepage management - wetland filter	ha	5500	5500.00		0.00	assumes wetland filter is in place and functioning	
Other	Low Permeability Material Cost to	m3	12.43	12.43	2850000	35,425,500	Cost based on Tetra Tech Calculations - 2012	Line item added to Security Calculation
						85674000.00		
DOMAIN 5 TOTAL						$85,674,000.00		

Domain 6: Stockpiles & Waste Rock Dumps

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Oxide waste rock dumps and extractive product stockpiles	Recontouring/battering for stabilisation	m^2	2.00-3.60	3.60		0.00	this includes the area requiring reshaping for stabilisation and preparation for revegetation	
	unshaped requiring minor earthworks, trim and deep rip	ha	550-1600	1600.00		0.00	enter the area requiring minor reshaping to 12-18° slopes and deep ripping to enhance revegetation	
	unshaped requiring major earthworks, trim and deep rip	m^3	1.21-4.00	4.00	721000	2884000.00	include volume of material requiring major reshaping to achieve approriate grades (<18° Or as specified in MMP) and deep ripping	HLP and LGO2 Store & Release Cover
	structural works for drainage	ha	700-1540	1500.00		0.00	earthworks for banks and drains to manage surface water on top of WRD.	
	source cart and spread topsoil or growth medium	m^3	2.50-5.50	5.50	180000	990000.00	required if it has not been demonstrated that WRD material is suitable as a growth medium	HLP and LGO2 PGM Cover
	or removal of stockpiles	m3/bcm	3.00-5.00	5.00	195000.00	975000.00	carting of stockpiles offsite or WRD to pit. Consider carting distance	remove contaminated material below HLP to TSF2
	trim, deep rip if required	ha	550-1600	1600.00		0.00	ripping stockpiles or surrounds if required.Assume ripping of waste rock dumps undertaken during reshaping.	
	revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation by direct seeding	ha	1200-2000	2000.00	90	180000.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	HLP and LGO2 Areas
	fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program - see assumptions	
						5,029,000		
Waste rock dumps with AMD or metals	unshaped requiring major earthworks, trim and deep rip	m^3	4.00-6.00	4.00		0.00	include volume of material requiring major reshaping to achieve approriate grades (<18° or as specified in MMP) and deep ripping	
	unshaped requiring minor earthworks, trim and deep rip	ha	550-1600	1600.00	241	385,600	enter the are requiring minor reshaping and deep ripping to enhance revegetation	Total WRD 3D Area
	source cart and spread suitable material for capping	m^3	2.00-5.00	5.00	1176000	5,880,000	volume of suitable material for capping the WRD. Must have appropriate chemical and physical properites.	GCL Protective and Bedding Layers
	apply capping design treatment eg 'store and release'	ha	25000-49500	75000.00	196	14,700,000	required to manage AMD or metals leachate from WRD. Capping layer assumed to be no less than 2m thick.	GCL covered area - Increased unit cost for GCL estimated at $7.50/m2 = $75,000/ha
	or removal of stockpiles	m3/bcm	3.00-5.00	5.00		0.00	removal to pit. Haulage distance needs to be considered at an additonal $1/km	
	source cart and spread topsoil if appropriate	m^3	2.50-5.50	5.50		0.00	required if it has not been demonstrated that capping material is suitable as a growth medium	
	final trim, deep rip	ha	550-1600	1600.00		0.00	to enhance vegetation program over infilled pit as required	

	structural works for drainage	ha	700-1540	700.00		0.00	earthworks for banks and drains to manage surface water on top of WRD area if required.	
	revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation by direct seeding	ha	1200-2000	2000.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	
	fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program - see assumptions	
						20,965,600		
Leachate and sediment management	Active recovery treatment of problem leachate	item	20000-200000	470,000	5	2,350,000	where seepage is at unacceptable levels and no wetland filter is in place and company has committed to recovery and treatment of seepage. Depends on size.	Based on Input From Tt Water Treatment Plant Designers for annual materials requirement for plant. Assume plant runs for five years prior to transition to passive treatment (5 items)
	Wetland filter	ha	5500	5500.00		0.00	assumes wetland filter is in place and functioning	
	Construct New Wetland Filter	item	15,314,000	15,314,000	1	15,314,000	Estimated cost to construct new passive water treatment system	Line Item added to Security Estimate Workbook, Cost based on 2011 PFS
	dams for sediment control	m^3	2.50-2.90	2.90		0.00	enter volume of dam required for sediment traps	
	Rocks or coarse material lined sediment trap	m^3	1.00-5.00	5.00		0.00	condsider distance to cart material	
Other						0.00		
						17,664,000		
DOMAIN 6 TOTAL						$43,658,600.00		

Domain 7: Exploration

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Drillholes, Pads, sumps, costeans	capping drillholes 30cm below ground	@	80-275	150.00		0.00	Cut collar, insert plug and backfill. Assume using, concrete or plastic cone plugs or bridge (no 'occy' plugs) Depends on number of holes	
	grout with concrete	@	1250	1250.00		0.00	Assume total grouting of drillhole	
	empty and remove plastic sample bags	hole	25-235	100.00		0.00	return cuttings to hole and remove plastic bags to a waste disposal facility. Bags cannot be disposed of on site.	
	ripping/scarifying pads	ha	440-2500	1600.00		0.00	Minor ripping/scarifying of pads to depth of 0.3m to assist vegetation in areas of flat/gentle terrain, includes sump infilling. Sumps should not remain open for extended periods of time.	
	reshape drill pads	@	320	320.00		0.00	Required in steep terrain where earthworks required with excavator/dozer to return pad to slope and establish erosion control, includes sump infilling. Using PC650 excavator or equivalent assumes one pad per hour @$320/hr.	
	infilling costeans	m^3	2.00-3.00	3.00		0.00	Backfilling of all costeans/trenches. Assumes material does not have to be carted.	
	bulk sample pits	m^3	2.00-8.00	2.00		0.00	dependent on depth of pit and if battering of walls required to form to 18^o slope	
	contouring for erosion control	ha	700-1540	1500.00		0.00	minor pushing to construct water management structures such as contour banks and diversion drains as required.	
	topsoil replacement if applicable	m^3	2.50-5.50	5.50		0.00	includes min of 10cm of topsoil to assist revegetation program. **this may be carried out when reshaping pads	
	revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation by direct seeding	ha	1200-2000	2000.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha if required. Required where area of disturbance is significant.	
	fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program	
						0.00		
Tracks and Gridlines	ripping/scarifying minor tracks and gridlines	km	120-500	500.00		0.00	assume using grader or equivalent to rip to 0.3m and no windrows, establishing erosion control measures (eg bunds) as required	
	ripping major tracks and roads	km	550-1000	1000.00		0.00	pushing in windrows and ripping track and establishing erosion control measures (ie bunds) across tracks as required	
	removal of gridpegs	item	1500	1500.00		0.00	includes removal offsite of all grid pegs in exploration area	
	topsoil replacement if applicable	m^3	2.50-5.50	5.50		0.00	includes min of 10cm of topsoil to assist revegetation program if required	
	revegetation by tube stock	ha	6000/ha (or 5/ea)	6000.00		0.00	includes acquisition of tubestock, fertiliser and guarding as necessary	
	revegetation by direct seeding	ha	1200-2000	2000.00		0.00	includes acquiring and spreading a range of native seed by direct broadcast at a rate of 4-10kg/ha.	
	fertiliser applicataion	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program	
						0.00		
DOMAIN 7 TOTAL						$0.00		

Domain 8: Access and Haul Roads

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Haul Roads	remove ARD material from road	m3/bcm	2.50-5.50	5.50		0.00	where haul road has been constructed with waste rock material that is leaching ARD removal and disposal in pit or similar will be required	
	reshape and deep rip	ha	2000-5000	5000.00	24	120000.00	windrows are pulled back and edges battered, area is deep ripped (road 12mwide)	Road area
	structural works for drainage	ha	700-1540	1500.00		0.00	pushing to construct water management structures such as contour banks and diversion drains as required.	
						120000.00		
Access Roads	breaking and removal of bitumen	m3	12.00-17.00	17.00		0.00	Includes area of bitument in roads car parks etc which needs to be removed and disposed of appropriately	
	reshape and deep rip	ha	2000-5000	2500.00		0.00	windrows are pulled back and edges battered, area is deep ripped	
	structural works for drainage	ha	700-1540	1500.00		0.00	pushing to construct water management structures such as contour banks and diversion drains as required.	
						0.00		
Revegetation activities - all roads	source cart and spread topsoil	m^3	2.50-5.50	5.50	48195	265072.50	assume minimum of 10cm depth	Assume 0.2m PGM placed on ripped and regraded roads
	revegetation by tubestock	ha	6000/ha (or 5/ea)	6000.00		0.00	enter total area for revegetation by tubestock. (or enter quantity of tubestock required (<15cm), and density/ha)	
	revegetation by direct seeding	ha	1200-2000	2000.00	24	48000.00	this rate includes acquiring a mix of native tree and shrub species appropriate for the area, mixing and treating the seed and applying by hand at a rate of 4-10kg/ha	Road area
	feriliser application	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program - see assumptions	
						313072.50		
DOMAIN 8 TOTAL						$433,072.50		

Domain 9: River Diversions

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Creek/River	channel maintenance	m	165.00	165.00		0.00	Includes earthwork repairs and stabilisation following flow events.	
	vegetation by tubestock	ha	6000/ha (or 5/ea)	6000.00		0.00	enter total area for revegetation by tubestock. (or enter quantity of tubestock required (<15cm), and density/ha)	
	vegetation by direct seeding	ha	1200-2000	2000.00		0.00	this rate includes acquiring a mix of native tree and shrub species appropriate for the area, mixing and treating the seed and applying by hand at a rate of 4-10kg/ha	
	vegetation maintenance	ha	140-744	140.00		0.00	includes a single application of fertiliser during the initial seeding program	
						0.00		
DOMAIN 9 TOTAL						$0.00		

Decommissioning & Post Closure Management

Management Area	Technique	Unit of Measure (UOM)	Range per UOM ($)	Cost per UOM ($)	Estimated Quantity	Sub Total ($)	Technique Notes	Comment (eg when $/UOM differs from DME)
Decommissioning and Closure	mobilisation/demobilisation	km	10.00-15.00	15.00	290	21,750.00	determined based on distance to the mine and machinery used ($/km) Assume mob/demob from largest centre unless otherwise stipulated & supported by the operator. Calculation assumes 5 pieces of machinery required per site. Adjust formula if necessary.	Trip from Darwin, NT
	Contaminated site assessment	@	35000	35000.00	1	35,000.00	has a contaminated site assessment been undertaken? If not this should be included for large metalliferous mines.	
	Pest and weed management, monitoring & assessment	ha	200 - 250	250.00	2091	522,850.00	Include total disturbed area , consider for minimum of 2 years during closure for larger sites only. Entry automated form 'Key Information' tab.	
	Contractor accommodation, messing and travel costs	man day	210-320	320.00	1000	320,000.00	Assume 5-9 people required for 2-10 weeks (or more) depending on size of site *quantity = number of days X number of people (eg 9 persons for 50 days = 450 man days)	Assuming crew operating 6-months
	Closure management	yr	110,000 - 300,000	110000.00	1	110,000.00	This includes project manaement team assuming 1 - 3 persons based on the magnitude of the process salaries, oncosts, tender preparation and closure report and coordination of works. Consider part of year only for small sites.	Assume work completed in one year
Post Closure	mobilisation/demobilisation	km	10.00-15.00	15.00	2900	43,500.00	Determined based on distance to the mine and machinery used ($/km) Assume mob/demob from largest centre unless otherwise stipulated & supported by the operator. Calculation assumes 1 piece of machinery required per site.	Trip from Darwin, NT, assume 10 pieces of equipment
	Post closure water monitoring	yr	adjust post closure worksheet - no entry required			1,833,900.00	Monitoring and measurement requirements that may be needed following the closure of the project - use the 'post closure worksheet' Estimated quanity refers to number of years required post closure	
	Pest and weed management, monitoring & assessment	ha	200 - 250	250.00	3137	784,275.00	Include total rehabilitated area , assumed for minimum of 3 years post closure Entry automated form 'Key Information' tab.	
	Earthwork maintenance	ha	1,100	1100.00	348	383,240.00	Assume 20% failure rate for the total areas of contructed landforms (eg WRDS, TSF etc) for a period of 2 years (if not stipulated otherwise) Entry automated form 'Key Information' tab.	
	Revegetation maintenance, monitoring & assessment	ha	1,250 - 2,500	2500.00	418	1,045,700.00	Assume a 20% failure rate for all disturbed areas for a period of 2 years. (if not stipulated otherwise) Entry automated form 'Key Information' tab.	
	Project management	yr	20,000	20000.00	1	20,000.00	This includes tender preparation, financial reporting procurement, contractor management etc. Time frame assumed is 1-10 years depending upon the site & the complexity of the issues present	Assume 1 year
	fire break maintenance	km	50-75	72.00		0.00	Grading of firebreaks during and after closure for a period of 1-10 years depending on site size *quantity = number km x number years	
						5,120,215.00		
POST CLOSURE TOTAL						5,120,215.00		

POST CLOSURE WATER QUALITY MONITORING WORKSHEET

NOTE:

Operators must enter numbers in the blue boxes, to the appropriate timeframes and reflecting the structures present on individual sites.

