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THOMPSON & BRETT PTY LTD
CONSULTING ENGINEERS

OCEANIA TAS

WASTE MANAGEMENT PLAN

DECEMBER 2003

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CLIENT	:	OCEANIA TAS
PROJECT	:	TAILINGS MANAGEMENT
REFERENCE/REVISION NO.	:	ZEEZ-01/R02
TITLE	:	WASTE MANAGEMENT PLAN DECEMBER 2003
AUTHOR	:	DAVID BRETT
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18 December 2003

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Dear Paul,

TAILINGS MANAGEMENT PLAN

Please find enclosed four copies of the final report on the Oceania Waste Management Plan December 2003.

Yours sincerely,
THOMPSON & BRETT PTY. LTD.,
per:

David Brett

1 INTRODUCTION

This report presents a Plan for management of waste rock and tailings at Oceania Tasmania Pty. Ltd (Oceania) Comstock Mine on the West Coast of Tasmania. The plan covers the preliminary mine development period where only primary gravity separation of ore is proposed. This period is expected to extend over three years. The Plan provides for disposal of the waste materials within an expanded lease area in the general location identified in the current Development Proposal and Environmental Management Plan (DPEMP). The expanded area of lease in the vicinity of the waste disposal site has allowed additional room for waste disposal. The new area includes additional relatively flat land that helps in the practical arrangement of the waste disposal and environmental management structures.

The Plan addresses the requirements of the Comstock Mine Permit Conditions.

2 PRODUCTION TARGETS

The mine expects to generate approximately 200,000 tonnes per annum (tpa) of ore over the next 3 years. This will be crushed and gravity separated to produce in the order of 50,000 tpa concentrate, which is expected to contain the bulk of sulphides. The remaining 150,000 tpa of tailings will be relatively coarse grained material (8mm minus) and will be transported to a tailings storage. In the process of removing the ore an estimated 450,000 tpa of waste rock will be generated.

Over the 3 years mine development period a total of 450,000 t of tailings and 1,350,000 t of waste rock are anticipated.

Allowing deposited dry density of 1.5t/m^3 for both tailings and waste rock suggests a total required storage capacity over 3 years of 1,200,000m^3.

3 NATURE OF MATERIALS

The current Allison's open pit comprises four rock types that form part of the Upper Oonah Formation. These include the carbonaceous shales, siliceous shales, sandstones and talcose altered dolomites. Sulphides are to be extracted in the gravity separation phase and sent off-site for further concentrating and processing.

Geotechnical testing of tailings will be necessary once production commences to confirm the nature of the material but initial planning will be conservative in making allowance that the tailings could be a potential source of acid drainage(AD).

The talcose altered dolomite hosts the Zn-Pb-Ag sulphide bodies (sulphide zone) that will be mined and processed. The weakly talcose altered dolomite unit outside this sulphide zone (waste rock) is barren in visual sulphides. Drill core from SY021 and SY022, intersected a dolomite horizon approximately 40m underlying the shale in the bottom of the open pit, suggesting that the geochemical nature of the waste rock could alter significantly as the pit develops.

Limited information is available on the precise nature of the tailings, however, some work has been undertaken on the waste rock materials, specifically, for AD classification (Appendix A). The tailings are expected to be relatively coarse and contain low levels of sulphides. Sulphides will be extracted in the gravity separation phase and sent off-site for further concentrating and processing.

The waste rock observed to date is particularly soft and expected to have a relatively low permeability once placed and, possibly, compacted in the dump. This could allow scope for selective placing and treatment to isolate more reactive materials. However, an ongoing program of geotechnical and physical classification of waste rock materials will be necessary for detailed dump design once development commences.

A preliminary program to determine Acid Drainage (AD) of waste rocks from around Allison's Pit were performed by Oceania. A total of 17 samples (12 surface and 5 downhole) were collected between July 1, 2002 to 30 September 2003 (see Table 2 in Appendix A). Analyses undertaken included net acid producing potential (NAPP), net acid generation (NAG), net acid generation pH (NAG pH), acid neutralising capacity (ANC% CaCO3), Electrical Conductivity (EC) and Total% Sulphur.

The samples were categorised based on three classification systems shown in Appendix A. Preliminary conclusions show that the shales are Potentially Acid Forming (PAF) rocks. However, the silica-micrite-talc and carbonate rocks have been classified as Non Acid Forming (NAF). Ongoing AD testing of waste rock will be necessary once extraction of ore recommences.

4 PROPOSED DISPOSAL AREA

The general site proposed for waste disposal is located within mining leases 123M/47 and 9M/2002, south of the mine and mill site as shown on drawing 02-2547-01. The area in the immediate vicinity of the existing waste disposal area has been increased in width from the original lease by 100 m to the south and east, giving in excess of 10 Ha additional area (ML 9M/2002). The area now comprises a relatively gently sloping site of approximately 37Ha bounded on the north by the old Comstock tramway and by the lease boundary on the other three sides.

The Comstock Creek flows through the western half of the site. Discharge from an historic adit enters the creek just to the north of the area. This adit collects drainage from the historic mined

areas of the site and will be used to collect stormwater from the new mining operation and to provide water for the gravity process.

Several test pits have been excavated over the site and are described in a report by Coffey attached as Appendix B.

The test pits show the site to comprise gravely silty clay overlying weathered volcanic bedrock. Of the 9 test pits dug the average depth of clay was approximately 1m.

5 DISPOSAL CONCEPT

The disposal concept is presented on drawings 02-2574-02 to 10 and described as follows.

Stage 1

1.1 Divert Comstock Creek – The Comstock Creek is to be diverted to a new channel to the west of the site. This allows the existing channel to be used for collection of potentially contaminated site run-off and seepage from historical workings. The diversion will comprise a 3m wide cut with batters of 1.5 hoz to 1 vert. to simulate the existing creek form. Batters will be flattened or supported if unstable ground is encountered. A diversion dam will be required. This will be approximately 3m high constructed of clay with coarse rock armouring. Rock will be selected from non-active rock types. Sound rock from the cutting will be used to armour the downstream stream bed to prevent erosion.

1.2 Construct an adit diversion weir and pipeline to collect adit water and divert it to the original creek bed downstream of the creek diversion described in 1.1. The adit diversion structure will incorporate a pump-out well to suit collection of process water for the gravity plant. It will also provide for input of liquid caustic soda for pH adjustment.

1.3 Construct a series of wetland ponds in the existing creek bed to aerate adit water and settle out precipitated metals.

1.4 Construct an access road to the site. This will grade at 1:10 down through the existing Swansea waste rock dump. The road will be suitable for use as a haul road with drainage provided to collect runoff and direct it to the silt trap/polishing pond described below

1.5 Construct a silt trap/polishing pond on the existing creek bed on the southern end of the site. This will allow collection and potential pre-treatment of water from the mill and waste disposal areas, including historic adit discharges. The dam will be approximately 5 m high, constructed from site materials including approximately 5,000 m3 of rock and clay with a rock lined face to limit erosion. The estimated storage volume is 45ML including the volume of excavated material. The pond overflow will incorporate a V-notch weir and will be the environmental monitoring point for water leaving the site. The weir will be fitted with a level

sensor and data logger for continuous flow monitoring together with continuous loggers for conductivity and pH.

