SRO

SIROCCO RESOURCES NL

ACN 003 049 714

QUEST 29 PROJECT, NT
PER

Commencement of
Mining and Processing Operations

at

Quest 29 Mining Leases
and
Tom's Gully Mine

Report Prepared By:

Sirocco Resources NL
Level 30, Riverside Centre,
123 Eagle Street,
Brisbane, Queensland 4000

February 1999

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Glossary of Selected Technical Terms

Term	Explanation
Open Cut	To extract near surface deposits using surface mining techniques
Dump Leach	To leach minerals from mined rock as it is dumped, without crushing. Similar process to heap leach.
Ore Processing	Extracting gold and associated minerals from the rock
Tailings	Waste products of some methods of ore processing
Waste dumps	Rock extracted from an open cut that has no valuable minerals placed on selected sites in a controlled way.
Metallurgy	The understanding of ore processing
Resource / Reserve	Measurements of the quantities of valuable minerals. Used in this report as per the JORC Code of the AusIMM..
Stripping (carbon)	Removing gold and associated minerals from activated carbon using other chemicals
Stripping column	A secure pressure vessel for containment of carbon.
Bunds	Walls (earthen) to contain various substances.
Decline	An access road to an underground mine
HDPE	High density polyethylene
Pregnant solution (liquor)	Process solutions containing gold and associated metals in solution.
Preg-robbing	A processing activity whereby natural carbon preferentially removes gold from activated carbon

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SIROCCO RESOURCES NL

Public Environmental Report (PER) – Public Comment Invited

Sirocco Resources NL propose to develop a gold project, known as the Quest 29 Project in the Mount Bundey area of the Northern Territory, approximately 100 km south east of Darwin.

In accordance with the Northern Territory Environmental Assessment Act 1992, a Public Environmental Report that describes the proposal and its potential environmental effects has been prepared. This document will be available for Public Review from 1 March 1999 to the close of business on 26 March 1999 and can be examined at:

The Environment and Heritage Division,
Department of Lands, Planning and the Environment,
2nd Floor, Darwin Plaza, Smith Street Mall.

The Department of Mines and Energy Library,
3rd Floor, Centre Point Building, Smith Street Mall

Northern Territory Library, Parliament House, Darwin

Palmerston Public Library, 2 Chung Wah Terrace, Palmerston

Taminmin Commmunity Library

Litchfield Shire Office, 7 Bees Creek Road, Bees Creek

Interested persons wishing to comment on the PER are invited to make written submissions by close of business on 26 March 1999 to:

Department of Lands, Planning and the Environment,
GPO Box 1680,
Darwin, NT 0801

Re: Sirocco Resources NL – Quest 29 Project
Attention: Mr Richard McAllister

Submissions will be treated as public documents unless confidentiality is requested. Submission should preferably be in black ink on A4 sized paper.

Sirocco Resources NL, PO Box 7066, Riverside Centre, Brisbane QLD 4001
Telephone (07) 3301 9808 Facsimile (07) 3301 9807

Executive Summary

Title of Proposal

Quest 29 Project – Commencement of Mining & Processing Operations

Name & Address of Proponent

Sirocco Resources NL
Level 30, Riverside Centre,
123 Eagle Street,
Brisbane Q 4000

Background to the Proposal

Since December 1996, Sirocco Resources N.L. (SRO) has been progressing planned re-commencement of operations at it's Tom's Gully gold project near Darwin in the Northern Territory. Kakadu Resources N.L. last operated the Tom's Gully mine in 1995.

A three staged development concept has formed the basis of this plan as follows:

Stage 1 - Re-commissioning of the existing Tom's Gully process plant using open cut ore sources from the nearby Quest 29 prospect. Dump leach ore processing at Quest 29 will commence as part of this Stage.

Stage 2 - Commence mining operations from underground at Tom's Gully and blend this ore with ore from Quest 29.

Stage 3 - Optimise the operation.

In the pre-feasibility study it is noted that the operational timing is not prescriptive. Current thinking involves allowing about 6-12 months for Stage 1 to settle down and at least 12 months for Stage 2. The staging is being undertaken to minimise capital expenditure from capital reserves. The pre-feasibility and feasibility study focuses on Stage 1 of the plan.

This PER has been prepared for Stage 1 at Quest 29 (open cut mining and dump leach processing) only. It is planned to transport high grade ore from Quest 29 to Tom's Gully for processing through the existing approved carbon in leach (CIL) facility. The annual MEMP will be prepared for Stage 2 (re-commencement of mining operations from underground) at the appropriate time.

Purpose of the Proposal

The purpose of this PER is to assess the existing environmental conditions at the proposed location and to identify actual and potential environmental effects of the proposed development, which will allow design and development of appropriate and effective management strategies aimed at minimising environmental risks and adverse consequence.

The PER is required to facilitate environmental approval for the proposed development by the Northern Territory Government in accordance with the Environmental Assessment Act 1982. The PER has been prepared by Sirocco Resources NL in conjunction with Consultants in order to address the requirements as outlined in the guidelines prepared by the Department of Mines and Energy and the Department of Lands, Planning and the Environment.

Description of the Proposal

Detailed drilling to shallow depths (<50m) at Quest 29 in 1997 and 1998 delineated a total resource of 2.6 million tonnes at 1.7 g/t Au (145,000 contained ounces of gold) in four zones at Quest 29, the West Koolpin, the Zamu Dolerite, Taipan Hill and the North Koolpin. During the feasibility study, preliminary pit design showed that a reserve of 800,000 tonnes at 1.9 g/t Au (0.4 g/t Au cutoff) can be mined from three shallow pits at a waste to ore ratio of 3.2: 1. The North Koolpin requires more drilling before a pit design is possible and is not included in the reserves.

Comprehensive metallurgical testwork has been undertaken on composite samples from all resources at Quest 29 to determine the cyanide leach gold recovery within the resources as well as physical testwork parameters. These tests have allowed characterisation of two main ore types viz. oxide and sulphide (primary). There may also be a transitional zone in the Zamu Dolerite zone. Gold recoveries in the oxide zones are excellent exceeding 90%. Lower gold recoveries occur in the Zamu Dolerite sulphide zone in particular. Further development metallurgical testwork is being undertaken to resolve the issues.

Infrastructure and services at Quest 29 will be established generally using refurbished secondhand equipment. The access road from the Arnhem highway to Rustlers Roost Mine road requires upgrading from the turnoff to the Quest 29 site (about 10 kilometres) as well as along a fenceline back into Tom's Gully for ore haulage and access for equipment. Site roads, power and water supply, office and workshop, a dump leach pad, associated ponding and stripping columns, pit bunding, creek diversion and a siltation pond and waste dump site(s) will need to be established for Stage 1 at Quest 29. An office upgrade and refurbishment of the process plant and re-erection of a crushing plant at Tom's Gully will also need to be undertaken for Stage 1.

SRO proposes to employ personnel on individual contracts and will operate on various shift arrangements depending on the final configuration of Stage 1. An accommodation strategy involving nearby available local motels, as well as own housing with bussing from Humpty Doo and Palmerston is being considered as most cost effective.

Trucking of high grade ore to Tom's Gully will be undertaken for about 2 years. The dump leach operation will run in parallel for the same period of time. Exploration in the North Koolpin in particular and within the Quest 29 and Mt Bundey joint venture leases in general should provide sufficient ore to allow the dump leach operation to extend for 3 to 4 years. The life of the high grade trucking operation is dependent upon further exploration discoveries and how quickly the Tom's Gully underground operation is brought into production. It is planned to blend this ore with Quest 29 high grade ore.

The initial production rate will be 250,000 tonnes per annum (tpa) of high grade ore from Quest 29 processed through the Tom's Gully CIL plant, as well as 300,000 tpa of low grade ore processed through as dump leach material at Quest 29. The Feasibility Study shows that this will produce about 20,000 ounces of gold in Year1. A total of 29,000 ounces of gold from high grade ore processing and 6,000 ounces from low grade (dump leach) ore will be recovered (excluding North Koolpin and new discoveries).

Description of the Existing Environment

Quest 29 is characterised by low, flat-topped hills with moderate to gentle slopes. Vegetation is characterised by eucalypt woodlands with tropical grass understoreys. The project area lies on the northern flank of the Pine Creek Inlier within a transgressive marine sequence dominated by folded shallow marine sediments of the Early Proterozoic South Alligator Group. The most extensive land use in the vicinity of the project area is pastoral, involving

the grazing of beef cattle over the woodland terrain. The industry is of low intensity with a few improvements made in regards to land tillage.

Tom's Gully is an existing mine site with infrastructure well established to control all potential environmental hazards in accordance with all Government regulations.

Principal Environmental Impacts

Environmental impacts particular to the project include:

- Potential acid generation from mine wastes at Quest 29;
- Management of cyanide used in the proposed dump leach at Quest 29;
- Rehabilitation; and
- Dewatering of acid mine water from the Tom's Gully pit

Quest 29, as a new operational site, will establish controls within the guidelines outlined in this PER.

Licenses are in place for controlled release of acid water from the Tom's Gully open pit into the Mt Bundey creek, during high creek flow events in the 1998 / 1999 wet season. Controlled release in past wet seasons has been shown to be effective. Careful independent monitoring of these releases has shown no damaging environmental effects from water toxicity. At the completion of the 1997 / 1998 wet season, containment of residual water in evaporation ponds during the dry season was necessary.

Continued dewatering of further inflows will be necessary once the pit is dry, however, this water is likely to be neutral to mildly acidic. The landowner has established a shallow containment area for water to be used for stock purposes in the dry season. A wetland filter will be established at the inflow to this area and any excess bore water may then be suitable for discharge through this filter into the landowner's containment area, subject to appropriate permitting and monitoring at that time. The water will be contained in the existing evaporation pond system until these approvals have been obtained.

Proposed Environmental Management Principles and Monitoring Procedures

The responsibility for the environmental performance of the Company at the Quest 29 and Tom's Gully sites rests with all employees (permanent or contract) of the Company. The Site Manager or his nominee will undertake management of the Companies environmental policy. He is directly responsible for enforcing the Companies policy within the guidelines set down by the Northern Territory Government and other relevant legislation. He will be responsible for management of all monitoring and reporting. The Manager will employ personnel including specialists as required.

The final responsibility for the environmental performance of the Company at Quest 29 and Tom's Gully rests with the Directors. The Operations Director will be responsible for internal review of the Companies environmental performance.

Monitoring and management will be undertaken as follows:

- Monitoring of water quality in the water management system;
- Leak detection in the dump leach facility;
- Management of ongoing waste characterisation;
- Monitoring of leachates from the waste rock dump;
- Dust Control; and
- Management of Re-vegetation and Rehabilitation

This PER forms part of the planning requirements for project development involving the Northern Territory Department of Mines & Energy and the Northern Territory Department of Lands, Planning and the Environment. This will enable the Company to respond to Government requirements and enable the project to proceed as soon as possible following completion of the feasibility study, formal Government approval and ultimately the Board's decision to mine is based on this process.

1 Introduction

1.1 Applicant

Sirocco Resources N.L.

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1.2 Consultants

1.2.1 Mining

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1.2.2 Process

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1.2.3 Engineering

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Fax: (02) 9251 3788
Email: TWA@onaustralia.com.au

1.2.4 Environmental (Waste Characterisation)

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Contact:

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Fax: (07) 3364 7477

1.3 Location

Quest 29 project is located approximately 100 kilometres south east of Darwin and 13 kilometres south of Tom's Gully gold mine. It is also located on Old Mt Bundey station, PPL 1163 (NT Portion 4937) owned by the Hon. Barry Coulter MLA as well as McKinlay Station PPL 1164 (NT Portion 4938) owned by Lawnhold Pty Ltd, represented by Hon. Barry Coulter MLA.

Tom's Gully mine is located about 90 kilometres south east of Darwin in the Northern Territory. It is 1.6 kilometres west of the Arnhem highway on Mt Bundey station at approximately 131°34'E and 12°50'S.

Figure 1-1 shows the general location of the Project area.

1.4 Mining Tenure

1.4.1 Quest 29

The Quest 29 area is covered by current Mining Lease Numbers (MLNs) 337, 338, 339 and 369 – 373 held by Sirocco Resource NL. The Company has also acquired the rights to adjacent current MLNs 281-284, MCNs 68-91and EL8508 held by Pinnacle VRB and Williams Resources (the Mt. Bundey Joint Venture).

The currently planned open cut mining and dump leach processing operation is contained within this area on the MLNs.

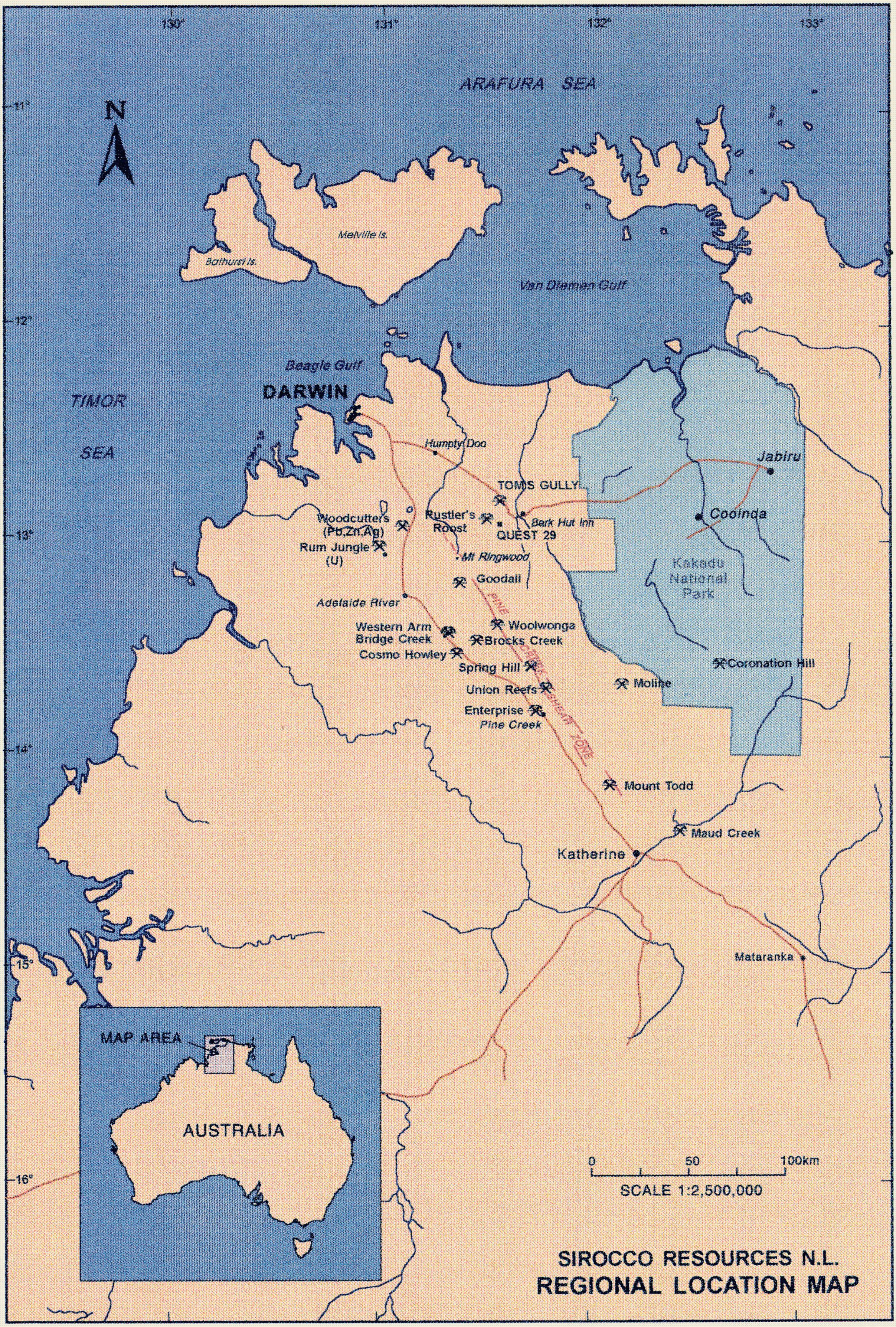

130°
131°
132°
133°
ARAFURA SEA
11°
N
Melville Is.
Bathurst Is.
Van Diemen Gulf
12°
Beagle Gulf
DARWIN
TIMOR
SEA
Humpty Doo
Jabiru
TOMS GULLY
Woodcutters
(Pb,Zn,Ag)
Rustler's
Roost
Bark Hut Inn
QUEST 29
Cooinda
13°
Rum Jungle
(U)
Mt Ringwood
Goodall
Kakadu
National
Park
Adelaide River
Western Arm
Bridge Creek
Cosmo Howley
Woolwonga
Brocks Creek
Spring Hill
Coronation Hill
Union Reefs
Molihe
Enterprise
Pine Creek
14°
Mount Todd
Maud Creek
Katherine
15°
Mataranka
MAP AREA
AUSTRALIA
16°
0
50
100km
SCALE 1:2,500,000
SIROCCO RESOURCES N.L.
REGIONAL LOCATION MAP

Figure 1.1

1.4.2 Tom's Gully

MLN 1058 was originally granted under the Mining Act for the purpose of mining and processing and ancillary operations (gold and silver). The Tom's Gully site is also covered by MLNs 281 - 284. All the leases are current.

The existing CIL process plant, crushing plant site, tailings dams, waste dumps, services and infrastructure are located within this area.

1.5 Project History

1.5.1 Quest 29

Geopeko originally discovered the area in 1972 and located two prospects on MLN339 (gold) and MLN338 (lead and silver). In 1989 Carpentaria Exploration Company Pty Ltd (CEC) a wholly owned subsidiary of Mount Isa Mines Ltd (MIM) commenced exploration in joint venture with Geopeko. An extensive drilling programme was undertaken following encouraging results from earlier exploration. In mid 1994, Kakadu Resources Ltd (Kakadu) undertook a programme of diamond core and RC percussion drilling. A resource estimate was undertaken at a cutoff grade of 0.23 g/t Au.

In 1997, Sirocco undertook extensive RAB and RC percussion drilling. This led to the discovery of a new resource, the West Koolpin. In 1998 continued exploration was undertaken to provide reserve information and to explore areas acquired from Pinnacle and Williams Resources (Taipan Hill and Mobile Hill). A revised resource estimate was undertaken at 0.4 and 1.0 g/t Au cutoff grades. This is shown in *Table 1.1*.

Table 1.1 **Quest 29 Resource Estimate**

Resource Classification	Cutoff Grade g/t Au	Tonnes	Grade g/t Au	Contained Gold (oz)
Indicated	0.4	2,050,000	1.96	120,800
	1.0	1,109,000	2.86	100,200
Inferred	0.4	540,000	2.01	24,500
	1.0	83,000	5.45	12,300
Total	**0.4**	**2,590,000**	**1.74**	**145,300**
	1.0	**1,192,000**	**2.94**	**112,500**

During 1998, detailed metallurgical testwork was undertaken, various studies and reports were completed including a Pre-Feasibility Study and a Notice of Intent (NOI) to commence mining was lodged with the DME. The Company was advised that a PER would be required to enable consideration of the environmental impacts of the Project to be made. The guidelines for that PER were prepared and the Company was instructed to prepare the PER in January 1999. A draft Feasibility Study was completed in January 1999.

1.5.1 Tom's Gully

Tom's Gully was discovered by CEC in 1986. Gold production commenced in 1988 and the operation processed 356,651 tonnes of ore at a grade of 9.23 g/t Au from an open pit mine on the Tom's Gully vein. The ore was processed on site using a plant that has subsequently been removed. The remaining resource estimate at Tom's Gully, which was undertaken by CEC, is summarised in *Table 1.2*.

Table 1.2 **Tom's Gully Resource**

Classification	Tonnes	Grade (g/t Au)	Contained Gold (oz)
Measured	46,823	6.62	9,967
Indicated	285,000	8.41	77,069
Inferred	840,000	10.38	280,360
Total	**1,171,823**	**9.75**	**367,396**

CEC developed a decline from the eastern end of the open pit. This was stopped in late 1990, 465 metres from the portal.

In 1992, CEC sold the mine and associated leases to Esmeralda Exploration Ltd who removed the services from the decline and allowed the pit to flood. Kakadu acquired Tom's Gully from Esmeralda and built and commissioned a plant to re-treat the tailings. This is the plant currently on site. The plant was commissioned in May 1995, and it is estimated that Kakadu treated about 65,000 tonnes of tailings at an overall recovery of about 35%.

Kakadu was placed in liquidation in 1995. Following a creditor's meeting and with the support of Seco Resource Finance, Kakadu was placed under an Administrator. In December 1996, after a seed capital fund raising, and with a new Board of Directors and management, Kakadu was re-listed on the ASX as Sirocco Resources N.L. (SRO). A further capital raising was successfully completed in July 1998, the Company is now adequately capitalised to proceed with re-opening of a combined Quest 29 / Tom's Gully operation.

1.6 Scope and Purpose

The purpose of this PER is to assess the existing environmental conditions at the proposed location and to identify actual and potential environmental effects of the proposed development, which will allow design and development of appropriate and effective management strategies aimed at minimising environmental risks and adverse consequence.

The PER is required to facilitate environmental approval for the proposed development by the Northern Territory Government in accordance with the Environmental Assessment Act 1982. The PER has been prepared by Sirocco Resources NL in conjunction with Consultants in order to address the requirements as outlined in the guidelines prepared by the Department of Mines and Energy and the Department of Lands, Planning and the Environment. These guidelines were compiled in accordance with Clause 6 of the Northern Territory Environmental Assessment Act Administrative Procedures.

This PER has six sections structured generally in accordance with the guidelines for the preparation of a PER:

- Section 1 - introduces the project;
- Section 2 – provides a detailed description of the proposed project including it's major components, construction and operation;
- Section 3 – describes the existing environment in which the Project will operate, including the physical, biological, and socio-economic environments;
- Section 4 – analyses the possible environmental effects of construction and operation of the Project;
- Section 5 - proposes safeguards to mitigate the impacts discussed in section 4; and
- Section 6 - outlines the environmental monitoring programme proposed for the Project.

Technical appendices, which provide detailed information on many aspects of the Project, are attached to the PER.

2 Description of the Proposed Development

2.1 Introduction

2.1.1 Location, site description and planning considerations

The Quest 29 Project is located approximately 100 kilometres south east of Darwin and 14 kilometres south of Tom's Gully gold mine. Quest 29 is located on MLNs 337, 338, 339 and 369 - 373. The Quest 29 leases have recently (1998) been renewed, MLNs 337 - 339 to 31st December 2006 and MLNs 369-373 to 31st December 2007. During 1998, Sirocco acquired the tenements immediately surrounding Quest 29 held by the Williams Resources NL / Pinnacle VRB joint venture (the Mount Bundey Project) and tenements held by Williams Resources (the Pine Creek Inlier joint venture). These comprise MLNs 281-284, MCNs 68-91and EL8508.

Tom's Gully is directly accessible from the Arnhem highway, a sealed road between Darwin and Jabiru. A good quality gravel road leads to the site approximately 1 kilometre from the highway. Quest 29 is accessed via the Rustlers Roost mine access road, a good quality gravel road leading off the Arnhem highway, about 1 kilometre south east of the Tom's Gully turnoff. Access is then via station tracks from the Rustlers Roost road. Tom's Gully is located on Mining Lease (MLN) 1058 and also comprises MLNs 281 - 284.

The tenements are located on Old Mt Bundey station, PPL 1163 (NT Portion 4937) owned by the Hon. Barry Coulter MLA as well as McKinlay Station PPL 1164 (NT Portion 4938) owned by Lawnhold Pty Ltd, represented by Hon. Barry Coulter MLA.

The area comprises low undulating hills with medium creek dissection. At Quest 29, the Koolpin metasediments form hills, whilst the Zamu dolerite largely covers the creek flats. At Tom's Gully, the original topography is largely disturbed by mine infrastructure.

Vegetation is characterised by eucalypt woodlands with tropical grass understoreys. These are poorly developed on the Koolpin metasediments at both Tom's Gully and Quest 29. The Zamu Dolerite supports some larger trees and a denser grass cover.

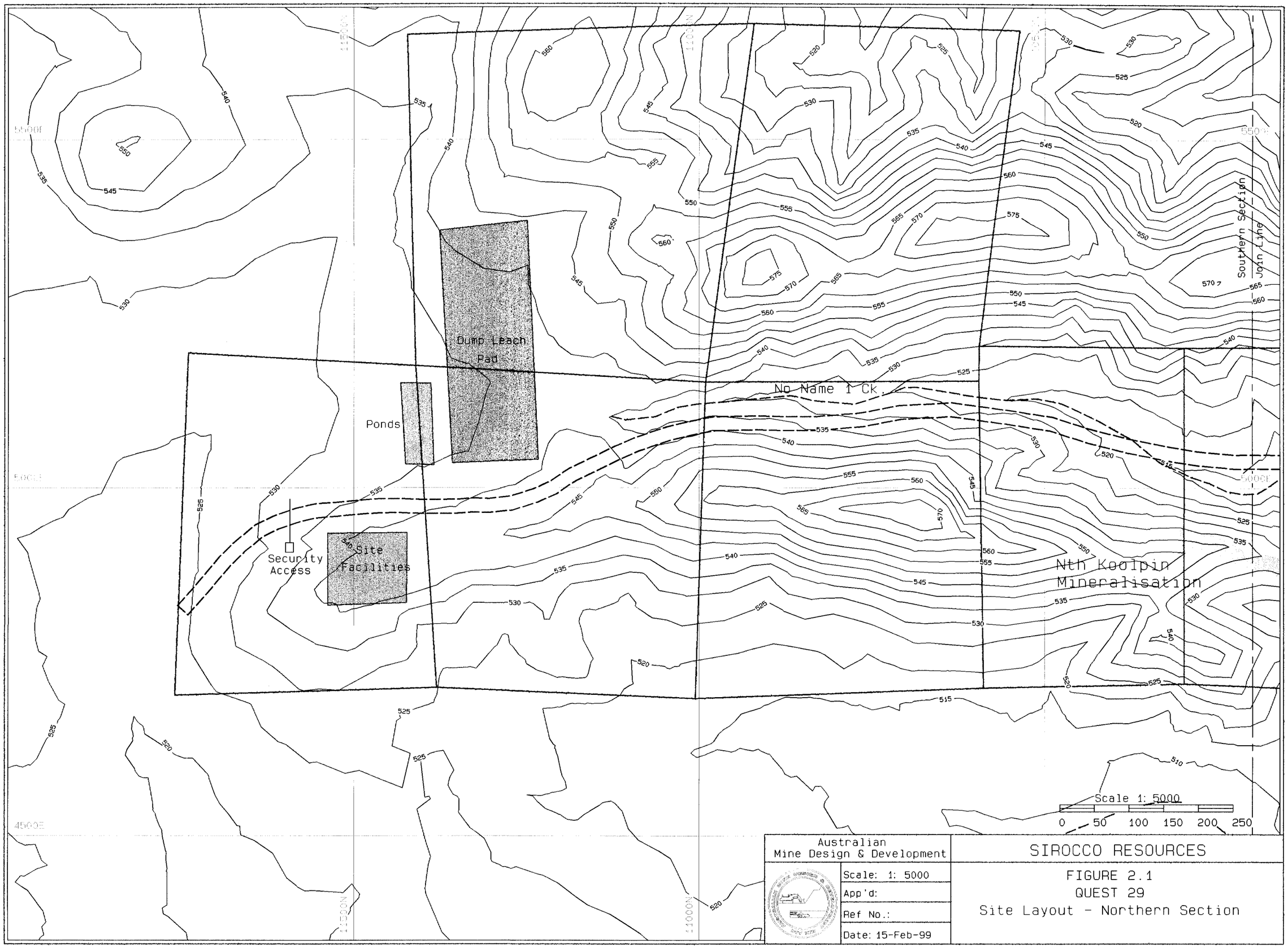
A three staged development concept has formed the basis of the proposed re-opening of the existing Tom's Gully Mine as follows:

Stage 1 - Installing a crushing plant and recommissioning of the existing process plant at Tom's Gully using open cut ore sources from the nearby Quest 29 project. Processing of low grade ore at Quest 29 using a Dump Leach process.
Stage 2 - Commence underground operations at Tom's Gully and blend this ore with ore from Quest 29.
Stage 3 - Optimise the operation.