SUMMARY

Item	Component	Cost ($)
1	Groundwater monitoring - Analytical	$1,050,000
2	Surface water monitoring - Analytical	$182,500
3	Field sampling and Expenses	$76,400
4	Water quality interpretation & reporting	$525,000
	TOTAL	**$1,833,900**

1 GROUNDWATER MONITORING - ANALYTICAL

Analytical & consumables

Assumptions: ICPMS, fields & laboratory consumables @ $250/sample

Mine site structures	Size (ha)	Enter the number of structures	Sampling points	Sampling per year	Enter the number of years 0-10	Subtotal cost ($)
Whole of site	All		3	2	*10*	0
Extraction bores for use after closure		*0*	1	2	*10*	0
Discrete infrastructure areas		*1*	3	2	*10*	15,000
Underground fuel storage areas		*0*	1	2	*10*	0
Pit voids/declines	All	*2*	3	2	*10*	30,000
Waste rock dump - oxide	<5		2	1	*10*	0
	5 - 20		3	2	*10*	0
	>20		4	2	*10*	0
Waste rock dump - mixed or sulfide	<5		2	2	*10*	0
	5 - 20		4	2	*10*	0
	>20	*2*	6	2	*10*	60,000
Tailings dam / residue disposal ponds	0 -20		3	2	*10*	0
	21 - 100		4	2	*10*	0
	100 - 150		6	2	*10*	0
	>150	*15*	10	2	*10*	750,000
Heap leach pad	<10		3	2	*10*	0
	>10	*3*	5	2	*10*	75,000
Water containment/retention ponds (water not suitable for passive release)	<10		2	1	*10*	0
	10 - 20		3	2	*10*	0
	>20	*4*	4	2	*10*	80,000
Waste disposal areas			2	1	*10*	0
Other		*4*	1	2	*10*	20,000
Other		*4*	1	2	*10*	20,000
Other						0
					sub total	***$1,050,000***

Denotes sampling of bores adjacent to structures

2

SURFACE WATER MONITORING - ANALYTICAL

Analytical & consumables

Assumptions: ICPMS, fields & laboratory consumables @ $250/sample

Mine site features	Number of features	Sampling points	Sampling per year	Enter No. of years 1-10	Subtotal cost ($)
Water retaining structures with no discharge	*2*	1	1	*10*	5,000
Water retaining structures with possible discharge	*1*	1	2	*10*	5,000
Bioremediation structures	*1*	1	1	*10*	2,500

PLUS

Mine site features	Number of features	Sampling points	Sampling per year	Enter No. of years 0-10	Subtotal cost ($)
Perenial streams discharging from site	*3*	2	4	*10*	60,000
Ephemeral streams discharging from site	*12*	2	2	*10*	120,000

OR Please note: Fill out either the streams or the site operational complexity, size and climate section, but not both

Site operation complexity & size and climate	Default sampling sites	Sampling per year	Enter No. of years 0-10	Subtotal cost ($)
Arid zone site - small to medium	5	1		0
Arid zone site - large	10	2		0
Wet/dry tropics site - small size, simple issues	10	2		0
Wet/dry tropics site - small size, moderate -complex issues	10	4		0
Wet/dry tropics site - medium size, simple issues	15	2		0
Wet/dry tropics site - medium size, moderate -complex issues	15	4		0
Wet/dry topics site - large size, moderate -simple issues	25	4		0
Wet/dry topics site - large size, moderate -complex issues	30	4		0
			sub total	***$182,500***

3

FIELD SAMPLING & EXPENSES

Assumptions:

Road travel <200km = day trip , 2 people, no accommodation, fuel (300km return) & expenses

Road travel 200 - 500km = minimum of 1 nights accom , 1 day travel + 1 night for each additional sampling day, 2 people , fuel (av 800km return)

Road travel >500km = minimum of 2 nights accom, 2 days travel + 1 night for each additional sampling day, 2 people, fuel (av 1600km return)

Fuel = $1.20/L @ 6km/L Accommodation & meals = $130 per person /per night Personnel = $800 per person per day Air travel = $2000 per person return Expenses (e.g. vehicle/consumables etc

Travel and expenses	Enter No. of years 0-10	Distance from nearest centre eg Darwin	Quantity	Enter est. days each sampling trip	Subtotal cost ($)
Field trips - Road travel		<200km	4	*1*	0
	5	200 - 500km	4	*1*	76,400
		> 500km	4	*1*	0
Field trip - Air travel (Proof of availability & suitability required)			4	*1*	0
				sub total	***$76,400***

4

WATER QUALITY INTERPRETATION AND REPORTING

Item	Site size& water mgmt challenges	Quantity	Enter No. of yrs 0-10	Unit cost ($)	Subtotal cost ($)
Quaterly data collation & interpretation	small	3		2,500	0
	medium	3		5,000	0
	large	3	*10*	10,000	300,000
Annual data collation & interpretation	small	1		1,000	0
	medium	1		5,000	0
	large	1	*10*	20,000	200,000
Other reporting		*1*	*5*	5,000	25,000
				sub total	***$525,000***

Assumptions

Ripping
deep rip low level disturbance - 14G grader or equivalent with multishank ripper to 3m width. At $180/hr and at 3km/hr with 0.83 efficiency will cover 7500m2/hr = $240/ha
Deep rip medium level disturbance- Cat D6 with triple shank rippers ripping to a depth of 0.3m and 3m width covered per pass. At $220/hr and 2km/hr with 0.83 efficiency will cover 4980m2/hr = $441/ha
deep rip high level of disturbance and compaction - using a Cat D9 with multishank
ripper to a width of 2.64m. At $300/hr and 1.6km/hr with 0.83 efficiency will cover 3320m2/hr = $900/ha

tracks
Assume D9 used to rip to depth of 0.3m, which can do 1.36km/hr. Assume $300/hr. Requires 2 passes on track ~5m wide = $440/km.
Windrows - 14G grader will grade in windrows at 3km/hr (2nd gear) and require two passes each side of road = 1500m of road/hr @ $180/hr =$120/km
two passes with grader to rip track <4m wide at 3km/hr =$120/km

grading firebreaks with 14G equivalent grader @$180/hr. Blade width of 14', travelling at ~5km/hr. Two passes required = 24minutes/km=$72/km

drillpads - major reshaping
using a Komatsu PC650 excavator or similar at $320/hr, can move 300bcm/hr assume one pad per hour

haul roads
haulroads assumed to be an average of 12m wide with an additional buffer of 5m each side of the road which has been cleared or significantly disturbed. Surfaces are heavily compacted and constructed of imported fill.
Road fill which may be ARD producing is removed using an excavator ($320/hr) and 3x50t dump truck ($750/hr), watercart @ $140/hr, dozer@$250/hr. Excavator will produce 300bcm/hr = $4.86/bcm

Stockpile/WRD removal/pit infill
Assume load and haul to pit using excavator and 3 dump trucks. Excavator ($320/hr) and 3 trucks ($840/hr total) as above = $3.87/bcm
bund - assume excavator and 3 dump trucks, with minimal haul distance (no greater than 1km.)
As per road fill above using and excavator and 3 trucks = $3.87/bcm. If bund is 5m wide and 2m high = 5m3/m then bund ~$19/m to construct

fertiliser - current (09/01/09) Landmark price per tonne for NPK fertiliser = $1487.50
fertiliser applied at 500kg/ha (best practice) = $743.75/ha
If applied at only 100kg/ha = $148.75/ha
application dependent on growth medium

RC drillpads assume average 10mx10m, DDH pads 10mx20m

post closure cost for pest, fire and weed management comes from contrators estimate for Woodcutters site

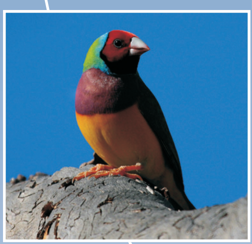
contractor costs for meals, accommodation, travel and supervision:
meals & accom @ $150/head/day
travel @$60/head/hr
supervision@$1000/day
so for 10.5hr day daily costs = $1845/hr/300bcm/hr of production = $6.15/bcm
This tool has assumed cost of $210-$320/man/day

Building Footprints From Vista Gold - January, 2012

Area	Drawing	Description	Length (m)	Width (m)	Area (m^2)
Site General Non Process	2131-A-0001	Administration Building	30.1	14.8	443.9
	2131-A-0002	Gatehouse Building	7	5.6	39.2
Sub Total					483.1
Process Plant	2131-A-0003	Process Plant Office and Ablutions	35.6	6.5	232.7
	2131-A-0004	Control Room	7	3	21
	2131-A-0005	Sample Prep and Laboratory	12	12	144
			20	8.4	168
			6.5	4.9	31.3
	2131-A-0008	Workshop and Warehouse	45.6	17.9	814.3
			24.4	5.3	130.4
			18.5	9.7	180
	2131-A-0009	Reagents Store	24	12	288
Sub Total					2,009.70
Mining Area	2131-A-0010	Mining Office	24	16.5	396
	2131-A-0014	Heavy Vehicle Workshop	112.2	36	4,039.20
Sub Total					4,435.20
TOTAL SITE BUILDING AREA					6,928.00

APPENDIX Z

EMP Framework



CLIENTS | PEOPLE | PERFORMANCE

Vista Gold Australia Pty Ltd

Mt Todd Gold Project

Environmental Management Plan Framework

June 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

1. Introduction

1.1 Overview

This document outlines the Environmental Management Plan (EMP) framework for the Vista Gold Australia Pty Ltd Mt Todd Gold Project (the Project), consisting of the re-establishment, operation and rehabilitation of the Mt Todd Gold Mine.

1.2 Purpose

The EMP Framework has been prepared as part of the Draft Environmental Impact Statement (EIS) for the Mt Todd Gold Project.

The EMP framework is intended to guide environmental management at the mine. It outlines an environmental management system including regular on-site environmental monitoring and annual review and reporting of environmental performance for the construction and operational phases of the Project. The EMP framework will need to be updated and finalised by Vista Gold and its Contractors to reflect final detailed design, construction and operation.

The objectives of the framework are to:

- provide Vista Gold with a clear framework for effective environmental management;
- define the statutory obligations that must be fulfilled;
- present a range of specific environmental management actions necessary to control, minimise or avoid impacts identified through the environmental assessment process;
- assign clear and appropriate responsibilities for the implementation of specific environmental undertakings;
- specify monitoring regimes to enable assessment of environmental performance;
- facilitate self-assessment to ensure that mitigation measures are implemented; and
- provide the community with evidence that the Project will be managed in an environmentally acceptable manner.

The EMP framework will be:

- reviewed and amended annually to maintain relevance to all aspects of the Project. Any updates to the framework will be included in the Mining Management Plan (MMP) annual review; and
- used by Vista Gold employees and its Contractors to assist them in performing their relevant roles and responsibilities.

1.3 Stakeholders

A list of stakeholders has been developed through background research in the local and regional area, and liaison with different individuals and organisations (Table 1).

Table 1 Key Stakeholders

Stakeholder Category	Representatives
Federal Government	
Federal Government Departments	◗ Sustainability, Environment, Water, Population and Communities (Department of)
Elected Representatives	◗ Member of Goyder ◗ Member of Katherine
Northern Territory Government	
Government Agencies	◗ Department of Mines and Energy ◗ Department of Housing, Local Government and Regional Services ◗ Department of Health ◗ Department of Lands Planning and the Environment and NT Environment Protection Agency ◗ Department of Business Employment ◗ Aboriginal Areas Protection Authority
Local Government	
Katherine Town Council	◗ Mayor, CEO, Aldermen, Key Council Officers
Roper-Gulf Shire Council	◗ Mayor, CEO, Aldermen, Key Council Officers
Victoria-Daly Shire	◗ Mayor, CEO, Aldermen, Key Council Officers
Local Communities	
Local Residents	◗ Katherine ◗ Pine Creek ◗ Indigenous communities (Werenbun, Rockhole, Binjari, Gorge Camp, Kalano, Eva Valley etc.)
Other Key Stakeholders	
Emergency and Health Services	◗ Police Service ◗ Ambulance and Emergency Services ◗ Fire and Rescue Service ◗ Katherine Hospital & Health Service ◗ Private Health Providers
Utility Service Providers	◗ Power and Water Corporation
Indigenous Groups and Traditional Owners	◗ Jawoyn Association ◗ Northern Land Council ◗ Nitmiluk National Park Board of Management

Stakeholder Category	Representatives
Community, Business and Industry Groups	◗ Katherine Chamber of Commerce ◗ Northern Territory Minerals Council ◗ Amateur Fisherman's Association of the Northern Territory ◗ Mt Todd Mine Site Rehabilitation Working Group ◗ Katherine Land Care Group
Environmental Groups	◗ Environment Centre Northern Territory
Media	
Print	◗ Katherine Times, Northern Territory News
TV / Radio	◗ ABC Radio, Katherine Community Radio

2. Draft EMP Framework

2.1 Purpose and Scope

The EMP will clearly describe the broad risk management strategies to be adopted by Vista Gold to manage the Mt Todd site during construction, operation and closure. The EMP will be based on the management principle of “plan, do, check and act”:

- Plan – and define the organisations policy commitments by setting objectives and processes needed to achieve the results in accordance with policy;
- Do – implement the plans;
- Check – monitor, measure and evaluate performance against relevant policy, legal requirements, objectives and plans; and
- Act – take actions to ensure continued improvement in environmental performance.