1.6 Construct an initial tailings storage facility (TSF) to suit the first 6-9 months production. This will comprise an excavated pond with clay lining, once again using the locally available materials. The crest level will be RL 220, requiring an embankment of approximately 15,000 m3 earthworks to create storage of approximately 50,000 m3. Overflow from the pond will be directed to the polishing pond via a decant tower comprising nested precast concrete sections to allow control of the water level. The tailings pond will be designed to allow future encapsulation of the tailings if testing finds that the material is potentially acid producing. The dam slopes are proposed to be 3 hoz to 1 vertical giving conservative factors of safety for stability.

1.7 Commence the development of a long-term, waste rock storage on the southern boundary with stripping and stockpiling of topsoil, placement of softer material on the outer part of the wall with coarser, hard material on the inner face. This will allow a low permeability facing to be developed. Once rock movement commences a continued program of AD testing will be initiated to further define waste material classification. The intention will be to refine waste rock placement to place high NAG materials on the inside and ultimately encapsulate them with low NAG material. If low NAG material is found to be unavailable, or of high permeability, the dump will be covered with clay.

Stockpiled topsoil will be used for re-vegetation.

Stage 2

Extend Waste Rock Dump as previously described to RL 220.

Stage 3

Provide a 5m minimum width bench to allow access and drainage and progressively raise the dump to RL 230, reshape batters to 2.5 horiz:1 vert and rehabilitate. During this Stage the initial tailings storage will be incorporated and the total design will need to be reviewed. The detail design for ongoing dumping will depend on NAG test results. However, if as expected, NAG tests are low, then tailings will be discharged from the inner edge of the waste rock dump and a co-disposal system developed as shown in Figure 6. The control of decant water will be critical if this type of co-disposal continues as the dump will not feature a "dam" wall. The decant will comprise a nested, precast structure to allow the water level to be maintained as low as possible, consistent with water quality issues.

Stage 4

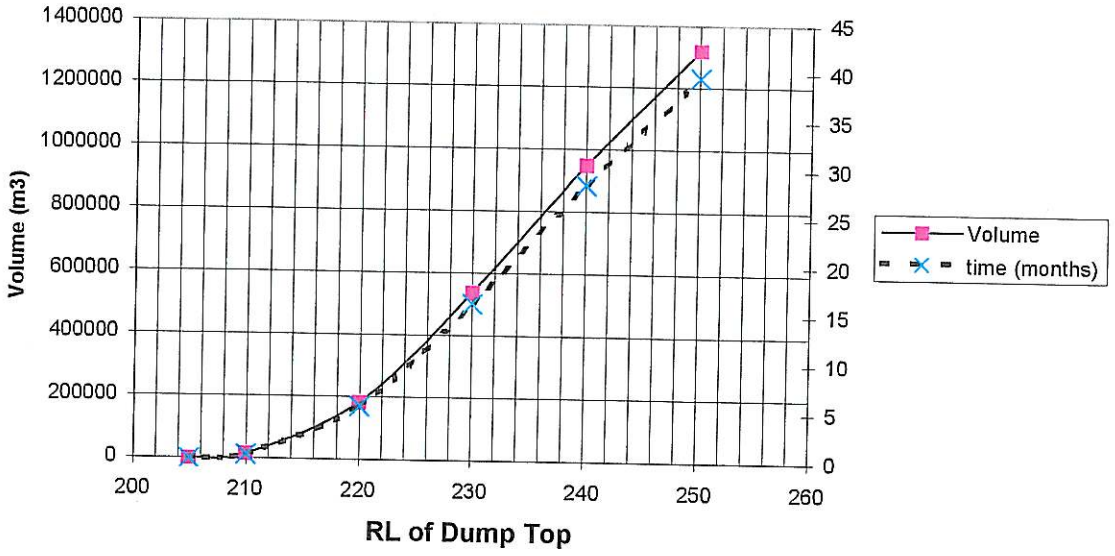
Continue the dump to RL 240

Stage 5

Continue raising to RL 250 with benching at RL 240

The total dump storage to RL 250 is 1,300,000 m3, considered adequate for the 3 year mine plan at currently predicted mining rates. The storage capacity and time frame to reach various dump heights is presented in Figure 1.

Figure 1 Height and Timing Relationships for Comstock Waste Dump



6 WATER QUALITY

The water quality leaving the tailings and waste rock disposal area will be very dependant on the quality of the existing adit water quality entering the site. Testing of this water source is presented in Table 1. Unfortunately limited flow readings have been taken at the time of sampling but the flow is reasonably consistent at around 45L/sec. A continuous monitoring weir is being established to develop a better picture of the flow.

Table 1 Adit Water Quality

Date	Fe (dis)	Fe (T)	Mn (sol)	Mn(T)	Ni(sol)	Ni (T)	Pb(sol)	Pb(T)	Zn(sol)	Zn(T)
22/10/1997		67700		12200		166		373		37700
08/03/2000	11700	43100	8620	8770	73	75	5	46	22500	23200
27/06/2000	19820		2780		30		170		13590	
22/09/2000	8980		6720		10		180		2840	
15/01/2001	1010	49000	8680	8660	250	256	91	122	37200	37100
04/02/2001	20	43700	5	8650	1	95	5	70	1	20
28/03/2001	2220	33600	6340	6360	109	110	579	631	33700	33900
18/05/2001		38300	5030	6080	62	75	231	287	13500	16500
12/07/2001	9300	54000	9100	9300	110	110	120	250	26000	27000
09/10/2001		57000		8800		130		160		28000
median	8980	46350	6530	8715	67.5	110	145	205	18045	27500

Table 1 Adit Water Quality (continued)

Date	TSS	Acidity	pH	Al (sol)	Al (t)	Cd (sol)	Cd (T)	Co (dis)	Co (T)	Cr (dis)	Cr(T)	Cu(dis)	Cu(T)
22/10/1997					2800		42		76		8		6
08/03/2000	57	98		441	1960	12	14	37	40	1		2	2
27/06/2000			5	1150		50		40		50		50	
22/09/2000			6	10		20		60		0		60	
15/01/2001	107		3.1	7040	8230	254	254	112	114	1	3	125	128
04/02/2001	86		3.5	20	1870		18		50	1			3
28/03/2001	68		3.4	8250	8430	191	190	53	55	1	2	56	56
18/05/2001	64	105	3.5		2260	106	129	32	39	1		7	7
12/07/2001	90	120	3.3	1800	2900	50	50	50	50	20	20	10	10
09/10/2001	50	740	3		2900		33		63				5
median	68	112.5	3.5	1150	2850	50	46	45	52.5	1	1.5	30	6.5

The results show a high metals content (specifically iron, zinc, and manganese, as well as a high average acidity. A variable pH ranging from 3 to 6 indicates underground water contact with acid-producing elements (e.g. pyrite). As it is proposed to use the adit as a process water source the pH will need to increase to >= 5, to avoid damage to the gravity separation mill. A liquid soda dosing system is proposed.

To maximise the potential for sound water management practice at the site it is proposed to divert the existing Comstock Creek from the tailing disposal area. The creek bed will be converted to a series of ponds with a large silt trap/polishing pond at the edge of the lease. The adit outflow will be diverted by piping into the old creek bed to allow the existing contaminated flow to benefit from flow through the new pond system. The small ponds will be constructed with gabions and rockfill to promote aeration. This will lead to precipitation of iron and manganese and possibly other metals. The mine water plan is to draw on the adit flow for process water. Over half of the flow could be utilised. This water will be neutralised and eventually be returned to the TSF with the tailings. A degree of improvement in water quality will result. This will be assessed during initial operation.