In order to commence operations at Quest 29 within the granted MLNs Sirocco has prepared this Public Environmental Report (PER) to evaluate the environmental impact. Tom's Gully has already completed a PER for processing gold ores.

2.1.2 Site design layout and options

Sirocco proposes to mine from a number of small open cuts based on the resources that have been discovered to date. These are shown on the Site Layout plan in **Figures 2-1 and 2-2**.



Australian Mine Design & Development

Scale: 1: 5000
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Date: 15-Feb-99

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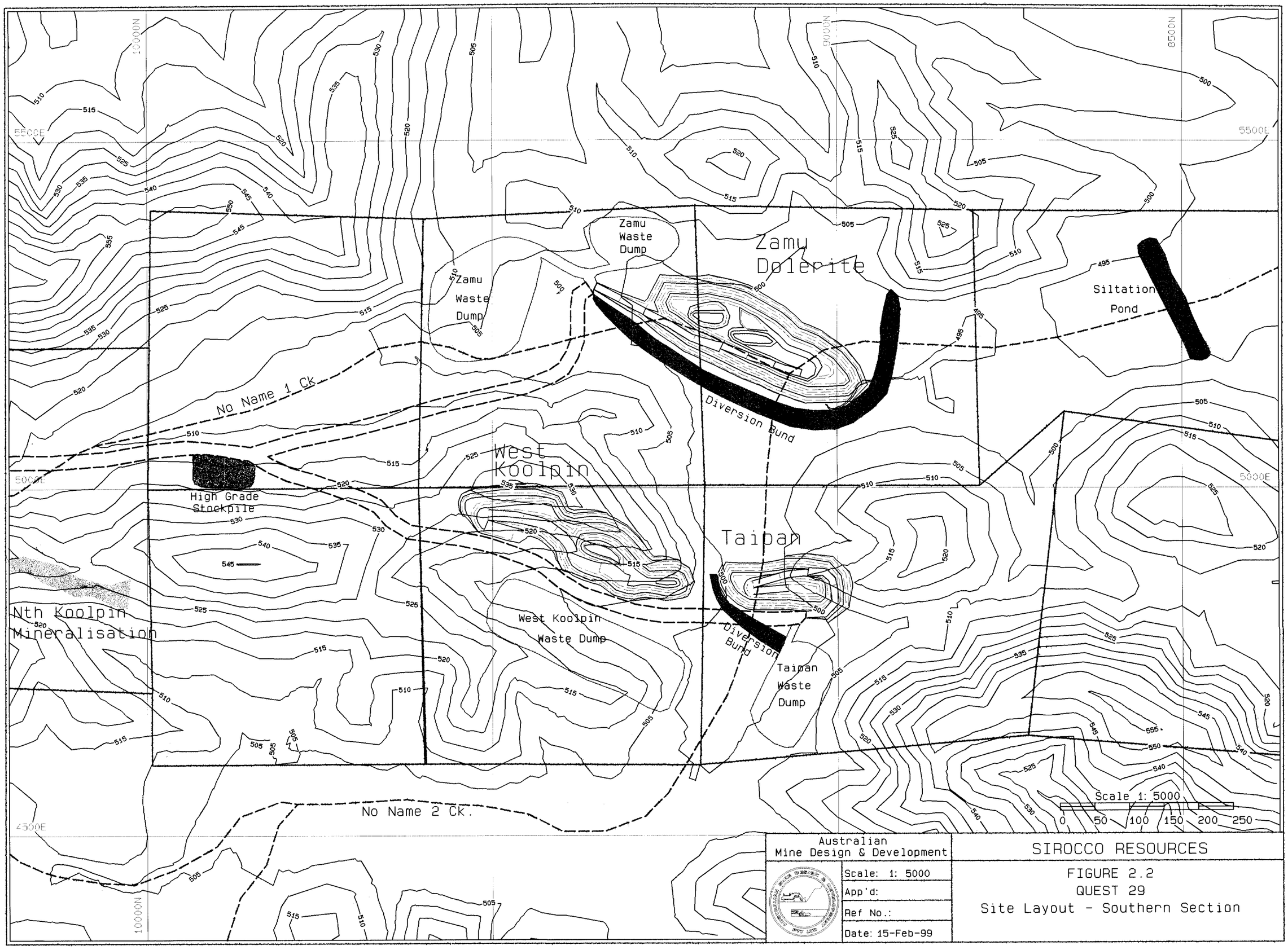
FIGURE 2.1
QUEST 29
Site Layout - Northern Section

q29sited.pf

SURPAC2000 - AMDAD



Australian Mine Design & Development	SIROCCO RESOURCES
Scale: 1: 5000 App'd: Ref No.: Date: 15-Feb-99	FIGURE 2.2 QUEST 29 Site Layout - Southern Section

q29sitee.pf

SURPAC2000 - AMDAD

Three of these have been outlined by Reverse Circulation (RC) percussion and diamond core drilling within the granted MLNs held by Sirocco, viz West Koolpin, North Koolpin and Zamu (Dolerite). A further resource has been outlined within the former Williams / Pinnacle MLNs at Taipan Hill (including Taipan South and South-East). A number of other prospects have also been assessed during 1998, including Mobile Hill, Zamu North and Bob's Reef. Sirocco intends to continue to actively explore the area and believes that further resources similar in style and grade to the West Koolpin, North Koolpin, Zamu (Dolerite) and Taipan Hill will be discovered in the Quest 29 area.

Sirocco currently plans to commence mining shallow high grade oxide resources from the West Koolpin, Zamu and Zamu North areas and trucking that ore to the Process Plant at Tom's Gully. The initial mining of near surface high grade oxide resource may also take place at Taipan Hill. Deeper pits will be developed at the West Koolpin and Taipan Hill areas in Year 1 and low grade resource will also be mined.

During the early mining of high grade material, a dump leach pad and associated ponds will be prepared at the selected site shown on the site layout plan. As low grade ore is mined, it will be placed on the pad for processing.

Waste from the mining operations will be placed on the site shown on the site layout plan. The waste dump will be monitored for leachate and a dam constructed at the toe of the dump will control this.

During Year 2, the North Koolpin resource and the Zamu (Dolerite) resource will be mined in a similar way. The low grade North Koolpin resource will be dump leached whilst the high grade Zamu (Dolerite) resource will be trucked to Tom's Gully. A safety berm will be constructed around the Zamu (Dolerite) pit to prevent flooding of the pit during operations.

A siltation dam will be constructed downstream of the mining area to control runoff and allow water quality to be monitored prior to controlled release. A wetland filter will be planted downstream of the siltation dam as an added precaution.

Access and haul roads will be constructed as shown on the site plan. The existing access road to Quest 29 from the Rustlers Roost mine road will be upgraded to allow ore haulage by road trains. An existing access road from the Rustlers Roost mine road to the southern side of the Tom's Gully site will also be upgraded. It is not proposed that road trains will use the Arnhem Highway for ore haulage to the Tom's Gully site.

Loaded carbon from the dump leach operation will be trucked to Tom's Gully for stripping at regular intervals (twice weekly) in a stripping column designed for the purpose. This column will be sufficiently robust that it will not be substantially damaged in the event of an accident during transportation. Stripped, reactivated carbon will be transported back to Quest 29 from the Tom's Gully site in the same column. A secure reagent storage and mixing area will be constructed at Quest 29, however, most stocks will be held at the Tom's Gully site.

Tailings from the processing operations at Tom's Gully will be pumped to the existing approved tailings dam on the site. A crushing plant will be re-erected at Tom's Gully on the site of the previous crushing plant established by Carpentaria Gold Pty Ltd in the late 1980's. The Tom's Gully process plant will be re-commissioned.

A small site office and power supply (diesel generator) will be sited at Quest 29, near to the dump leach operation. Accommodation will be off site. A fuel depot and workshop will be constructed for the mining fleet. All fuel storage areas will be bunded to adequately contain

spillage in accordance with permitting requirements in the unlikely event of a complete spillage

Mining will be undertaken based on the detailed schedule, and will continue as further resources are outlined by the proposed exploration drilling. These will be detailed in the annual environmental management and operating plans.

2.1.3 Existing infrastructure and infrastructure requirements

As described in the previous section, the existing infrastructure at Quest 29 includes an access road and tracks to drill sites. The required infrastructure is as follows:

- Access road upgrade;
- Site office, process and potable water supply and power supply;
- Dump leach pad, ponds and associated mixing tanks and reagent storage;
- Fuel depot and mine fleet workshop; and
- Haul and site roads.

As described in the previous section the existing infrastructure at Tom's Gully is complete. The only works proposed is an upgrade of the existing access track from the Rustlers Roost access road to the southern end of the site to enable ore to be hauled without using the Arnhem Highway.

2.1.4 Timetable for Operations

Sirocco proposes to commence mining and processing operations at Quest 29 as soon as the 1998/1999 wet season is finished and good access can be obtained to the site. Ore haulage to Tom's Gully for ore processing through the existing CIL plant that has been refurbished during 1998 will commence as soon as the access road has been repaired. Currently it is planned to undertake this during April; however, this will depend somewhat on the wet season.

It is proposed that Quest 29 site infrastructure will be progressively constructed during the first 3-4 months of operations. This will commence with roads, site office including facilities, the siltation dam and mine facilities. The dump leach site will be developed as mining progresses and an area is required for the low grade ore. It is currently planned to commence this work by preparing a membrane-lined pad at the start of mining. Other facilities will be commenced within two months of the commencement of other site operations. The dump leach operation will commence once sufficient of the pad and ponds and associated facilities have been constructed

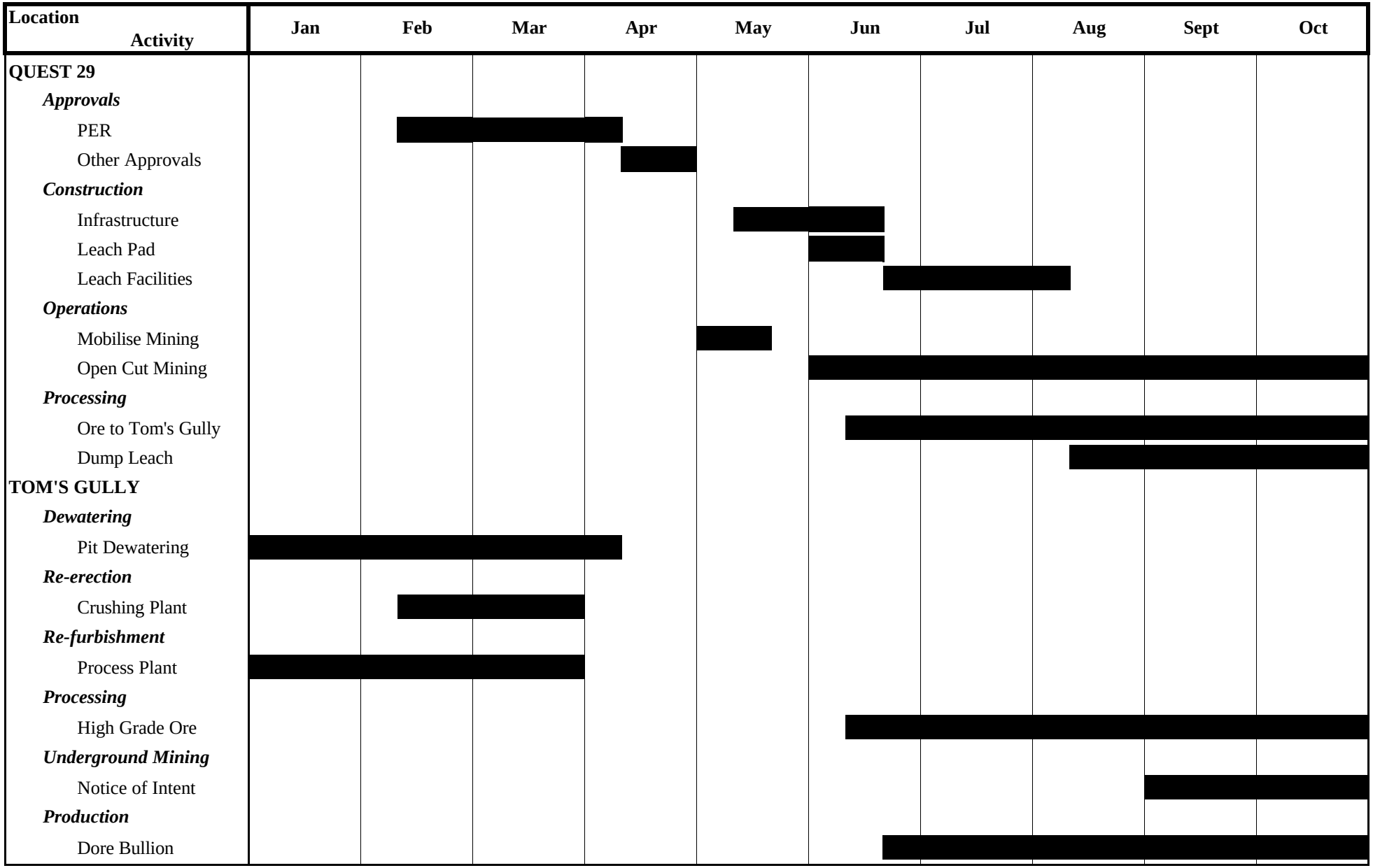
The crushing plant at Tom's Gully will be erected during the 1998/1999 wet season.

Mining and ore processing will be undertaken at the Quest 29 site for at least 2 years. This will depend on exploration success, as well as proposed mining at Tom's Gully.

During the 1998/1999 wet season, it is proposed to complete dewatering of the Tom's Gully open pit. Water release has been undertaken by Sirocco under approved licenses over the 1996/1997 and 1997/1998 wet seasons. Sirocco has performed to the terms and conditions of the licenses and will continue to do so.

An indicative program of key operations is shown in **Figure 2-3**.

Figure 2.3: **Timetable for Operations**



Once the open pit and decline have been dewatered, Sirocco intends to investigate the feasibility of developing an underground mine on the known resource at Tom's Gully. During 1999, once the Quest 29 operation is running smoothly, it is Sirocco's intentions to undertake some exploration development work as part of a feasibility study into commencing mining at Tom's Gully. This will be undertaken progressively during 1999 in order that a feasibility study and a mine operating plan can be prepared for the Northern Territory Government approval to commence mining operations from underground. If this is successful, it is proposed to commence operations in early 2000.

This will have the affect of lengthening the life of the Quest 29 operation as the Tom's Gully CIL plant will be treating blended ore from Tom's Gully underground as well as Quest 29.

Progressive rehabilitation at the Quest 29 site will commence as soon as practicable and will continue throughout the life of the operation. Final rehabilitation will be undertaken at the end of the overall operation, as well as at the end of individual pit operations.

2.2 Construction Operations

2.2.1 Programme, workforce and accommodation

The construction programme will be undertaken commencing in early April and continuing through as required for 3 – 4 months. It will comprise a workforce that will essentially become part of the operations workforce. Thus most of the roads and civil works will be constructed using the mining contractors equipment and workforce. Specialist workers will be required from time to time during the construction period, eg when the leach pad liner is being laid and welded, however, this will be done using a specialist contractor.

The construction works will be kept to bare necessity in order to keep any site disturbance to a minimum.

Workers will be accommodated at the nearby Bark Hut or Corroboree Roadhouses. Consideration is still being given to busing workers to site from Palmerston and Humpty Doo. A maximum of 15 construction workers will be on site at any one time.

2.2.2 Material Requirements

Materials that will be required for construction at Quest 29 are shown in *Table 2-1* as follows:

Table 2-1: **Construction Materials**

Materials	Source	Quantities (approx.)
Concrete for footings and plinths	Darwin	$25m^3$
HDPE liner for the leach pad and ponds	Interstate	$45{,}000m^2$
Clay lining for the siltation pond	Local	$400\ m^3$
Mechanical and electrical equipment for the leach pad	Various	As required
Power generator and diesel tank	Darwin	Single
Site office and facilities	Darwin	Portacabin
Steel framed roof for workshop	Darwin	As required
Security fencing	Darwin	As required

All of the materials will be sourced locally or in Darwin, except specialist material such as the HDPE liner which may need to be sourced elsewhere and transported to Darwin. Some of the materials are already owned by Sirocco eg the carbon columns.

No specialist transportation or storage is required. Transport using normal semi trailers is envisaged. Temporary storage of some materials may occur at the Tom's Gully site until secure storage facilities have been finished at Quest 29.

2.2.3 Standards, site management and supervision

All site works will be built to the relevant Australian Standard. Relevant testing of materials will be undertaken using NATA certified laboratories.

The works will be undertaken under the supervision of the Tom's Gully Mine Manager as well as the Manager of the relevant contractor. Sirocco's OH & S manual and site procedures manual will be issued to all employees and contractors and enforced by the Mine Manager or his nominee.

2.2.4 Site preparation and erosion control

Site access already exists; site works will only be required to repair the existing site access road after the wet season. Any road materials will be sourced from existing borrow pits.

Haul roads will be constructed on the site using inert oxide material from the open pits where possible. This material will also be used to construct the planned dams and diversion berm. Sufficient clay material exists in the overburden of the Zamu (Dolerite) pit to provide for the clay lining requirements of the dams.

Earthmoving will be undertaken after topsoil stripping and stockpiling for rehabilitation, by the mining fleet using a conventional excavator / truck configuration. Drill and blast methods are not envisaged for civil works, although some bulldozer ripping may be required.

Haul roads and the site access road will be constructed to ensure that soil erosion is minimised. Re-vegetation of stripped areas will be encouraged to reduce potential erosion. Catch drains and other devices will be used to ensure any runoff is properly controlled.

The area that will be disturbed by site works is shown on the accompanying site plans (**Figures 2.1 and 2.2**) and covers approximately 33.5 Ha.

2.2.5 Construction wastes and disposal methods

The company will instruct and actively supervise contractors to comply with the following waste disposal methods:

- Waste material from construction activities will be transported to the proposed waste dump sites for subsequent burial upon commencement of mining activities;
- Combustible material will be burnt prior to waste rock being dumped; and
- All waste oils and solvents will be removed from site for recycling.

2.3 Mining Development & Operations

2.3.1 Geology & Mineralisation

The Company's projects in the Mount Bundey area cover early Proterozoic rocks assigned to the Wildman Siltstone, Koolpin Formation, Gerowie Tuff, Mount Bonnie Formation, and Burrell Creek Formation. Zamu Dolerite, commonly as sills, intrudes the Koolpin Formation. These rocks tend to be moderately to tightly folded with fold axes striking roughly south, with variable plunges either to the north or south. At Mount Bundey, later early Proterozoic Mount Bundey Granite and Mount Goyder Syenite intrude this sequence of folded rocks. Regional metamorphism is lower greenschist but this has been locally overprinted by thermal metamorphism in the granite aureoles.

Younger rocks may have covered the Mount Bundey area but these have been eroded away. Alluvium (black soil) covers the area extensively. The 1:100,000 Mary River - Point Stuart geology map and monologue explains the regional geology in more detail (Stuart-Smith et al, 1978).

The Quest 29 prospect covers rocks of the Koolpin Formation overlain by Gerowie Tuff. A sill of Zamu Dolerite intrudes the Koolpin Formation. The Sirocco leases are located along the trend of an anticlinal structure. The Koolpin Formation comprises meta-pelites and cherts. These may be laminated and contain pyrite and pyrrhotite. The Gerowie Tuff comprises a silicified meta-siltstone. Previous exploration located gold mineralisation in a complex array of narrow quartz sulphide veins in the Zamu (Dolerite) [ZDZ]. Gold mineralisation has now also been found in the Koolpin Formation to the west of the anticline at West Koolpin [WKZ] as well as at Taipan Hill, and North Koolpin. The mineralisation at all these prospects is structurally controlled.

It is intended to mine the oxide portion of the pits initially. Low grade (nominally >0.4 g/t Au) ore will be placed on the dump leach pad and high grade (nominally >1.0 g/t Au) ore will be trucked to Tom's Gully for processing through the CIL plant. Only high grade ore will be mined below the base of oxidation. The Koolpin style ores are preg-robbing in the primary zone and unsuitable for dump leaching. There is very little low grade ore in the Zamu ore reserve.

2.3.2 Pit Design

Sirocco's consultant mining engineers (Australian Mine Design and Development [AMDAD]) have designed shallow open pits for the WKZ, ZDZ and Taipan Hill resources. The pits have been essentially finalised, although minor adjustments to the final shape may take place closer to the decision to mine.

These designs have been based on the following parameters:

WKZ Pit

- 15m wide ramp at 1 in 8;
- Overall wall angle 45 degrees;
- East wall: 50 degree batters, 2.5m berm;
- West wall: 55 degree batters, 4.5m berm;
- 15m high berms;
- Pit base RL 485;
- 2 x "goodbye" cuts to RL 477.5 and RL 480; and
- Length 320m, width 90m, depth 50m.

ZDZ Pit

- 10m wide ramp at 1 in 8;
- West wall: 55 degree batters, 4.5m berm;
- East wall: 50 degree batters, 2.5m berm excluding SE quadrant;
- East wall (SE Quadrant): 30 degree batters, from RL 475 to RL 460;
- 15m high berms;
- Pit base RL 460;
- 2 x "goodbye" cuts from RL 460 to RL 455 and from RL 465 to RL 455; and
- Length 300m, width 120m, depth 45m.

Taipan Hill Pit

- 10m wide ramp at 1 in 8, down to RL 475 then 10m wide down to base;
- Overall wall angle 45 degrees;
- East wall: 50 degree batters, 2.5m berm;
- West wall: 55 degree batters, 4.5m berm;
- 15m high berms;
- Pit base RL 470; and
- Length 190m, width 105m, depth 40m.

Pits have not yet been designed for the other resources. Further exploration drilling is required to outline ore reserves before pits can be designed.

The preliminary design base for all the pits is less than 50m, reflecting the current base of drilling.

The pit designs are shown on the location plans. Typical geological sections of each pit are attached to this report (**Appendix 2-2**).

2.3.3 Mining

It is planned to mine the planned pits at Quest 29 using conventional drill and blast, truck / excavator operations except in the near surface oxidised zones. It is anticipated that these zones will be able to be mined by a simple excavator / truck operation or by ripping with a bulldozer, followed by extraction.

Mine operations have been based on the following considerations:

- The WKZ orebody is on the side of a hill, whereas the ZDZ orebody is in a valley near a creek junction;
- The WKZ orebody has a low waste : ore ratio and appears more amenable for processing, based on the metallurgical test work;
- The Taipan Hill orebody has a higher waste : ore ratio and similar metallurgy to the WKZ ore;
- The ZDZ orebody has a higher waste : ore ratio again and appears less amenable, except in the top 10 - 12 metres (where there is limited ore);
- Grade increases with depth for both the WKZ and ZDZ orebodies;
- The WKZ orebody is soft (based on the grinding tests);
- Waste characterisation studies; and
- Some small zones of shallow (<10m), high grade (>3.0 g/t Au) oxide ore may be amenable to early mining (North ZDZ Pits) and the top zones of all the other pits. Exploration drilling is being completed to delineate these reserves and evaluate the potential for start-up mining

With these considerations in mind, it was decided that a schedule should be based upon mining the high grade upper zones first, then the WKZ and Taipan Hill orebodies in Year 1, followed by the ZDZ and North Koolpin orebodies in Year 2.

Ore Reserves have been estimated as shown in *Table 2.2*.

Table2.2: **Quest 29 Ore Reserves**

Orebody	Tonnes	Grade (g/t Au)	Gold (oz)	Strip Ratio
ZDZ (starter)	**14,400**	**4.48**	**2,080**	**3.2 : 1**
WKZ	**439,000**	**1.36**	**19,200**	**1.2 : 1**
Low Grade	238,000	0.59	4,500	
High Grade	201,000	2.27	14,700	
Taipan Hill	**153,000**	**1.43**	**7,000**	**3.4 : 1**
Low Grade	104,000	0.72	2,400	
High Grade	49,000	2.95	4,600	
ZDZ	**228,000**	**2.81**	**20,600**	**6.4 : 1**
Low Grade	53,000	0.68	1,200	
High Grade	175,000	3.45	19,400	
TOTAL	**834,400**	**1.82**	**48,880**	
Low Grade	395,000	0.63	8,100	
High Grade	439,400	2.89	40,780	

Because the ZDZ orebody is in the bottom of a valley, it will require more dewatering, in addition, because of the proximity of two intersecting creeks, a bund wall will need to be constructed on the western and southern sides of the pit. The bund walls will be built with 'free-digging' waste stripped from the top 10m of the ZDZ pit. This will reduce mining costs at the ZDZ pit.