2.2 Objectives

The objectives of the EMP are to provide a practical working framework for environmental management of the Mt Todd Gold Mine that:

- set objectives and benchmark performance measures to address risk;
- outlines management of the process and activities to ensure that adverse environmental impacts are avoided or minimised during all phases of the Project;
- establishes monitoring protocols as a means of evaluating the success of the management practices and mitigation measures; and
- provides for review of management strategies at regular and appropriate intervals to determine success areas and areas requiring additional attention.

2.3 Targets

The targets of the EMP are as follows:

- avoid, minimise or control health and safety risk to site personnel, visitors and surrounding land users;
- avoid, minimise or control environmental incidents and hazards;
- no non-vexatious complaints from surrounding land users;
- no unauthorised clearance of vegetation;
- no harm to cultural heritage values of the site;
- zero non-conforming water discharges;
- no uncontrolled release or discharge of chemicals to the receiving environment; and
- zero native fauna deaths.

2.4 Legal and Other Requirements

The EMP will contain a register of related approvals, licences and approval conditions. This register is the primary source for Vista Gold managers and staff in relation to the relevant legal, regulatory and other associated requirements in relation to environmental risk and performance.

2.5 Structure and Responsibility

Vista Gold will maintain responsibility for the overall environmental management of the Project during the construction phase. Contractor selection will depend in part on proven environmental health and safety performance on projects of similar size and complexity. Contractual conditions will apply in terms of compliance with the EMP.

The construction contractor will be responsible for the preparation and implementation of the construction elements of the EMP. The contractor will identify responsibilities and the organisation required to implement the accountabilities of the construction phase of the EMP, including the principal contractor and all sub-contractors.

The contractor will also develop and implement a site-specific induction program for all construction workers. This program will include EHS hazards and aspects and their control measures. Construction workers will be trained and hold the appropriate certification to competently carry out the tasks that they will be undertaking.

In the event of a non-compliance with the EMP, the construction contractor must investigate, report and implement appropriate corrective actions in accordance with Vista Gold procedures.

Vista Gold's General Manager will have overall responsibility for ensuring that all environmental commitments are met during the operational phase of the mine. All employees will be responsible for day-to-day implementation of the requirements of the EMP. Supervisors will report on the implementation and performance of the EMP within their areas of responsibility.

In the event of a non-compliance with the EMP, it will be the responsibility of the Supervisors to undertake appropriate investigation, reporting and implementation of corrective actions in accordance with Vista Gold procedures.

The EMP will be progressively updated to include changes associated with the mine as they occur.

3. Environmental Management System

3.1 Training, Awareness and Competence

Effective implementation of the EMP requires all staff to receive appropriate training in order to have an awareness of their roles and responsibilities. All staff and contractors have a cooperative responsibility to minimise adverse environmental impacts and to understand the compliance requirements of the EMP and the environmental assessment / approval conditions.

The training program will outline processes for:

- identifying training needs;
- development of appropriate training programs; and
- maintaining training records.

Details of training requirements, content, dates and personnel involved shall be documented for the Project. Training will include, but not be limited to, Environmental Awareness Inductions, formal presentations, Toolbox meetings, Job Safety Environment Analysis (JSEA's) and Execution Plans.

3.2 Communication and Reporting

Internal communication and reporting mechanisms will be developed to facilitate:

- communication to employees and contractors regarding the EMP requirements, the identified environmental impacts, objectives and targets, and other relevant environmental issues;
- communications and liaison with stakeholders in relation to environmental policy and EMP; and
- reporting internally to management and staff on environmental performance.

3.3 Emergency Preparedness and Response

The definition of an emergency is a situation that poses a serious threat to life, health or the environment and requires immediate attention by site staff and possibly more resources than the Project personnel have available at the time of the incident.

In the event of an emergency, Project personnel and subcontractors are to follow the procedures outlined in the Project Emergency Preparedness and Response Plan. Immediately following an incident, emergency services are to be contacted if required, followed by the General Manager.

A Communication Plan for unexpected or emergency discharge of waste water has been developed as per the requirement of the Waste Discharge Licence (WDL).

A record of dangerous goods, chemicals and fuels stored and used on the site will be developed. Specific management and handling procedures will be developed for each storage facility.

In the event of an incident which has a direct or indirect environmental impact the following steps will be taken:

- make site safe and secure;
- isolate the source or cause of pollution or environmental damage, id possible; and
- follow incident management protocols in the Emergency Response Plan, Communication Plan, and EMP (whichever is appropriate).

3.3.1 Emergency Contact Register

The contact names and phone numbers of key Project personnel, other relevant authorities and off site emergency services phone numbers will be displayed on site. Emergency procedures and contact telephone numbers will be displayed in a prominent position.

3.3.2 Emergency Procedure

After a person causes, or becomes aware of an environmental incident, they should:

1 - Ensure the site is safe	First, consider personnel safety and *<u>if safe to do so</u>*, prevent any further environmental impact from occurring
2 - Notify	The General Manager and emergency services as required
3 - Follow Procedure	Follow the Vista Gold Emergency Response Procedure

Employees and contractors are required to report all environmental incidents. These include, but are not limited to:

- spills of hydrocarbons, chemicals any other potentially toxic substance greater than 25 litres;
- significant discharge of Acid Metalliferous Drainage (AMD); and
- injury to, or deaths of, threatened native fauna / flora.

Personnel are asked to report threatened species deaths and photograph the animal / plant to confirm species identification.

DME may make a written request for further details in relation to any of the incident matters if it is not satisfied with the report provided. The General Manager will provide further details to the DME within the time specified in the request.

3.4 Monitoring and Measurement

Environmental performance will be monitored and reported against performance indicators specified in this EMP and in the environmental approval conditions. The methodology for measuring, reviewing and reporting on environmental performance indicators to track progress towards environmental objectives and targets will be outlined in environmental aspect specific procedures.

Regular auditing and review of the EMP, combined with corrective and preventative action, will facilitate continual improvement on environmental performance.

3.5 Non-Conformance and Corrective and Preventative Action

To ensure continual improvement any non-conformance with the environmental approval conditions will be registered and investigated, followed by corrective and preventative actions to minimise the risk of re-occurrence. An EMP non-conformance is defined as a failure to:

- meet nominated environmental objectives and targets (within a two year period);
- comply with EA conditions, environmental legislation or other requirements; or
- comply with EMP procedures.

Once a non-conformance has been identified, corrective or preventative action is initiated. Any EMP improvement opportunities, identified as a result of emergencies or incidents, monitoring or measurement, unforseen environmental impacts, audit findings or other review, will be documented.

3.6 Review, Records and Audits

Environmental audits will be conducted prior to construction, during construction, prior to operations, and regularly during operations. Audit results will be fed back into the review process and contribute to continual improvement of environmental performance.

Where the audit identifies the need for corrective action, the EMP procedures and the EMP will be amended accordingly.

The EMP will be reviewed and updated on an as-needs basis depending on any non-conformance issue or incident. Review may also be initiated by a change in operating strategy or production process, or by any amended licence or approval and their associated conditions.

An internal audit of compliance with the EMP will be undertaken on a quarterly basis. The findings of this audit will be recorded and referred to when applying continuous improvement processes and subsequent changes to operational activities.

3.7 Environmental Reporting

Site and Management Personnel will be made aware of issues regarding the Project's environmental performance. A written report of non-conformance will be reported to the Health, Safety and Environment Manager and General Manager. Details provided will include the date, type and location of the non-conformities, how the non-conformities occurred and the corrective action employed.

The Health, Safety and Environment Manager and General Manager should monitor environmental performance based on reports received from the Environmental Team and other personnel. Additional strategies or training will be developed / implemented when environmental strategies do not attain the management objective. Records will be kept, along with a Non-Conformance Register.

Non-conformities (e.g. serious spills) or other incidents requiring reporting will be made to NT EPA / DME / appropriate agency within time limits specified in legislation.

Documentation of environmental management activities will be held by the Health, Safety and Environment Manager in the designated site office during the operational phase.

Reports to DME on environmental performance will be made as required by the MMP.

Following the audit procedure an inspection report will be forwarded to the DME.

All environmental management is subject to continual review and improvement as required.

3.8 Environmental Management and Mitigation Measures

The following section has been prepared in accordance with the draft EIS Guidelines identifying key risks. The measures contained below build on current caretaker responsibilities, and also adopt the mitigation measures recommended in different sections of the draft EIS.

The framework has been prepared to be a strategic guidance document for environmental management during the construction, operation and closure phases of the Project. Prior to each phase of the Project, specific sub-plans will be developed that recognise the need to tailor management and mitigation measures to specific activities.

A final EMP framework will be prepared at the conclusion of the assessment process, taking into account comments on the Draft EIS, the EIS Supplement, and incorporating Assessment Report recommendations.

3.8.1 Community

Objectives	◗ Maximise beneficial social and/or community effects from the Project
Target	◗ No complaints
Actions	**Community Values and Change** ◗ A community and stakeholder engagement plan will be developed. ◗ The Project will establish a community and stakeholder relations role and a community reference group that will advise the Proponent on community matters. ◗ The community reference group will include representatives of vulnerable groups. ◗ A complaints and feedback register will be established to track complaints and feedback and the response of the Proponent. ◗ The Proponent will continue to maintain, develop and operate the Mt Todd Project Website in order to inform the community **Local Industry Participation, Employment and Training** ◗ An Industry Participation Plan will be developed in accordance with the requirements of the Northern Territory Government, and with a preference to build business, industry and community capability within the Northern Territory. ◗ The Proponent will work with local training providers to develop local training programs that will provide opportunities for employment to unskilled people. **Housing and Accommodation** ◗ Further develop the preferred housing and accommodation strategy with key stakeholders prior to construction. **Workforce Management Strategy** ◗ Develop an overall workforce management strategy including workforce sources, management, health and wellbeing and appropriate behaviour prior to construction. ◗ The workforce management strategy will include a recruitment policy that allows for appropriate notice periods to be served for new employees. ◗ A purpose built construction camp will be built outside of existing communities. **Near Neighbour Program** ◗ Develop and implement a near neighbour program with adjacent and downstream landholders to maintain a regular system of contact with landholders to monitor any concerns or issues that might arise. **Indigenous Resources, Values and Aspirations** ◗ Continue to work with the Jawoyn Association under a partnership agreement. ◗ Establish clear mechanisms for ongoing consultation and communication with Indigenous groups potentially affected by the Project. ◗ Implement and monitor the Cultural Heritage Management Plan. **Community Health and Safety** ◗ Occupation health and safety policies will be developed for the construction and operational phases of the Project. ◗ First aid will be available at the mine site.

	◗ A site safety plan will be developed that includes preventative measures for a range of on and off-site incidents that might impact on community health and safety. ◗ An Emergency Response Plan will be developed that includes any emergency incidents that might involve members of the public. The Proponent will work closely with the Katherine Emergency Services in developing the plan.
Performance Indicators	◗ Community and Stakeholder relations role, Community Reference Group and Stakeholder Engagement plan established. ◗ Community feedback mechanism in place. ◗ Local employment and training plan in place. ◗ Number and type of employment opportunities available. ◗ Near neighbour program developed and implemented. ◗ Continued involvement with Jawoyn Traditional Owners as part of the Jawoyn Partnership Agreement. ◗ Emergency Response Plan prepared. ◗ Number of community initiatives funded. ◗ Value of community development fund. ◗ Comprehensive database maintained on complaints, employee health and social issues. ◗ Recurring issues analysed and addressed.
Monitoring	◗ Track the identified impacts and the delivery of their mitigation strategies ◗ Identify new impacts arising from changing conditions and develop responses ◗ Enable regular stakeholder contact and feedback ◗ Comprehensive database maintained on complaints, employee health and social issues
Reporting	To facilitate monitoring various reporting mechanisms will be put in place including: ◗ A newsletter will be regularly prepared and distributed to the community and stakeholders. In addition to reporting on activities at the mine and upcoming events it will also provide a snapshot of the key performance indicators as they relate to mine operations, provide up-to-date realistic information on forecasts for mining operations, workforce (including contractors) and any Project changes. ◗ Internal reporting within Vista Gold – Annual Corporate Reporting ◗ Internal reporting within Vista Gold – including monthly reporting on the grievance and dispute resolution mechanism. ◗ Community issues will be reported in the annual Mining Management Plan.
Responsibility	◗ Community and Stakeholder Relations role.
Contingency	◗ In the event of noncompliance, an investigation will be undertaken by the General Manager (or suitable delegate) into the cause of the incident, and the failure to comply.