The net effect of the mining and tailings separation operations over the next few years is expected to significantly improve discharge water quality from the site, effectively reducing an historical environmental impact. However, if water quality deteriorates from these historic levels then, pH adjustment will be carried out as necessary.

7 ENVIRONMENTAL MANAGEMENT

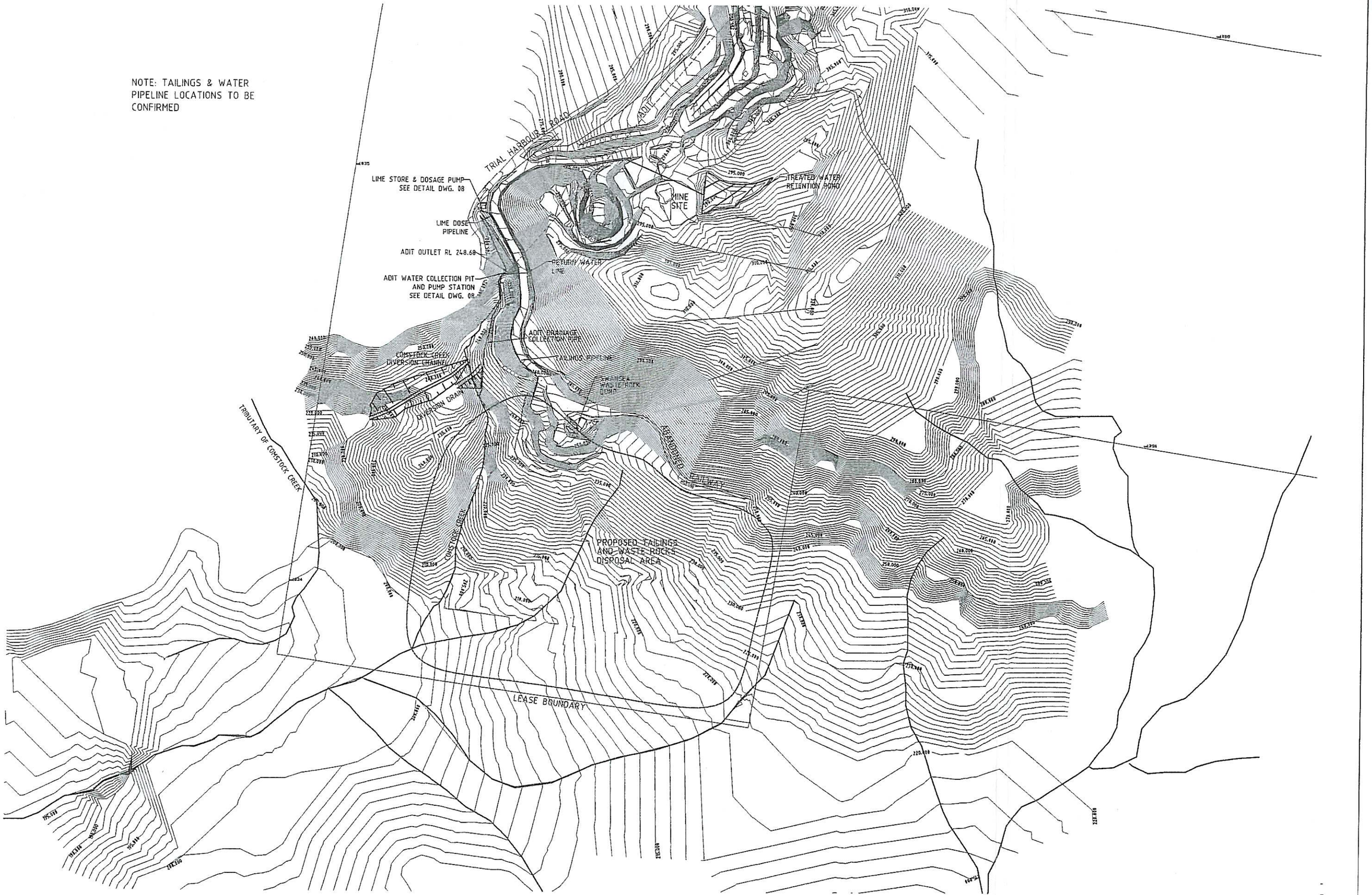
The environmental management of this area will be carried out as follows:

1) Comstock Creek – The Comstock Creek water will be diverted from the area into an adjacent tributary. The tributary has been inspected by Oceania geological staff who have preliminary assessed that the tributary bed has appropriate underlying geology for an increased flow. The adit water will be diverted from the new creek by piping to the tailings dam area.
2) Adit Water – Water required for process uses will be treated with a pH buffer (liquid caustic soda is proposed) and pumped to the gravity separation mill. The excess water will be diverted past the Comstock Creek diversion and into the existing creek bed. If necessary, due to increased contamination loads from the mining operation this water will also be treated. Testing carried out for Oceania has shown that treatment followed by retention ponds allow the pH buffer to raise the pH and precipitate up to 80% of its dissolved and total metals (Nalco, 2002).
3) Tailings Water – This water that is being used to transport the tailings from the gravity separation mill to the tailings disposal area will have a raised pH (>=5). Depending on the tailing characteristics, the pH will vary accordingly but expectations are that it will increase due to neutralising capacity in the tailings. Water levels will be controlled by a decant tower that will gravity feed the tailings water to join the adit water in the treatment pond area.
4) Surface Water – Surface water from the two existing adits and all road runoff will be collected and delivered via open drains and piping to the largest treatment pond at the mining lease boundary for mixing and retention.
5) Waste Dump Walls – The dump walls will initially be capped with clay until accurate geochemical characterisation is established. If the waste rock is deemed non-acid producing, or of adequate permeability to prevent oxidation, notification will be given and supported with characterisation documentation to seek approval to cease clay capping. After the dump walls are constructed and stabilised, progressive rehabilitation will commence.

Monitoring of the site will entail all appropriate activities as is set in the Comstock mine Permit Conditions of July 6, 2001. A continuous flow monitoring station at the treatment pond discharge (into the existing creek path) will gather daily recordings of pH, conductivity, and average flow. Monitoring these results will dictate the need for treatment taking into account current water quality.

Three ground water monitoring stations will be strategically located downstream of the tailings storage facility to be monitored regularly.