In order to mine the Pits over 2 years about 64,000 bcm per month will need to be mined (2,100 bcm per day). The exact roster needs to be agreed with the mining contractor when that is finalised. However, at this stage Sirocco is planning a 24 hour per day, 7 day per week mining roster, as this is the most efficient roster for the contractor.

2.3.4 Drilling and Blasting

All the pits will be mined using drill and blast mining techniques below the base of the soft oxide material. The initial design for the blasting will not be finalised until a mining contractor has been selected. All blasting will be undertaken during daylight hours only. Indicative blasting parameters have been selected as follows:

- Frequency – 1 to 2 blasts per week;
- Minimum size wet season - 130 to 200 holes (dependent on hole size);
- Nominal hole pattern - 3.3m by 3.8m (staggered); and
- Blast medium – ANFO (dry conditions) or Powergel / DP370 (wet conditions).

2.3.5 Clearing

The area that will need to be cleared will comprise the following:

- surface areas of each of the proposed pits;
- the waste dump sites;
- the dump leach site;
- the high grade ore stockpile site;

- the area of the haul roads;
- the siltation pond and diversion berm walls; and
- smaller areas for the office, mine workshop and facilities.

All of these areas are shown on the attached site plan. The total area of clearing will be about 33.5 Ha.

Erosion control will be undertaken as discussed in section 2.2.4. and every effort will be made to minimise disturbance to existing landforms where possible.

2.3.6 Borrow Materials

Borrow materials for the haul roads will be sourced from oxide materials mined from the top of the open pit.

Screened material from the top of the open pits will be used to form a protective layer on top of the membrane for the dump leach pad. As an alternative, consideration is being given to accessing some of the sized, crushed material from the spent heaps at Rustlers Roost to form this protective layer. This requires the permission of Williams.

2.3.7 Project Extensions

Sirocco will be actively exploring within the tenements under its control during the next dry season, once the project has been brought into production. This will be aimed at extending the life of the Quest 29 operation as well as identifying further resources away from the Quest 29 area. It is likely that these will be similar in nature, and hence similar style operations will be contemplated.

In the immediate Quest 29 area, the North Koolpin resource will be targeted to enable a reserve to be delineated. Other targets include the Taipan extensions, Mobile Hill and the general Saddle prospect area. It is likely that further resources of the Taipan Hill type will be delineated in these areas and these will be described in detail in future operational plans.

2.4 Treatment Process & Products

2.4.1 Ore

Ore will be sourced from the open pits as described in section 2.3.3. High grade (>1.0 g/t Au) ore will be stockpiled, loaded and transported to the existing Tom's Gully CIL process plant for processing and recovery of dore bullion (gold & silver recovery). Low grade ore will be placed on the leach pad, leached and dore bullion will be produced as well (at Tom's Gully).

The ore will be grade controlled such that the grade of ore trucked to Tom's Gully has a grade of at least 2.5 g/t Au. The low grade will be about 0.7 g/t Au, except where high grade zones are mined especially for dump leaching (as will most likely be the case for the North Koolpin resource).

The primary objective of the dump leaching operation is to provide incremental revenue from the low grade that would otherwise be waste and hence an operating cost. Once the operation is established, it can also process ore that cannot be economically transported to Tom's Gully, but which is profitable to process using this type of process route.

2.4.2 Ore Characterisation

Metallurgical testwork has been undertaken, primarily on the Zamu (Dolerite) and West Koolpin ore. Work has also been undertaken on Tom's Gully ore, primarily to investigate the potential for improving the recovery of gold from the sulphide fraction.

Bottle Roll Testwork

A selection of composite samples was collected from 1997 drilling residues on site by tube coring. These samples were composited at the laboratory into 33 composite samples (15 from the WKZ and 18 from the ZDZ) for bottle roll testwork.

Based on the metallurgical response, the programme clearly identified two main ore types in each mineralised zone, as well as a possible 'mixed or transition zone' in the ZDZ. Thus a WKZ Oxide and Primary ore type was identified, as was a ZDZ Oxide, Primary and Transition type. The results of this bottle roll programme were encouraging.

Development Programme

A development programme was undertaken to determine standard cyanide leach parameters and optimise grind sizes for all ore types identified by the bottle roll testwork. The programme also examined the potential for gravity concentration and fine grinding for sulphide and transition ore types. Samples were also examined for mineralogy.

A comparison of simple cyanidation versus CIL was undertaken. This showed that the WKZ and ZDZ oxide samples leached well (>90% recoveries were obtained. The WKZ primary was preg robbing but >85% recovery was obtained in the CIL test. Recoveries decreased with depth from the ZDZ oxide to the ZDZ primary, from 97% (oxide) to 76% (transition) to 62% (primary). Oxidation tests showed that the ZDZ primary response could be improved by roasting (non-optimised >80% recovery).

Design Criteria Testwork

Design criteria testwork has also been undertaken on core samples from the WKZ and ZDZ ores.

This showed that the ores had a low abrasion index (0.023 – 0.170) and Bond Ball mill work indices varying from 7.6 kWh/t (Oxide) to 17.7 – 18.6 kWh/t (primary)

Near optimum leach conditions for Oxide ore (WKZ) were a p80 grind size of 80 microns, a leach density of 35% solids with leaching at pH 10 to 11 under CIL conditions and a cyanide consumption of 0.7 to 0.9 kg/t. Hydrated lime consumption was 3.2 kg/t. A gold extraction of 94.6% was obtained under these conditions.

2.4.3 Process Route

CIL

As previously described, it is intended that the high grade ore (>1.0 g/t Au) will be processed through the existing Tom's Gully CIL Plant.

At Tom's Gully, ore will be fed to an open coarse ore stockpile where it can be blended to provide a selected crusher feed. The ore will be fed over a grizzly to a jaw crusher by front end loader (FEL). Jaw crushed ore will be secondary crushed in open circuit in a standard cone crusher which discharges to a double deck screen with a lower deck screen opening of

12.7 mm. Screen oversize will be tertiary crushed in a short head cone crusher and re-cycled to the double deck screen. Fine crushed ore will be stockpiled in a 5,000 t stockpile. Tertiary crushing may not be required for Quest 29 oxide ore.

Fine ore will be reclaimed by FEL and fed into a hopper from which it will be withdrawn at the selected feed rate to feed the closed circuit 600 kW ball mill. The mill is closed with 6 operating 250 mm hydrocyclones to give a product sizing of approximately 80% passing 75 µm.

In the early stages of operations, when only oxide ore is being treated, the cyclone overflow will be fed directly to the CIL feed thickener. As increasing quantities of sulphides occur in the mill circuit, it is proposed that the cyclone overflow will be fed to a flotation circuit (not yet constructed).

Gold will be extracted from the CIL feed in a carbon-in-leach circuit to minimise the gold losses in preg-robbing graphite. Loaded carbon will be treated in a standard AARL (Anglo-American Research Laboratories) gold elution circuit with acid wash capabilities. Dore bullion will be the final on-site product. This will be transported off-site for refining using a security carrier.

Tailings will be disposed of in the new existing tailings dam with water re-cycled from the dam to the plant re-cycled water tank.

Gold extractions are expected to range from >90% for total oxide down to about 75% for most refractory ores. It is currently thought that all feed in Year 1 will be oxide, with sulphide (refractory) ores being gradually blended in to the feed during Years 2 and 3. It is planned that the selected sulphide processing plant will be approved and installed during this period, in order to improve gold recoveries from 75%.

Dump Leach

As previously described, it is intended that the low grade ore (>0.4 g/t Au) will be processed using a dump leach facility at Quest 29. The design criteria for this operation are currently being finalised. Preliminary data suggests the process route will be very close to that described.

The leach pad will be typically sloped between 2% and 5%, and positioned to utilise natural slopes to reduce civil construction costs. The Pad will be located as shown on **Figure 2.1**.

The site will be prepared by removing vegetation and topsoil (which will be stockpiled). A smooth surface is then consolidated using a grader, watercart and heavy roller. The perimeters are suitably bunded to ensure retention of gold solutions. A 1 mm thick HDPE (high density polyethylene) liner will be installed over the entire area of the pads including the bunded perimeter. The liner will be welded and carefully scrutinised for holes.

100 mm slotted drain coil is placed on top of the HDPE before covering and ore loading, to assist solution flow through the heap. The drain coil is spaced 3 - 5 metres apart depending on the pad slope. The liner will be covered with a 300 mm layer of appropriate medium screened from the oxide material at the top of the pit. Ore is directly hauled to the Pad during mining operations. Ore is placed on the Leach Pad sequentially so that sections of the Pad that are producing gold are constantly being replenished to provide predictable cashflow. Dimensions of each cell will be in the vicinity of 50m - 60 m wide and 150m – 200m deep with the potential for these to be constructed progressively as cashflow and ore supply dictate.

Ore is placed on a pre-determined area of heap with care. An access point is established and finer ore is used, where possible, to create a tipping area. Loads of ore are dumped short of the tipping face and bulldozed off to advance the tipping face across the section of the pad. An initial layer of 1.2 to 1.7 metres high is progressively extended until the desired area is covered. The face height is determined by the pad slope and needs to be high enough to minimise compaction of the heap.

Each section is then built up to a lift height of 5 metres, with 3 additional layers being constructed in a similar fashion to the above. Lime is added between each layer of ore, the bottom lime layer being used as a marker to protect the liner. In addition, the heap may be ripped using a bulldozer between each layer, depending on the amount of compaction during construction. Lime is added for pH control probably at a rate of about 3.5 kg / tonne.

The success of dump leaching using heaps constructed in this way is largely a factor of decompaction allowing improved solution permeability. This also may decrease the size of large ore blocks. An alternative to bulldozer ripping is to turn the heap using an excavator. This will be carefully monitored to determine the most efficient method for Quest 29 ore.

An irrigation network is placed on the section to be irrigated and connected to the barren line, which supplies solution from the Barren Pond to the Leach Pond. Sodium Cyanide is dosed into the barren line to build up its concentration to about 300 ppm. Once the pad is supersaturated, pregnant solution is collected via a V-notch weir box and is pumped to the Pregnant Pond before being sent to the Adsorption Circuit.

It is proposed to irrigate the pad using a wobbler sprinkler system at about 12 l/m^2/hour.

Solution is pumped from the pregnant pond to carbon adsorption columns at the process plant. The gold is adsorbed onto carbon as it passes through the columns. Loaded carbon will be placed in secure containers, 1 tonne at a time and trucked to Tom's Gully for gold recovery and for carbon regeneration.

2.4.4 Inputs and Outputs

Dump Leach

Reagents and services necessary for the operation of the dump leach processing plant are shown schematically ion **Figure 2.4**. These include:

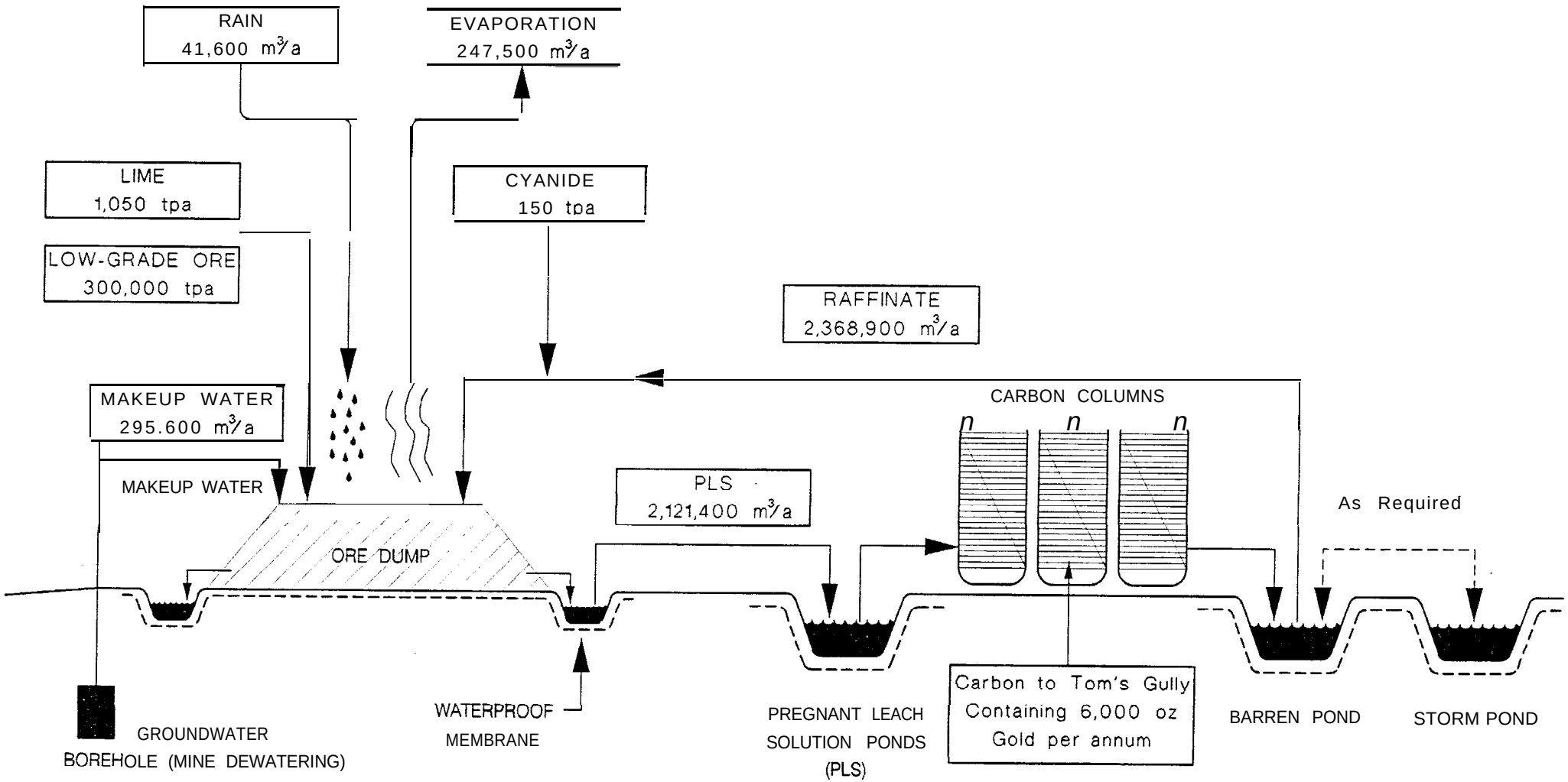
Lime - Lime in the form of dry hydrated lime ($CaCO_3$) is used for pH control in the Dump. The lime is delivered to Tom's Gully in bulker bags and trucked to Quest 29 as needed. The lime is spread in layers as the ore is dumped, at the design dosage rate.

Cyanide - Cyanide in the form of sodium cyanide (NaCN) solution at approximately 300 ppm is dosed to the barren line. Cyanide is delivered to Tom's Gully in dry bulk form in bulker bags and trucked to Quest 29 as needed. Cyanide solution is prepared by dissolution of the solid cyanide in water. An agitating mixing tank, storage tank and dosing pumps are provided for this purpose.

Minimal reagent stocks as determined for efficient operation will be stored at Quest 29. The bulk of stocks will be held at Tom's Gully and controlled from this site.

The dump will be built at a rate of about 300,000 tpa. At the design dosage rate of 0.5 kg/t NaCN and 3.5 kg/t $CaCO_3$, about 150 t of NaCN and 1,050 t of $CaCO_3$ will be used per annum. It will require a site area of about 250m x 250m per lift.

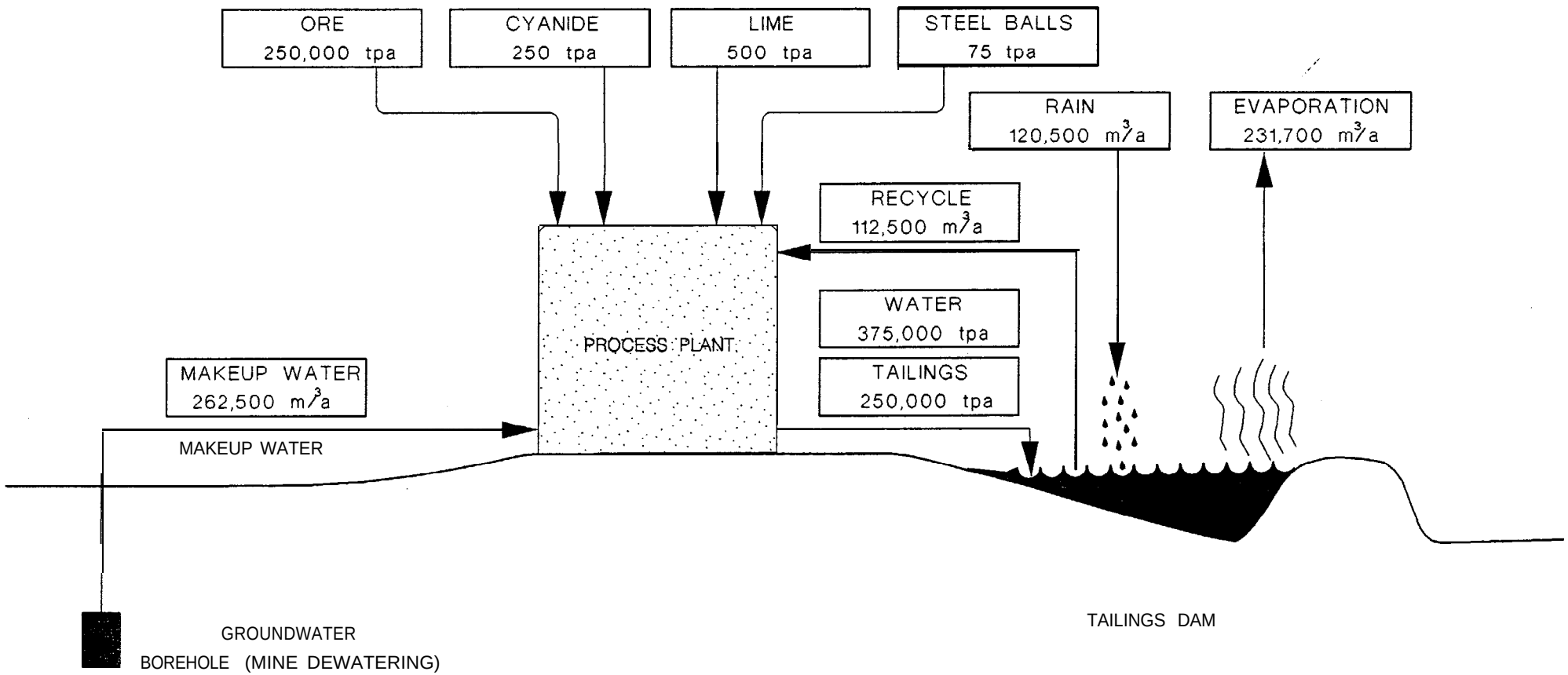
Figure 2.4 Dump Leach Mass Balance



NOTE: All quantities are averages and approximate.

tpa=Tonnes per annum (year)
m³/a=Cubic metres per annum

Figure 2.5 CIL Mass Balance



NOTE: Ail quantities are averages and approximate.

tpa=Tonnes per annum (year)
m³ /a-Cubic metres per annum

CIL

Reagents and services necessary for the operation of the CIL processing plant are shown schematically ion **Figure 2.5**.

2.5 Waste Rock Dumps & Stockpiles

2.5.1 Dimensions of Dumps

Waste rock dumps will be placed as close as possible to the pits. The currently proposed sites for the waste rock dumps are shown on the attached site plan. The amounts of waste rock that will require dumping are summarised in *Table 2.3*.

Table 2.3: **In Situ Pit Waste Volumes**

Pit	In Situ Waste Volume m3
WKZ	235,000
Taipan Hill	165,000
ZDZ	670,000
Total	**1,070,000**

It is planned to construct the waste dumps as close as possible to each pit ramp. Thus a Taipan Hill waste dump will be located next to the Taipan Hill pit. Final dimensions will be about 150m x 90m x 22.5m (3 lifts) with a crest RL of about 525 RL. The WKZ waste dump will be located next to the WKZ ramp and will be about 300m x 80m x 22.5m (3 lifts). This dump will slope down the valley from about 520 RL to 500 RL. The crest height of the dump will be about 535 RL. The Zamu and North Zamu waste dumps will be located on two sites near to the ramps. They will have areal dimensions of about 150m x 150m and 90m x 100m. Final height will depend on whether some of the waste is backfilled into the WKZ and Taipan Hill pits. The proposed locations are shown on the site layout plan.

A temporary stockpile for high grade (1.0 g/t Au) ore will be sited as shown on the site layout plan. This site will only be used for the duration of operations.

The spent dump leach pad will be progressively rehabilitated once operations have been completed at the site as shown on the site layout plan.

2.5.2 Location of Dumps

The dumps have been sited as shown on the attached site layout plans. The principal reasons for these site locations are:

- Proximity to open pits to minimise haul distances
- Areas less prone to possible sheet flooding and consequent erosion in the wet season
- Areas are not gold mineralised
- Area where catchment drainage control will operate

In order to minimise disturbance to the local environment a catchment has been selected to contain all site works, apart from the access road and the dump leach facility.

Any acid rock drainage will be controlled in a number of ways, by direct control via a catch drain and dam at the toe of the dump. Secondary control will be via a downstream ‘siltation

pond' designed to control water flows off the site. Downstream control will be effected by the placement of a Reed bed filter downstream of the siltation pond to remove any small amounts of toxicity from the water.

Once operations have ceased, the ZDZ pit will be allowed to flood. This can also be used as an overflow pond during the wet season for any acid effluent from the upstream dumps. Any effluent generated in this way will be minimised by minimising the amount of potentially acid generating material that is encapsulated in the dumps. It is intended that this type of material will be placed in the WKZ and Taipan Hill pits when they have been mined out, if at all possible.

Surface water flows, during the wet season will be diverted around the dumps and pits and directed into the 'siltation pond' before being released through the spillways from the siltation pond.

The final landform of the dumps and stockpiles will be slopes between a 1:3 and a 1:5 gradient, which experience and erosion tendencies will dictate over time. The local topography in the Quest 29 area is predominantly steep sided hills and rocky outcrops, so the dumps once re-vegetated will blend in with the local topography.

2.5.3 Waste Rock Characterisation

Waste rock characterisation has been undertaken to identify potentially acid forming material that can be selectively managed in the waste dump(s). Woodward Clyde has undertaken a preliminary waste rock characterisation study for the Company. This study classified high grade and low grade ores as well as oxide and fresh waste for the three proposed pits, and for the North Koolpin inferred resource. The results of the study are summarised in *Table 5.1* in section 5.0 of this report. A copy of the study is attached as **Appendix 5.1.**

2.5.4 Dump Construction

The waste dump(s) will be constructed in sequentially built lifts. It is planned that initially the dump(s) will be built by 'valley fill' methods and then raised to the target height of 20m - 25 m. Dump trucks will end dump each 7.5 m lift at the angle of repose (37^{o}). The overall slope of the dump will be 29^{o}.

The dump(s) will be constructed in such a way that acid-forming material can be encapsulated within non acid-forming material. As an alternative consideration will be given to dumping this type of material in worked out pits.

2.6 Tailings

2.6.1 Existing Dams

There are two tailings dams on the Tom's Gully site. One contains tailings from the previous operations; the other was built as a new facility by Kakadu resources and contains a small amount of tailings from this more recent operation.

The old tailings dam at Tom's Gully is a 'valley fill' type dam that is not completely full. It is estimated to contain approximately 250,000 tonnes of tailings. The new tailings dam is a 'turkeys nest' type dam that is essentially empty. It was sized to contain all the tailings from the previous operation, ie 350,000 tonnes.

The dam will be adequate for about 18 months of operations. It will then require enlarging, or alternatively the old tailings dam will be enlarged. This will be investigated during the

first year of operations. Any expansion of the tailings dams will be undertaken in close co-operation with the responsible Government Authorities.

2.6.2 Acid Mine Drainage

Once the Tom's Gully pit and decline have been de-watered, any water inflows will be managed by pumping to the artificial wetland being created by the landowner. Reed bed filtration will be used to remove any small amounts of toxicity from the water in a similar manner to that previously undertaken during the past operations. Bore sampling has previously shown that the groundwater has a pH varying from 5.4 to 7.1 (Kinhill PER – 1988).

2.6.3 Tailings Characteristics

New tailings will be pumped to the dam from the treatment plant through a continuously welded HDPE pipeline. The tailings will be ground slurry with a size of about 80% passing 75 μm. They will contain lime, free cyanide, cyanide wad, and some finely ground carbon. They will have a pH of about 10. Proposed cyanide levels in the dam will not exceed 50 ppm cyanide in wad.

A multi-element scan of the old tailings is included in the environmental management plan for re-treatment by Kakadu Resources. This report commented 'Of the elements in the analysis, lead is the most significant in terms of environmental impact. The solubility of lead is likely to be low in a tailings where sulphate salts are present'

Water balance calculations show that operations will be directed to optimising recovery of water to minimise the requirement for make-up water from other sources. Adequate storage is provided for a 1: 100 return period 72 hour storm.

2.7 Water Management

2.7.1 Water Requirements

Water will be required at Quest 29 during mining and processing operations as follows:

- Potable water;
- Process Water, including safety showers; and
- Dust Suppression.

A drinking water contractor will supply potable water from off-site. This water will be available in the office, crib room. first aid room and workshop.

Process water will be supplied from dewatering bores near the pits for a total of 190,000m3 required by the process predominantly through the dry season months (**Appendix 2-1**). Fresh makeup process water will be piped to the safety showers, clearly marked not for drinking purposes. Most process water will come from the barren solution pond at the dump leach operation. The operation will aim to minimise the use of make up water.

Dust suppression water will also come from pit dewatering bores pumped to a header tank standpipe arrangement controlled by the Mining contractor.

2.7.2 Drainage

Two unnamed streams drain the Quest 29 area, called No Name 1 and No Name 2. These are shown on **Figures 2.1 and 2.2**. No Name 1 creek draining the ZDZ pit area has a

catchment area of about 1.1 square kilometres (sq.km). This joins a larger tributary, No Name 2 creek, with a catchment of approximately 2.6 sq.km.

2.7.3 Control Strategies

Control strategies to be adopted by the Company will be:

Diversionary Berms – To ensure creek flow and floodwaters are diverted around active mining areas. This will achieve two main goals in that Pits will not be subject to excess water from upstream catchments and also this water will be directed away from disturbed areas to minimise sediment transport.