Relevant standards and legislation	◗ International Principles for Social Impact Assessment, International Association for Impact Assessment (IAIA 2003). ◗ International Association for Public Participation, Core Values for Public Participation Processes (IAP2 2007). ◗ Territory: 2030 Strategic Plan 2009 and relevant government initiatives falling within this plan such as Housing the Territory and Working the Future. ◗ Local Government Regional Management Plan – Big Rivers Region (Northern Territory Government – NTG 2008). ◗ Katherine Town Council Municipal Plan 2011-2016. ◗ Roper Gulf Shire Plan 2011-2012. ◗ Victoria Daly Shire Plan 2011. ◗ ICMM Community Development Toolkit. ◗ Enduring Value - The Australian Minerals Industry Framework for Sustainable Development 2005.

3.8.2 Cultural Heritage

Objectives	◗ Minimise impacts on the region's cultural heritage values. ◗ All personnel aware of constraints to site access/movements/activity due to presence of archaeological, sacred and heritage sites.
Target	◗ Activities on site do not impact on archaeological, sacred or heritage sites or objects. ◗ Cultural heritage values understood and protected by Vista Gold.
Actions	The following management measures are recommended: **Ground disturbance and land clearing** ◗ Where possible impacts to archaeological sites of medium and high significance will be avoided. ◗ Areas of heritage and or archaeological significance will be clearly demarcated at a given buffer/standoff distance and 'no go' areas will be applied. ◗ Permit to Disturb applications and consultation for isolated artefacts and small sites if necessary to disturb and or relocate. ◗ Consultation with traditional owners as part of the management, permitting and possible salvage of sites using acceptable archaeological methodology. ◗ Implement a Cultural Heritage Management Plan for the sites remaining and sites to be removed with approval. ◗ Consultation with Heritage Branch and other relevant stakeholders in relation to heritage management decisions and location of heritage objects removed with approval under the Heritage Act. ◗ Maintain Authority Certificate(s) for the Project Area and the proposed works. ◗ Undertake inductions and provide all personnel with an understanding of the need to understand and comply with the conditions of the AAPA certificate. ◗ Locations of unrecorded archaeological sites that may be discovered during the course of works to be reported to the Heritage Brach of DLPE and the Jawoyn Association **Major open pit slope failure** ◗ Identify sacred sites within close proximity of open pit crest. ◗ Ensure adjacent slope design configuration and Factor of Safety and / or Probability of Failure are commensurate with nature of sensitive site (i.e. acceptable design tolerance given level of confidence in geotechnical model and analysis – within detailed design phase). ◗ Develop and implement a suitably robust and appropriate Ground Control Management Plan (including comprehensive slope design verification, protection measures and monitoring routines). ◗ Any sacred sites in proximity to the open pit crest will be the subject of a Ground Control Management Plan. The plan will be accompanied by verification of slope design, protection measures and monitoring routines that are commensurate with the sensitivity of the site.

Performance Indicators	◗ Implementation of, and compliance with, the Cultural Heritage Management Plan ◗ Record of disturbance, or infringement of cultural heritage.
Monitoring	◗ Vista Gold, in conjunction with Traditional Owners, to undertake heritage clearances before disturbance are undertaken in new areas. ◗ Known sacred sites, Aboriginal sites and archaeological sites will be monitored during mining activity to ensure none is being disturbed (other than those that have a Permit to Disturb). ◗ Review feedback from the Traditional Owners.
Reporting	The Construction Contractor, Community and Stakeholder Relations Officer and Health, Safety and Environment Manager will keep records of the locations of all known sites, report new sites to the General Manager, DME, Jawoyn Association, NLC and NT EPA as appropriate.
Responsibility	◗ Construction Contractor(s). ◗ Community Relations Officer. ◗ Health, Safety and Environment Manager.
Contingency	Accidental or other disturbance to sites will be recorded by Vista Gold and reported to the Jawoyn Association, AAPA or Heritage Branch of DLPE as appropriate.
Relevant standards and legislation	◗ *NT Aboriginal Sacred Sites Act 1989.* ◗ *Heritage Act 2011.*

3.8.3 Acid and Metalliferous Drainage (AMD)

Objectives	◗ The footprint, intensity and duration of AMD impacts associated with waste rock and tailings disposal is minimised. ◗ Prevent, mitigate or manage AMD so that it does not create off-site environmental impact during mine operations and legacy issues both on and off site after mine closure.
Target	◗ To manage AMD utilising the following hierarchical approach: – prevention; – minimisation; – control; and – treatment.
Actions	**Batman Pit (RP1)** ◗ Continue current treatment of RP1 waters to level deemed appropriate for discharge in accordance with the WDL. ◗ Ongoing monitoring of water quality prior to discharge. ◗ Collection and treatment of AMD pit waters resulting from incident rainfall. ◗ Develop and implement a Water Management Plan and Closure Plan with detailed monitoring and contingency plans. **Waste Rock Dump** ◗ A Waste Rock Management Plan (WRMP) will be developed that specifies how waste rock is to be handled to minimise the potential for AMD and maximise the beneficial use of NAF waste rock for closure. **Tailings Storage Facilities** ◗ Comply with approved tailings management plan that will specify how tailings will be handled to minimise AMD, closure, rapid dewatering and consolidation of tailings. **Existing and new diversion drains** ◗ Maintain existing diversion drains. ◗ Restrict excavation depths to oxidised material. ◗ Inspect material types and classify as necessary.
Performance Indicators	◗ Surface and groundwater quality will be measured against the dilution factor, and site specific trigger value at monitoring location SW4. ◗ No visible trace of AMD on site outside processing and managed areas.
Monitoring	◗ A surface water monitoring program is a component of the WDL. ◗ Surface water samples will be collected in accordance with the Australian Standard Surface Water Sampling Guidelines by trained environmental scientists.
Responsibility	◗ Construction Contractor(s). ◗ Health, Safety and Environment Manager/Scientist. ◗ Process Plant Manager.

Reporting	◗ Water quality monitoring reported as part of MMP requirements.
Contingency	Should noncompliance with the EMP occur, the following corrective actions will be undertaken as appropriate: ◗ contain and remediate, and, or dispose of contaminated material through the appropriate facility. ◗ review cover and seepage and collection systems.
Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Waste Management and Pollution Control Act 2009.* ◗ International Network for Acid Prevention (INAP) Gard Guide http://www.gardguide.com/index.php/Main_Page. ◗ Australian Government Department of Resources, Energy and Tourism Leading Practice Sustainable Development Program Handbooks – Managing Acid and Metalliferous Drainage: http://www.ret.gov.au/resources/Documents/LPSDP/LPSDP-AcidHandbook.pdf ◗ The Australian Standards used for monitoring include: – Australian/New Zealand Standard, Water Quality – Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples. AS/NZ 5667.1:1998. – Australian/New Zealand Standard, Water Quality – Sampling Part 4: Guidance on sampling from lakes, natural and man-made AS/NZ 5667.4, 1998. – Australian/New Zealand Standard, Water Quality – Sampling Part 6: Guidance on sampling from rivers and streams AS/NZ 5667.6, 1998.

3.8.4 Groundwater

Objectives	◗ Protect the quality of the existing groundwater resource. ◗ Protect the local groundwater regime from significant drawdown.
Target	◗ No deterioration in groundwater quality.
Actions	◗ Manage disposal of wastes in accordance with the Waste Management and Pollution Control Act and waste management hierarchy through the MMP. ◗ Chemical and hydrocarbon storage facilities bunded and managed in accordance with the MMP including inventory of chemicals onsite, material safety data sheets, spill kits and spill response procedures. ◗ Monitoring of bores that are potentially influenced by groundwater drawdown. ◗ Rehabilitation of monitoring bores proposed to be retained, to meet most current Minimum Construction Requirements for Water Bores in Australia; and closure of redundant bores and/or grouting of exposed exploration drill holes. **Tailings Storage Facilities** ◗ Tailings will be managed in accordance with the Tailings Management Plan. ◗ Reinstate existing TSF1 underdrainage system and associated infrastructure to reduce seepage to groundwater. ◗ TSF2 will be underlain by a system of under-drains, geo-membrane liner, toe drains and over-drains. There will be no hydraulic contact between TSF2 and groundwater. ◗ Monitoring of water levels and quality adjacent to TSFs to establish if there is a linkage with the surrounding environment. **Waste Rock Dump** ◗ Investigate alternative methods of neutralising PAF rock. ◗ AMD materials selectively handled to remove oxygen and water. ◗ WRD will be managed in accordance with the Waste Rock Management Plan. ◗ Groundwater Monitoring Program. ◗ Construction of 8m wide benches at 30m vertical intervals to collect stormwater drainage and convey to surface water collection ditch. ◗ A surface water collection ditch will be constructed down gradient of the WRD to collect flows for treatment prior to discharge. ◗ Potentially Acid Forming rock will be contained in a Non-Acid Forming shell reducing exposure to air and water during operations and post mining. ◗ Monitoring of water levels and quality adjacent to WRD to establish if there is a linkage with the WRD and the surrounding environment. ◗ Continued collection of seepage from WRD by RP1 ◗ Installation of Geosynthetic Clay Liner (GCL) progressively throughout closure of areas of the WRD. The GCL will reduce/eliminate infiltration and generation of AMD in the structure.

	Heap Leach Pad ◗ Processing or rehabilitation of heap leach materials. ◗ Ongoing maintenance of HLP post wet season. ◗ Cleaning of moat and repairs of liners as required. ◗ Pumping of stormwater from HLP to TSFs. ◗ Monitoring of water levels and quality adjacent to HLP to establish if there is a linkage with the surrounding environment.
Performance Indicators	◗ Adherence with the Water Quality Monitoring Plan. ◗ Groundwater level monitoring shows consistent baseline levels. ◗ Where an incident causing pollution occurs the NT EPA will be informed within 24hrs, as per the *Waste Management and Pollution Control Act 1998*.
Monitoring	Groundwater monitoring should include: ◗ Monitoring of groundwater levels (and usage) on neighbouring properties (Edith Falls and Werenbun) and the subsequent development of trigger values to monitor and manage any drawdown or contamination resulting from the proposed development. ◗ The geochemical monitoring of a limited set of key groundwater bores (including those deemed 'background' or 'boundary' bores continued on a quarterly basis. ◗ Water retention structures and dumps should have specific groundwater monitoring infrastructure installed. ◗ Site water balance data, including pumping, rainfall and stream flows, should be maintained in a suitable format. ◗ Water levels monitored in all groundwater monitoring bores on site.
Reporting	◗ The results groundwater monitoring program will be reported in the annual MMP.
Responsibility	◗ Contractor(s). ◗ Health, Safety and Environment Manager.
Contingency	◗ Should an incident or failure to comply with the EMP occur in relation to groundwater management, the following corrective actions will be considered where relevant: – identify the source of the seepage and effect remedial action to the seepage control system – recover contaminated groundwater for reuse in the processing plant.
Relevant standards and legislation	◗ *Waste Management and Pollution Control Act 2009.* ◗ *Water Act 1992.* ◗ Australian Drinking Water Guideline (NHMRC and NRMMC 2004). ◗ Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000).