NOTE: TAILINGS & WATER PIPELINE LOCATIONS TO BE CONFIRMED



Revisions			
REV. No	Date	Description	By

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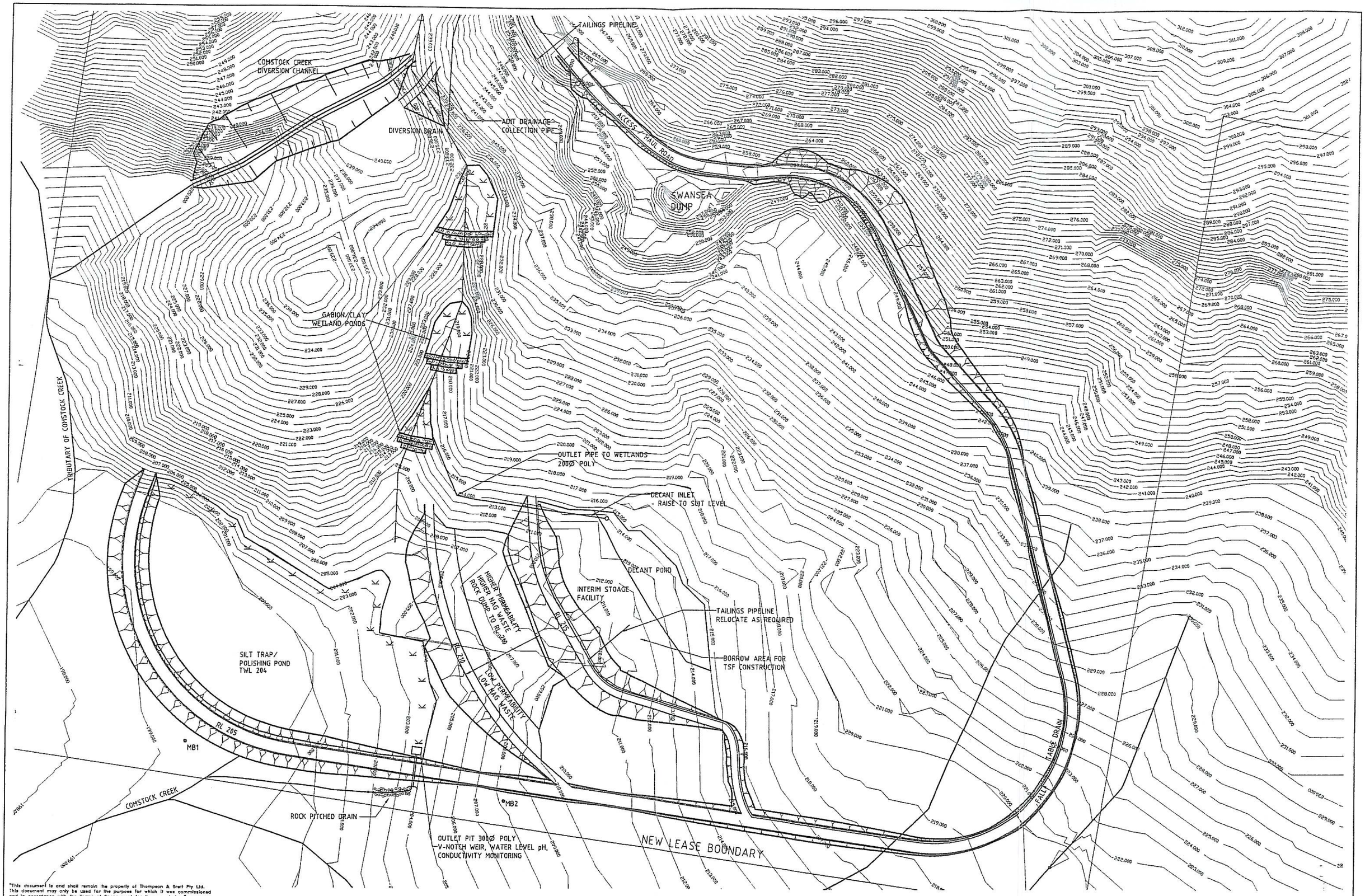
Design Check	Date	Controlled Document	Yes	No
Drawing Check	Date	Approved Director		

ISO 9001 JAS-ANZ

Client & Project
ZEEHAN ZINC
COMSTOCK MINE
WASTE MANAGEMENT PLAN

Drawing Title: LOCALITY PLAN

Acad Name 03-2547-01-P1	Issue	
MX Project Name. TALINGSMANAGEMENT	Drawing No. 03-2574-01	Rev. P1



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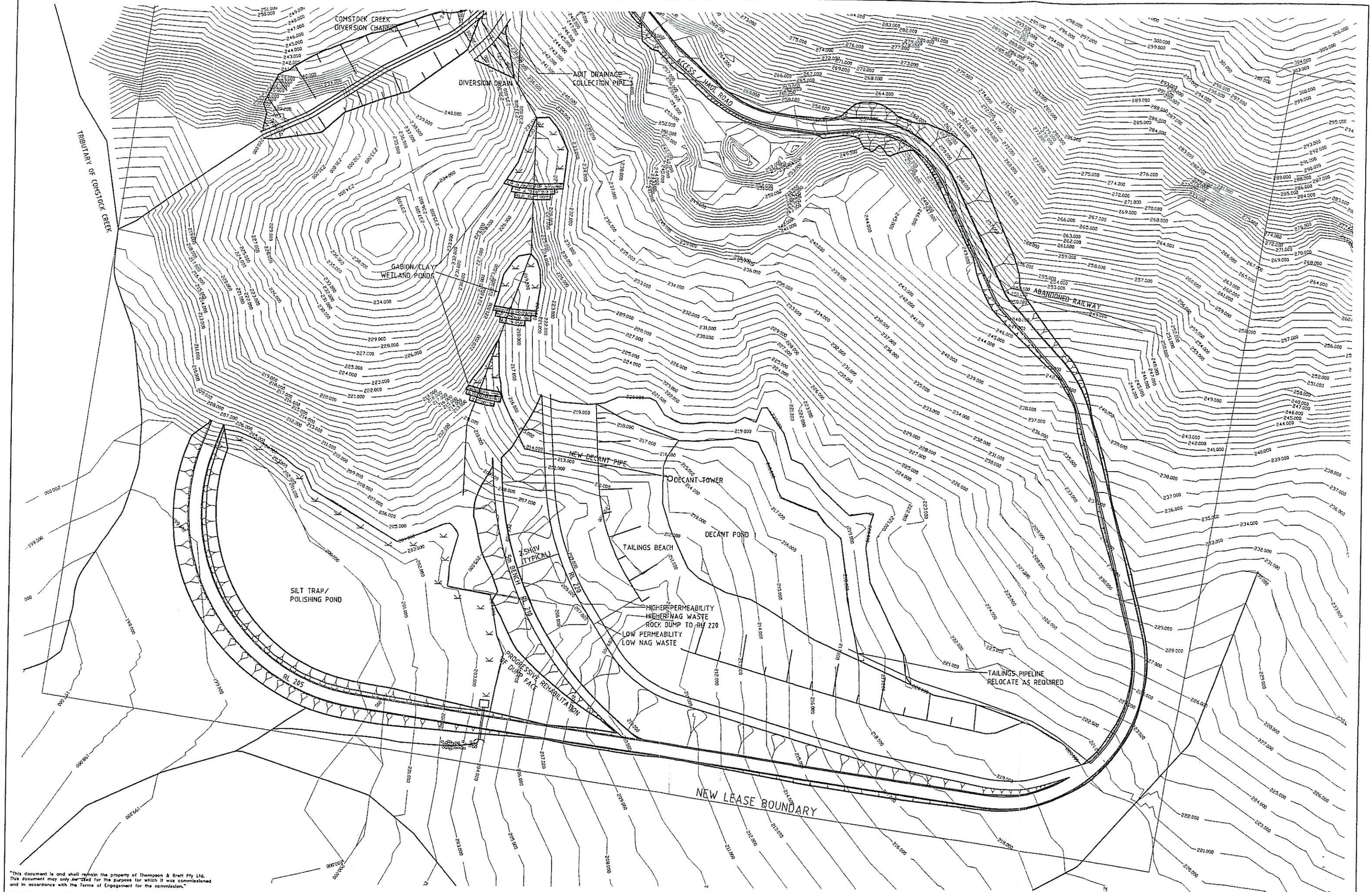
Drawing Check	Date	Approved Director	

Client & Project
ZEEHAN ZINC
COMSTOCK MINE
WASTE MANAGEMENT PLAN

Drawing Title
STAGE 1 PRELIMINARY SITE WORKS & TAILINGS DAM DEVELOPMENT

Acad Name 03-2574-02	Issue	
MX Project Name. TAILINGSMANAGEMENT	Drawing No. 03-2574-02	Rev.