Siltation Dam – To enable suspended solids that are picked up from mining areas to be deposited within the confines of the Dam rather than allowed to disperse over downstream catchment and run-off areas.

Process Storage – provide sufficient storage capacity to contain all Process solutions and run-offs rather than require discharge from this area.

Wetland Filter - In the event that discharge from the process area is unavoidable or that groundwater discharge from Pit de-watering bores contains unacceptably high concentrations of contaminants the establishment of a Wetland filter is anticipated immediately downstream of the mine site.

Water Monitoring – The company will devise in conjunction with regulatory bodies a Monitoring regime to effectively assess the mines impact if any on the surrounding environment and allow for early detection of possible changes and/or effects.

2.7.4 Off-Site Discharge

Discharge from the Dump leach operation is expected to be kept to a minimum if required at all. Pond capacity will be such that given average or better rainfall including a 1: 100-year storm event solution off-flow will be completely contained. (**Appendix 2-1**)

Discharge from the Pit dewatering bores is expected to be a year round exercise however, a wetland filter is contemplated for all downstream water release. Release during the dry season months will be minimal however as the drop off in evaporation and rainfall events occur with the onset of the wet season this rate will increase.

Water quality will be closely monitored to ensure compliance with a wastewater discharge licence, which will be applied for annually as per waste discharge from the Tom's Gully site at present.

2.7.5 Water Balance

The water balance in **Appendix 2.1** uses data from the proposed Mining plan to model plant solution flows and required containment capacities for the first 18 months of production which will offer the worst case scenario in terms of containment required.

In the table actual data from site records (Tom's Gully) were used to show **(Rainfall average mm)**, these records were collected during the Carpentaria Gold and Kakadu Resources occupancies of the site and cover the years 1990 – 1995 inclusive.

Sirocco Resources compiled evaporation data used during processing operations at the Rustlers Roost Gold Mine an operation that is similar in style and closely located to that

proposed for Quest 29. Pan Evaporation rates have little bearing on actual rates as evaporation in this type of process is greatly enhanced with the use of Wobbler sprinkler irrigation. Based on this, evaporation losses as shown in the **(Evaporation Loss)** column from the spray system are expected to be in the region of 156,000m3 annually.

The catchment area **(Area under Irrigation)** is considered to be each complete cell surface area from the commencement of stacking of Ore on the Cell. Each cell has an approximate surface area of 8,400m2 and will contain when full 92,400t of ore.

Water required to achieve saturation is a function of water take-up in the heap before flow is achieved **(Spray to Saturation)**. 20% total moisture content is considered Industry standard for this purpose.

Storage Capacity is calculated giving as a minimum 4,000m3 of process solution in the process ponds at any time and deducting progressively from the Water gained through rainfall catchment.

As shown in the water balance for the Dump leach process a total of 190,000m3 of make-up water is required annually given a stacking rate of approximately 300,000tpa(**figure 2.4**).

Rainfall effects in the wettest months of December, January & February will create excesses of approximately 15,500m3 of solution in circuit, which will need either to be contained, or released under controlled circumstances.

Given that this solution will be gold bearing it is in the company's best interest to contain this solution for treatment through the process plant. Ponds will be designed to give a total containment capacity of 34,000m3 to give some leeway for extraordinary events and flexibility of process control.

2.8 Infrastructure

2.8.1 Buildings

Because the operation at Quest 29 will have a relatively short life and will be administered from Tom's Gully, offices, staff amenity and workshops at the site will be kept to a minimum.

Offices for the dump leach operation will comprise a porta-cabin with an office, a first aid room, and a crib room and toilet facilities. The mine offices will be determined by the requirements of the contractor. The Company will administer the mining operation from Tom's Gully.

Similarly, the Company will provide workshop facilities for Quest 29 at Tom's Gully. The mining contractor will need a concrete laydown area, with a roof, and a secure area for equipment storage. The exact size will be determined when the contractor has been selected.

2.8.2 Explosives

Explosives will be stored in an approved magazine to Australian Standards. The magazine will be supplied as part of the mining contract.

Studies by the Company has shown that ANFO will be used as an explosive in dry conditions whilst bulk emulsions will be required in wet conditions. Prilled ammonium nitrate (fertiliser) will be stored in the magazine and mixed with fuel oil on site as required. Powder factors, the weight of explosives per cubic metre of rock, and the frequency of blasts

will determine the quantity of ammonium nitrate to be stored no site at any one time. In the oxide zone approximately 4 tonnes per week will be consumed. This could rise to up to 10 tonnes per week in the primary zone of the ZDZ pit. Because of the proximity to supply, it is anticipated that minimum storage will be required on site.

Bulk emulsions will be prepared offsite and transported to site by the explosives contractor in an approved fashion. Small quantities of detonators will be stored in a separate approved facility.

Explosives will be transported to site using a licensed carrier in an approved fashion.

2.8.3 Hazardous Substances

The supply of hazardous substances will be on a free-in-store basis whereby transport is the contractor's responsibility up to the delivery point. Once on site a secure yard will serve as a cyanide warehouse. Quicklime will be stored in a silo. Access for supply vehicles and a forklift will be provided.

Cyanide will be transported to site in sea-containers containing 20 individual 1tonne boxes. Quicklime will be brought in by a tanker and pneumatically transferred to the silo.

Cyanide containers will be recycled to the supplier.

2.8.4 Fuel, oil and lubricant storage

The fuel (diesel) supplier will provide the tanks and necessary dispensing apparatus with sufficient storage for 14 days operation to Australian Standards. This will provide adequate containment in the unlikely event of spillage.

2.8.5 Sewage and refuse disposal

Sewage disposal from ablution facilities will drain to installed septic systems utilising absorption trenches. These will be designed to approved Northern Territory Health standards.

Waste oils and solvents will be re-cycled. Non-recyclable flammable liquids will be burned in a designated area approved by the DME. Industrial refuse from the plant will be recycled where feasible. Under the mining contract, the contractor will be made responsible for disposal of their Industrial refuse according to the requirements of the DME.

Domestic refuse will be collected and returned to Tom's Gully for disposal in the designated disposal area.

2.8.6 Communications and security

Portable two-way radios will be used to communicate around the site and with the Tom's Gully site.

The process plant, leach pad, and ponds as well as the mine contractor's compound and the reagents store will be enclosed by an approximately 1.8m high security fence. Entry to the processing area will be through one gate near the office.

Any bullion on site will be temporarily stored in the existing security area at Tom's Gully. Bullion will be transported off site for sale using security contractors.

2.8.7 Infrastructure alternatives

Infrastructure alternatives that could be applied to the project would be to duplicate many of the existing office buildings and process plant equipment (Gold Room & Carbon Stripping facility etc.) that already exist at the Tom's Gully mine site. However given the close proximity of Quest 29 to Tom's Gully and the tight economics of the venture these are not seen as being warranted or indeed necessary.

2.9 Transport Corridors

The project access from the Tom's Gully site is via the Arnhem Highway to the Rustlers Roost Mine turnoff, thence via a good quality unsealed road to the Quest 29 turnoff. This section of the road is a bush track, but has been substantially upgraded during recent exploration activities.

Some beneficial improvement is currently being undertaken by the landowner, on behalf of the Company. The aim is to provide an unsealed gravel road of similar quality to the Rustlers Roost access road by the commencement of operations next year.

The Company is also upgrading an existing road to the south of the Tom's Gully operation to ensure that all ore haulage is undertaken on gravel roads, and not along the Arnhem Highway.

Services vehicles will continue to use the existing site access. This will be restricted to vehicles no larger than those currently used by the Boral Quarries Mount Bundey operations.

En-route from the Rustlers Roost road to Quest 29 there are two potential wet season obstacles, these being minor wet season creeks which are subject to flooding during periods of localised rainfall. Temporary culverts have been installed at these two locations to minimise disturbance to creek flow characteristics and allow vehicular access year round to site.

Drainage in the form of table drains has been established to the proposed route to gauge the viability of year round access and haulage whilst attempting to minimise alterations to the natural flow of run-off waters.

The roads will be fenced as already agreed with the landowner to protect both stock and wild animal populations from increased vehicle movement.

2.10 Workforce

2.10.1 Number

During the construction phase of the operation, it is estimated that up to 15 workers will be required.

The Company will use contract mining services for the open cut mining services. This workforce is estimated at 25 people. Company employees will number approximately 17.

Each contractor will be responsible for recruitment of their workforce. The Company's workforce will be recruited from the region if at all possible.

Training will be available for the Company's operators.

2.10.2Health and Safety

The Company has a progressive policy towards the safety of its workforce and contractors. A St. John Ambulance Senior First Aid certificate will be a prerequisite to employment of which the company will take responsibility for renewals as they fall due. A Health Safety and Environmental Officer will be appointed to implement Company Policy with regard to Health and Safety issues. Primarily Tom's Gully will be set up with a dedicated fully equipped First Aid Room which will be the supply centre for Quest 29 which will have comprehensive First Aid Kits located at the Companies site office and also at the Earthmoving contractors Office/Crib room.

- Employee Safety

  A Company Occupational Health Safety and Induction Manual is to be issued to all employees on commencement. In addition compliance with the Northern Territory Mine Management Act and Regulations is Mandatory.

- Chemical Handling and Usage

  Usage of all hazardous and corrosive chemicals will be in accordance with Northern Territory regulations and will also be taken under advisement from chemical suppliers.

- Explosives

  The use and storage of explosives on site will be in strict compliance with the Northern Territory Mine Management Act and the Australian Dangerous goods Act.

- Public Safety

  It is not anticipated that public access to Quest 29 will be routinely required. All access to the site will be under escort from the Tom's Gully Mine site by Company personnel as the only transport route will be via an active mine haul road closed to the public.

2.10.3Education and Training

In accordance with the Northern Territory Mine Management Act, all employees with undertake an induction as part of training. Ongoing training will be undertaken as necessary in accordance with the requirement of a properly trained workforce of trained people doing appropriate jobs.

As part of the induction, the workforce will be provided with education to ensure that sites of historical and cultural significance are treated appropriately. Should any sites be identified, either of Aboriginal or historical significance by the relevant Departments conducting surveys the following will apply:

- These will form an addendum to the Company induction Manual with maps clearly illustrating their whereabouts. No unnecessary access will be granted to these area's and if in Danger of disturbance will be clearly marked or fenced.

- The company will request descriptions and where possible a short narrative on identified sites from The Aboriginal Area's Protection Authority or The Department of Lands Planning and Environment (Environment and Heritage Division) to ensure employees understand and respect these sites.

2.10.4 Accommodation

The Company does not expect to establish accommodation of any description at Quest 29. The locale of two nearby Roadhouses (Corroboree Park & Bark Hut) mean that Construction workers in the Preliminary stages and Mining and Operational personnel on commencement of operations can be housed in either of these if need be.

In addition infrastructure (minus buildings) still exist at the Tom's Gully site from past operations such that if during feasibility it is shown that Company supplied accommodation is the preferred option this could quite easily be restored to an operational status.

The company's philosophy at present is that employees will reside in the Darwin – Humpty Doo area.

2.10.5 Transportation

The Construction development phase for Quest 29 is expected to occupy six to eight weeks whereby heavy Earthmoving equipment will be mobilised to site. It is estimated that no more than twenty items of equipment will make up the Mining fleet and that they would be mobilised to site in this initial period.

Once mining has commenced a Road Train with a capacity of approximately 75t will be required to make approximately two hundred cycles per month between Quest 29 and Tom's Gully on the designated site access road.

Light vehicle movements will be strictly controlled on a 'needs only' basis given that the road to site will be an active haul road and thus access restricted.

3 Description of the Existing Environment

3.1 Biophysical Environment

3.1.1 Climate

The climate of the Darwin-Katherine region is broadly classified as tropical monsoon. It is characterised by seasonal shifting of the prevailing winds and consequent marked changes of air mass properties. Two distinct seasons can be identified, with two subsidiary transitional periods between them. The distinct seasons are commonly known as the wet and dry. The former period is commonly referred to as the monsoon season; a term which, although convenient, is somewhat exaggerated because of the imperfect development of the Australia monsoon (Gentilli, 1972).

The warm dry winter or dry season occurs from May to September. It is characterised by prevailing south easterly winds. The hot "dry-wet" transition from October to November has high humidity and variable winds. The wet season is a hot wet summer from December to March with dominant north west to westerly winds. The hot "wet-dry" transition of April has variable winds though dominantly westerly. Thunderstorms are still common but decrease markedly in intensity.

Long term weather rainfall records as determined by the Bureau of Meteorology are from Oenpelli. Data is available for the average rainfall received at Oenpelli from 1910 to date and Beatrice Hill from 1884 to 1992. The Company has used data collected at Tom's Gully between 1990 and 1995 to model the dump leach water balance

The area experiences high temperatures year round. Oenpelli has records dating back to 1963. The highest temperature recorded was in October 1987, reaching 42.2°C, the lowest was in July 1974 of 9°C. The average daily maximum temperatures range from 32-37°C, with the highest being recorded during the months of September to November. The daily minimum temperatures range from 18-24°C, the lowest occurring in June-August. Details and summaries are available at Oenpelli.

Evaporation data has been used from the Rustlers Roost Gold operation for modelling the dump leach water balance. This was collected during the life of the operation. The highest evaporation occurs during the latter half of the dry season, and the lowest evaporation occurs during the height of the wet season.

Wind data has been collected at Middle Point since 1965. These readings are taken at 9:00 am and would be indicative of wind patterns expected at the project. The main feature of the wind data is the predominance of the south easterly winds during the dry season and north to north westerly winds prevailing during the mid-wet season of December and January. Winds for the rest of the year are varied, though south easterly winds are still predominant.

3.1.2 Physical Setting

Topographically the project area is characterised by low, flat-topped hills with moderate to gentle slopes. Relief in the immediate vicinity is approximately forty metres AHD but it ranges from 30m to 190m AHD in the region.

The project abuts Marrakai Catchment however the majority of drainage is within Mount Bundey Creek Catchment. The latter forms a part of the Mary River Catchment.

Vegetation is characterised by eucalypt woodlands with tropical grass understoreys. These lie within the Tropical Floristic Zone (Burbidge, 1960) and Northern Savanna Region (Doing, 1981).

The project area is included in the broad-scale land system surveys and mapping of both Story *et. al.*, 1969 and Christian and Stewart, 1953. Forster and Fogarty, 1975 described land units for Mount Bundey Station of which the mining claims are a small part. Their study area is to the south west of the nearby Rustlers Roost mine.

Kinhill Engineers, Darwin completed a flora, fauna and soils study in 1993 for Stage 1 of the Rustlers Roost mine. The following excerpt from this report summarises the soils present in the Rustlers Roost area that are typical of the Quest 29 area as well:

Three distinctive soil types area associated with each plant community:

- Low Woodland - skeletal and gravelly yellow lithosoils;
- Open Forest - shallow lithosoils and deep red earths; and
- Low Open Woodland/Grassland – alluvium

3.1.3 Regional & Local Geology

The project area lies on the northern flank of the Pine Creek Inlier within a transgressive marine sequence dominated by folded shallow marine sediments of the Early Proterozoic South Alligator Group. In general the Pine Creek Inlier consists of an extensive, but poorly exposed sequence of Early Proterozoic sediments of low to medium metamorphic grade, which were deposited in a shallow intra-cratonic geosyncline. Cratonic basement consists of Late Archaean granites. The sediments were intruded and overlain by late Early Proterozoic felsic volcanism and by later platform sequences of Middle Proterozoic age.

The project area is underlain by shallow marine, iron rich and tuffaceous sediments of the South Alligator Group, which are openly to tightly folded about gently south plunging axes. The group includes the Koolpin Formation, Gerowie Tuff, Mount Bonnie Formation and the intrusive Zamu Dolerite. The Koolpin Formation consists of ferruginous siltstone and shale, with silicified haematite and chert breccias and minor silicified dolomite. The Gerowie Tuff consists predominantly of thinly interbedded fine grain sediments, glassy crystal tuffs and tuffaceous cherts. Both the Koolpin Formation and Gerowie Tuff show extensive attenuation at fold hinges. The Koolpin Formation and Zamu Dolerite occupy the major portion of the project area.
Conformably overlying the Mount Bonnie Formation is the Burrell Creek Formation of the Finniss River Group. This formation consists of flysch style sediments consisting predominantly of interbedded shale, millstone, phyllite and greywacke. Fluviatile sediments of the Mount Partridge Group unconformably underlie the South Alligator Group.

The Quest 29 Gold Project is underlain by folded and sheared sediments of the Koolpin Formation and dykes / sills of intrusive Zamu Dolerite.

Two main auriferous trends have been identified along approximately north-south trending sheared structures. The main prospects occur on shear zones within the Koolpin Formation and Zamu Dolerite.

Gold mineralisation at Quest 29 is related to a structurally prepared environment. In the Koolpin Formation the gold is hosted by weakly sulphidic (pyrite-arsenopyrite) carbonaceous siltstone sequences with minor quantities of thin quartz veining. The dominant mineralised shear direction is 350°-020° (ie. parallel to fold axes) dipping 20°-40° west.

In the Zamu Dolerite the gold is hosted by sulphidic (pyrite-arsenopyrite) shears within the Dolerite and along the western contact between the Dolerite and host sediments. The dominant mineralised shear direction is 350-020° (ie. parallel to fold axes) dipping 30-50° west within the Dolerite and steeply east on the eastern contact.

The siltstone units are comprised of varying amounts of quartz, chlorite, muscovite, kaolin, goethite, graphite and sulphides in the primary zone. These units weather to essentially similar mineralogy without the sulphides and the graphite and with increased clay and goethite. The Zamu Dolerite is comprised of varying quantities of quartz, chlorite, plagioclase, muscovite, K-felspar, Ca-amphibole, biotite, goethite and sulphides. On weathering the Dolerite is altered to smectite clay with K-felspar, goethite and minor amounts of mica.

The sediments are moderately folded about South West plunging fold axes which have near vertical axial planes. Fold axes plunge between 30° and 50° towards 170° to 200°. Folds are generally asymmetric with steeply dipping western limbs (40-65°) and more moderately dipping eastern limbs (30°-50°).

3.2 Hydrology and Water Quality

3.2.1 Local Catchment

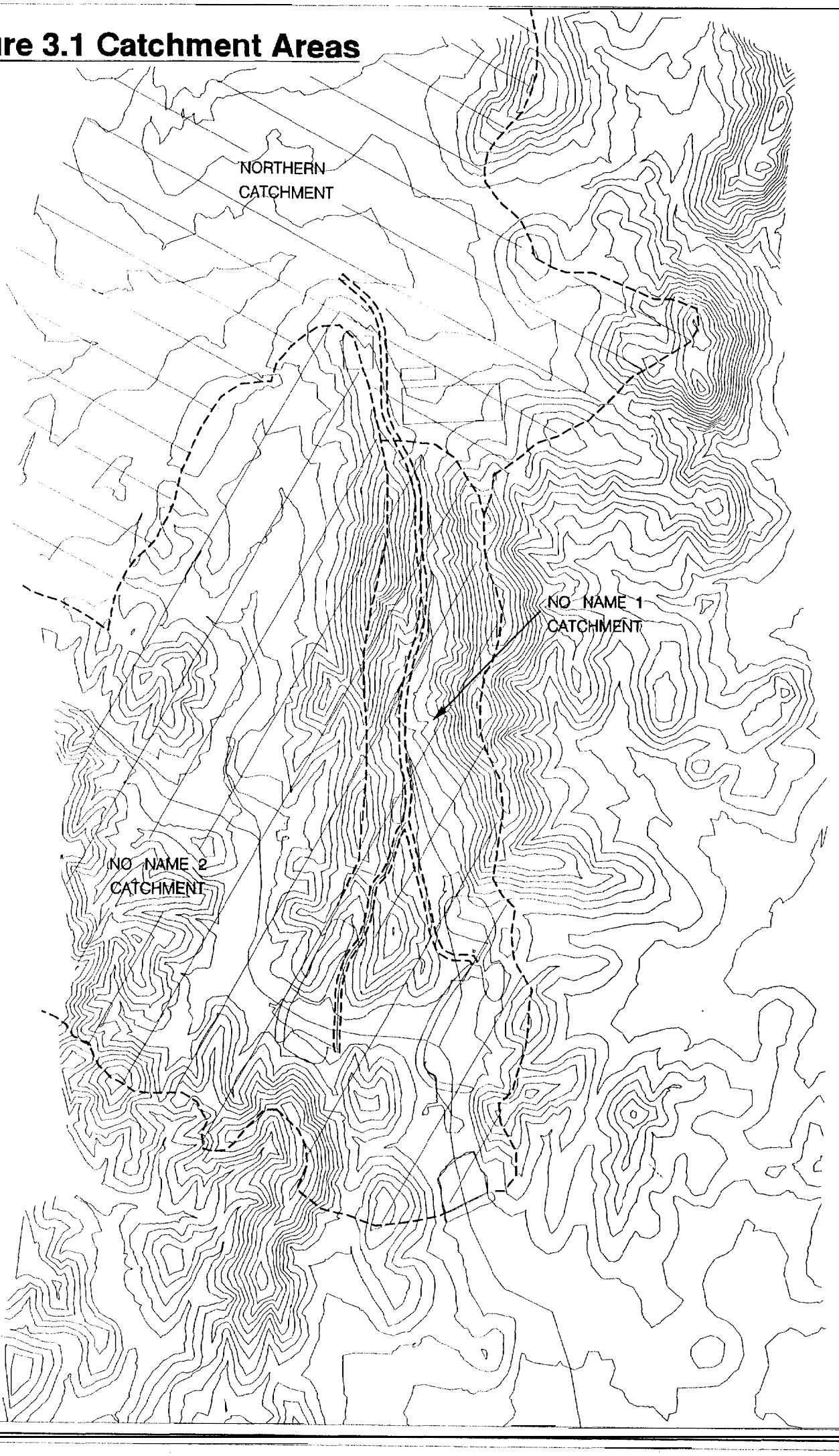
The project is situated in the headwaters of two No Name Creeks which ultimately flows south and into the McKinley River. North draining tributaries flow into Mt Bundey Creek and the Mary River. The local catchment comprises a series of small ridges and dissected hills, which are drained by small steep rivulets. These small valley systems converge into a single creek channel near the south east corner of the Sirocco mineral claims. The majority of the catchment upstream of here contains outcropping rock with skeletal soil cover. The drainages have shallow alluvium. The north south stream, No Name 1 Creek, through the centre of the area drains approximately 110 hectares. This joins a larger stream, No Name 2 Creek that drains an area of about 230 hectares. At the very northern end of the claims a separate catchment drains northerly and ultimately into Mt Bundey creek. **Figure 3.1** shows the catchments of these areas.

There are no records of licensed extraction or storage on these ephemeral Quest 29 creeks. The current surface water usage is limited to stock drinking water during the wet season.

Surface water quality data has been collected on the nearby Mount Bundey Creek near the Arnhem Highway by the Northern Territory Government, Carpentaria Gold and the Company as part of a check monitoring programme for the Tom's Gully Mine. Based on this, the upper reaches of Mount Bundey Creek are typically very slightly acidic and show a high variability in dissolved and suspended solids including sulphate, aluminium, iron and manganese.

Observations of the creek bed and banks during site activities in 1997 and 1998 within the headwaters catchment confirms that they are relatively stable. Therefore, suspended loads derived from upslope disturbance after intense rainfall events early in the wet season would dominate sediment transport. Sediment (siltation) traps have assisted in reducing the source of sediment from mine-sites during active mining, while rehabilitation will be the long-term remedy.

Figure 3.1 Catchment Areas



3.2.2 Water Quality

The site is situated near the northern flank of the Pine Creek Inlier, which is comprised of predominantly Proterozoic metasediments of the South Alligator Group. Groundwater has been intersected during mineral exploration and development drilling at Quest 29.

Aquifers are typically associated with increased structural deformation within the dolerite and metasediments as well as the interface between the oxidised and primary zones. The local aquifer system recharges by direct infiltration of rainfall and run-off through areas of aquifer outcrop or shallow subcrop and overlying cover materials. These conditions typify the project area. There are no reliable records available for prediction of wet season recharge.

Current usage is restricted to stock watering. Samples for baseline data purposes are currently being taken of ephemeral water flows both upstream and downstream of the proposed developments for water quality analysis.

Groundwater from the pit area is fresh with low total dissolved solids (TDS). Within the area, at both Tom's Gully and Rustlers Roost, low ionic concentrations have indicated the groundwater is relatively recently recharged. It is anticipated that this would be the same at Quest 29. However, it is proposed that trial pumping from existing boreholes will be undertaken to assess the groundwater conditions prior to the commencement of mining.

3.2.3 Catchments - Beneficial Use

Under the Water Act, waste discharge to or pollution of natural waters is only allowed by licensing and only in areas where the Beneficial Uses of the receiving waters has been formally declared by the Controller of Waters under the Water Act.

In the case of 'No Name' Creeks, the Beneficial Uses of the lower McKinley River have not been declared

The Company requires and has successfully obtained a Waste Discharge Licence on an annual basis at Tom's Gully to cover any wet season surplus water discharge requirements. Regular water samples are taken to evaluate background conditions in Mt Bundey Creek. It is not anticipated that a Waste Discharge Licence will be required for the Quest 29 operation.

3.3 Flora and Fauna

3.3.1 General

Kinhill Engineers Darwin completed a flora, fauna and soils survey over the majority of the Quest 29 project area when undertaking a study for the Rustlers Roost Project. This Flora, Fauna and Soils Study (DC2645) for the Rustler's Roost Gold Mine was reported by Kinhill Engineers Pty Ltd for Valdora Minerals NL in November 1993.

The following summary has been extracted from this report**:**

'The project area encompasses low rolling hills with deeper soils and outcropping laterite. The vegetation of these hills is low, open and largely deciduous; and, the dominants of the plateaus are taller and for the most part evergreen. Creek lines in the hills have a minimum of alluvium with the vegetation indistinguishable from the adjoining slopes; and, the lowermost basins and creek lines have varying degrees of silty alluvium and support a distinctive tree and grass flora.

Three plant communities have been mapped:

- Eucalyptus dichromophloia - E. tintinnans Low Woodland;
- Eucalyptus miniata - E. tetrodonta Open Forest, and;
- Eucalyptus polycarpa Low Open Woodland/Ercachne burkittii Grassland.

None of the plant species recorded during the site visit is listed as of conservation significance.

No fauna species are listed as rare or endangered.'