3.8.5 Surface Water

Objectives	◗ Avoid, minimise or control adverse impact on surface water quality. ◗ Avoid, minimise or control erosion and the discharge of contaminated surface water generated from construction activities to the surrounding environment. ◗ Minimise the discharge of mine affected (or 'contaminated') surface water to the surrounding environment.
Target	◗ Compliance with the WDL. ◗ Water quality monitoring assessed in accordance with site-specific trigger levels. ◗ No erosion or deposition of sediment within surface water courses beyond natural fluctuations. ◗ Year-round collection, containment and treatment of all AMD prior to release. ◗ Ensure treated AMD complies with the WDL water quality standards. ◗ Minimise the volume and water content of sludge produced from water treatment. Provide adequate long-term storage and containment of sludge. Promote rapid sludge consolidation.
Actions	**Stormwater Management** ◗ Infrastructure includes erosion protection and sediment control structures. ◗ Segregate "clean" from "dirty" stormwater runoff and collect and treat "dirty" water runoff within the mine site. ◗ Stormwater drainage will be designed for a 100 year ARI design event and all drainage will be regularly checked and maintained. ◗ Minimise stormwater runoff into the pit by construction of runoff barriers (e.g. engineered mounds / levees) around the pit. ◗ Stormwater runoff from material storage dumps will be minimised by: – construct dumps in a manner that dissipates runoff through seepage and evaporation – construct the outer batter slopes of dumps with inert overburden material – construct perimeter drains that collect runoff from the outer batter slopes and perimeter areas – construct drainage lines that convey runoff from dump perimeter drains to water retention ponds **Surface water contamination and flooding** ◗ Water retention ponds will be sized to capture an ARI event appropriate to their hazard category, plus an appropriate freeboard allowance for sedimentation. ◗ The ponds will be designed to discharge to the natural environment in periods of extreme rainfall to protect the integrity of the structure. ◗ A Water Management Plan will be developed, implemented and regularly reviewed. ◗ Water retention ponds will be managed to maximise their available storage in the wet season, including discharge in accordance with the WDL.

	◗ Additional pumping capacity will be installed to accommodate severe rainfall. ◗ If all water storages are at capacity, in an emergency, excess water will be transferred to the TSFs for temporary storage. ◗ Surface Monitoring will be undertaken to validate Water Balance Model. ◗ Design and construction of infrastructure in accordance with Australian National Committee on Large Dams (ANCOLD) requirements ◗ Capacity of WTP and equalisation pond will be sufficient to prevent overflows in normal operating conditions. ◗ Mine pit water will evaporate or be pumped to the water treatment plant. ◗ During operations, water will be treated for general on-site use and to meet discharge criteria for release to the Edith River during the wet season. ◗ During the pre-production phase, construct a lined equalisation pond for mixing of AMD from various on-site sources prior to treatment and to temporarily store AMD in case of system upset. A lined sludge disposal cell will also be constructed for the permanent disposal of water treatment sludge. **Tailings management** ◗ Comply with the Tailings Management Plan. ◗ Design and construct infrastructure in accordance with (ANCOLD) requirements. **HazMat** ◗ All chemicals, fuels and oils will be stored and contained according to Australian Standards and Regulations for the protection of surface water from impacts of spills. ◗ Surface water quality monitoring.
Performance Indicators	◗ Adherence with: – WDL – surface water site specific trigger values.
Monitoring	◗ Monthly surface water monitoring program implemented in accordance with WDL. ◗ Surface water quality monitoring will be conducted in accordance with the Australian Standard Surface Water Sampling Guidelines by trained environmental scientists. ◗ The data from the monitoring programs will be reviewed on a monthly basis and the requirements for modifying the sampling programs will be assessed. ◗ The use of trigger values will determine the quality of water observed at the monitoring sites. ◗ Regular engineering safety/ audit assessments will be undertaken on the integrity of water storages where there is potential for spill to receiving waters in the event of a storage breach.
Reporting	◗ surface water monitoring reports submitted to the NT EPA as per WDL requirements. ◗ Annual site Mining Management Plan reporting to DME.

Responsibility	◗ Contractor(s). ◗ Health Safety and Environment Officer. ◗ Process Plant Manager.
Contingency	◗ Should an incident or failure to comply occur in relation to surface water, Section 14 of the *Waste Management and Pollution Control Act* 2009 stipulates a process for notifying the NT EPA about incidents causing, or threatening to cause pollution. ◗ Contingency management measures include: – repair water management controls (e.g. ponds, pipes or drains) – contain and remediate or dispose using an appropriate carrier and facility – modify the operating strategies for the surface water management system – clean out the sedimentation ponds – modify channel cross sections – implement additional revegetation – provide other rectification measures as appropriate ◗ Increase/change monitoring schedule and review actions, if it is found there is evidence of contamination or impact to downstream users.
Relevant standards and legislation	◗ *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. ◗ *National Environment Protection Measures (Implementation) Act 1998*. ◗ *Mining Management Act 2001*. ◗ *Heritage Act 2011*. ◗ *Water Act 1992*. ◗ *Waste Management and Pollution Control Act 2009*. ◗ *Territory Parks and Wildlife Conservation Act 2006*. ◗ *Dangerous Goods Act 1994*. ◗ Australian and New Zealand guidelines for Fresh and Marine Water Quality ANZECC & ARMCANZ (2000). ◗ Guidelines to Prevent Mosquito Breeding, Department of Health and Community Services 2005. ◗ Australian/New Zealand Standard, Water Quality – Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples. AS/NZ 5667.1:1998. ◗ Australian/New Zealand Standard, Water Quality – Sampling Part 4: Guidance on sampling from lakes, natural and man-made AS/NZ 5667.4, 1998. ◗ Australian/New Zealand Standard, Water Quality – Sampling Part 6: Guidance on sampling from rivers and streams AS/NZ 5667.6, 1998.

3.8.6 Air Quality

Objectives	◗ Avoid, minimise or control impacts associated with dust and other emissions resulting from, and during, mine construction and operation.
Target	◗ Mitigation measures will be progressively implemented as required to meet air quality objectives at the lease boundary. ◗ Management of emissions to air, including dust causing or likely to cause a significant impact or nuisance on Werenbun Community, Yinberrie Hills (site of conservation significance) or beyond the lease boundaries.
Actions	**Dust** ◗ Standard dust mitigation will include chemical treatment of roads to reduce dust generation, use of water sprays, wetting of ore prior to crushing, hooded crushers and enclosed HPGR (High Pressure Grinding Rolls). ◗ Sprays on primary crusher dump pocket. ◗ Dust suppression sprays on conveyor. ◗ Monitoring of dust levels during preproduction, construction and operations to validate the model results. ◗ Reconsider likely risks with validated model results. ◗ Implement additional management controls if exceedance is likely. ◗ Retention of vegetation around the boundary as a buffer, and to limit potential dust sources. ◗ Covering areas of disturbed soil, stockpiles and temporary spoil containment with mulch or other material as best practicable. ◗ Whenever possible, avoid conducting dust generating activities during high wind speed conditions. **Other** The following mitigation measures should be progressively implemented as required, to meet required air quality objectives: ◗ Operation and maintenance of power station in accordance with the design and emission criteria. ◗ All construction and maintenance equipment / vehicles to be operated and maintained to manufacturers' specifications in order to minimise exhaust emission. ◗ Defined haul routes to be used wherever it is necessary for vehicles to traverse unsealed surfaces or unformed roads. ◗ All gravel roads to and from the Project can be upgraded from gravel to a spray sealed surface of "all weather" road designation. ◗ Vehicular speeds limited to 25km/h on areas of unsealed surfaces. ◗ Burning of waste and materials is not allowed on site at any time.
Performance Indicators	◗ Comply with NEPM (Air) air quality objectives and goals, and the Mining PEM criteria at the closest sensitive receptor location of Werenbun

Monitoring	◗ A Dust Management Plan will be developed including monitoring to indicate how well the system is performing and whether additional mitigation is required. ◗ Consideration will be given to the PEM for Mining (EPA Victoria 2007) which provides guidance on operational control requirements and monitoring for reactive management purposes as there are no specific Territory guidelines. ◗ Monitoring of potential dust impacts on fauna as a component of the proposed monitoring program.
Reporting	◗ Results of dust monitoring will be stored in a monitoring database and reviewed. ◗ Dust levels exceeding monthly trigger levels, inclusive of adjustment for background, will implement a review of the management plan and additional dust control measures used to reduce dust levels to the guideline value. ◗ Vista Gold's air quality performance will continue to be reported in the annual MMP.
Responsibility	◗ Construction Contractor(s). ◗ Health, Safety and Environment Manager.
Contingency	◗ Should an incident or failure to comply with the EMP occur, Vista Gold will take the necessary actions to identify the causes of the non-conformance and implement all actions necessary to achieve compliance ◗ Reactive management to exceedances in emissions and dust deposition.
Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Fire and Emergency Act 2012.* ◗ *Waste Management and Pollution Control Act 2009.* ◗ *Work Health and Safety Act 2011.* ◗ AS 2724.3 Ambient air particulate matter – Determination of total suspended particulates (TSP) – High volume sampler gravimetric method. ◗ AS 3580 Methods of sampling and analysis of ambient air. ◗ National Environment Protection Measures (Implementation) Act 1998, Section 14 (1) NEPM. ◗ PEM for Mining (EPA Victoria, 2007).

3.8.7 Greenhouse Gases, Sustainability and Climate Change

Objectives and targets	◗ Reduce or minimise greenhouse gas emissions to as low as is practicable. ◗ Promote energy efficiency and management. ◗ Project facilities and features designed with consideration for extreme weather events and climate change projections.
Actions	**Fuel** ◗ Implement a fuel management strategy. ◗ Opportunities for the use of biodiesel on the Project should be further examined. **Energy Efficiency and Management** There are a number of legislative requirements for measuring, monitoring and reporting GHG emissions and energy consumption that are applicable to the Project: ◗ Commit to energy efficiency within the final site EMP. ◗ Integrate appropriate management into all activities and processes. ◗ Monitor greenhouse gas emissions and report Scope 1 and Scope 2 emissions as part of NGERS. ◗ Seek continuous improvement in compliance and emissions reduction throughout the Project life through assessment and review processes including legislative reporting. ◗ Consider voluntary offsets for additional GHG emissions when assessing the Project's liability under the carbon pricing mechanism. **Climate change** ◗ Consideration of appropriate temperature ranges in selection of plant and equipment. ◗ Undertake adequate preventative maintenance of plant, pumps and generators etc. as part of standard procedures. ◗ Monitor plant and equipment on days of extreme weather conditions. ◗ Appropriate design of structures and material selections. ◗ Consider appropriate temperature suitability of stored chemicals and explosives. ◗ Site drainage will be sufficient to manage potential extremes in rainfall events. ◗ Appropriate bunding of watercourse redirection and overflow collection areas. ◗ For recycled plant process water, design will consider both dry and wet periods. ◗ Ponds sized appropriately, including overflow capacity. ◗ Open pit slopes walled and designed to withstand appropriate flood volumes.

	Sustainability Implement a system to effectively monitor measure and report on environmental management. This may include: – Key Result Areas; – Key Performance Indicators; – Environmental Management Systems. ◗ Educate Vista Gold personnel, Contractors and other individuals on-site to make them aware of EMS procedures and work within the system. ◗ Where practicable incorporate sustainability criteria and requirements into tender documents such as material specifications (i.e. establish preferential priority to products which are locally sourced/contain recycled materials/are low in volatile organic compounds/etc.). ◗ Communicate procedures to ensure Contractors are aware of any requirements that have been incorporated into tender documents. ◗ Review key contractors based on past performance and/or audit during contract delivery. ◗ Identify appropriate and achievable sustainability goals for the Project and reflect outcomes of subsequent monitoring and reporting annually. ◗ Consider whole of life costing in the design. ◗ Consider resilience of equipment to reduce long term costs. ◗ Undertake mine planning to achieve efficient recovery, processing and resource use. ◗ Apply risk management systems to provide early identification and corrective action to avoid Project/mine failure. ◗ Create a culture of risk awareness and risk management through site construction and operational activities. **Extreme weather events** ◗ Appropriate bunding of watercourse redirection and overflow collection areas should be provided as appropriate / necessary. ◗ Ensure site drainage is sufficient to manage potential extremes in rainfall events.
Performance Indicators	◗ Fuel management strategy recording fuel use and efficiency. ◗ Greenhouse gas emission levels. ◗ Project performance during extreme weather events.
Monitoring	◗ Undertake regular energy efficiency review to identify opportunities for improving processes and reducing energy use. ◗ Review design criteria and functionality of operational components sensitive to climatic changes. ◗ Record and analyse fuel and energy consumption and cost.

Reporting	◗ Estimate and report annual greenhouse gas emissions to relevant regulatory authorities, as required under *National Greenhouse and Energy Reporting Act 2007*, the *Clean Energy Act 2011* and the *Energy Efficiency Opportunities Act 2006*. ◗ The Projects fuel and energy use, and ability to function during extreme weather events will be reported in the annual environmental performance report.
Responsibility	◗ Construction contractor(s). ◗ Health, Safety and Environment Manager.
Contingency	Should an incident or failure to comply occur, Vista Gold will: ◗ Take the necessary actions to identify the causes of the non-conformance. ◗ Implement all actions necessary to achieve compliance.
Relevant standards and legislation	◗ *National Greenhouse and Energy Reporting Act 2007.* ◗ *Clean Energy Act 2011.* ◗ *Energy Efficiency Opportunities Act 2006.* ◗ Environmental Protection (National Pollution Inventory) Objective 2004. ◗ ICMM Sustainable Development Framework. ◗ Enduring Value - The Australian Minerals Industry Framework for Sustainable Development 2005.