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Drawing Check	Date	Approved Director	

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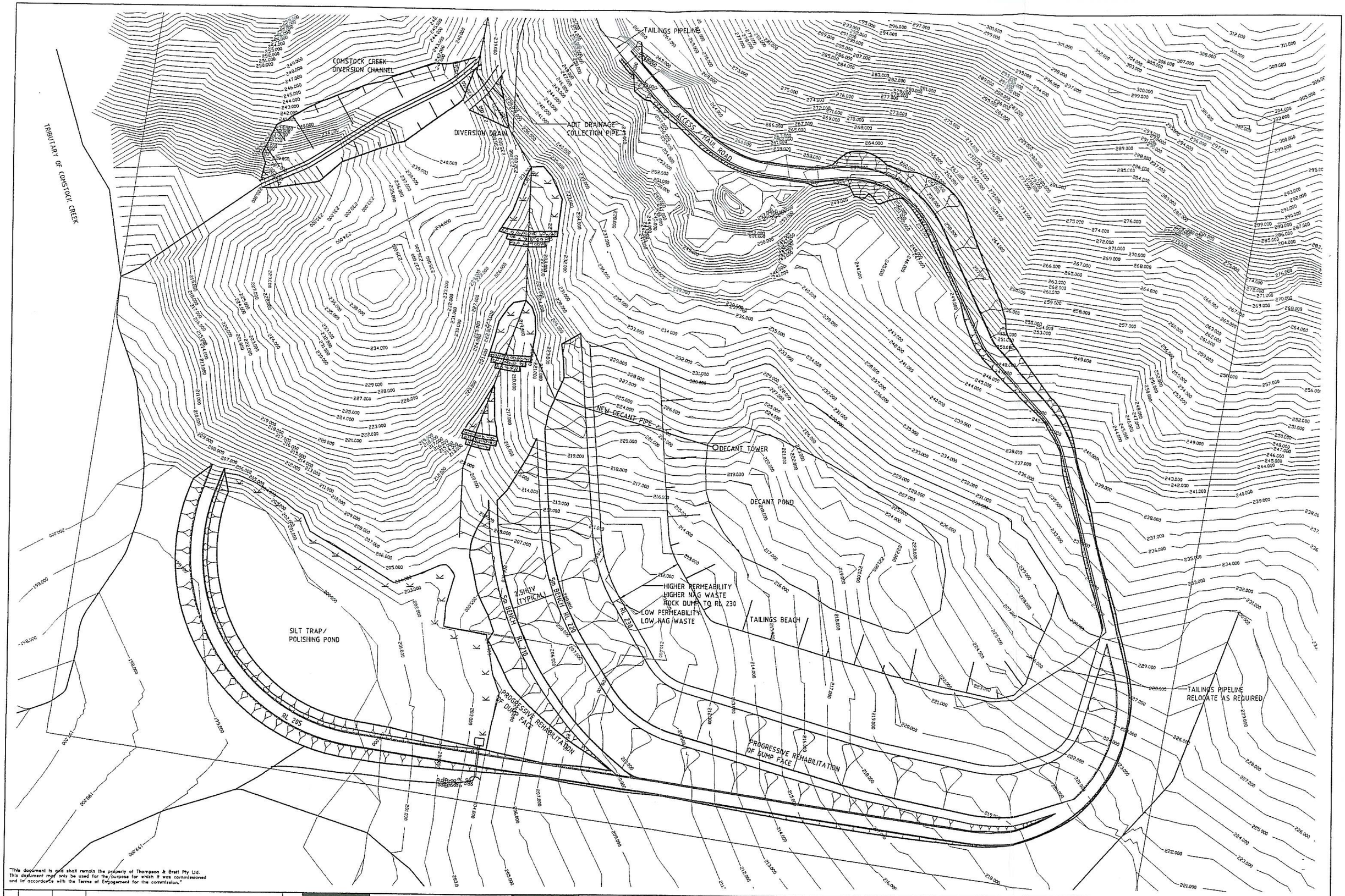
ZEEHAN ZINC
COMSTOCK MINE
WASTE MANAGEMENT PLAN

Drawing Title
GENERAL ARRANGEMENT
STAGE 2 WASTE ROCK TO RL 220

Acad Name 03-2574-03		Issue N	
MX Project Name. TAILINGSMANAGEMENT		Drawing No. 03-2574-03	Rev. P1



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Drawing Check	Date	Approved Director		

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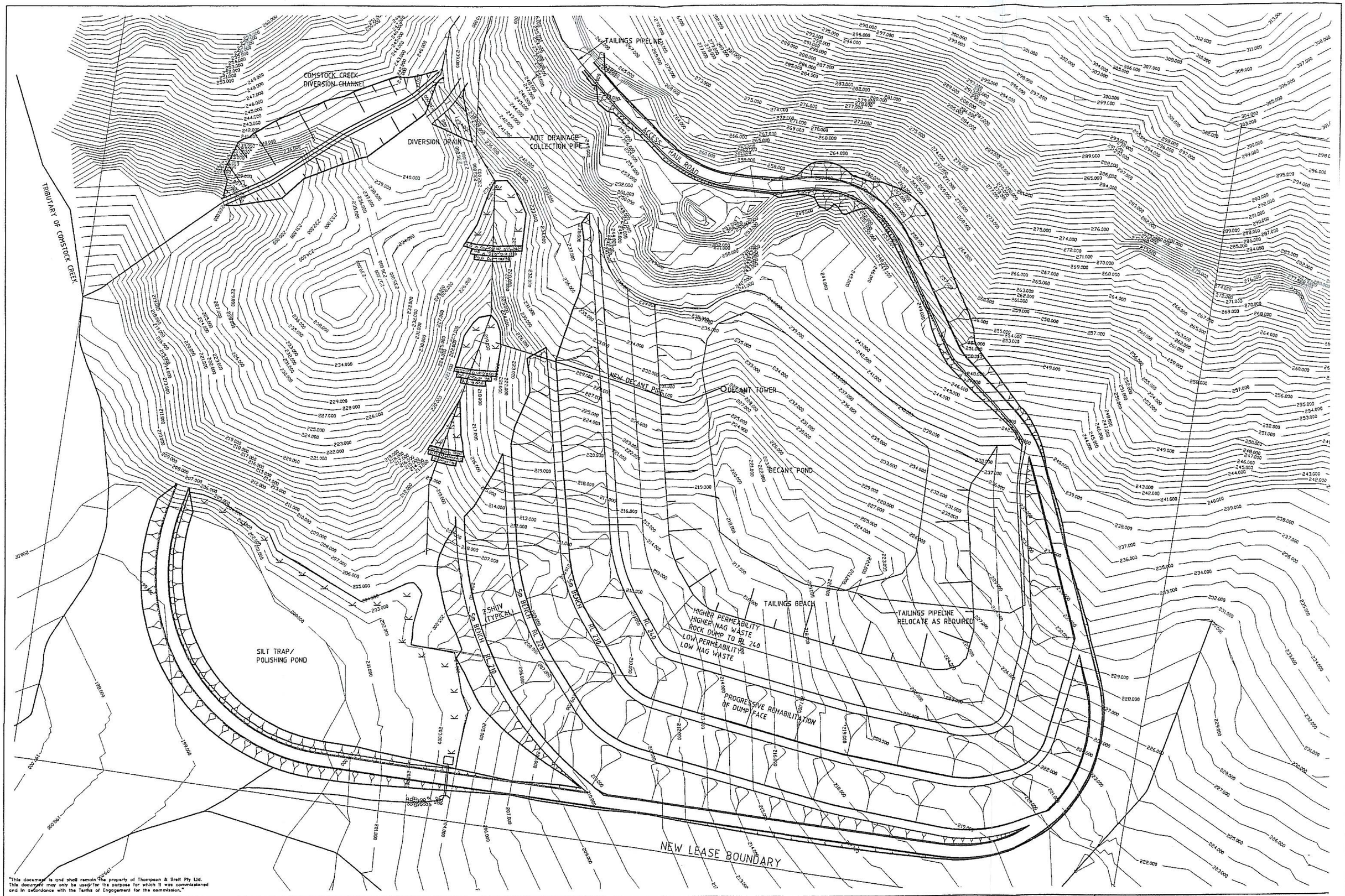
WASTE MANAGEMENT PLAN