3.3.2 Feral Animals

Scat or tracks for Pigs and Water Buffalo were observed within the Rustlers Roost mine site during the Fauna, Flora and Soils Study conducted by Kinhill Engineering in 1993. Scat or tracks for Pigs have been observed during exploration at the Quest 29 project site.

3.3.3 Weed Species

The area was observed to have very few weed species. Isolation of the site combined with harsh environmental conditions suggests that weed control will not be an issue. This has proved to be the case to date.

3.3.4 Mosquito and Other Biting Insects Habitats and Populations

Little to no Mosquito breeding occurs in the area. Most populations have been found to fly in from floodplains and nearby swampland.

3.3.5 Fire Regime

Bushfire frequency of annual controlled, mosaic burning during the late wet / early dry season will be implemented. These fires are coordinated with the Bushfire Council and local pastoralist. Roads and fenced areas around the processing facilities and the mosaic burns serve as fire breaks. In addition, a water truck will be used daily to suppress dust on the roads, and will be available in case of an emergency or in the controlled burning programme.

3.3.6 Ambient Noise

There has not been an ambient noise survey conducted at the Quest 29 project site. The nearest habitation is approximately 11km from the site. Natural screening by vegetation and landforms as well as the distance from the site will ensure that site noise does not significantly impact upon these habitations.

3.4 Socio-Economic Environment

3.4.1 Land Use

The most extensive land use in the vicinity of the project area is pastoral, involving the grazing of beef cattle over the woodland terrain. The industry is of low intensity with a few improvements made in regards to land tillage. There has been some improvement to pasture on Old Mount Bundey.

Apart from the historical small scale mining for gold over the project area, the region is known for iron ore mining at Mount Bundey. Gold deposits at the Tom's Gully (Carpentaria Exploration and Kakadu Resources) and Rustlers Roost (Williams Resources) mines have been worked in the past. These occur 12 to 15 kms west and north west of the project.

Quarrying by Boral in the Mount Bundey granite occurs about 5kms east of the Tom's Gully site.

Tourism, including recreational fishing, is growing in the region. A number of conservation reserves and parks managed by the Parks and Wildlife Commission of the Northern Territory occur within a 50 kilometre radius of the mining area. These include:

- Mary River Crossing Reserve (15 km)
- Mary River National Park (15 km).
- Leaning Tree Lagoon Nature Park (25 km)
- Wildman Reserve (40 km)
- Fogg Dam Conservation Reserve (45 km)
- Djukbinj National Park (35km)

The boundary of the Kakadu National Park, managed by the Australian National Parks and Wildlife Service, lies 60 km East of the project area along the lowlands of the Wildman River. The park currently covers 1.3 million ha, encompassing the drainage systems associated with the Wildman, West Alligator and South Alligator Rivers.

3.4.2 Aboriginal, European Heritage Sites

Kinhill Engineers completed an archaeological survey of the Rustlers Roost project area in 1993. Four prehistoric archaeological sites and a number of background scatters were located during the surveys. Sites 1, 2 and 3 were best described as small, low density artefact scatters and similar to many others located in the wider Mount Bundey region. Site 4 consists of an artefact scatter and knapping location.

Sirocco Resources has commenced informal discussions with the Northern Territory Department of Lands, Planning and the Environment (Environment and Heritage Division) to determine the status of this area if not covered by the previous study carried out at Rustlers Roost.

The mining history of the region is recent, having commenced in the 1940's. There are no known past mining activities of any note within the Quest 29 lease areas.

A search for sacred sites on MCN's 84 – 85, 88, 369 – 373, 337 - 339 was conducted in accordance with the Northern Territory Sacred Sites Act. No sites were recorded within or adjacent to the project area and an Authority Certificate No C98/147 was issued in December1998.

4 Environmental Impacts and Proposed Safeguards

This section describes the Company's environmental policies and predicted outcomes of the environmental impacts from the proposed development. Section 5 discusses the management of these predicted outcomes.

4.1 Company Environmental Management

4.1.1 Environmental Policy

The Company seeks to achieve environmental sustainability by the vigorous pursuit of its environmental policy. This policy is as follows:

- To integrate economic, environmental, social and cultural considerations into all decision making and management activities in a manner consistent with sustainable development;
- To develop an environmentally responsible culture through a dynamic Environmental Management System (EMS);
- To provide resources to train employees and contractors in all relevant facets of the EMS
- To maintain honest, open and co-operative relationships with all interested parties of the community in which the Company operates;
- To ensure all activities are consistent with avoiding or mitigating adverse environmental impact.;
- To set environmental performance objectives to improve procedures and maintain best practice; and
- To report on a regular basis, the Company's environmental performance internally, to our shareholders, government, industry bodies and the community.

4.1.2 Responsibilities

The responsibility for the environmental performance of the Company at the Quest 29 and Tom's Gully sites rests with all employees (permanent or contract) of the Company. The Site Manager or his nominee will undertake management of the Company's environmental policy. He is directly responsible for implementing the Company's policy within the guidelines set down by the Northern Territory Government and other relevant legislation. The Manager will employ personnel including specialists as required.

The final responsibility for the environmental performance of the Company at Quest 29 and Tom's Gully rests with the Directors. The Operations Director will be responsible for internal review of the Company's environmental performance.

4.2 Impacts and Safeguards

4.2.1 Soils

Policy

The Company aims to conserve surface soil if possible to assist in the long term rehabilitation of the site and to minimise environmental degradation.

Control Measures

- Surface soil will be removed progressively to ensure large surface areas are not left exposed;

- All areas of proposed development will be stripped of their surface soil and stockpiled for later rehabilitation;
- Slope gradients will be controlled to minimise erosion and soil loss;
- Diversion channels will be installed as necessary to control local surface water runoff to minimise overland flow and consequential erosion; and
- Rehabilitation will be undertaken progressively, where possible, to minimise the stockpile storage period.

Predicted Outcome

By minimising surface disturbance and applying the control measures described above, erosion, loss of surface soil and increased sediment load in the creeks should not pose a significant problem.

4.2.2 Surface Water Quality

Policy

The Company aims to minimise any deterioration in surface water quality through changes in pH, sediment load, chemicals (eg. cyanide) and hydrocarbons.

Control Measures

- Rainwater runoff from waste dumps will be collected at the base of the dump(s) in the toe control pond. Perimeter drains will direct all flows to this pond for monitoring and release control;
- Upslope diversions from the open pits (especially the Zamu pit) will be collected in the siltation pond, or discharged through a downstream wetland filter to the natural drainage at peak flow events in the wet season;
- Pit water ingress from rainfall or groundwater migration will be pumped to the surface and diverted to the siltation pond;
- All the above waters are expected to be of a quality similar to natural water;
- The process water system is designed to be a closed (non-discharging) system. Rainfall runoff from within the leach pad and all circulating process waters will report to the water management system. In the unlikely event of discharge being necessary, due to critical storm events, this will occur during peak flow events in the creek system, and will consist of barren 'raffinate' only with minimum metal and chemical content;
- Siltation will be controlled through the siltation pond, as well as the construction of diversion channels through disturbed areas and the provision of sediment traps on these drainage channels; and
- Hydrocarbons will be stored in appropriately designed (eg. bunded) areas.

Predicted Outcomes

The effect of mining on surface water quality will principally be to generate increased sediment load. This will be controlled through the use of sediment traps and the siltation pond. Cyanide dilution modelling undertaken for the nearby Rustlers Roost Project suggests that off-site surface water quality will not be adversely affected in the unlikely event of a cyanide spill from the process water system.

4.2.3 Ground Water Quality

Policy

The Company will endeavour to maintain groundwater quality, minimise groundwater usage and minimise the impact on any nearby groundwater user.

Control Measures

- Pumping for process water supply and pit dewatering will be minimised to ensure low draw down on the water table;
- The Company is not aware of any user within a distance that could be affected by pumping from the local groundwater reservoir;
- All leach pads and ponds will be lined with welded high density polyethylene (HDPE);
- Monitoring systems will be installed to alert operators to any leakage during the life of the operation; and
- A contingency plan is being developed for cleanup in the unlikely event of leakage.

Predicted Outcomes

The effect of groundwater pumping will be temporary draw down of the water table during the life of the operation. In the unlikely event of any leakage from the process water system, it will be identified and managed under the contingency plan.

4.2.4 Flora

Policy

The Company aims to minimise loss of habitat and re-establish appropriate habitat through rehabilitation. The Company will endeavour to manage and control the spread of weed species onto and off the site.

Control Measures

- Programmes of re-seeding and re-planting disturbed areas with local species will be undertaken as part of the rehabilitation programme;
- Clearing will be minimised;
- Annual controlled mosaic bushfire burning will be undertaken in consultation with the Bushfire Council and the local landowner(s);
- Weeds will be controlled through prevention, monitoring and early eradication. A plan will be prepared in conjunction with the Northern Territory Government Controller of Weeds and other relevant experts; and
- The Company will minimise any trafficking away from made roads to minimise any potential vehicle borne spread of weed species.

Predicted Outcome

Vegetation communities and species are widespread regionally with no recognised rare or threatened species recorded, therefore loss of vegetation due to new works will not have a significant impact. Local surface disturbance will reduce vegetation communities and thus habitat areas in the immediate Project area. Run off diversion from ephemeral watercourses will not adversely affect these waterways or their associated flora.

Overall the impact will be minimal with loss of habitat locally significant, but regionally minor. Re-colonisation will occur once operations have ceased.

4.2.5 Fauna

Policy

The Company aims to minimise loss of fauna habitat and re-establish appropriate habitat through rehabilitation. The Company will not allow firearms or domestic animals on the site.

Control Measures

- The Dump Leach pad and ponds area will be securely fenced;
- No domestic animals or firearms will be allowed on site;
- Hunting will not be allowed in the Company's Project area;
- Clearing will be minimised; and
- There will be no camp site, therefore control of rubbish (for feral animals) is not considered to be an issue

Predicted Outcome

Fauna species are widespread regionally with no recognised rare or threatened species recorded, therefore loss of habitat due to new works will not have a significant impact. Local surface disturbance will reduce vegetation communities and thus habitat areas in the immediate Project area. Run off diversion from ephemeral watercourses will not adversely affect the waterways or their associated habitat.

Overall the impact will be minimal with loss of faunal habitat locally significant, but regionally minor. Re-colonisation will occur once operations have ceased.

4.2.6 Biting Insects and Disease Vectors

Policy

The Company aims to minimise impact of change of changes to the environment on the proliferation and distribution of biting insects. The Company aims to minimise the effects of biting insects amongst its workforce.

Control Measures

- The project's employees will be educated about mosquito-borne diseases and control of breeding areas
- In consultation with Territory Health Services design of any facilities to reduce mosquito breeding areas will be undertaken. This includes minimising vegetation around raw water ponds, ensuring borrow pits are free draining, minimising ponding, varying water levels, maximising the steepness of slide slopes, and preventing rainwater storage in vessels.

Predicted Outcome

Studies undertaken at the nearby Rustler's Roost during the operation's life showed that there are not biting insect breeding habitat in the mine area. All biting insects were shown to fly in from nearby breeding areas. The Project area will be managed to attempt to ensure that no breeding areas are established in the Project area.

4.2.7 Heritage and Archaeological Sites

Policy

The Company will avoid unnecessary disturbance to any identified Heritage and Archaeological sites.

Control Measures

- Significant sites will be identified and protected (eg. fenced) to avoid unnecessary disturbance of those areas; and
- Employees will be trained to ensure that the Company's policy is maintained at all times.

Predicted Outcome

Currently there are no known sites of heritage or archaeological significance within the Quest 29 Project area hence it is anticipated that any impact will be minimal.

4.2.8 Socio-Economic

Policy

The Company's activities will provide employment. The Company will obtain the provision of services from the local economy where at all possible. The Company will aim to minimise any impact on the existing land use in the area.

Control Measures

- Ore transportation will not be undertaken along the Arhem Highway;
- The access road will be fenced as agreed with the landowner to control stock movements;
- Employment opportunities will be advertised locally; and
- Provision of services will be advertised locally.

Predicted Outcome

Local land use will change from pastoral (stock grazing) to active mining. It will revert to pastoral use when mining is complete with land alienation of up to 35 Ha. There will be increased traffic on the Arnhem highway from light vehicles as well as supply trucks. A short term (2 week) increase in heavy traffic during the mobilisation and demobilisation of the mining contractor will occur.

Project development will not impact on recreational or tourist uses of the surrounding areas. The majority of the workforce will be already living in the region. The project will provide a significant economic boost to the area.

4.2.9 Air Quality

Policy

The Company will aim to minimise and control any emissions that are likely to affect air quality

Control Measures

- Emissions will be reported as part of the National Pollutant Inventory;
- Roads will be regularly watered to control dust as warranted;
- Re-vegetation will occur systematically ongoing during the project to reduce fugitive dust to a minimum level; and
- Slight cyanide emissions will be controlled using standard industry practice for this type of operation as approved by the DME.

Predicted Outcome

Fugitive dust will be generated from mining activities, vehicular movement and wind erosion. The dust will be localised and settle in the local area. Dust will be controlled to minimise any impact on personnel or the environment.

Cyanide emissions as droplets and vapour will be generated during operations. Overseas studies have shown negligible effects from these sources due to the rapid breakdown of cyanide in the atmosphere and atmospheric dispersion of resultant non-toxic products. This will occur in the controlled area of the process plant site.

Air quality impacts will be minimal both during operations and upon de-commissioning.

4.2.10 Noise

Policy

The Company will aim to minimise noise from intermittent and continuous operations.

Control Measures

- Blasting will occur at regular intervals during daylight hours only;
- Mobile equipment will be maintained to manufacturers standards; and
- The diesel power generator will be properly muffled.

Predicted Outcome

Blasting noise from near surface areas may be strong enough to be heard for some distance. The immediate area is uninhabited, however, noise may have a minimal impact on the nearest residents (11 kilometres distance). Pit walls will ameliorate deeper blast noise.

Continuous noise sources will be mining equipment and a diesel power generator. Vegetation and landform should form a natural acoustic barrier to reduce off-site noise.

4.2.11 Visual

Policy

The Company aim to minimise the impact on the visual amenity of the Project site.

Control Measures

- Limited project access;
- Contouring of dumps to blend in with the natural topography;
- Containment ponds will be rehabilitated as natural wetlands or water bodies or removed if required; and

- Areas of land clearing and disturbance will be minimised.

Predicted Outcome

The project will not have a visual impact from the Arnhem Highway. The site location is such that any impacts will be local. The pits, waste rock dumps and leach pads will remain at the end of the project. These will have a low visual impact following rehabilitation owing to the site's isolated location and the control measures implemented.

4.2.12 Tabulated Summary

A summary of potential impacts associated with the proposed project is attached. Information in this tabulated summary has been derived from an analysis of the preceding sections of this report. This provides a perspective for the various impact conclusions by reviewing the impacts in terms of the following criteria:

- Is the impact considered beneficial or adverse?
- Is the impact avoidable or unavoidable?
- Is the impact's duration short-term or long-term?
- Is the impact irreversible or an irretrievable commitment of resource?

Although the terms beneficial or adverse are subjective, the judgements are made regarding the overall nature of the projected change and in terms of the specific affected resource.

Certain impacts are unavoidable consequences of the proposed project. An avoidable impact is one that may be prevented if mitigation measures are implemented. Short-term impacts occur during the length of the project life. Long-term impacts may last beyond the project life. An irreversible commitment of a resource is one that cannot be changed once it occurs. This means it is permanently lost.

Overall the impacts of project development are considered low. Beneficial impacts are primarily economic

Adverse impacts are primarily site-specific disturbance to construct and operate the project.

ENVIRONMENTAL IMPACT SUMMARY

RESOURCE & IMPACT	UNAVOIDABLE IMPACT	DURATION of IMPACT SHORT	DURATION of IMPACT LONG	IRREVERSIBLE or IRRETREVABLE IMPACT	MITIGATION - IDENTIFIED MANAGEMENT	PREDICTED IMPACT
Soils ▪ Increased Erosion ▪ Disturbance	Yes	Yes	Yes	No	Both progressive and final rehabilitation will reduce the impact of soil disturbance. Limiting surface exposure by progressive stripping and effective sediment control measures will reduce erosion.	Low
Surface Water ▪ Increased sediment load ▪ Potential chemical spill	No	Yes	No	No	Rainwater runoff from the waste dumps and the upslope diversions from the open pits will be either collected in the sediment traps (toe ponds) or the siltation pond. Pit water ingress will be pumped to the siltation pond or the process water pond. Rainfall on the lined facilities is designed to be fully contained within the water management system. Sediment control will minimise the effects of suspended load transport.	Low
Groundwater	Yes	No	No	No	Project design and operational management obviates groundwater impacts	Nil
Flora & Fauna ▪ Habitat Loss	Yes	Yes	No	No	Final rehabilitation of the Project site will lessen the impact to Flora and Fauna.. Pioneering will re-establish the Flora and Fauna. Mosquito-borne disease and breeding areas will be minimised through project design and employee education. Allowing no rubbish to be dumped will control feral animals. Monitoring and early eradication will minimise weed and plant disease infestation. Controlled mosaic burning policies will be co-ordinated with the local Bushfire Council to affect fire management.	Low
Archaeological ▪ Site Disturbance	Yes	No	No	No	The Company will fence any sites identified.	Nil
Socioeconomic ▪ Conversion of Land Use	Yes	Yes	No	No	The land use will return to it's pre-mining use except for the alienated lands	Low
Air Quality ▪ Increased Particulate	Yes	Yes	No	No	Fugitive dust will be suppressed as required with water and minimised upon completion by rehabilitation	Low
Noise	Yes	Yes	No	No	None identified	Nil
Visual ▪ Increased Contrasts	Yes	Yes	Yes	Yes	Visual aesthetics will be changed from their natural conditions due to permanent topographic changes. Upon project rehabilitation these affects will be moderate.	Moderate

5 Environmental Management Safeguards and Practices

Section 4 described the Company's environmental policies and predicted outcomes of the environmental impacts from the proposed development. This identified that the two primary issues relating to the development of the Quest 29 Project are management of waste rock that has the potential to generate acid, and water management, in particular management of water containing chemicals eg. cyanide. This main emphasis of this section is how these particular issues will be managed.

Other environmental issues will be managed using standard management techniques and operating systems. These are described in section 5 as well.

5.1 Waste Rock Management

5.1.1 Characterisation Studies

A waste rock characterisation study has been undertaken to determine the characteristics of the various types of waste rock that may be encountered during mining in the open pits. The results of this type of study determine the need for selective handling of waste rock to manage the anticipated characteristics of the rock.

Woodward Clyde has undertaken a preliminary waste rock characterisation study for the Company. This study classified high grade and low grade ores as well as oxide and fresh waste for the three proposed pits, and for the North Koolpin inferred resource. The results of the study are summarised in *Table 5.1*. A copy of the study is attached as **Appendix 5.1.**

Table 5.1 **Waste Characterisation Study Summary of Results**

Pit/Prospect	Waste Sample Type	Sample Depth (m)	NAG (Kg H_2SO_4/t)	Class
WKZ	Oxide	10 - 13	6.3	Uncertain
	Oxide mineralised	16 - 20	10.2	PAF
	Fresh mineralised	34 - 39	564	PAF
ZDZ	Oxide	10 - 15	4.8	NAF
	Fresh	25 - 30	13.4 - 49.4	PAF
Taipan Hill	Oxide mineralised	3 - 8	4.4	Uncertain
	Shale Oxide	15 - 20	4.3	PAF
	Fresh mineralised	28 - 33	33.9	PAF

Note: PAF – potentially acid forming; NAF – non-acid forming; NAG – Net Acid Generation

Table 5.2 summarises currently planned pit volumes to various depths as an indicator of the quantities of various types of material.

The Net Acid Generation (NAG) data indicated that samples with low NAG values, even though they are classified as PAF or uncertain (such as the WKZ oxide, oxide mineralised and Taipan oxide mineralised and shale oxide samples) are not likely to be of significant concern. *Table 5.2* indicates that only small volumes of material that is likely to be of significant concern may be mined.

Table 5.2 **Pit Volumes**

Pit	Depth (m)	Class	NAG	Volume (m3)	% of Pit
WKZ	0-15	Uncertain	Low	64,400	27%
	15-35	PAF	Low	163,000	69%
	+35	PAF	Very High	8,700	4%
ZDZ	0-20	NAF	Low	480,000	72%
	20-30	PAF	Low	136,000	20%
	+30	PAF	Moderate	54,000	8%
Taipan Hill	0-15	Uncertain	Low	119,300	72%
	15-30	PAF	Low	36,900	21%
	+30	PAF	Moderate	8,500	5%

The Company intends to conduct further studies prior to mining to examine the uncertain and PAF material in the WKZ and Taipan Hill pits in more detail. Additional samples have been collected and Woodward Clyde is preparing a further programme of testing focussed on the materials that will be mined as waste. The Company intends to conduct on-going characterisation studies throughout the mine life to ensure proper management of waste rock.

The results of this study have been integrated into the open pit scheduling plan. It is currently intended to commence mining with ore from the WKZ and Taipan Hill pits. The Taipan Hill pit is small and will be completed prior to the commencement of the 1999 / 2000 wet season. Any PAF material with high NAG values (such as primary WKZ material) will either be encapsulated in the dump(s) in NAF material or placed in the mined out Taipan Hill pit. Although the Company has no intention of mining the primary WKZ ore or waste, there is a possibility that some may be encountered in the pit. At the completion of mining, the Taipan Hill pit will be allowed to flood rapidly with natural waters. This strategy has been successful elsewhere in the Northern Territory in controlling acid generation from mine waste.

Grade control sampling will be routinely analysed to develop comparisons to existing waste characterisation studies so that 'alert' thresholds can be developed. This will enable adequate sampling levels to be determined.

5.1.2 Dump Construction

The waste strategy is designed to either place acid generating waste in the mined out Taipan Hill pit, or encapsulating it in the NAF waste in the above ground dump(s).

It is planned to locate three separate dumps close to each pit, sited so that any drainage from the dumps, post mining can be directed into the mined out pit(s) if necessary. The waste dump(s) will be constructed in sequentially built lifts. Initially the dump(s) will be built by 'valley fill' methods and then raised to the target height of 20 -25 m. Dump trucks will end dump each approximately 2.0 m lift at the angle of repose (37^o). The maximum overall slope of the sides of the dump will be 26^o (1 in 3). Trafficking over the dump(s) during dumping will ensure that the dump(s) are compacted to reduce water inflows through the dump. This will minimise contact between the waste rock and oxidation processes.

The capacity of the dump(s) is 1.45 M m^3 assuming a swell factor of 35% for the broken dumped material.

5.1.3 Waste rock dump runoff/seepage

Runoff/seepage from the waste rock dump will be directed to the containment pond at the toe of the dump. The dump(s) will comprise primarily oxidised waste rock that has been

classified as NAF or PAF with a low NAG capacity. Transitional and sulphide waste that is PAF with a moderate or higher NAG will either be encapsulated in the other waste or retained in or returned to the open pit(s). On completion of the pit(s) runoff/seepage will be directed to a nearby pit or the siltation pond for storage and evaporation.

5.2 Water Management

5.2.1 Dump Leach Process

The water management will enable the Company to use appropriate strategies to manage solution levels in this non-discharge system.

The water storage will be designed to contain run-off solution from the 1 in 100 year, worst month statistic. As detailed in **Appendix 2-1,** January 2001 will have the maximum catchment area open to rainfall ingress and lowest evaporation loss to counteract rainfall gain. This period will from the basis for the plant design.

Free board in the pond system will be maintained such that at all times a 1 in 100 year storm event can be contained.

Launders in the process off-flow system will be designed so that process solutions can only be directed into either the Pregnant Liquor pond or the Storm Surge pond. Liquor is recovered from the latter pond at a later stage during the drier months.

Each pond will be constructed with an internal spillway such that in the event of excessive flow, ponds will overflow into each other prior to any possibility of overflow into the surrounding environment.

In general practice, water is managed in the process system by continuous recirculation to the active heaps. During the wetter months, a back-up generator and pumps will be installed in the unlikely event of equipment failure.

5.2.2 Run-off segregation

Process solution segregation occurs through a series of lined collection ditches which drain the leach pad. These enable the solution flow to be directed to the appropriate ponds within the water management system.

5.3 Tailings Management

The Company has two tailings dams at Tom's Gully. Both dams have been designed and approved by relevant Government Authorities for total containment of tailings. They are 'no-release' systems.

The old (No 1) tailings dam contains tailings from past mining operations. The new (No 2) tailings dam was designed to contain re-processed old tailings from the proposed Kakadu operations. It contains a small amount of tailings from that era.

The Company intends to use the No2 tailings dam for tailings from processing of high grade Quest 29 ore. The tailings will generally comprise a finely ground pulp, mixed with water and containing low levels of cyanide. The Company aims to maintain a maximum level of 50 ppm cyanide wad. The tailings are alkaline and generally have a pH of about 10. Excess water is re-cycled to the process plant, to control the water levels in the pond. **Figure 2.5** shows that additional water is required to maintain the water levels in the system.

Tailings are pumped along an aboveground HDPE pipe to the tailings dam. The pipe will be regularly inspected for leakage. In the unlikely event that this occurs, the discoverer will instigate emergency response procedures.

The No 2 tailings dam was designed to contain approximately 350,000 tonnes of tailings. When the dam nears capacity the Company proposes to increase capacity of the No 1 tailings dam. Designs will be submitted for approval from the relevant authorities at the appropriate time.

5.4 Soil Management

The Company will undertake the following soil management programmes:

- Routinely (monthly) inspect infrastructure and roads with respect to soil stability.
- Routinely inspect all soil stockpiles for erosion and/or disturbance;
- Manage progressive rehabilitation; and
- Check erosion after significant rainfall events.

The Company will undertake appropriate remediation programmes if significant soil erosion is observed during these routine inspections.

5.5 Flora and Fauna Management and Conservation

The Company will undertake the following Flora and Fauna management programmes:

- Ensure land clearing is minimised;
- Assess effectiveness of revegetation programmes annually; and
- Inspect vegetation along creeks within the project areas annually.

5.6 Weeds and Feral Animal Control

The Company will undertake the following management programmes:

- Routinely inspect all infrastructure and haul and access roads to monitor any noxious weeds and undertake appropriate remedial action if necessary after consultation with appropriate authorities;
- Monitor any illegal hunting, trapping and plant collecting activities and report as soon as practicable to the appropriate authorities; and
- Record and report sightings of feral animals to the appropriate authorities.