3.8.8 Flora, Vegetation and Terrestrial and Aquatic Fauna

Objectives	◗ Avoid, minimise or control potential for significant impact on native flora and fauna and the conservation significance of the Yinberrie Hills SOCS. ◗ Avoid, minimise or control the impact of construction activities on biodiversity adjacent to construction areas (including prevention of weeds).
Target	◗ Implement actions to avoid or manage adverse impacts on biodiversity. ◗ No disturbance of native flora and fauna outside of designated construction activity areas.
Actions	**Land Clearing** ◗ Adhere to buffer widths recommended by the NT Land Clearing Guidelines where possible, with regard to riparian vegetation in drainage lines. If not possible install structures that would capture sediment downstream of development. ◗ Stage clearing of vegetation to minimise areas of bare ground and clear land only as required and in accordance with Erosion and Sediment Control Plan (ESCP). ◗ Avoid land clearing for construction during the wet season (Dec-May). ◗ Develop and implement Vegetation Clearing Plans which include areas not to be cleared (no-go areas) and make all workers aware of them through EMPs. ◗ Clearly mark limits of clearing. ◗ Project personnel and contractors will be educated to understand the vegetation clearing plans as part of general environmental inductions for the workforce. ◗ Clearing will be monitored to ensure compliance with areas marked for clearing; no intrusion of any kind will be made on areas outside the clearing zone. ◗ Areas of potential habitat for threatened species will be fenced off and clearly marked as 'no-go' areas. ◗ Where clearing is proposed for habitat of the threatened *Ultricularia singeriana* or *Fimbrostylus fimrostyoloides*, a targeted survey will be conducted prior to clearing. ◗ The Gouldian finch habitat, *E. tintinnans* woodlands adjacent to the pit, will only be cleared during the non-breeding season i.e. the wet season. ◗ Standard noise mitigation will be applied to minimise noise levels during clearing. **Dust** ◗ Standard dust mitigation will include chemical treatment of roads to reduce dust generation, use of water sprays, wetting of ore prior to crushing, hooded crushers, and enclosed HPGR (High Pressure Grinding Rolls). ◗ Additional mitigation measures are planned should dust levels prove excessive. ◗ Monitoring of the Gouldian finch breeding population will continue and will also assist with inferring impacts on the crested shrike-tit and partridge pigeon populations. ◗ Dust levels will be monitored. ◗ Artificial nest boxes will be established throughout the area of Gouldian finch habitat potentially subject to >50 µg/m^3 levels of dust as part of the monitoring program.

Fire

- The existing system of early dry season controlled burns will be maintained to support the Gouldian finch and other significant species. Subsequent fires late in the dry season (following early dry season burns) should be avoided. Expansion of fire management to the entire Yinberrie Hills site of conservation significance is recommended.

Feral Animals

- Good housekeeping and waste management onsite should be enforced to prevent introduction, or limit potential for colonisation of exotic species (e.g. Black rats)

Artificial Light

- Artificial light will be mitigated in accordance with an EMP and include:
  - limiting artificial light to areas actively required at any given time, and turning off lights that are not required
  - ensuring that artificial lighting does not point vertically upwards or laterally i.e. should point towards the ground
  - use of lower rather than higher lighting installations
  - avoiding the flood of light into natural habitats
  - use of lower wavelengths of light wherever possible i.e. red/yellow lights
  - use of light intensities that are as low as possible
  - avoiding painting large structures bright colours.

AMD Contamination of Aquatic Environments

- Proactive management of water levels to ensure adequate storage capacity.
- Increase the rate of treatment and discharge if uncontrolled release likely.
- Ongoing monitoring and evaluation of water quality, macroinvertebrate and fish community structure.
- Targeting sampling of refugia pools during the dry season to investigate the potential of groundwater seepage to impact aquatic fauna
- Effective implementation of site Water Management Plan.
- Compliance with the WDL.
- Effective implementation of site Water Management Plan.
- Tailings dam design to ANCOLD guidelines.
- Surface Water Monitoring program.
- Compliance with MMP conditions.

Diversion Channel Design

- A revegetation plan will be developed prior to creek diversion to suit the physical characteristics and requisite environmental values of the waterway.
- Incorporate appropriate materials into the design to achieve the requirements for habitat creation.
- Post-construction monitoring to assess creek bank remediation measures.

- A macroinvertebrate monitoring program will be developed that takes into account the location of potential sources of impact, rainfall during the wet season and the necessary level of statistical power to detect change in macroinvertebrate communities.
- Modelling at normal flow conditions will be undertaken to assess the hydraulic impacts of diversion channels on fish passage.
- Fish passage will be considered in the design of diversion channels to provide sufficient depth, velocity and resting habitat during regular flow events.

Diversion Channel - Sediment and Erosion Control

- A clearly definable site boundary will be delineated (where practicable), with construction and vegetation clearance not occurring outside of this area. Site entry and exit points will be clearly defined.
- Works will be scheduled so that construction coincides with periods of low flow and low rainfall.
- Implement spill and sediment control measures (such as silt curtains within the river channel) to minimise the potential for sediments to deposit on downstream foraging areas.
- Stabilise banks, including appropriate native plantings, to consolidate banks post-construction and restore habitat to current, or improved, condition.
- Avoid stockpiling of soil along existing drainage lines, keep vehicles to tracks and divert storm water away from disturbed areas to minimise soil loss.
- Minimise the area of exposed ground.
- Conduct excavation in stages to minimise ground exposed to erosion.
- Existing crossings should be used to move equipment across the waterway. If there is no crossing, machinery should be carefully 'walked' across the waterway.
- If frequent crossings are required, a pad of clean rock will be laid at a shallow point of the waterway to make a temporary crossing. Temporary crossings will be entirely removed when works have finished.
- Any diversion will be constructed using clean non-erodible material.
- Develop contingency measures to prevent flooding of the worksite by a rapid rise in the creek.
- Long-term measures will be used to control erosion at the works site including slope stabilisation, revegetation, soil coverings, rip-rap and armouring, check dams, sediment traps, brush barriers and vegetation filters.

Diversion Channel - Pollution Control

- Implement spill control measures.
- Petroleum products and other hazardous substances will be kept out of the waterway.
- Refuelling, top-ups and oil checks will be done well away from the waterway.
- Non-toxic hydraulic fluids, such as vegetable-based fluids will be used if possible.

	◗ All equipment will be inspected and repaired regularly to prevent oil and other fluids leaking. ◗ If equipment is to be immersed in the waterway, it will be cleaned beforehand to remove any external grease, oil and other fluids. ◗ Dirt and mud will be removed from all equipment before entering the works site and waterway to avoid transferring weeds and disease. ◗ Wash-down water will not be allowed to enter waterways. ◗ Any cast-in-place concrete will be isolated from the waterway for at least 48h to allow pH to neutralise. ◗ Paints will not be allowed to enter the waterway when constructing, repairing and maintaining in-stream structures. ◗ If using wood treated with preservatives, the chemicals will be given enough time to fix before immersing the wood in the water.
Performance Indicators	◗ Clearing has only occurred on approved areas and in accordance with the EMP and approved Project footprint/disturbance areas. ◗ Minimal disturbance to native flora, vegetation and terrestrial and aquatic fauna. ◗ Results of flora and fauna monitoring programs. ◗ Native flora and fauna recolonising the mine site following decommission works.
Monitoring	**Dust** ◗ Monitoring will focus on dealing with uncertainties surrounding the highest recorded risk to the Yinberire Hills fauna. Monitoring program would include: – the levels of near ground dust concentration and dust deposition in the breeding habitat adjacent to the Mt Todd mine before and during mine operation – the effects of dust levels on intensity of Gouldian finch nesting and nesting success. ◗ Monitoring of nesting frequency and success will artificial nest boxes throughout the area potentially subject to >50ug/m^3 of dust. ◗ Continuation and expansion of the long term monitoring of Gouldian finch conducted by the NT Government to determine the presence and size of populations adjacent to the Yinberrie Hills and/or Mt Todd to Pine Creek region. **Aquatic Fauna Monitoring** ◗ A macroinvertebrate monitoring plan for future assessment of surface water mine impacts on the biological communities of the Edith River is required under the WDL. ◗ Sampling should focus on targeting refugia pools during the dry season to investigate to potential of groundwater seepage impacting the aquatic fauna. Sites should be located upstream and downstream of known discharge locations. **Other** ◗ Conduct ongoing weed monitoring during the construction and operation of the mine, especially in areas disturbed by ongoing construction activities. ◗ Use photo monitoring points to help determine success/failure of rehabilitation.

Reporting	◗ Reporting of incidents in accordance with relevant legislation (e.g. Section 29 of Mining Management Act) ◗ Internally report any native fauna kills (including fish and birds). ◗ Internally report any evidence of plant stress as a result of construction activities. ◗ Internally report any occurrence of additional, excessive or unapproved vegetation clearing. ◗ Internal reports to be collated and information included in the updated MMP. ◗ Record any occurrence of listed weed species in the MMP. ◗ Record conditions of inspections / monitoring / occurrences for reporting to the Health, Safety and Environment Manager. ◗ Any non-compliance will be recorded, and reported to the Health, Safety and Environment Manager. ◗ Reporting on the results of monitoring will be undertaken in accordance with the requirements of the DME. ◗ All injuries and deaths of native animals are to be reported using the identified internal reporting system.
Responsibility	◗ Construction contractor(s). ◗ Health, Safety and Environment Manager.
Contingency	◗ In the event of a failure to comply with the EMP, investigations will be undertaken and the appropriate actions will be carried out.
Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Endangered Species Protection Act 1992.* ◗ *Environment Protection and Biodiversity Conservation Act 1999.* ◗ *Fisheries Act 1988.* ◗ *Weeds Management Act 2001.* ◗ *Plant Diseases Control Act 2000.* ◗ *Territory Parks and Wildlife Conservation Act 2006.* ◗ *Planning Act 2009.* ◗ NRETAS Land Clearing Guidelines 2010.

3.8.9 Invasive Species Management

Objectives	◗ Avoid, minimise or control the introduction of listed weeds and feral animals or spread of existing species across the mineral leases.
Target	◗ Construction and operation does not increase the spread of existing weed and feral species across the mineral leases ◗ Construction and operation does not cause the introduction of new weed and feral species to the mineral leases.
Actions	**Weeds** Preparation of a Weed Management Plan to include: ◗ Control measures to eradicate existing infestations of listed weeds. ◗ Protocols for the movement of people and machinery around the mine site and to and from the mine site, including wash down procedures. ◗ Management of soil stockpiles to prevent sediment and/or weed transfer. ◗ Installation of erosion and sediment control devices. ◗ Protocols for sourcing soil and other earthen materials from offsite (where required). ◗ Surveillance of the greater mine area for newly established infestations. **Exotic Fauna** ◗ Vehicles and equipment inspection procedures and wash down. ◗ Standard mitigation, good housekeeping and waste management to limit potential for colonisation by black rats (*Rattus rattus).*
Performance Indicators	◗ Impacts associated with weeds and feral animals are minimised on the mineral leases.
Monitoring	◗ Weed Management Plan will include inspections of mine site and the broader mineral lease and recording and control of weed infestations that appear to be associated with mining activities e.g. weeds not previously seen/recorded from the area/region. ◗ Exotic fauna and weeds will be regularly monitored, and any incursion eradicated.
Reporting	◗ Weeds or feral animal reported to the Health, Safety and Environment Manager.
Responsibility	◗ Construction contractor(s). ◗ Health, Safety and Environment Manager.
Contingency	◗ Failure to comply with the EMP will be reported, followed by an investigation, and the appropriate action undertaken.
Relevant standards and legislation	◗ *Territory Parks and Wildlife Conservation Act 2006.* ◗ *Weeds Management Act 2001.* ◗ ICMM: Good Practice Guidance for Mining and Biodiversity. ◗ Enduring Value - The Australian Minerals Industry Framework for Sustainable Development 2005.