Drawing Title
GENERAL ARRANGEMENT
STAGE 3 WASTE ROCK TO RL 230

Acad Name 03-2574-04	Issue N	
MX Project Name. TAILINGSMANAGEMENT	Drawing No. 03-2574-04	Rev. P1



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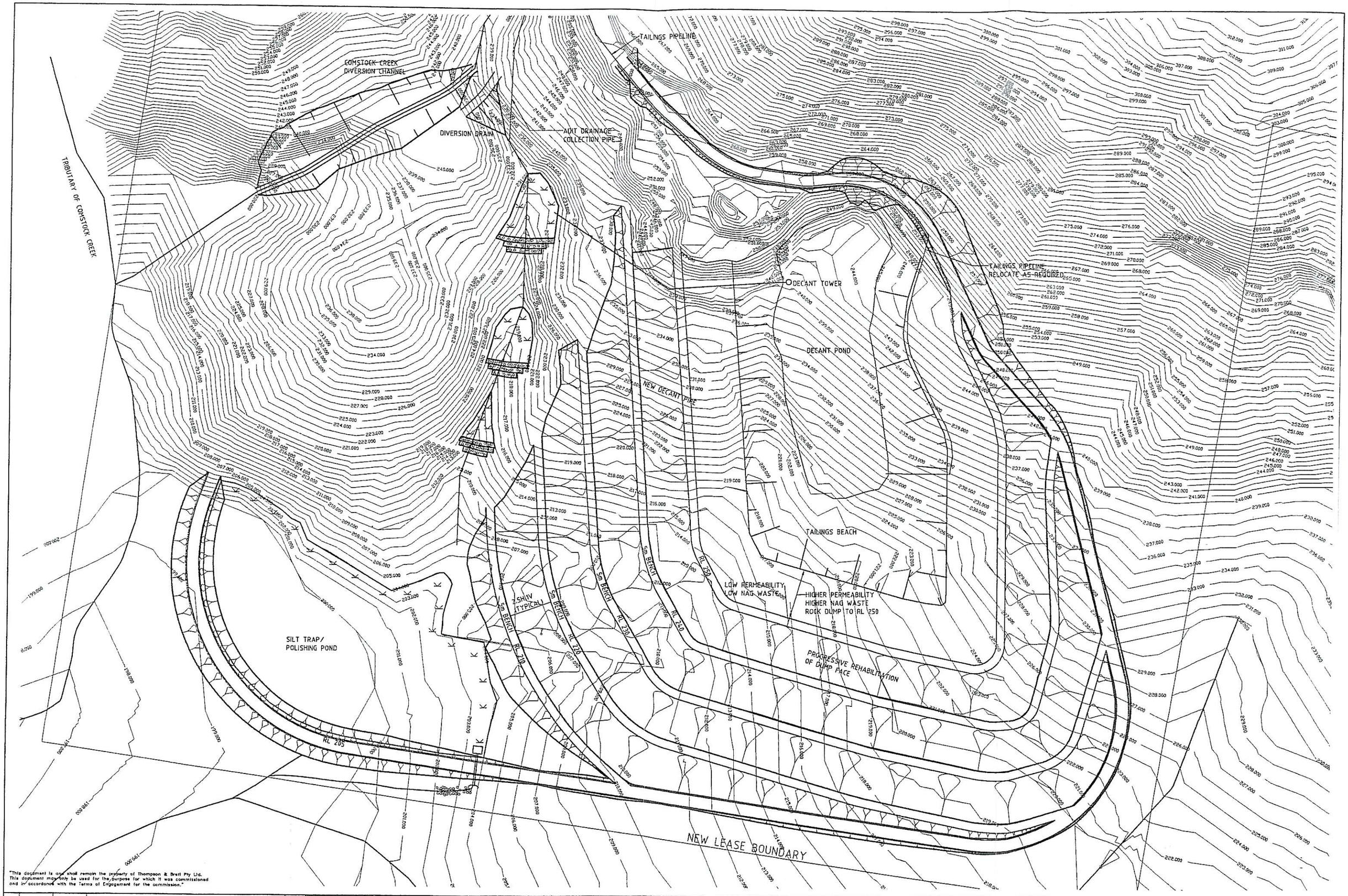
COMSTOCK MINE
WASTE MANAGEMENT PLAN

Drawing Title
GENERAL ARRANGEMENT
STAGE 4 WASTE ROCK TO RL 240

Acad Name 03-2574-05	Issue N
MX Project Name. TAILINGSMANAGEMENT	Drawing No. 03-2574-05



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Drawing Check	Date	Approved Director	

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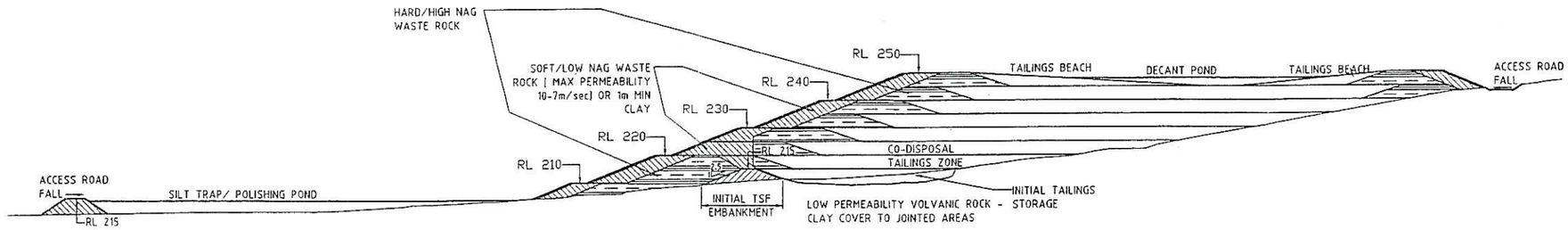
COMSTOCK MINE
WASTE MANAGEMENT PLAN

Drawing Title
GENERAL ARRANGEMENT
STAGE 5 WASTE ROCK TO RL 250

Acad Name 03-2574-06	Issue N	
MX Project Name. TAILINGSMANAGEMENT	Drawing No. 03-2574-06	Rev. P1



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Drawing Check	Date	Approved Director	