5.7 Cultural and Heritage Management

The Company will undertake the following management programmes:

- Ensure by regular monitoring that any identified sites have not been disturbed or destroyed; and
- Workforce education programme.

5.8 Biting Insect Control

The Company will undertake the following management programmes:

- Consult with appropriate authorities prior to the wet season about a mosquito breeding and monitoring programme;

- Inspect site for unplanned ponded water and undertake effective remediation; and
- Ensure all employees undertake appropriate education programmes with respect to health issues of biting insects.

5.9 Waste Management

The Company will undertake the following management programmes:

- Routinely inspect the effectiveness of planned pollution prevention and appropriate waste collection and disposal;
- Routinely inspect chemical and hydrocarbon storage and distribution areas for safe management and contamination. Undertake appropriate remedial action including if necessary emergency response procedures; and
- Undertake surface soil tests as necessary to ensure all wastes are contained within the site.

5.10 Emergency Response

The plan for responding to emergencies in the event of a major release or significant spill from the water management system outlines the actions which will be initiated and by whom. The water management system for the dump leach includes the following:

- the process recovery area (the columns) with associated piping, pumps and vessels
- the process liquor and storm surge ponds
- the primary and secondary liners and the leak detection system
- all other pipes, pumps and ditches connecting the system elements.

The plan also applies to significant spills of hydrocarbons. The procedures apply to major releases and significant spills within the project boundaries as well as those that may flow off-site.

Specific spill procedures for dangerous chemicals will be handled in accordance with the requirements of the Australian Dangerous Goods Act.

5.10.1 Notification

The discoverer of a chemical or petroleum spill or an accidental discharge from the water management system will immediately notify the Health, Safety and Environmental (HSE) manager or designate. The HSE manager will be responsible for notifying all other appropriate personnel and coordinating the emergency response following the procedures outlined below:

- Discoverer notifies HSE Manager or designated alternative
- HSE Manager or designate notifies Mine Manager and Operations Director at any time
- Standby notification to Metallurgist and Senior Mine Geologist
- Mine Manager or Operations Director notifies DME of spills within statutory timeframes

5.10.2 Action

The following action will be taken in the event of a significant chemical or petroleum spill or a major failure of the water management system:

- Discoverer notifies HSE Manager or designated alternative with details on location, and magnitude

- Discoverer immediately takes all possible safe action to contain the release
- HSE Manager or designate notifies Mine Manager and Operations Director
- HSE Manager immediately assesses the incident at the scene, furnishes technical and other assistance at the site as required and assesses the environmental impact of the spill
- The Mine Manager immediately organises the timely dispatch of the required equipment, manpower and materials to the site
- The HSE Manager will supervise the final containment and clean-up operation.

5.10.3 Containment and Mop-up Operations

The containment and mop-up operations will be designed to contain the spill, dispose of any polluted material in an appropriate manner and to remediate the contaminated site as agreed with the appropriate authorities. Specific spill procedures will depend upon the circumstances of the spill.

5.10.4 Reporting

A significant spill from the water management system will be reported orally to the DME by 5.00 pm of the next regular working day after the release has occurred. A written summary will be provided to the DME within 10 working days of the oral report. The written report will contain a description of the release and it's cause, the periods of release, whether the release has been corrected and if not, the expected time it will be corrected and the steps taken or the plan to reduce, eliminate and prevent recurrence of the release.

5.11 Decommissioning

5.11.1 Timing

Current ore reserves will support operations for 2 years. However, the life of the operation may be extended due to increased ore reserves (exploration success) as well as a supply of high grade ore from Tom's Gully slowing the rate of extraction at Quest 29.

Assuming a life of 2 years, leaching, washing and rinsing will continue for an additional 8-12 months. Rehabilitation will be undertaken during this time to complete the open pit(s) closure and waste dump(s) re-vegetation.

Once the final rinsing cycle is completed and the ponds have been evaporated, re-vegetation of the final heaps and the site facilities area can be concluded and the columns and process facility can be removed from site.

5.11.2 Closure

Temporary Closure

Temporary closure may occur for the following reasons:

- Unseasonably wet weather
- Interruptions to the active process
- Power outage of more than 72 hours
- Labour dispute

A plan has been developed in the unlikely event of it needing to be implemented. Temporary closure would occur as a response to an event, which could cause damage to the overall operation of the facility. At all times provision will be made for active solution management. However, closure would protect the facility and allow it to start up again

without major repairs. If the operation was not closed temporarily, environmental degradation may occur which could cause a more extended closure.

Temporary closure will be reported to the DME as follows:

- Less than 72 hours duration – in the half yearly report
- More than 72 hours but less than 144 hours duration – telephone notification to the DME and in the half yearly report
- More than 144 hours – telephone report to the DME and a written report within 30 days

Permanent Closure

Any permanent closure will have to comply with the prevailing DME regulations and policies in effect at the start of closure. Design of specific closure procedures will depend on factors that exist at the mine at the time operations cease. Therefore this preliminary plan only outlines closure in general terms. A more detailed plan will be developed at the time of proposed closure.

This preliminary plan outlines procedures at closure for the open pit(s), waste rock dumps, leach pad and ponds at Quest 29 as follows:

- Open pit(s) – Water inflow and quality will return to its pre-mining level once mining ceases. The pit(s) will be allowed to rapidly fill to preclude the development of acid leachate. Any sulphide or transitional waste in the bottom of the pits will be capped with 5m of oxide waste prior to filling with water
- Waste Rock Dump(s) – The dump(s) will be progressively re-vegetated according to the rehabilitation plan. During active waste rock disposal, the dump will not be reclaimed. The top of the dump will be slightly sloped and will provide a level surface for re-vegetation. The side slopes will be less than the angle of repose and will also be re-vegetated
- Leach Pad – Residual cyanide will be reduced in the spent heaps until WAD cyanide levels in the rinsate reaches the levels required by the DME. The perimeter berms and ditches will be graded to prevent water ponding. If possible, the top of the heap will be re-vegetated
- Ponds – All rinse and residual process liquids will be contained within the ponds and evaporated. The liner will be folded around the evaporate and buried. The ponds will be backfilled and graded to prevent water ponding. Re-vegetation of the pond area will be undertaken in accordance with the rehabilitation plan
- Miscellaneous Facilities – All process chemicals and petroleum products and their containers will be removed from site. The process plant will be removed from site. Roads not required for access will be ripped. All buildings will be progressively removed from site. Disturbed areas will be re-vegetated in accordance with the rehabilitation plan.

5.11.3 Post Closure Monitoring

Post closure monitoring of the leach pads will be undertaken until the cyanide WAD levels meet the requirements of the DME.

5.12 Rehabilitation

The information presented in this section of the report contains a general strategy for rehabilitation and indicates the intentions of the Company. Prior to final closure of operations a detailed plan will be prepared for approval by the relevant authorities.

5.12.1 Objective

The Company will rehabilitate the project site to standards acceptable to the relevant authorities. Progressive and final rehabilitation of the site are important components of the Companies mining objective. The Company intends to leave the site in a safe and stabilised condition by aiming to prevent hazardous contamination and minimising erosion.

5.12.2 Acid Drainage Control

The Company will attempt to retain within or backfill to the open pit all PAF waste with moderate or high NAG values rather than place the material in the waste dump. If this becomes impracticable this material will be placed in the dump in such a way as it is encapsulated within neutral NAF waste. This will prevent the possible formation of acid leachate.

Current testwork indicates that all of the oxidised material will not significantly form acid leachate. Continuing characterisation studies will be undertaken during mining operations to provide further information for long term prevention of acid drainage. This will result in additional information to enable final adjustments to be made as necessary to prevent acid drainage.

All of the ore contained within the leach pad will be oxidised material and will not form acid leachate. The placement of transitional ore on the leach pad will be minimal, as graphite in the ore is preg-robbing.

5.12.3 Erosion control and surface soil stockpiling

The main soil management programme will be as follows:

- Progressive soil removal to reduce large surface areas from exposure to reduce erosion;
- Perimeter bunding to reduce erosion and siltation; and
- Stockpiles will be maintained for as short a period as possible by progressive rehabilitation to prevent seedstock loss and deterioration.

5.12.4 Re-vegetation

The Company will re-vegetate with appropriate local native species as well as local easily established approved native ground covers. The following programme will be undertaken:

- Rehabilitation trials during year 1 of operations to determine the most appropriate or suitable plant species; and
- Re-vegetation will commence in the late ‘dry’ season to benefit from the ‘wet; season rains.
-

5.12.5 Waste Rock Dumps

The Company plans to progressively rehabilitate the waste rock dumps although the actual mining sequence will dictate its timing. Long term waste dump stabilisation will be a primary emphasis and will be achieved as follows:

- The outer slopes will be shaped as required to ensure stabilisation although the benches formed during construction will most likely suffice;
- The upper surface will be capped with a minimum 0.5m loose layer of oxide waste and stockpiled surface soil, if available; and
- Re-vegetation of the upper surface will be completed.

5.12.6 Leach Pad

The leach pad will be progressively rehabilitated following its washing and rinsing cycle as follows:

- Surface soil (if available) will be used to cap the new surface and re-vegetation will be started; and
- The side slopes of the leach pad will be stabilised as required and the dump surface will be contoured to enhance drainage off the leach pad.

5.12.7 Mine open pit(s)

At the completion of mining the Company will undertake the following to leave the open pits(s) as a safe landform:

- The upper bench will be bulldozed to form a scree slope for limited surface soil to attract pioneering plants
- All road access points will be blocked in an appropriate manner to prevent vehicular access in to the pit(s)
- Vehicular access to the pit(s) perimeters will be hindered by the construction of bunds and/or diversions
- The pit(s) may be allowed to rapidly flood with natural waters.

5.12.8 General Site

The Company will rehabilitate the general site following the decommissioning operations and facilities removal. These areas include the process plant and facilities site(s), the workshop and office site(s), any borrow sources and haul roads. The following works will be undertaken:

- Minimisation of erosion through the use of spoon drains to divert water runoff;
- Ripping of compacted surface to loosen the sub-base prior to surface soil replacement; and
- Re-vegetation of all areas that contain replaced surface soil with appropriate, approved native species through seeding and/or allowing pioneering to occur.

5.13 Summary of Impacts, Safeguards and Commitments

Table 5.3 summarises the commitments and safeguards made in the previous sections to minimise the potential impacts of the proposed development.

Table 5.3 **Potential Development Impacts – Summary of Commitments**

Potential Impacts	Commitments
Acid Generation from Waste Rock	▪ Ongoing waste characterisation study ▪ Ongoing characterisation of wastes during mining to enable selective handling ▪ Selective handling of waste material and placement in safe areas ▪ Monitoring and control of runoff and seepage from waste dumps
Water Management	▪ Dump leach and tailings systems designed as non-release systems ▪ Dump leach storm pond sized for worst case rainfall scenario ▪ Tailings pipe designed for easy monitoring for leakage ▪ Borehole monitoring at Dump Leach facility to detect leakage
Soils	▪ Minimise clearing ▪ Undertake bulk earthworks in the dry season ▪ Stabilise drainage against erosion and implement erosion controls ▪ Implement progressive rehabilitation / re-vegetation
Flora	▪ Minimise clearing and report any observed plant collection ▪ Implement progressive rehabilitation ▪ Workforce education ▪ Retention, where possible, of existing vegetation
Fauna	▪ No firearms, traps or pets will be allowed on site ▪ Use of non toxic herbicides in weed control ▪ Fencing of specified areas
Weeds	▪ Weed programme to be determined with appropriate authorities ▪ Seed used for rehabilitation will be certified weed-free. ▪ Regular inspections of site area
Biting Insects	▪ Biting insect programme to be determined with appropriate authorities ▪ Workforce education ▪ Monitoring of ponded water areas and appropriate remediation ▪ Sealing of septic systems
Fire	▪ Control programme to be developed (appropriate authorities and landowner)
Cultural and Heritage	▪ Obtain necessary certificates ▪ Workforce education ▪ Secure sites of cultural and / or heritage significance
Waste	▪ Use of approved disposal methods and areas ▪ Re-cycling will be undertaken where possible ▪ Approved hazardous waste management programme
Dust	▪ Minimise clearing ▪ Water roads
Noise	▪ Natural vegetation and landform buffers to distant nearest habitation ▪ No on-site accommodation ▪ Appropriate mufflers fitted to equipment ▪ Supply of appropriate safety equipment and workforce education

6 Environmental Monitoring

6.1 Quest 29

6.1.1 Water Quality

There is no perennial water source within the proposed mining area. Any water in the creeks is ephemeral relating to rainwater runoff during the 'wet' season and immediately after it.

Water quality will be monitored at regular intervals, to be determined. Monitoring of any significant changes in the receiving water quality will be undertaken as follows:

- At the collection pond at the toe of the waste dump(s);
- At the siltation pond; and
- At an agreed distance (eg. 3.0 km) downstream of the siltation pond.

Typically samples will be checked for pH and conductivity and regular samples will be analysed for agreed trace elements. Approximate sample locations are shown on **Figure 6.1**.

6.1.2 Process Area

Monitoring in the process area will be to detect fugitive leaks of process fluids in the pad and/or ponds. Experience at Rustlers Roost showed that near surface, unsaturated zone monitoring is more appropriate for the early detection of fugitive fluids from the pad rather than groundwater observation wells due to the depth of groundwater.

Monitoring bores will be installed down slope of the leach pad and process plant. Each bore will penetrate the surface soil and terminate in bedrock. Typically the bores will be 10m in depth. A perforated sleeve will be installed that enables permeating fluids that might move horizontally through surface soil and the weathered zone to be sampled and analysed.

The bores will be monitored at regular intervals, to be determined. Analyses will be undertaken to detect cyanide and to measure pH.

The process water ponds will incorporate a leak detection system within their design.

6.1.3 Waste Rock Dump

Waste characterisation will continue through the life of mine. Samples will be taken at regular intervals of any solutions in the containment pond at the toe of the dump, to monitor potential generation of acid leachate as described in section 6.1.1.

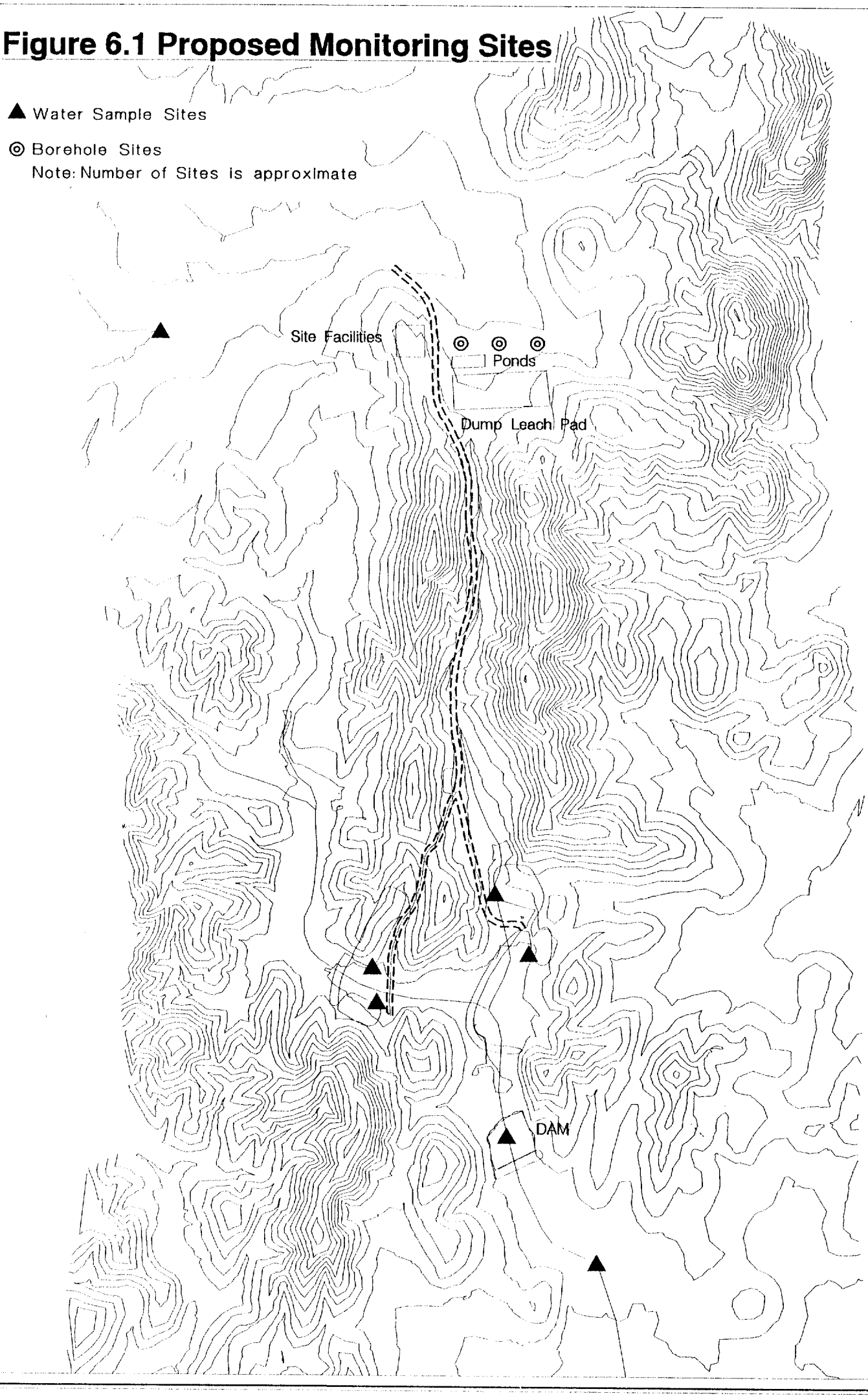
6.1.4 Dust

Dust will be controlled by surface wetting as required and by limiting stripping of vegetation cover. Air quality monitoring is not proposed at this time.

6.2 Tom's Gully

Tom's Gully has a current approved monitoring programme. This will be reviewed in conjunction with the appropriate Regulatory Authorities and upgraded as necessary for the commencement of processing operations.

Figure 6.1 Proposed Monitoring Sites



Appendix 2-1

Water Balance - Quest 29 Dump Leach
Average Rainfall
Bulk Density 2.2
Lift Height 5mtrs

Month		Tonnes Stacked	Cumm Tonnes Stkd	Area Under Irrigation m2	Spray Volume m3	Spray to Saturation m3	Evaporation loss m3	Evaporation Rate %	Rainfall mm Average	Rainfall Gain m3	Available Operating Storage Capacity m3	Water Gain m3	Total Make-up m3
June	30		-		-	-	0	15		0	34000	0.00	-
July	31		-		-	-	0	15		0	30000	0.00	-
August	31	28,800	28,800	8400	19,479	5,184	2922	15		0	30000	-2921.89	8,106
September	30	28,800	57,600	8400	37,702	5,184	5655	15	11.10	93	30000	-5562.03	10,746
October	31	40,333	97,933	16800	66,238	7,260	7949	12	41.00	689	30000	-7259.80	14,520
November	30	40,333	138,266	16800	90,501	7,260	5430	6	159.72	2683	30000	-2746.79	10,007
December	31	40,334	178,600	16800	120,799	7,260	2416	2	274.86	4618	27798	**2201.68**	
January	31	23,466	202,066	25200	136,670	4,224	1367	1	372.76	9394	19771	**8026.85**	
February	28	23,466	225,532	25200	137,780	4,224	1378	1	257.76	6496	14654	**5117.76**	
March	31	23,467	248,999	25200	168,414	4,224	10105	6	148.20	3735	21024	-6370.19	10,594
April	30	32,666	281,665	33600	184,363	5,880	22124	12	100.48	3376	30000	-18747.38	24,627
May	31	32,666	314,331	33600	212,602	5,880	31890	15	68.20	2292	30000	-29598.79	35,479
June	30	32,667	346,998	33600	227,126	5,880	34069	15		0	30000	-34068.89	39,949
July	31	6,566	353,564	33600	239,138	1,182	35871	15		0	30000	-35870.67	37,053
August	31	6,566	360,130	33600	243,579	1,182	36537	15		0	30000	-36536.83	37,719
September	30	6,567	366,697	33600	240,020	1,182	36003	15	11.10	373	30000	-35630.02	36,812
October	31	7,133	373,830	33600	190,349	1,284	22842	12	41.00	1378	30000	-21464.28	22,748
November	30	7,133	380,963	33600	188,878	1,284	11333	6	159.72	5367	30000	-5966.06	7,250
December	31	7,134	388,097	33600	199,999	1,284	4000	2	274.86	9235	24765	**5235.32**	
January	31	5,900	393,997	33600	203,989	1,062	2040	1	372.76	12525	14280	**10484.84**	
Totals		**393,997**			**2,907,625**	**70,919**	**273,929**		**2,293.52**	**62,252**		**-211677.18**	**295,609**

1 : 100 Storm event from attached graph. Gives a worst case scenario of an additional **13,778m3** into the process catchment area.

January 2001 would have the maximum contained solution of which storage capacities would be modelled.

Therefore, January 2001 rainfall gain = 10,485m3 + 1:100 storm in January gain 13,778m3 **Total = 24,263m3**

Rainfall data - Toms Gully 5 year average (attached)
Evaporation data used in this model are actual rates encountered during the processing phase at Rustlers Roost Gold Mine and as such are far more accurate than if Bureau of Meteorology pan evaporation rates are applied. Evaporation is enhanced in the process by the act of spraying the process liquors which elevates evaporation loss volumes.

Tom's Gully Mine Site
Rainfall Register

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Yearly Total
1990	237.4	103.8	179.4	95.8	89.8					22.4	230.2	193.0	**1151.8**
1991	429.0	385.0	133.8	235.6							242.4	80.4	**1506.2**
1992	274.4	332.4	125.4	61.4	46.6				8.8	32.2	100.2	269.6	**1251.0**
1993	384.0	262.2	173.4	26.6					13.4	68.4	74.9	303.5	**1306.4**
1994	242.2	240.2	247.0	94.2						68.4	150.9	254.4	**1297.3**
1995	539.0	205.4	129.0	83.0						No	Records		

DESIGN RAINFALL INTENSITY DIAGRAM

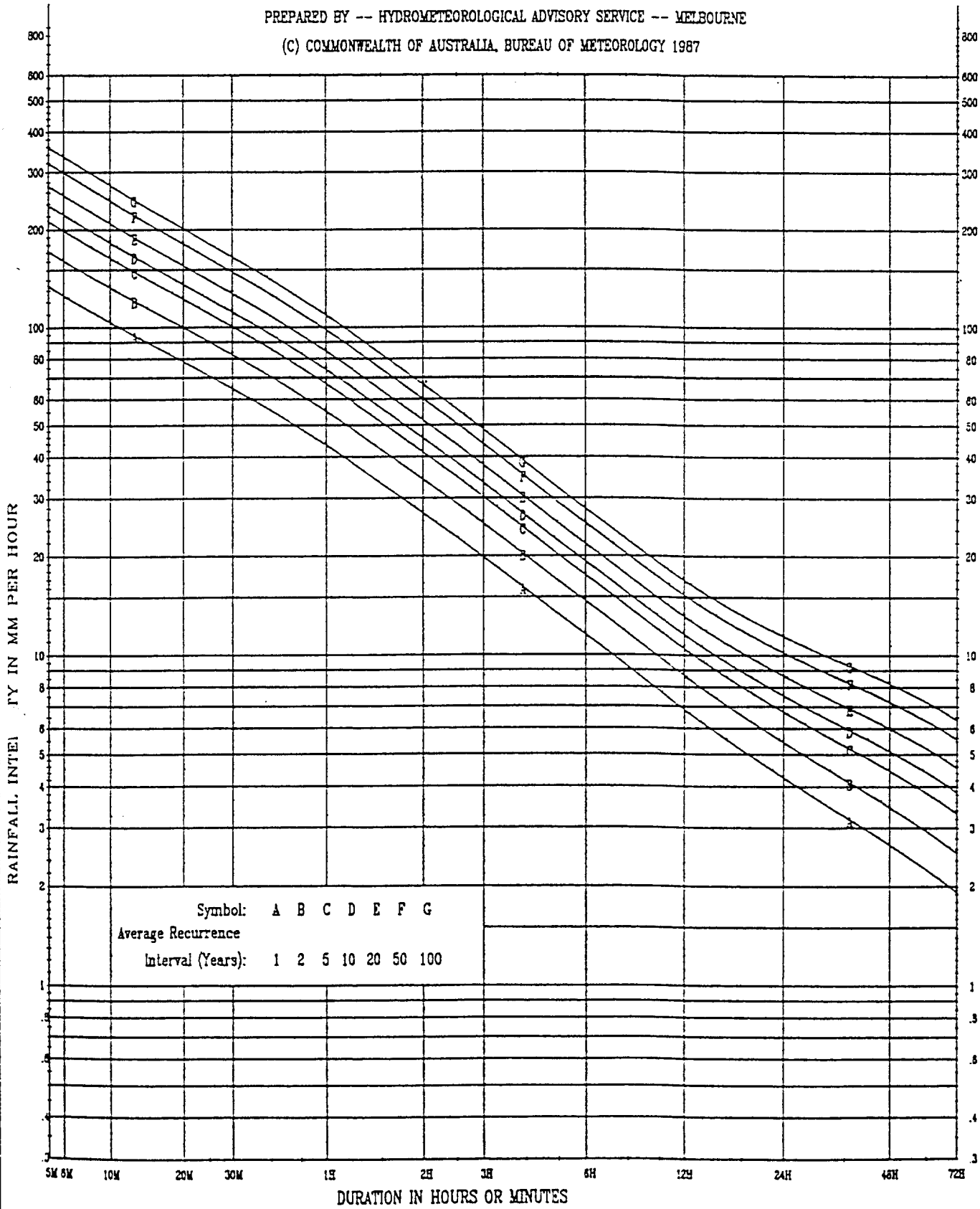
LOCATION 12.925 S 131.475 E * NEAR.. Rustler's Roost Gold

* ENSURE THE COORDINATES ARE THOSE REQUIRED.
SINCE DATA IS BASED ON THESE AND NOT THE LOCATION NAME.