3.8.10 Biting Insects Management

Objectives and Targets	◗ Avoid, minimise or control increase in nuisance levels of mosquitoes. ◗ Avoid, minimise or control the potential for disease transmission by biting insects. ◗ Avoid, minimise or control possible breeding sites of biting insects in the leases.
Actions	◗ Storm water drainage designed and managed to avoid ponding and maximise sheeting. ◗ Containers (drums, tyres etc) to be appropriately disposed of, stored under cover. ◗ Rainwater tanks appropriately screened at the inlet and outlet. ◗ Construction to avoid establishment of areas of temporary water. ◗ Monitoring for mosquito presence. ◗ Larvacides used if breeding detected. ◗ Personnel to wear long sleeved shirts, long trousers and mosquito repellent. ◗ The Project will comply with “Guidelines for preventing mosquito breeding sites associated with mining sites” (Medical Entomology Centre for Disease Control 2005). ◗ Drainage of grassy waterways will be maintained or improved.
Performance Indicators	◗ Nuisance level onsite attributed to biting insect. ◗ Biting insect disease transmission.
Monitoring	◗ Regularly inspect buildings and work areas to repair damage to insect screens. ◗ Have appropriately trained people survey the site for potential mosquito breeding sites within 5 days of rain occurring twice in the wet season, and as appropriate during the dry season.
Reporting	◗ The Health, Safety and Environment Manager will record results of inspection for breeding mosquitoes and make recommendations on use of larvacides. ◗ Occurrences of biting insect transmitted disease are to be reported to the Health, Safety and Environment Manager and Department of Health, Centre for Disease Control.
Responsibility	◗ Health, Safety and Environment Manager.
Contingency	Should failure to comply with the EMP occur, the following actions will be taken: ◗ An investigation will be undertaken into why directives are not being carried out. ◗ Employees will be informed on desired practices. ◗ Consultation with authorities (Department of Health, Centre for Disease Control) may occur.
Relevant standards and legislation	◗ Guidelines for preventing mosquito breeding sites associated with mining sites in the NT, (Department of Health and Families, Northern Territory Government 2005). ◗ Personal protection from mosquitoes & biting midges in the NT (Department of Health and Families, Northern Territory Government 2010).

3.8.11 Erosion and Sedimentation

Objectives	◗ Avoid, minimise or control extent of soil disturbance that leads to erosion and sedimentation. ◗ Reduce potential for erosion and sedimentation impacts on drainage lines and water courses
Target	◗ Rehabilitation works will result in a stable vegetated landscape and stable drainage channels with minimal impact on the surrounding environment.
Actions	◗ Prepare an Erosion and Sediment Control Plan to minimise soil erosion and the discharge of sediment to land and waterways. **Prior to Construction** ◗ Identify existing and proposed site drainage patterns. ◗ Identify the location of permanent and temporary sediment holding ponds to prevent debris escaping into the natural drainage systems and contain sediment to the designated construction areas. **During construction** ◗ Minimise the disturbance footprint and undertake progressive rehabilitation. ◗ Avoid clearing of new areas during the wet season, where practicable. ◗ Keep vehicles to well-defined tracks and roads. ◗ Excavate and rehabilitate progressively, where practicable. ◗ Minimise the area of exposed ground by utilising appropriate construction measures, to minimise the amount of ground subject to erosion problems. ◗ Avoid the stockpiling soils near existing and proposed drainage lines. ◗ Provide optimal surface conditions to promote revegetation. ◗ Revegetate final surfaces with fast establishing ground cover. ◗ Ensure compliance with relevant guidelines and apply appropriate techniques to minimise impacts on areas especially sensitive to erosion. ◗ Implement measures to mitigate and manage erosion resulting from changes in drainage patterns and localised concentrations of stormwater flow. ◗ Suspend construction work during heavy rain. **During operation** ◗ During mining operations, quantification of soil resources available for rehabilitation works, stripping and re-application schedules and stockpiling inventories would be included in a Sediment and Erosion Control Plan. ◗ Where practicable, recovered topsoil and subsoil would be spread directly onto mine waste rock emplacements that have been prepared for rehabilitation. ◗ Where direct spreading is not practicable, the material would be stockpiled. Soil stockpiles would be managed to improve long term viability of the soil resource through implementation of the following management practices: – soil stockpiles to be located outside of active mining areas – stockpiles to be constructed with a rough surface condition to reduce erosion

	hazard, improve drainage and promote revegetation – cover stockpiles with weighted plastic or tarpaulins, when not being actively used, to minimise the mobilisation of sediments during storm events – stockpiles which are inactive for extended periods will be fertilised and seeded, to maintain soil structure, organic matter and microbial activity – soil stockpiles to be deep-ripped to establish aerobic conditions, prior to soil use in rehabilitation. **Post Construction** ◗ Implement a soil stabilisation and revegetation program. ◗ Maintain sediment control measures (including clearing where necessary) until the site is completely stabilised (at least 4 weeks).
Performance Indicators	◗ Levels of erosion following high rainfall. ◗ Evidence of sedimentation in, and surrounding watercourses.
Monitoring	◗ Based on the Erosion and Sediment Control Plan, develop and implement a monitoring system, to review the effectiveness of erosion mitigation measures during construction, operation and decommission.
Reporting	◗ The construction contractor will report monthly to Vista Gold's General Manager on the following: – compliance with the approved erosion and sediment control plan – incidents of erosion – incidents of any discharge of contaminated runoff – results of weekly inspections – results of any corrective actions. ◗ The results of Vista Gold's monitoring and rehabilitation program will be reported in the annual MMP on the sites environmental performance.
Responsibility	◗ Construction contractor(s). ◗ Health, Safety and Environment Manager.
Contingency	◗ Should failure to comply with the EMP occur, an investigation will be undertaken by the Health, Safety and Environment Manager into the cause of the incident and the appropriate actions will be taken.
Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Water Act 1992.* ◗ *Waste Management and Pollution Control Act 2009.* ◗ *Soil Conservation and Land Utilisation Act 2001.* ◗ NRETAS Erosion and Sediment Control Plan Guidelines 2006.

3.8.12 Noise and Vibration

Objectives	◗ Avoid, minimise or control the generation of noise emissions and mitigate any potential noise impacts.
Target	◗ Noise levels from operational activities not to exceed 35dB at closest receptor site (Werenbun). ◗ Construction and operational traffic arising from the proposal should not lead to an increase of more than 2dB on existing noise levels.
Actions	◗ A complaint system will be implemented during construction of the Project. ◗ Management measures adopted should noise complaints be received. ◗ Operation and maintenance of power station in accordance with the design and emission criteria. ◗ Operation and maintenance of equipment in accordance with standard noise and vibration controls. ◗ Blast design for production.
Performance Indicators	◗ Recorded acoustic levels attributable to construction and operation. ◗ Number of complaints associated with noise nuisance.
Monitoring	A complaint management system will be implemented during construction of the Project. The complaint system will include the following measures as relevant: ◗ A community liaison phone number and permanent site contact number will be established so that noise complaints can be received and addressed in a timely manner. ◗ Determine whether any unusual activities were taking place at the time of the complaint that may have generated higher noise levels than usual. ◗ Conduct noise monitoring at the location of the complainant. ◗ If noise levels are excessive, or above environmental authority conditions, implement noise mitigation and amelioration measures.
Reporting	◗ Any complaints will be documented in the complaints register, investigated and reported to the Health, Safety and Environment Manager and Vista Gold's General Manager. ◗ Complaints to be addressed in a timely manner. ◗ Results of audits and use of complaints register to be reported in MMP.
Responsibility	◗ Construction contractor(s). ◗ Health, Safety and Environment Manager.
Contingency	Should failure to comply with the EMP occur, Vista Gold will: ◗ Identify the source of the noise. ◗ If appropriate, adjust work practice and/or maintain or replace equipment or implement a monitoring program.

Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Waste Management and Pollution Control Act 2009.* ◗ *Waste Management and Pollution Control (Administration) Regulations 2012.* ◗ *Work Health and Safety Act 2011.* ◗ AS 1055 Description and measurement of environmental noise. ◗ AS 2012 Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors. ◗ AS 2221 Methods for measurement of airborne sound emitted by compressor units including prime movers and by pneumatic tools and machines. ◗ AS 2436 Guide to noise control on construction, maintenance and demolition sites. ◗ AS 2659 Guide to the use of sound-measuring equipment.

3.8.13 Waste Management

Objectives	◗ Efficient use of resources and minimisation of waste generation and disposal. ◗ Appropriate disposal of wastes over the life of the mine.
Target	◗ Reduce level of waste produced and associated environmental impact. ◗ Reuse and recycle where practicable. ◗ Create awareness of the waste management strategy and waste commitments/targets. ◗ Optimise re-use and recycling systems.
Actions	◗ Waste management addressed in EMP. ◗ Separation of waste for disposal, recycling and recovery. ◗ Removal of residual waste to landfill. ◗ Record waste types and volumes generated on-site and being transported off-site. ◗ Treatment of sewage. ◗ All site employees and contractor's to undertake the necessary training on the handling of, and disposal of, waste material types on site. ◗ Wherever practical and economically viable, all waste materials will be recycled. ◗ Disposal areas will be appropriately maintained. ◗ Putrescible and domestic waste will be collected and disposed of at a designated landfill site. ◗ Contaminated waste from both the mine site and sludge from the sewerage treatment plant will be disposed of in the tailings storage facility. ◗ Hazardous waste material will be transported off-site by a licenced carrier for disposal/treatment at an appropriate facility. ◗ Waste oil will be collected for transport and disposal off-site. ◗ Batteries will be transported off-site for disposal. ◗ Vegetation waste (weed free) will be managed on site through reuse for ground surface stabilisation and rehabilitation.
Performance Indicators	◗ Volume of waste disposal and associated cost. ◗ Volume of waste minimised and reused/recycled wherever possible.
Monitoring	Monitoring the activities and outcomes related to waste management include: ◗ Recording of waste types and volumes generated on-site and transported off-site. ◗ Assessing actual waste results against forecasted waste volumes. ◗ Monitoring any potential environmental impacts. These activities will help form the appropriate corrective actions to reduce or eliminate waste generation or impacts associated with waste.

Reporting	◗ During construction, the Contractor will report every month to the Vista Gold General Manager on the results of the waste monitoring program and other relevant waste management issues. ◗ During operation, waste management is the responsibility of the Health, Safety and Environment Manager. ◗ Annual reporting of Project waste emissions will be conducted in accordance with the National Pollutant Inventory (NPI) Guide. ◗ Reporting of incidents in accordance with relevant legislation (e.g. Section 29 of *Mining Management Act 2001.* ◗ Reporting requirements occur under the *National Greenhouse and Energy Reporting Act 2007* (NGER).
Responsibility	◗ Construction Contractor. ◗ Health, Safety and Environment Manager.
Contingency	Should failure to comply with the EMP occur, Vista Gold will: ◗ Take the necessary actions to identify the causes of non-conformance with the waste management plan performance requirements. ◗ Implement all actions necessary to achieve compliance.
Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Dangerous Goods Act 1994.* ◗ *Dangerous Goods (Road and Rail Transport) Act 2012.* ◗ *Public Health Act 1987.* ◗ *Waste Management and Pollution Control Act 2009.* ◗ *Water Act 1992.* ◗ *National Greenhouse and Energy Reporting Act 2007.* ◗ National Pollutant Inventory (NPI) Guide (SEWPAC 2011b). ◗ Enduring Value - The Australian Minerals Industry Framework for Sustainable Development 2005.

3.8.14 Fuels and Chemicals Management

Objectives	◗ To safely manage, store, handle and dispose of fuels and chemicals. ◗ Avoid minimise or control the uncontrolled release of chemicals to the environment. ◗ No human health issues or incidents from the use of fuels and chemicals.
Target	◗ Compliance with relevant Australian Standards (e.g. for the storage and handling of flammable and combustible liquids and dangerous goods). ◗ No spills of chemicals or release of chemicals to the environment.
Actions	**Fuels and Chemicals** ◗ Diesel will be stored on-site in a bunded area. Refuelling facilities will be provided in the heavy vehicle workshop area for vehicles belonging to the operation. ◗ Implement standard procedures for the transport, storage, containment, disposal and spill response for potentially hazardous materials. ◗ All hydrocarbons will be stored and handled in accordance with the requirements of AS 1940:2004: 'The Storage and handling of combustible and flammable liquids'. ◗ All chemicals will be stored, handled and used according to provisions in their MSDA. MSDSs of all chemicals used during operations will be kept in a register. ◗ Contaminants from the workshop and truck wash-down areas will be directed to a sump or drain where they can be contained for treatment or disposal. ◗ All relevant workers will be trained in appropriate handling, storage and containment practices for chemicals and dangerous goods. ◗ Emergency spill response will be employed, including training and handling procedures. ◗ Any land contamination that occurs will be recorded on a register and remediated. ◗ Records will be kept on the storage, location and disposal of all chemical and hazardous goods used on-site. ◗ Spills of dangerous goods will be rendered harmless and collected for treatment and disposal at a designated site, including cleaning materials, absorbents and contaminated soils. ◗ Spills must be appropriately cleaned up as soon as is reasonably practicable. ◗ Contaminated runoff and soil will be collected and disposed of in the TSFs. ◗ Non-toxic hydraulic fluids, such as vegetable-based fluids, will be used if possible. ◗ The use of non-hazardous, low toxicity non-ionic or anionic flocculants will be investigated. **Ore Processing Plant reagents** ◗ Cyanide management in accordance with International Cyanide Management Code. ◗ Reagents will be appropriately handled and stored in the proper designated location. **Explosive Magazines/Depot** ◗ Explosives will be stored in storage bins, powder magazines and a cap magazine, to be built and operated in accordance with the Dangerous Goods regulations.