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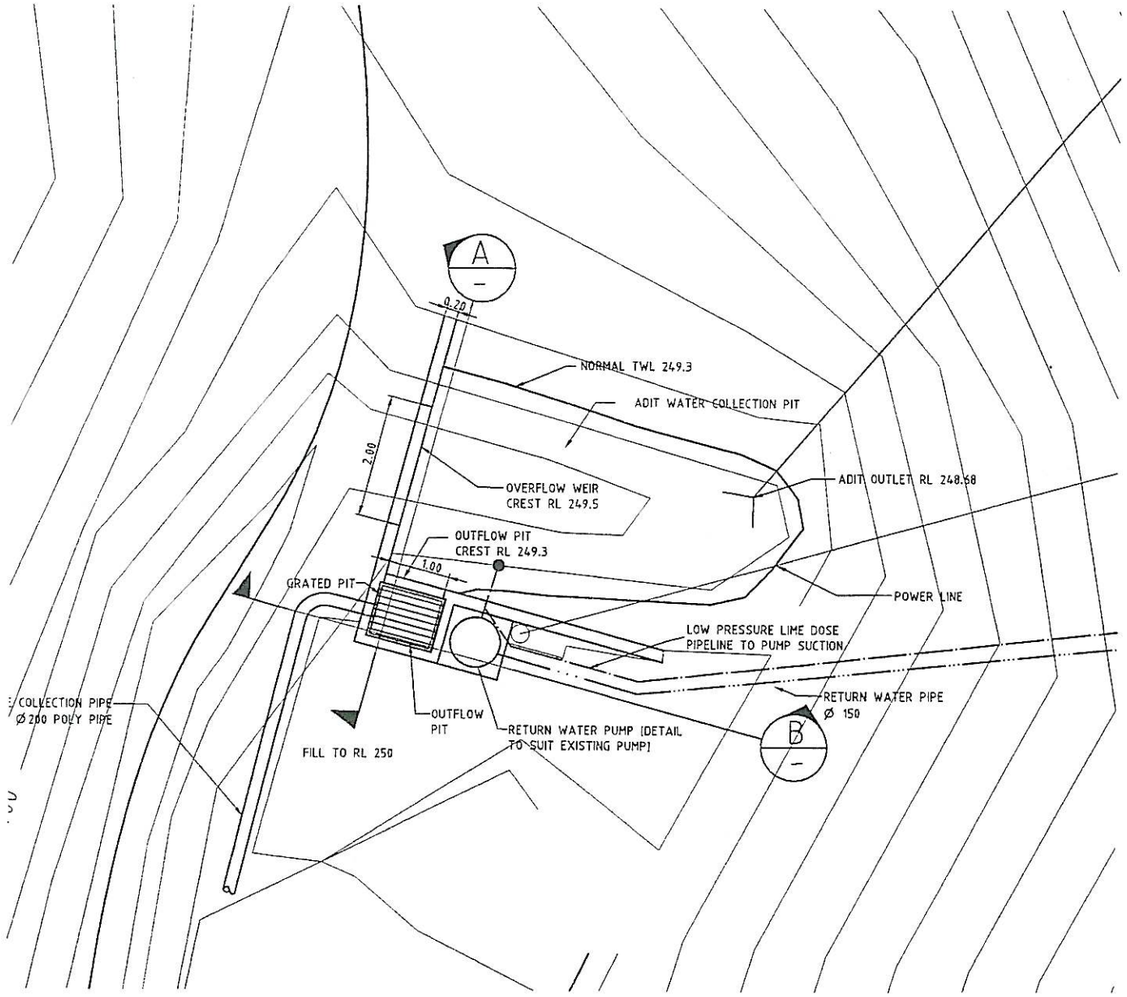
Client & Project
ZEEHAN ZINC
COMSTOCK MINE
WASTE MANAGEMENT PLAN

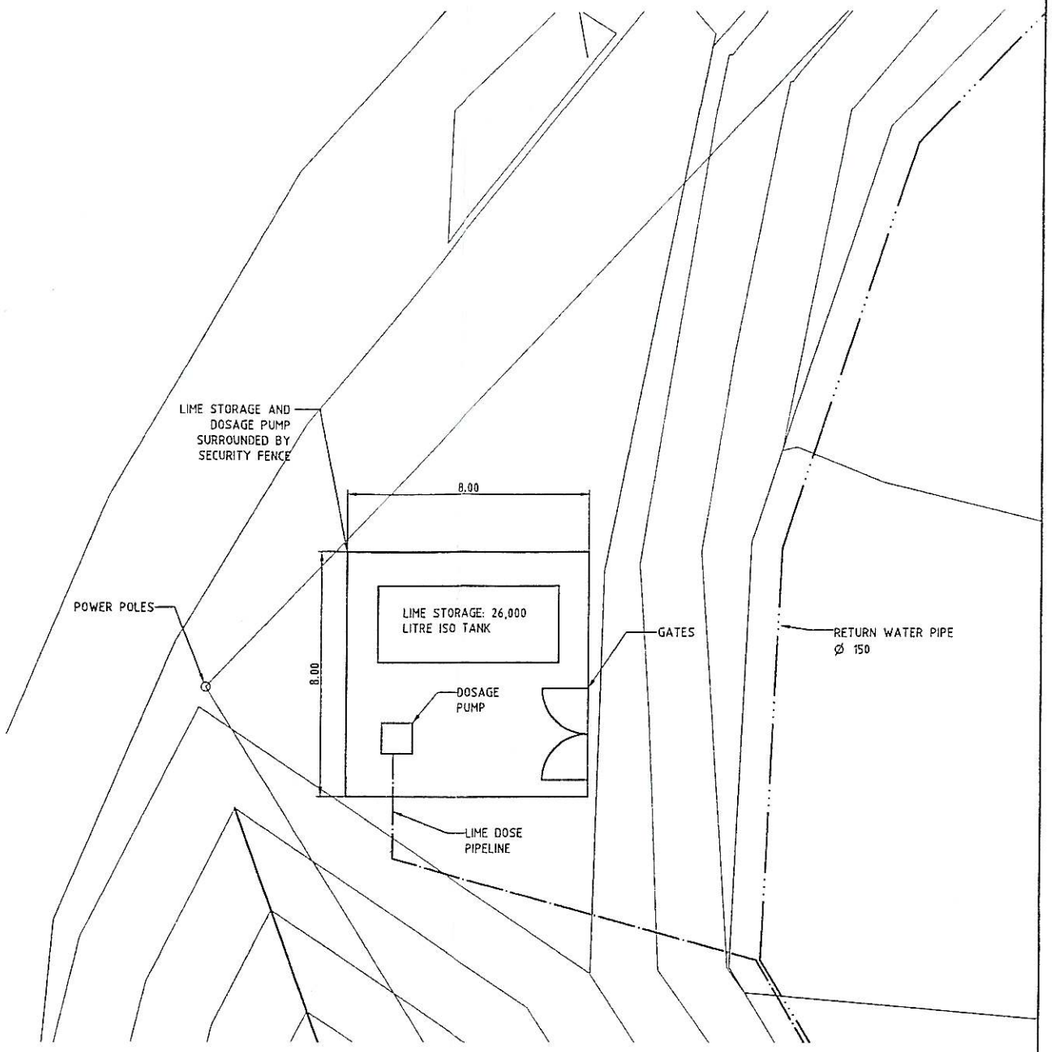
Drawing Title
TYPICAL CROSS SECTION OF
TAILINGS / WASTE ROCK DUMP

Acad Name 03-2574-07	Issue
MX Project Name. TAILINGSMANAGEMENT	Drawing No. 03-2574-07 Rev.