ISSUED 5TH JULY 1995 REF.-FN4228

(RAW DATA: 37.52, 8.76, 2.58, 34.65, 14.18, 5.18, .345, 38A)

PREPARED BY -- HYDROMETEOROLOGICAL ADVISORY SERVICE -- MELBOURNE



Appendix 2-2

4900 mE
4925 mE
4950 mE
4975 mE
5000 mE
525 mN
500 mN
475 mN
450 mN
Final
Pit Outline
Base of Oxidation
Top of Primary
QR010
QR115
QR009
QR114
QR145
QR308
QR312
SNR
20.0m
22.0m
24.0m
36.0m
42.0m
50.0m
17.0m
HoleID
Rock_Type
Trace Shade
Au_ppm
Text
EOH
2 - 999
1.2 - 2
0.8 - 1.2
0.5 - 0.8
0.25 - 0.5
0.01 - 0.25
SNR
Legend for Au ppm
Aluvium
Oxidised Zamu Dolerite
Transitional Zamu Dolerite
Primary Zamu Dolerite
Oxidised Meta-Sediments
Transitional Meta-Sediments
Primary Meta-Sediments
Legend for Rock_Type
Sirocco Resources NL
Typical WKZ Section
Showing Pit Outline,
Base of Oxidation &
Top of Primary
9400N
Date: 17/2/1999
Author: Holly
Office: Tom's Gully
Drawing:
Scale: 1:500
Projection: Non-Earth (meters)
0
5
10
20
metres

5150 mE 5175 mE 5200 mE 5225 mE 5250 mE 5275 mE 5300 mE 5325 mE 5350 mE

500 mN 475 mN 450 mN 425 mN 400 mN

Final
Pit Outline

Base of Oxidation

Top of Primary

HoleID
Rock_Type
Trace Shade
Au_ppm
Text
EOH

Legend for Au ppm

- 2 - 999
- 1.2 - 2
- 0.8 - 1.2
- 0.5 - 0.8
- 0.25 - 0.5
- 0.01 - 0.25
- SNR

Legend for Rock_Type

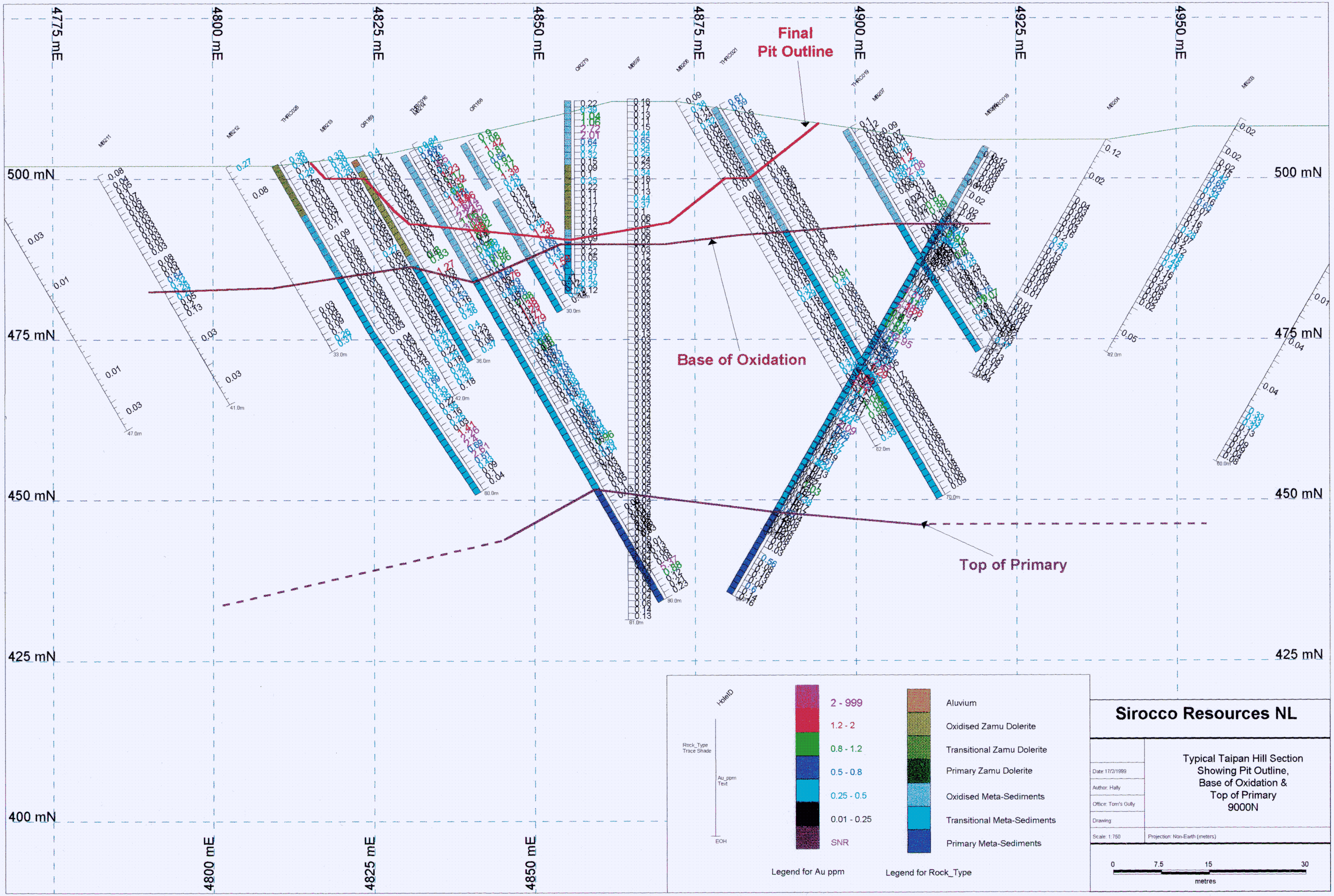
- Aluvium
- Oxidised Zamu Dolerite
- Transitional Zamu Dolerite
- Primary Zamu Dolerite
- Oxidised Meta-Sediments
- Transitional Meta-Sediments
- Primary Meta-Sediments

Sirocco Resources NL

Typical ZDZ Section
Showing Pit Outline,
Base of Oxidation &
Top of Primary
9150N

Date: 17/2/1999
Author: Hally
Office: Tom's Gully
Drawing
Scale: 1:750
Projection: Non-Earth (meters)

0 7.5 15 30
metres



Sirocco Resources NL

Typical Taipan Hill Section
Showing Pit Outline,
Base of Oxidation &
Top of Primary
9000N

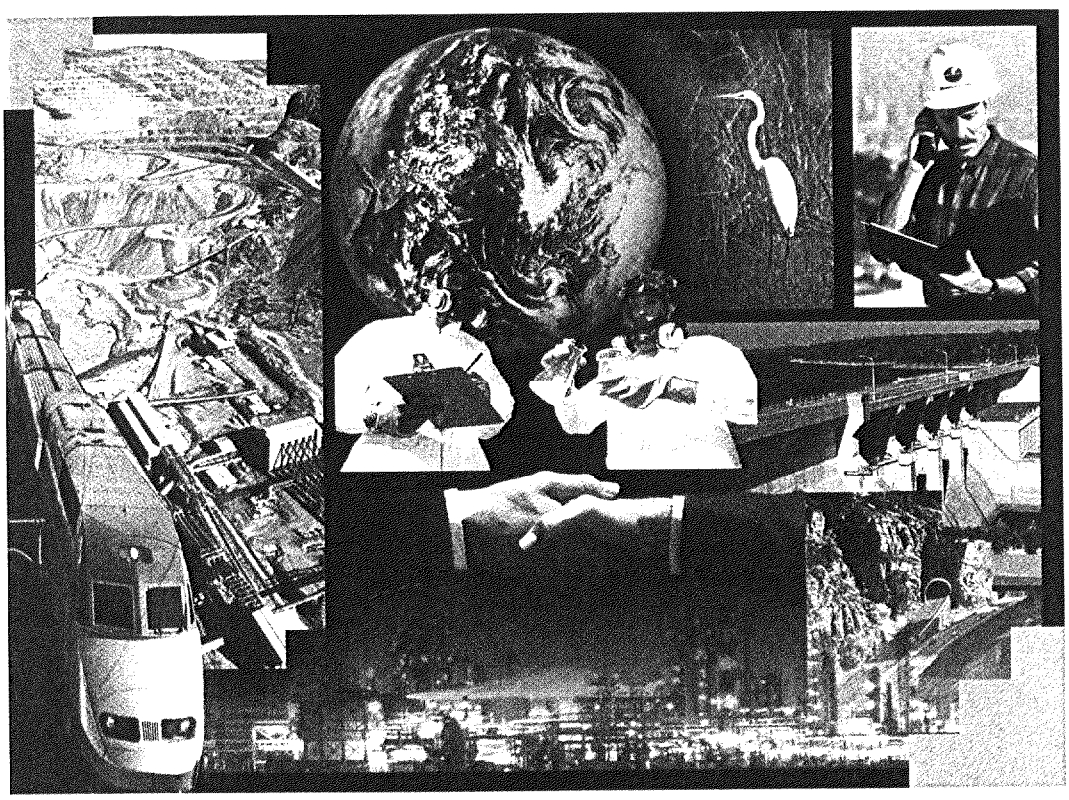
Date: 17/2/1999	
Author: Hally	
Office: Tom's Gully	
Drawing:	
Scale: 1:750	Projection: Non-Earth (meters)

0 7.5 15 30
metres

Appendix 5-1

DRAFT REPORT

PRELIMINARY WASTE ROCK CHARACTERISATION - PROPOSED QUEST 29 OPEN PITS



Prepared for
Sirocco Resources NL
Level 10, Grosvenor Place
225 George Street
SYDNEY NSW 2000

26 November 1998

AGC WOODWARD-CLYDE PTY LIMITED
ACN 000 691 690
49 Park Road, MILTON QLD 4064 Australia
Tel: (07) 3364 7444 • Fax: (07) 3364 7477
A3201 41 1\0001\WP\R001-A.DOC

Woodward-Clyde

Engineering &sciences applied to the natural and built environment

2 December 1998
Project No. A320141 l-0001

Sirocco Resources NL
Level 10, Grosvenor Place
225 George Street
SYDNEY NSW 2000

Attention: **Mr Ralph Stagg**
Technical Director

Dear Ralph

RE: QUEST 29 PROJECT PRELIMINARY WASTE CHARACTERISATION STUDY

Please find enclosed the preliminary waste characterisation study report for mine waste from the Proposed Quest 29 pit areas.

If you have any queries on the report please contact Peter Scott on 07 3364 7444. Thank you.

Yours sincerely
AGC WOODWARD-CLYDE PTY LIMITED

Peter Scott
Principal Environmental Geochemist

DOCUMENT2\0 XXX 0000\PAS:pas

TABLEOFCONTENTS

Tables

Figures

Appendices

SECTIONONE Introduction

Woodward-Clyde Pty Limited (Woodward-Clyde) was commissioned by Sirocco Resources NL to undertake preliminary waste characterisation and geochemical investigations on potential waste rock to be mined from small open pits in the Quest 29 area. The results of this study will form part of the requirements for the PER to be submitted early December.

It is understood that Sirocco Resources propose to recommence operations at their Toms Gully mine site near Darwin, Initially this will involve mining from a number of small open pits in the Quest 29 area about 14 km from Toms Gully. It is envisaged that high grade ore will be trucked to Toms Gully for treatment. Dump leaching of low grade ore on site is being considered. It is understood that the bulk of both ore and waste will be oxide material. The waste material requires acid base accounting testwork to be undertaken to determine potential environmental impacts and to develop effective management procedures to mitigate acid drainage.

The static acid base accounting testwork is a coarse definition tool for predicting the acid producing potential of mine waste. It provides a theoretical value for the parameters tested and assumes that each parameter measured will be fully available to acid generating and consuming reactions that may occur during the oxidation of waste similar in composition to the material tested, An acid base accounting or net acid producing potential (NAPP) test was conducted on the 20 samples collected from the Quest 29 area during this investigation, Other geochemical static tests conducted during this investigation were the net acid generation (NAG) test, the saturated paste pH and conductivity (EC) tests and the total metal analysis test. The NAG test provides an indication of sulphide reactivity and available neutralising potential. Paste pH and conductivity tests give a preliminary indication of the in-situ pH of waste materials and the immediate reactivity of minerals present in the sample. Sulphide oxidation may enhance the solubility of metal constituents in waste rock. Metal analysis is carried in order to provide an indication of the metal concentration in the waste rock in comparison to that of the background soils and country rock. The chemical and physical properties of the rock will further affect their potential for mitigation from the source. In addition to waste rock analysis, ore grade sample material was also examined for each prospect area.

This report is a preliminary assessment of the acid producing potential of mine waste from the Quest 29 Project, and describes the sampling strategy used, outlines the static testwork procedure, and provides discussion of the results. The investigation is indicative rather than quantitative and simply provides a preliminary indication of the acid producing potential of the material to be extracted from the proposed pits. Before mining commences a further testwork program for waste block modelling and mine waste scheduling will be undertaken.

1 .I SCOPE OF STUDY

The study is to assess the potential for acid drainage from typical mine waste (rock, tailings) that will be extracted in mining the Quest 29 open pits. This includes the assessment of potential mine waste for the Koolpin Hill, Koolpin North, Taipan Hill and Dolerite areas.

The scope of work for the waste rock study included the following:

- Identification of the acid producing potential of the waste rock material utilising acid base accounting, NAG testing, saturated paste pH and conductivity (EC) testing and geochemical analysis by selective elemental scan on the selected samples.
- Identification of the selected waste and ore samples' potential to produce acid

The Quest 29 area is situated about 14 km from Sirocco's Toms Gully mine site approximately 100 km ESE from Darwin. This area lies within the Pine Creek Geosyncline. 'The main components of this geosyncline are a series of late Archaean basement domes overlain by a Paleoproterozoic sedimentary and volcanic sequence deposited in a shallow intracontinental rift.' (Miller, G. C., *et al* 1998 p. 410). These sedimentary sequences were deformed during the 'Top End Orogeny at 1870 to 1800 Myr resulting in tight folds and lower greenschist metamorphism'. (Miller, G. C., et *al* 1998 p. 411). Two main episodes of granitic intrusion also occurred at about this time.

The South Alligator Group lies at the base of the Paleoproterozoic sequence. The Koolpin Formation is the host rock to the mineralisation at the Koolpin Hill, Koolpin North and Taipan Hill prospects at Quest 29. The Koolpin Formation lies at the base of the South Alligator Group. Table 1 below gives the rock types and thicknesses of the Formations within the South Alligator Group.

Unit	Rock type	Thickness (m)
Mount Bonnie Formation	Greywacke, carbonaceous argillite, argillite, chert, cherty tuff, BIF	150-400
Gerowie Tuff	Argillite, chert, cherty tuff	200-400
Koolpin Formation	Carbonaceous argillite, chert, BIF, silicified dolomite	300-1000

Table 1 - South Alligator Group stratigraphy (from Nicholson, Ormsby and Farrar (1994)).

This sedimentary sequence is intruded by the Zamu Dolerite. Mineralisation is hosted by Zamu Dolerite at the Dolerite prospect.

There are two major types of mineralisation recognised in the central Pine Creek Geosyncline. Firstly there is the quartz vein set or stockwork style such as at Mount Todd, Enterprise, Union Reefs and Woolwonga Second is the stratiform style represented at Cosmo Howley in part, Golden Dyke, Mount Bonnie and Rustlers Roost. (Miller, G. C., *et al* 1998 p. 411). Mineralisation in the region has been associated with granite intrusions (high temperature hydrothermal), shearing, chemical controls and skarn alteration. In the Quest 29 area mineralisation is likely to be linked to structural processes including deformation and shearing. Mineralisation at the Koolpin Hill, Koolpin North and Taipan Hill prospects is hosted mainly by carbonaceous siltstone containing disseminated pyrite and minor arsenopyrite in the primary zone. At the Dolerite prospect ore is strongly arsenopyritic with some pyrite.

3.1 SAMPLE SELECTION

Samples for waste characterisation were collected from four areas, Koolpin Hill, Koolpin North, Taipan Hill and Dolerite. The sample selection was based on a review of the geological cross-sections, the drill hole database and examination of the diamond core from the mine sequence. A suite of material types were selected to identify the potential for acid generation in mine waste from each. It is noted that although the data set is small, it is designed to provide indicative information on Acid Mine Drainage (AMD) only. Representative samples of mineralised, waste, oxide and fresh rock were collected for each area.

Proposed Pit Areas

The sample material selected for assessment relates to material that may be mined from pits in each area. Samples were selected from Reverse Circulation drill holes from these areas. A total of 20 samples were collected from 18 drill holes from the various potential pit areas. Samples were collected from oxidised and partially oxidised material as described in Tables 2 and 3. Sample depths ranged from 3 to 65 m. Samples were collected as composites of intervals ranging from 2 to 5 m. To preserve sample representativeness, intervals generally should not exceed 2 m. It was concluded from examination of the diamond drill core that the composition of the waste and ore rocks was relatively homogenous. Due to the homogeneous nature of the rock units, composites of 2 to 5 m were considered representative of the major rock units.

Koolpin Hill

A total of 5 RC drill holes were sampled from the Koolpin Hill area. Sample depths range from 10 to 39 m below ground surface. A total of 5 representative samples were collected as 3 to 5 m composites. Samples were representative high grade ore, low grade ore, oxide waste, oxide and fresh mineralised waste. The material sampled is Koolpin Formation siltstone.

Kooipin North

A total of 5 representative samples were collected as 4 to 5 m composites from 5 RC drill holes. Sample depths range from 10 to 30 m below ground surface. Samples collected were representative high grade ore, low grade ore, oxide mineralised waste, fresh and transition mineralised waste. The material sampled is Koolpin Formation siltstone.

Taipan Hill

A total of 6 representative samples were collected as 3 to 5 m composites from 5 RC drill holes. Sample depths ranged from 3 to 33 m below ground surface. Samples collected were representative high grade ore, low grade ore, oxide waste, oxide, oxide shale and fresh mineralised waste. The material sampled is Koolpin Formation siltstone and shale.

D olerite

A total of 4 representative samples were collected as 2 to 5 m composites from 3 RC drill holes. Sample depths ranged from 10 to 39m below ground surface. Samples collected were representative high grade ore, oxide and fresh mineralised waste. The material sampled is Zamu Dolerite. The Dolerite prospect contains a relatively small proportion of oxide and a higher proportion of primary rock in comparison with the above sedimentary-hosted prospects.

Samples were collected from selected Reverse Circulation drill holes, Tables 2 and 3 provide **hole** locations, sample depths and sample types.

3.2 SAMPLE PREPARATION AND ANALYSIS

Samples were dried, crushed and pulverised to 80% passing 75 μm.

Acid base accounting and geochemical analyses were performed by Australian Laboratory Services (ALS) Brisbane and Woodward-Clyde (Brisbane). The results of the testwork are presented in Tables 2, 3 and 4.

3.2.1 Geochemistry

Geochemical analysis of all samples was undertaken by ICP optical emission spectrometry on a mixed acid digest (total extraction) for copper, lead, zinc arsenic, molybdenum, cobalt, cadmium, and nickel.

These elements were selected in consultation with Sirocco Resources geological staff on the basis of trace element concentrations common to the Quest 29 deposit. These elements are also common to many of the major deposits in the region including Brocks Creek and Union Reefs. The Quest 29 results may therefore be used in comparison to other deposits in the future.

The results of the geochemical testwork are presented in Table 2.

3.2.2 Acid Base Accounting

Acid base accounting was undertaken on all samples submitted for analysis. Acid base account testwork included:

- total sulphur content by high temperature Leco furnace method (ALS method Al 6-l);
- acid neutralising capacity (ANC) by titrametric analysis.

Total sulphur was selected as a conservative assessment of the acid producing potential of the waste material tested. (MPA) was calculated directly using the stoichiometric relationship with total sulphur and sulphuric acid.

The results of the acid base account testwork are presented in Table 3. ANC:MPA ratios are also shown in Table 3. ANC versus MPA is plotted in Figure 1.

3.2.3 Net Acid Generation (NAG)

NAG testwork was undertaken on all samples submitted for analysis.. Sample selection was weighted towards samples with positive NAPP results, with sulphur levels >0.2%, in order to verify the positive acid base accounting results. The results of the NAG testwork including final pH and NAG values in kg H_2SO_4/t are presented in Table 3.

3.2.4 Paste pH and Conductivity

Paste pH and conductivity tests were carried out in order to give a preliminary indication of the in-situ pH of waste materials and the immediate reactivity of minerals present in the sample. The results of the pH and conductivity tests are presented in Table 4.

Table 2
Geochemical Scan Results

Sample Number	Area	Section (N)	Easting	Depth (m)	Sample Type	Cu ppm	Pb ppm	Zn ppm	As ppm	Mo ppm	Co ppm	Cd ppm	Ni ppm
QR268	Koolpin Hill	9400	4990	10-13	High Grade	161	292	165	802	5	<5	<5	22
QR269	Koolpin Hill	9450	4994	11-14	Low Grade	135	22	76	1120	9	<5	<5	28
QR140	Koolpin Hill	9525	4988	11-15	Oxide Waste	207	752	180	726	7	34	<5	45
QR145	Koolpin Hill	9400	4955	16-20	Oxide Mineralised Waste	226	680	220	638	5	<5	<5	43
QR115	Koolpin Hill	9400	4900	34-39	Fresh Mineralised Waste	63	327	150	295	16	36	<5	115
QR263	Koolpin North	10025	4827	25-30	High Grade	462	137	145	327	33	11	<5	69
QR191	Koolpin North	10150	4870	20-25	Low Grade	395	216	196	818	30	9	<5	51
QR189	Koolpin North	10100	4854	10-15	Fresh Mineralised Waste	53	216	54	53	7	<5	<5	<5
QR188	Koolpin North	10075	4852	15-19	Oxide Mineralised Waste	201	407	143	151	21	5	<5	43
QR184	Koolpin North	9975	4860	19-24	Transition Mineralised Waste	133	289	107	216	8	6	<5	15
QR172	Taipan Hill	9040	4837	30-33	High Grade	247	367	443	9390	9	21	18	169
QR168	Taipan Hill	9000	4839	17-22	Low Grade	282	1730	326	2720	19	7	<5	64
QR168	Taipan Hill	9000	4839	10-15	Oxide Waste	149	200	142	1370	14	9	<5	27
QR180	Taipan Hill	9120	4848	28-33	Fresh Mineralised Waste	100	771	872	725	12	11	9	75
QR175	Taipan Hill	9060	4836	3-8	Oxide Mineralised Waste	249	102	345	1060	11	22	6	176
QR162	Taipan Hill	8860	4872	15-20	Shale Oxide Waste	198	179	493	1650	8	28	7	47
QR137	Dolerite	9275	5300	30-32	High Grade	104	62	116	43600	7	216	<5	94
QR134	Dolerite	9025	5194	10-15	Oxide Waste	103	29	216	1690	5	79	<5	305
QR137	Dolerite	9275	5300	25-30	Fresh Waste	178	38	115	2340	<5	72	<5	57
QR132	Dolerite	8975	5091	61-65	Fresh Waste	107	28	108	2300	<5	52	<5	103
Shale - Average abundance						50	20	100	15	3	20	0.2	70
Environmental Trigger levels for Surface Soils						60	300	200	20	4		3	

* Average crustal abundance in the earth's crust (Field Geologists Manual AusIMM, 1989, p 54)

Table 3
Acid Base Accounting Results

Sample Number	Area	Section (N)	Easting	Depth (m)	Sample Type	S %	pH after oxidation	NAG kg/t	ANC kg/t	MPA kg H_2SO_4 /t	NAPP kg H_2SO_4 /t	ANC: MPA ratio
QR268	Koolpin Hill	9400	4990	10-13	High Grade	0.16	3.5	6.4	0.6	4.9	4.3	0.12:1
QR269	Koolpin Hill	9450	4994	11-14	Low Grade	0.06	4.2	12.8	0.6	1.8	1.2	0.33:1
QR140	Koolpin Hill	9525	4988	11-15	Oxide Waste	0.02	4.4	6.3	1.2	0.6	-0.6	2.00:1
QR145	Koolpin Hill	9400	4955	16-20	Oxide Mineralised Waste	0.58	3.8	10.2	0.4	17.8	17.4	0.02:1
QR115	Koolpin Hill	9400	4900	34-39	Fresh Mineralised Waste	20.78	2.4	564	<0.1	636.4	636.3	0.00:1
QR263	Koolpin Nth	10025	4827	25-30	High Grade	8.22	2.4	224	<0.1	251.7	251.7	0.00:1
QR191	Koolpin Nth	10150	4870	20-25	Low Grade	0.38	3.9	5.2	0.7	11.6	10.9	0.06:1
QR189	Koolpin Nth	10100	4854	10-15	Fresh Mineralised Waste	1.84	3.6	11.5	<0.1	56.4	56.3	0.00:1
QR188	Koolpin Nth	10075	4852	15-19	Oxide Mineralised Waste	0.63	3.8	7.8	<0.1	19.3	19.2	0.00:1
QR184	Koolpin Nth	9975	4860	19-24	Transition Mineralised Waste	0.13	4.4	6.6	1.3	4.0	2.7	0.33:1
QR172	Taipan Hill	9040	4837	30-33	High Grade	4.89	2.5	73.6	3.5	149.8	146.3	0.02:1
QR168	Taipan Hill	9000	4839	17-22	Low Grade	0.65	3	12.3	<0.1	19.9	19.9	0.00:1
QR168	Taipan Hill	9000	4839	10-15	Oxide Waste	0.12	3.7	6.1	0.7	3.7	3.0	0.19:1
QR180	Taipan Hill	9120	4848	28-33	Fresh Mineralised Waste	1.3	2.6	33.9	3	39.8	36.8	0.08:1
QR175	Taipan Hill	9060	4836	3-8	Oxide Mineralised Waste	0.07	4.8	4.4	4.7	2.1	-2.6	2.24:1
QR162	Taipan Hill	8860	4872	15-20	Shale Oxide Waste	0.27	4.9	4.3	0.6	8.3	7.7	0.07:1
QR137	Dolerite	9275	5300	30-32	High Grade	2.55	7.5	<0.1	93.4	78.1	-15.3	1.20:1
QR134	Dolerite	9025	5194	10-15	Oxide Waste	0.03	5.5	4.8	9.4	0.9	-8.5	10.4:1
QR137	Dolerite	9275	5300	25-30	Fresh Waste	2.53	2.6	49.4	13.6	77.5	63.9	0.18:1
QR132	Dolerite	8975	5091	61-65	Fresh Waste	1.19	3.2	13.4	16.7	36.4	19.7	0.45:1

Table 4

Summary of Paste pH and EC Results

Sample Number	Paste pH	Paste EC µS/cm
QR268	4.72	30
QR269	4.60	30
QR140	5.93	30
QR145	4.48	20
QR115	1.13	*700.00
QR263	1.81	7970
QR191	4.33	100
QR189	3.82	10
QR188	4.02	20
QR184	5.10	90
QR172	3.69	1500
QR168 17-22 m	4.04	800
QR168 10-15 m	4.87	20
QR180	4.32	1680
QR175	4.77	320
QR162	4.92	20
QR137 30-32 m	7.43	630
QR134	7.14	340
QR137 25-30 m	7.04	940
QR132	7.09	1000

*Paste EC as mS/cm

4.1 ACID BASE ACCOUNT STATIC TESTWORK

4.1.1 Total Sulphur

The total sulphur content of the samples tested ranged from 0.02 to 20.78 %. Out of 20 samples 7 recorded low total sulphur content (less than 0.25 % S). Five ore grade samples recorded total sulphur contents of >0.25%. The remaining 8 waste samples had total sulphur contents >0.25% and were collected from both the carbonaceous siltstone at the Koolpin Hill, Koolpin North and Taipan Hill areas and the dolerite from the Dolerite area.