	Waterways ◗ Petroleum products and other hazardous substances will be kept at a reasonable distance from waterways. ◗ Refuelling, top-ups and oil checks will be done at a reasonable distance from waterways. ◗ If equipment is to be immersed in the waterway, it should be cleaned beforehand to remove any external grease, oil and other fluids. ◗ Wash-down water is not to enter waterways. ◗ Fresh concrete should be kept out of the waterway. Any cast-in-place concrete should be isolated from the waterway for at least 48h to allow the pH to neutralise. ◗ Paints should not be allowed to enter the waterway when constructing, repairing and maintaining in-stream structures. ◗ If using wood treated with preservatives, the chemicals should be given enough time to fix before immersing the wood in water.
Performance Indicators	◗ No contamination of the environment by hazardous goods. ◗ Any spills are addressed and appropriate remedial action has been implemented.
Monitoring	**Surface Water Quality Monitoring** ◗ Additional analytes have been included into the proposed surface water monitoring program. **Other** ◗ Inspections of storages, tanks and bulk containers and the integrity of bunded areas, pavement and associated containment systems will be conducted at least quarterly. ◗ Inspections will be undertaken on the process plant, mine mobile maintenance shop, fuel bays, explosive magazines and ANFO facility. ◗ Regular audits will be conducted.
Reporting	◗ Spills will be reported to the General Manager. ◗ Spills reported to the appropriate authorities, as required. ◗ Any non-compliance to be reported in the MMP.
Responsibility	◗ Construction contractor(s). ◗ Health, Safety and Environment Manager.
Contingency	◗ Should a failure to comply with the EMP occur, the following corrective actions will be undertaken as appropriate: – contain and clean up spilt material immediately and remediate or appropriately dispose of contaminated material – report to the appropriate authorities as soon as possible – repair containments systems – review storage and handling areas – if a spill occurs, sandbags or earth bunds will be placed to block flow path to drains and watercourses.

Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Waste Management and Pollution Control Act 2009.* ◗ *Public Health Act 1997.* ◗ *Dangerous Goods (Road and Rail Transport) Act 2001.* ◗ *Dangerous Goods (Road and Rail Transport) Regulations 2004.* ◗ *Petroleum Amendment and Related Matters Act 2010.* ◗ *Water Act 1992.* ◗ *Work Health and Safety Act 2011.* ◗ AS 4452 The Storage and Handling of Toxic Substances. ◗ AS 1940 The Storage and Handling of Flammable and Combustible Liquids. ◗ AS 3740 The Storage and Handling of Corrosive Substances. ◗ National Standards for the Storage and Handling of Dangerous Goods [NOHSC:1015(2001)]. ◗ National Code of Practice for the Storage and Handling of Workplace Dangerous Goods [NOHSC:2017(2001)]. ◗ Environmental Health Information Bulletin No. 6 Requirements for Mining, Construction & Bush Camps, NT DHCS 2006. ◗ International Cyanide Management Code.

3.8.15 Traffic and Transport

Objectives	◗ Manage construction and operation traffic to and from the Project.
Target	◗ Avoid, minimise or control impact on road safety and pavement conditions. ◗ Minimal increase in road congestion.
Actions	◗ Prepare Road Transport Management Plan (TMP), including community consultation strategy, haulage routes and hours, requirement for over-dimensional permits, requirement for traffic controllers. ◗ Use of pooled vehicles such as buses and work vehicles (to minimise exposure). ◗ Fitness for work assessments for site personnel. ◗ Workforce management strategy and TMP to address driver fatigue. ◗ Prepare Contractor Management Plan. ◗ Regular pavement condition review of Edith Falls Road. ◗ Liaise with NT Government to ensure funding and maintenance routines are appropriate. ◗ Consolidation of freight and reagent transportation to rationalise transport movement. **Dangerous Goods Transport** ◗ Loads being transported to and from the mine would be secured in accordance with the relevant legislation. ◗ Transport of dangerous goods in accordance with relevant legislation with measures incorporated into the TMP. ◗ Prepare Incident Management Plan ◗ Prepare and comply with TMP and statutory approvals. **Tracking of Dirt** ◗ Measures to minimise the tracking of soil off-site will be implemented at access gates and may include exit rumble grids or wheel wash facilities, sweeping of sealed roads to remove deposited material where applicable, and/or stabilisation of site roads/tracks with aggregate where appropriate.
Monitoring	◗ A pavement condition monitoring program would assist in identifying any pavement deterioration during the life of the Project. ◗ Routine monitoring of near-misses and traffic accidents (incident reporting system).
Performance Indicators	◗ Road safety. ◗ Pavement conditions.
Reporting	◗ Data will be gathered and communicated through various reporting systems. ◗ Independent reports will be produced for any investigations triggered by a complaint or audit findings.

Contingency	Should a failure to comply with the EMP occur, the following measures will be implemented: ◗ If practicable, alternative routes will be investigated and logistics plan altered as required and/or traffic monitoring will target the particular route. ◗ Any spills will be cleaned up in accordance with best practice standards and an investigation will be conducted into the incident, followed by remedial action.
Responsibility	◗ Construction contractor(s). ◗ Administration Manager. ◗ Health Safety Environmental Supervisor.
Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Waste Management and Pollution Control Act 2009* ◗ *Public Health Act 1997.* ◗ *Dangerous Goods (Road and Rail Transport) Act 2001.* ◗ Dangerous Goods (Road and Rail Transport) Regulations 2004 ◗ *Petroleum Amendment and Related Matters Act 2010.* ◗ *Water Act 1992.* ◗ *Work Health and Safety Act 2011.*

3.8.16 Bushfire Management

Objectives	◗ Adopt appropriate fire management regimes to assist in minimising damage to flora and fauna and conservation significance of the Yinberrie Hills SOCS. ◗ Avoid, minimise or control impact from wildfires.
Target	◗ Controlled burning maintains grass species diversity and minimises impact on flora and fauna and conservation significance of the Yinberrie Hills SOCS. ◗ No wildfires resulting from mining activities.
Actions	**Controlled Burning** ◗ The existing system of early dry season controlled burns will be maintained. Fires late in the dry season (following early dry season burns) will be avoided. Expansion of fire management to the Yinberrie Hills SOCS is recommended. ◗ Controlled fires are to focus on burning patches of vegetation in a mosaic. ◗ Fire breaks constructed to prevent wildfires entering the site from Edith Falls Road. **Personal Behaviour** ◗ All site inductions are to include instruction fire safety. ◗ Mine vehicles will carry fire extinguishers and/or 'on-board' fire suppressant systems. ◗ The undercarriage of mine vehicles is to be regularly checked and cleaned to ensure build-up of grass is limited, minimising the risk of vehicle fires and trailing spot fires. **Wildfires** ◗ Personnel will avoid wildfire areas and evacuate to downwind positions. Evacuation location will be clearly marked and identified to all staff during induction. ◗ If fire threatens the mine site, emergency services will be notified, and staff evacuated to a safe location.
Performance Indicators	◗ No fires as a result of mining activity. ◗ No fire damage to surrounding environment and mine facilities.
Monitoring	◗ Monitor the presence of bushfires on www.firenorth.org.au. ◗ Record any fires attributable to mining activities and as appropriate remedy procedures/training. ◗ Record early dry season burning regime.
Reporting	◗ The Health, Safety and Environment Manager is to record all fire incidents and report incidents and findings to the General Manager.
Responsibility	◗ Health, Safety and Environment Manager
Contingency	◗ The Health, Safety and Environment Manager will report all major fires to, and consult with the NT Bushfires Council as appropriate.
Relevant standards and legislation	◗ *Bushfires Act 2009.*

3.8.17 Rehabilitation, Decommissioning and Closure

Objectives	◗ Limit environmental impact and to leave mineral leases with minimal or no ongoing management requirements once Project is complete. ◗ Achieve a stable and functioning landform which is consistent with environmental and stakeholder values.
Target	◗ To establish realistic and achievable closure criteria, in consultation with key stakeholders. ◗ Integrate rehabilitation, decommissioning and closure program into mine plan during operations ◗ Control AMD conditions. ◗ Minimise erosion of facilities containing mine waste. ◗ Reduce or eliminate the acid and metal loads of seepage and runoff water. ◗ Minimise adverse impacts to the surface and groundwater systems surrounding the mineral leases. ◗ Physical and chemical stabilisation of mine waste and other mine-related surface disturbances. ◗ Protect public safety. ◗ Comply with NT Government regulations governing mine development and closure. ◗ Ensure that the full cost of decommissioning and rehabilitation is understood.
Actions	◗ Development of a Tailings Management Plan. ◗ Rehabilitation Plan prepared and regularly updated. ◗ Ongoing revegetation and weed management trials. ◗ Erosion and Sediment Control Plan. ◗ Annual review of security calculations. ◗ Closure Plan included as part of the MMP conditions. ◗ Progressive rehabilitation where practicable. ◗ Cost estimation processes with contingency. ◗ Further study will be undertaken prior to mine operation on – waste and cover material hydraulic properties characterisation and analysis – tailings trafficability testing – improvement of the watershed hydrologic data collection system to enable an update of precipitation-yield characteristics of the site – completion of the site-wide soils and closure cover materials inventory and characterisation to identify material sources, properties, and balance – erosion and sediment control analysis ◗ Effective and appropriate design of cover thickness on WRD. ◗ Engagement with NT regulatory authorities on plans to leverage off other projects. ◗ Implement passive water treatment system.

	◗ Vista Gold will retain responsibility for legacy water until the NT Government accepts relinquishment. ◗ Temporary erosion controls should remain in place until long-term erosion control methods are established and functioning. ◗ The rehabilitation strategy will remain flexible and will be amended as new rehabilitation techniques emerge and as environmental investigations progress, or when the mine plan is modified.
Performance Indicators	◗ Consulting with stakeholders prior and during closure. ◗ Achievement of closure criteria. ◗ Compliance with mining legislation.
Monitoring	◗ Develop an environmental monitoring and reporting program which is focused towards demonstrating the achievement of closure outcomes. ◗ Within this program, rehabilitation will be monitored to validate rehabilitation performance and identify any additional work required to meet success criteria. ◗ The drainage channels will be monitored for vegetation health and growth success including before and after each wet season until the vegetation matures and bank stability is attained. ◗ Weeds across the mineral leases will be monitored.
Reporting	◗ The results of Vista Gold's rehabilitation program will be reported in the MMP. ◗ A Closure and Rehabilitation Strategy will be developed over the life of the Project and a current version will be provided to relevant authorities at all times.
Responsibility	◗ Construction Contractor(s). ◗ Health, Safety and Environment Manager. ◗ General Manager.
Contingency	**Unexpected closure** The Closure and Rehabilitation Strategy will include plans and strategies for the Project's forced or otherwise unanticipated early closure. At the minimum, unexpected closure would result in the following actions: ◗ An environmental audit of the entire site. ◗ A review of the Care and Maintenance Plan. ◗ Submission of the reviewed Care and Maintenance Plan to the relevant authorities for their information. In order for this to occur, the Care and Maintenance Plan will include: ◗ An Emergency Response Procedure. ◗ A mine access and security review. ◗ A geotechnical monitoring program to monitor stability of Batman Pit, the WRD, TSF1 and TSF2. ◗ A program to address incomplete rehabilitation and remediation works.

	◗ An environmental monitoring and inspection program, which includes: – license requirements – chemical and hydrocarbon storage – treatment plant condition – pit water monitoring – erosion monitoring – rehabilitation monitoring.
Relevant standards and legislation	◗ *Mining Management Act 2001.* ◗ *Mineral Titles Act 2010.* ◗ *Native Title Act 1993.* ◗ Rehabilitation Management Plan. ◗ Department of Resources Mine Close Out Objectives (February 2008). ◗ ANZMEC/MCA (2000), Strategic Framework for Mine Closure. Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia. Canberra, Australian Capital Territory. ◗ Association of Mining and Exploration Companies Mine Closure Guidelines (AMEC, 2000). ◗ Australian Mining Industry Council (1989), Mine Rehabilitation Handbook. ◗ Commonwealth Guidelines for Mine Closure and Completion (March 2009). ◗ Commonwealth Guidelines for Mine Rehabilitation (October 2006). ◗ Medical Entomology, Centre for Disease Control, DOH and Families, NTG 2005.

Level 5, 66 Smith Street, Darwin, Northern Territory, 0800
T: (08) 8982 0100 F: (08) 8981 1075 E: drwmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	A Robertson H Sloane	K Fitzpatrick		I McCardle		18/07/2012