4.1.2 Maximum Potential Acidity

Conventional wisdom and experience suggests that a material sulphur content of generally >0.25%S would be potentially acid producing in the absence of acid neutralising minerals such as calcite. (0.25 %S is equivalent to 0.5 % pyrite or trace pyrite).

The acid producing potential for the majority of the waste rock material examined in this study is moderate to high, with 62% of samples tested exceeding 0.25% sulphur.

4.1.3 Acid Neutralising Capacity (NAC)

The ANC results of the material tested ranged from the detection limit of <0.1 kg H_2SO_4/tonne to a high of 93.4 kg H_2SO_4/tonne. The highest ANC reading was recorded for a sample of high grade dolerite ore. The ANC results of the waste rock material tested ranged from the detection limit of <0.1 kg H_2SO_4/tonne to a high of 16 kg H_2SO_4/tonne. The highest reading for the waste rock material was also in dolerite.

The acid neutralising capacity is limited in the carbonaceous siltstone waste rock material examined and relatively high in the dolerite waste.

4.1.4 Net Acid Producing Potential (NAPP)

The classification system used to categorise the samples into three classes are described in Table 5. The classification is based on established procedures developed through Canadian AMD research (Brodie *et al* 199 1; Smith and Barton Bridges 199 1; Ferguson and Morin 199 1; Ferguson and Robertson 1994; Miller 1998) and built upon by Woodward-Clyde. The three categories used are shown in Table 5. The ANC was plotted against MPA in Figure 1. The plot shows that the acid producing potential of most of the samples tested is low to moderate and the neutralising capacity is low.

Ore Samples

The majority of ore rock material tested was classified as potentially acid forming (PAF) in Table 5.

Waste Samples

The majority of waste rock material tested (9 of 13 samples) was also classified as potentially acid forming (PAP) in Table 5.

4.1.5 Net Acid Generation (NAG)

The results of the testing suggest the following, based on the system of classification developed by Miller (1998) which is summarised in Table 5.

Ore Samples

The samples of ore from the Koolpin Hill, Koolpin North and Taipan Hill areas. have final NAG pH values <4.5, NAG values of >5 kg H_2SO_4/t and positive NAPP results indicating they are PAF material. The dolerite ore sample from the Dolerite area has a final NAG pH value >4.5, NAG values of <5 kg H_2SO_4/t and negative NAPP results indicating it is non-acid forming (NAP) material.

Waste Samples

Samples of fresh, oxide and transition mineralised waste from Koolpin Hill and Koolpin North areas returned final NAG pH values <4.5, NAG values of >5 kg H_2SO_4/t and positive NAPP results indicating they are PAF material. The sample of oxide waste from Koolpin Hill returned an uncertain result with a final NAG pH value <4.5, NAG value of >5 and negative NAPP suggesting the material is most likely to be relatively neutral.

Samples of oxide and fresh mineralised waste material from the Taipan Hill area showed final NAG pH values <4.5, NAG values >5 kg H_2SO_4/t, and a positive NAPP, suggesting this material is PAF. The sample of oxide mineralised waste from Taipan Hill showed a final NAG pH value >4.5, NAG value <5 and negative NAPP suggesting this material is NAP. The sample of shale oxide waste from Taipan Hill returned an uncertain result with a final NAG pH value >4.5, NAG value of <5 and positive NAPP suggesting the material is most likely to be PAP.

Samples of fresh waste material from the Dolerite area showed final NAG pH values <4.5, NAG values >10 kg H_2SO_4/t, and a positive NAPP, suggesting this material is PAF. The sample of oxide waste from Dolerite showed a final NAG pH value >4.5, NAG value <5 and negative NAPP suggesting this material is NAF.

4.1.6 Paste pH and Conductivity

'A sample with a pH less than 4 indicates the sample is naturally acidic regardless of the NAPP, while an EC greater than 2000 microSiemens per metre (µS/m) indicates a high level of soluble constituents.' (Environment Australia 1997, p 29).

The results of the paste pH testing revealed that 4 of the 20 samples tested were naturally acidic. These were fresh mineralised waste from Koolpin Hill, high grade ore and fresh mineralised waste from Koolpin North, and high grade ore from Taipan Hill.

Only 2 of the 20 samples had an EC greater than 2000 µS/m. This was the fresh mineralised waste sample from the Koolpin Hill area and the high grade ore sample from the Koolpin North area.

The results of the pH and conductivity tests are presented in Table 4.

Table 5

Classification of Mine Waste using NAG testing

Mine Waste Type	Final NAG pH	Static NAG value kg H_2SO4/t	NAPP kg H_2SO4/t
Potentially Acid Forming - High Capacity (PAF)	<4.5	>5	positive
Potentially Acid Forming - Low Capacity (PAF-LC)	<4.5	≤5	positive
Non-Acid Forming (NAF)	24.5	0	negative
Acid Consuming (ACM)	24.5	0	less than -100
Uncertain	24.5	0	positive
	<4.5	>0	negative

After: Brodie *et al* 1991; Smith and Barton Bridges 1991; Ferguson and Morin 1991; Ferguson and Robertson 1994: Miller 1998.

4.2 CLASSIFICATION OF WASTE ROCK

The classification system used to categorise the samples into three classes are described in Table 5. The classification is based on established procedures developed through Canadian AMD research (Brodie *et al* 1991; Smith and Barton Bridges, 1991; Ferguson and Morin, 199 1; Ferguson and Robertson, 1994) and built upon by Woodward-Clyde. The three categories used are shown in Table 5.

The ANC was plotted against MPA in Figure 1. The plot shows that the acid producing potential of most of the samples tested is low to moderate and the neutralising capacity is low. It appears that the majority of carbonaceous siltstone samples from the Koolpin Hill, Koolpin North and Taipan Hill areas are PAF with the exception of the oxide mineralised waste sample from Taipan Hill. This is likely to be a function of the samples' low ANC results.

The majority of waste rock material tested was classified as potentially acid forming (PAP) in Table 5. The ANC: MPA ratios confirm this.

4.3 GEOCHEMICAL TESTWORK

The results of the geochemical analyses are contained in Table 2. Average crustal abundance levels of the selected elements in sediments have been provided for comparison. In addition, environmental 'trigger levels' for soil contaminants have also been provided for comparison. The discussion below will refer to elevated levels of metal ions with respect to crustal abundances and trigger levels. Trigger levels are used as a guide only, and when interpreting results in mineralised areas should be used with discretion. The effects of elevated metal concentrations depend on numerous site specific factors, not least being the sensitivity of the receiving environment. However, the trigger levels are useful in providing an indication of which particular metals may potentially impact on rehabilitation procedures.

Proposed Pit Areas

In summary arsenic is the dominant metal ion exhibiting extremely elevated concentrations in the test material with respect to crustal abundance for sediments and environmental trigger levels. Moderately elevated levels of copper, lead, zinc and molybdenum were also recorded for some samples. Slightly elevated levels of cobalt and nickel were recorded for some samples, Cadmium was slightly elevated in the Taipan Hill samples, The ore samples show the highest concentrations in the elements selected for testing. The oxide waste samples of siltstone from Koolpin Hill, Koolpin North and Taipan Hill appear to show higher levels of arsenic and copper than the fresh siltstone samples,

Kooipin Hill

The samples from the Koolpin Hill area are elevated in arsenic, copper, lead and molybdenum with respect to crustal abundances and environmental trigger levels.

Koolpin North

Highly elevated levels of arsenic are shown for the ore samples at Koolpin North. The waste samples are also elevated in arsenic. All samples are elevated in copper and molybdenum. There are also minor elevations in lead with respect to crustal abundances and environmental trigger levels.

Taipan Hill

The samples from the Taipan Hill area are elevated in arsenic, copper, lead, molybdenum and zinc with respect to crustal abundances and environmental trigger levels.

Dolerite

The samples from the Dolerite area are elevated in arsenic, copper, cobalt and nickel with respect to crustal abundances and environmental trigger levels. Slightly elevated levels of zinc and molybdenum are also displayed.

5.1 ACID PRODUCING POTENTIAL

The potential for acid mine drainage from waste rock for the Quest 29 area is moderate to high with a low acid neutralising capacity for all siltstone waste from the Koolpin Hill, Koolpin North and Taipan Hill areas. The fresh waste at the Dolerite prospect has the potential to produce acid, yet the oxide sample from this area appears to be less reactive. All siltstone ore from the Koolpin Hill, Koolpin North and Taipan Hill areas also has the potential to produce acid. Ore samples from the Dolerite area are less reactive. Table 6 classifies the samples using the categories outlined in Table 5.

5.1.1 Acid Base Accounting

Of the 7 ore samples tested, 6 are PAP. The results from the Dolerite area ore sample suggest the potential of the material to form acid is uncertain. Of the 13 waste samples tested, 10 are PAF. Results indicate that the oxide waste from the Dolerite area is NAF. The oxide waste sample from the Koolpin Hill area and the oxide mineralised waste sample from the Taipan Hill area returned uncertain results. The data suggests that both fresh and oxidised waste rock material that will potentially be extracted from pits at the Koolpin Hill and Koolpin North areas is likely to be potentially acid producing. Three of the four waste samples taken from the Taipan Hill area suggest that the waste will be acid forming. Results for one of the samples indicated that the oxide mineralised waste would not be acid forming. Further tests to confirm this may be necessary. The Dolerite samples suggest that the fresh waste has a greater potential to generate acid than the oxide waste and that the oxide waste may in fact be NAF. Sampling of the sediments surrounding this dolerite intrusion is also recommended if it is to be included in the waste material for this area. It is suggested from this that special waste handling procedures such as encapsulation of the potentially reactive waste may be necessary.

The distribution and volume of this material should be quantified through further investigation including waste resource modelling and management strategies defined for it if deemed necessary.

5.1.2 Net Acid Generation (NAG)

The testing for NAG capacity on selected samples confirmed that the samples tested were potentially acid forming. The samples of oxidised mineralised waste from the Taipan Hill area and oxide waste from the dolerite area are potentially non acid forming.

5.2 GEOCHEMISTRY

The metals content of the test samples generally is elevated in arsenic for the waste and ore rock material. Copper, cobalt and nickel are slightly elevated in some of the sample material tested. Lead, zinc and molybdenum is slightly to moderately elevated in the siltstone samples from the Koolpin Hill, Koolpin North Taipan Hill areas, This is common to deposits in the Pine Creek Geosyncline.

The acid base accounting results indicate that there may be a potential for acid leachate generation and hence potential for mineral mobilisation from the material tested.

Special handling of the waste from the potential pit areas may be required, subject to further static based testwork. Kinetic based testwork would also be necessary in order to confirm this.

Table 6 - Waste Characterisation - Classification of Samples

Sample Number	Area	Section (N)	Easting	Depth (m)	Sample Type	ANC: MPA	Class
QR268	Koolpin Hill	9400	4990	10-13	High Grade	0.12:1	PAF
QR269	Koolpin Hill	9450	4994	11-14	Low Grade	0.33:1	PAF
QR140	Koolpin Hill	9525	4988	11-15	Oxide Waste	2.00:1	uncertain
QR145	Koolpin Hill	9400	4955	16-20	Oxide Mineralised Waste	0.02:1	PAF
QR115	Koolpin Hill	9400	4900	34-39	Fresh Mineralised Waste	0.00:1	PAF
QR263	Koolpin North	10025	4827	25-30	High Grade	0.00:1	PAF
QR191	Koolpin North	10150	4870	20-25	Low Grade	0.06:1	PAF
QR189	Koolpin North	10100	4854	10-15	Fresh Mineralised Waste	0.00:1	PAF
QR188	Koolpin North	10075	4852	15-19	Oxide Mineralised Waste	0.00:1	PAF
QR184	Koolpin North	9975	4860	19-24	Transition Mineralised Waste	0.33:1	PAF
QR172	Taipan Hill	9040	4837	30-33	High Grade	0.02:1	PAF
QR168	Taipan Hill	9000	4839	17-22	Low Grade	0.00:1	PAF
QR168	Taipan Hill	9000	4839	10-15	Oxide Waste	0.19:1	PAF
QR180	Taipan Hill	9120	4848	28-33	Fresh Mineralised Waste	0.08:1	PAF
QR175	Taipan Hill	9060	4836	3-8	Oxide Mineralised Waste	2.24:1	uncertain
QR162	Taipan Hill	8860	4872	15-20	Shale Oxide Waste	0.07:1	PAF
QR137	Dolerite	9275	5300	30-32	High Grade	1.20:1	uncertain
QR134	Dolerite	9025	5194	10-15	Oxide Waste	10.4:1	NAF
QR137	Dolerite	9275	5300	25-30	Fresh Waste	0.18:1	PAF
QR132	Dolerite	8975	5091	61-65	Fresh Waste	0.45:1	PAF

KEY: • PAF - Potentially Acid Forming • NAF - Non-Acid Forming

(* Assessment of ANC:MPA ratio; >3: 1 -NAF, 1-3: 1 - uncertain, <1: 1 -PAF)

5.3 CONCLUSIONS

This preliminary characterisation of waste rock from the Quest 29 proposed pits has found the majority of samples (10 of 13) to be potentially acid forming. Two results were uncertain and the oxide waste from the Dolerite area was NAF. There was a large contrast between some of the sample results (for example sample QR 115 / 34-39 m had a S % of 20.78 compared to sample QR 140 / 1 l-l 5 m with a S % of 0.02). This is acceptable for the purpose of this preliminary assessment report. Due to the acid forming capacity of the majority of samples, it is concluded that if the project is to proceed a larger set of samples would need to be collected and assessed.

Further information on the deposit's mineralogy is necessary in order to characterise the waste rock on this basis. A more detailed lithology description, a description of the sulphides and their abundance, a description of the carbonates and their abundance, more detailed oxidation state description, and alteration descriptions would be useful if available.

Due to the limited number of samples tested, this data is indicative only. Further sampling and testing of the potential waste from the proposed Quest 29 pit areas will be required to develop a waste resource model. This will enable volumes and distribution of potentially acid forming waste to be quantified and waste handling strategies to be developed to minimise acid drainage,

The discussions and conclusions contained within this report are based on a limited number of samples. The sample sites were selected by Sirocco Resources staff, Samples were selected from RC holes drilled at proposed pit sites in the Quest 29 area. Woodward-Clyde take no responsibility for the accuracy of identification of the geological units sampled.

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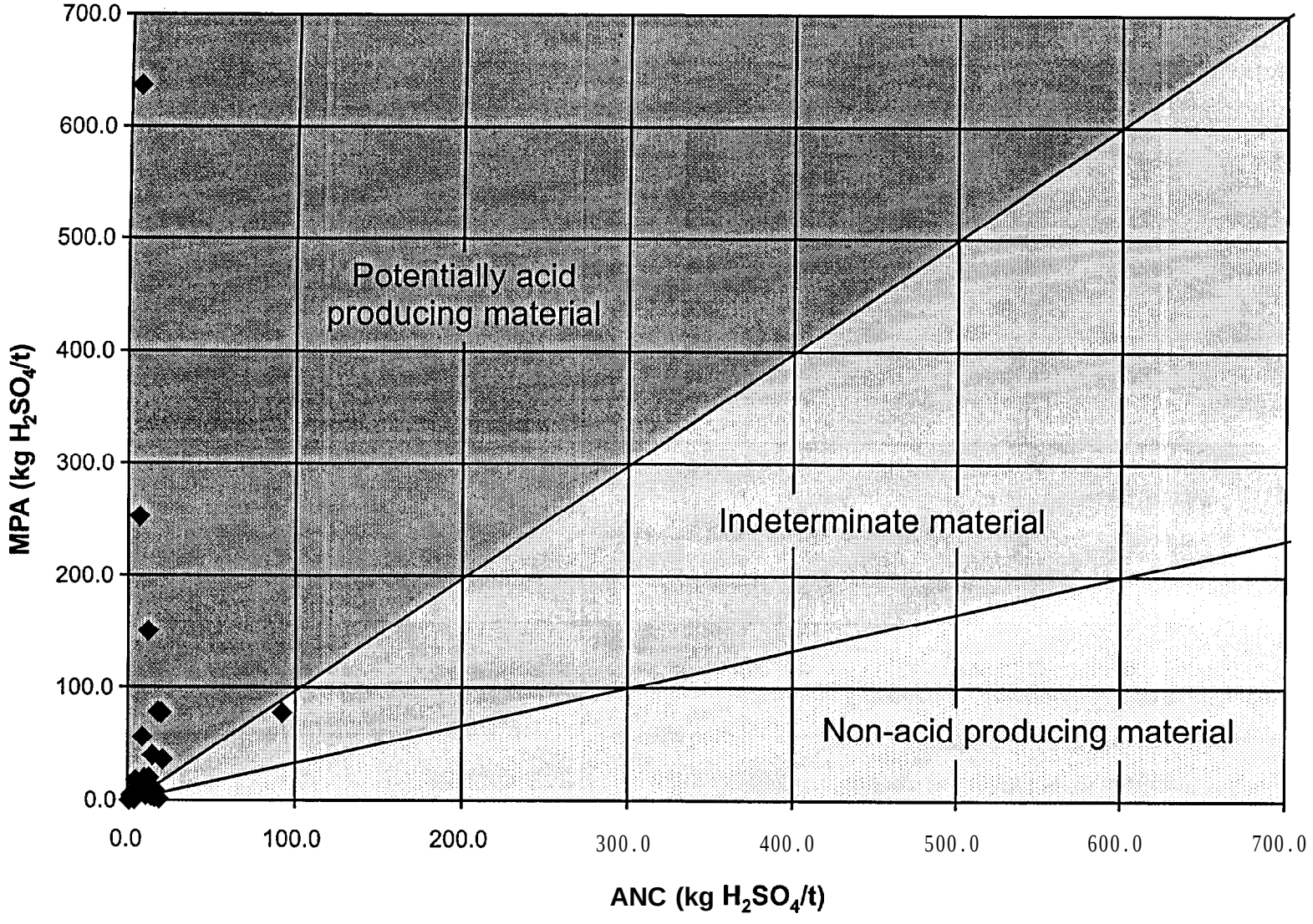
FIGURES

Figure 1



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CHECKED: MA CAD FILE No: -G-001

APPROVED: RE REVISION: A

DATE: DEC 98

LEGEND

◆ QUEST 29 Samples - ANC vs MPA

SOURCE: **S:\A32\01411\0001\XLS\T001-1.xls** chart

CLIENT **SIROCCO RESOURCES NI**

PROJECT **PRELIMINARY WASTE ROCK CHARACTERISATION - PROPOSED QUEST 29 OPEN PITS**

TITLE ACID BASE ACCOUNTING - ANC vs MPA

FIGURE **1**

Woodward-Clyde

APPENDIX 1 ALS Analytical Reports

AUSTRALIAN LABORATORY
SERVICES P/L
A.C.N. 009 936 029

ANALYTICAL REPORT

CONTACT: MS B HYNCH
CLIENT: AGC WOODWARD-CLYDE (QLD)
ADDRESS: 49 PARK ROAD
MILTON QLD 4064

LABORATORY: STAFFORD
BATCH NUMBER: ST24370
SUB BATCH: 0
No. OF SAMPLES: 20
DATE RECEIVED: 29/10/98
DATE COMPLETED: 03/11/98

ORDER No.: A3201411/0001 SAMPLE TYPE: SOIL PROJECT: SIRROCCO

SAMPLE NUMBER	ELEMENT UNIT METHOD L.O.R.	S % A16-1 0.01	cu ppm IC587 5	Pb ppm IC587 5	Zn ppm IC587 5	AS ppm IC587 5	Mo ppm IC587 5
QR268		0.16	161	292	165	802	5
QR269		0.06	135	22	76	1120	9
QR140		0.02	207	752	180	726	7
QR145		0.58	226	680	220	638	5
QR115		20.78	63	327	150	295	16
QR263		8.22	462	137	145	327	33
QR191		0.38	395	216	196	818	30
QR189		1.84	53	216	54	53	7
QR188		0.63	201	407	143	151	21
QR184		0.13	133	289	107	216	8
QR172		4.89	247	367	443	9390	9
QR168	17-22	0.65	282	1730	326	2720	19
QR168	10-15	0.12	149	200	142	1370	14
QR180		1.30	100	771	872	725	12
QR175		0.07	249	102	345	1060	11
QR162		0.27	198	179	493	1650	8
QR137	30-32	2.55	104	62	116	4.36%	7
QR134		0.03	103	29	216	1690	5
QR137	25-30	2.53	178	38	115	2340	<5
QR132		1.19	107	28	108	2300	<5

COMMENTS:

This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

All pages of this report have been checked and approved for release.

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Orange Laboratory
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AUSTRALIAN LABORATORY SERVICES P/L
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ANALYTICAL REPORT

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ADDRESS: 49 PARK ROAD
MILTON QLD 4064

LABORATORY: STAFFORD
BATCH NUMBER: ST24370
SUB BATCH: 0
No. OF SAMPLES: 20
DATE RECEIVED: 29/10/98
DATE COMPLETED: 03/11/98

ORDER No.: A3201411/0001 SAMPLE TYPE: SOIL PROJECT: SIRROCCO

ELEMENT / UNIT / METHOD / L.O.R.	Co ppm IC587 5	Cd ppm IC587 5	Ni ppm IC587 5			
QR268	<5	<5	22			
QR269	<5	<5	28			
QR140	34	<5	45			
QR145	<5	<5	43			
QR115	36	<5	115			
QR263	11	<5	69			
QR191	9	<5	51			
QR189	<5	<5	<5			
QR188	5	<5	43			
QR184	6	<5	15			
QR172	21	18	169			
QR168 17-22	7	<5	64			
QR168 10-15	9	<5	27			
QR180	11	9	75			
QR175	22	6	176			
	28	7	47			
QR137 QR162 30-32	216	<5	94			
QR134	79	<5	305			
QR137 25-30	72	<5	57			
QR132	52	<5	103			

COMMENTS:

This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

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Orange Laboratory
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Perth Laboratory
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Townsville Laboratory
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AUSTRALIAN LABORATORY SERVICES P/L
A.C.N. 009 936 029

ANALYTICAL REPORT

CONTACT:	MR P SCOTT	LABORATORY:	ENV BRISBANE
CLIENT:	AGC WOODWARD-CLYDE (QLD)	BATCH NUMBER:	EB17518
ADDRESS:	49 PARK ROAD	SUE BATCH:	0
	MILTON QLD 4064	No. OF SAMPLES:	20
		DATE RECEIVED:	30/10/98
		DATE COMPLETED:	10/11/98

ORDER No.: A3201411/0001 SAMPLE TYPE: SOIL PROJECT: SIRROCCO

SAMPLE NUMBER	ELEMENT UNIT METHOD L.O.R.	Volume mL ALS 0.05	pH (H202 EA-002 0.1	NAG kg/t EA-011 0.1	ANC kg/t EA-013\ 0.1		
	QR268	0.30	3.5	6.4	0.6		
	QR269	<0.05	4.2	12.8	0.6		
	QR140	<0.05	4.4	6.3	1.2		
	QR145	0.15	3.8	10.2	0.4		
	QR115	104	2.4	564	<0.1		
	QR263	7.80	2.4	224	<0.1		
	QR191	0.05	3.9	5.2	0.7		
	QR189	0.35	3.6	11.5	<0.1		
	QR188	0.25	3.8	7.8	<0.1		
	QR184	<0.05	4.4	6.6	1.3		
	QR172	5.70	2.5	73.6	3.5		
QR168	17-22	0.55	3.0	12.3	<0.1		
QR168	10-15	0.25	3.7	6.1	0.7		
	QR180	2.45	2.6	33.9	3.0		
	QR175	<0.05	4.8	4.4	4.7		
	QR162	<0.05	4.9	4.3	0.6		
QR137	30-32	<0.05	7.5	<0.1	93.4		
	QR134	<0.05	5.5	4.8	9.4		
QR137	25-30	3.45	2.6	49.4	13.6		
	QR132	2.20	3.2	13.4	16.7		

COMMENTS:

ANC by WWC supplied method. ANC expressed as kg H2SO4/tonne. NAG by WWC supplied method. pH in "final" solution after reaction. Volume is mL of titrant required to bring "final" solution to pH 4.0. ALS is not NATA Accredited for NAG and ANC. This report supersedes any previous preliminary reports of the same batch number.

THIS IS the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

All pages of this report have been checked and approved for release.

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ANALYTICAL REPORT

CONTACT:	MR P SCOTT
CLIENT:	AGC WOODWARD-CLYDE (QLD)
ADDRESS:	49 PARK ROAD MILTON QLD 4064
LABORATORY:	ENV BRISBANE
BATCH NUMBER:	EB17518
SUB BATCH:	0
No. OF SAMPLES:	20
DATE RECEIVED:	30/10/98
DATE COMPLETED:	10/11/98

ORDEA No.: A3201411/0001 SAMPLE TYPE: QUALITY CONTROL PROJECT: SIRROCCO

SAMPLE NUMBER	ELEMENT UNIT METHOD L.O.R.	Volume mL ALS 0.05	pH (H202 EA-002 0.1	NAG kg/t EA-011 0.1	ANC kg/t EA-013w 0.1		
*** METHOD	BLANK	----	4.1	<0.1	----		
*** QR184	CHK	<0.05	4.4	6.1	0.6		
*** QR132	CHK	2.25	3.2	13.2	16.8		

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COMMENTS:

Results which appear on this report are routine laboratory checks for QUALITY CONTROL purposes.

This is the Final Report which supersedes any preliminary reports with this batch

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