DETAIL OF ADIT WATER COLLECTION PIT AND PUMP STATION

NTS

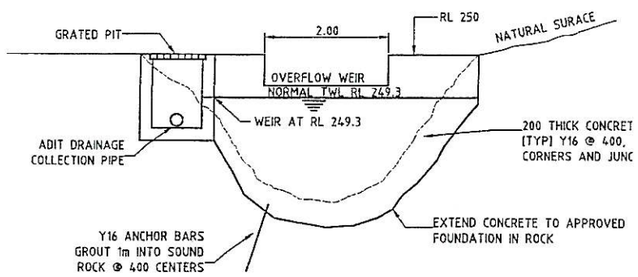


DETAIL OF LIME STORAGE AND DOSAGE PUMP

SCALE 1:100

NOTES: ARRANGEMENT IS DIAGRAMATIC - ADJUST TO SUIT ACTUAL SITE CONDITIONS

DESIGN SHOWS LOW PRESSURE LIME DOSING TO PUMP SUCTION -ALTERNATIVE HIGH PRESSURE INJECTION TO PIPE IN VICINITY OF DOSAGE PUMP



A – ADIT WATER COLLECTION PIT AND PUMP STATION

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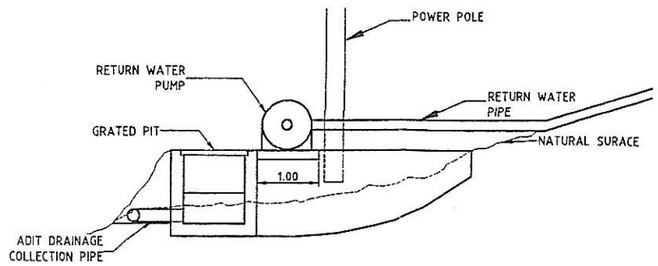

B – ADIT WATER COLLECTION PIT AND PUMP STATION

SCALE 1:50

Revisions	REV. No	Date	Description	By

THOMPSON & BRETT PTY LTD CONSULTING ENGINEERS

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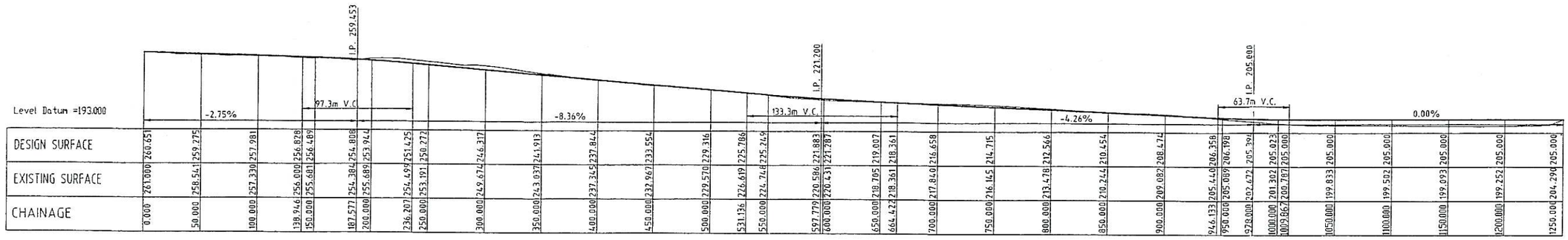
Drawn J.D.B	Date 29/09/03	File ZEEZ -03	
Design Check	Date	Controlled Document Yes / No	
Drawing Check	Date	Approved Director	

ISO 9001 JAS-ANZ

Client & Project
ZEEHAN ZINC
COMSTOCK MINE
WASTE MANAGEMENT PLAN

Drawing Title
DETAIL
LIME TREATMENT PLANT DETAILS

Acad Name 03-2574-08	Issue N	
WX Project Name. TAILINGSMANAGEMENT	Drawing No. 03-2574-08	Rev. P1



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200.000	255.689	253.944
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250.000	253.191	250.272
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350.000	243.037	241.913
400.000	237.345	237.844
450.000	232.967	233.554
500.000	229.570	229.316
531.136	226.619	225.786
550.000	224.744	225.249
597.779	220.586	221.883
600.000	220.431	221.787
650.000	218.705	219.007
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700.000	217.840	216.658
750.000	216.145	214.715
800.000	213.478	212.566
850.000	210.244	210.454
900.000	209.082	208.474
946.133	205.440	206.358
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978.000	202.672	205.394
1000.000	201.302	205.023
1009.867	200.787	205.000
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1100.000	199.502	205.000
1150.000	199.093	205.000
1200.000	199.252	205.000
1250.000	204.290	205.000

Revisions

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Drawing Check	Date	Approved Director	

JAS-ANZ

Client & Project
ZEEHAN ZINC
COMSTOCK MINE
WASTE MANAGEMENT PLAN

Drawing Title
ROAD LONGITUDINAL SECTION

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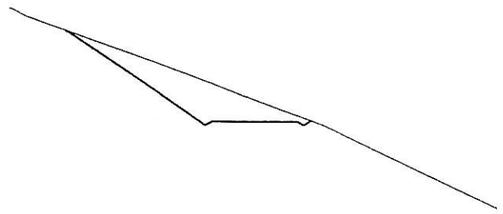
MX Project Name. TAILINGSMANAGEMENT	Drawing No. 03-2574-09	Rev. P1



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Chainage = 500.000

Level Datum =208.000

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EXISTING SURFACE	263.767	263.000	262.395	261.627	261.003	260.583	260.006	259.442	259.000	257.918		257.000	257.000	257.000	258.000	258.000	258.000	258.635

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Level Datum =230.000

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Level Datum =212.000

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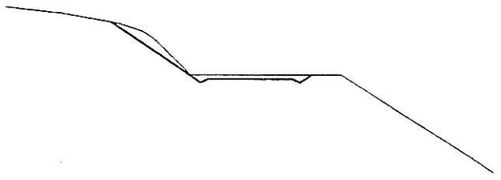

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EXISTING SURFACE	266.697		266.000		265.190	263.385	262.673	261.000	261.000				261.000	260.371	259.798	258.813	257.834	255.788	253.126

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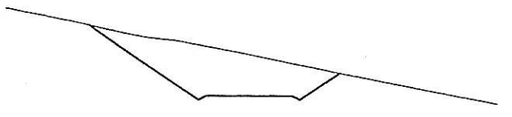

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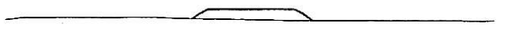
EXISTING SURFACE	253.403	253.000	252.817	252.000		251.239	251.000	250.799		250.000	249.769	249.411	249.000	248.688	248.680	248.000	247.843	247.000	246.942	246.183	245.603

Chainage = 300.000



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EXISTING SURFACE	220.421		220.635	220.536				220.388	220.345			220.323	220.313

Chainage = 600.000

Revisions				
REV. No	Date	Description	By	

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Drawn J.D.B	Date 29/09/03	File ZEEZ -03	
Design Check	Date	Controlled Document Yes No	
Drawing Check	Date	Approved Director	

ISO 9001 AQA JAS-ANZ

Client & Project
ZEEHAN ZINC
COMSTOCK MINE
WASTE MANAGEMENT PLAN

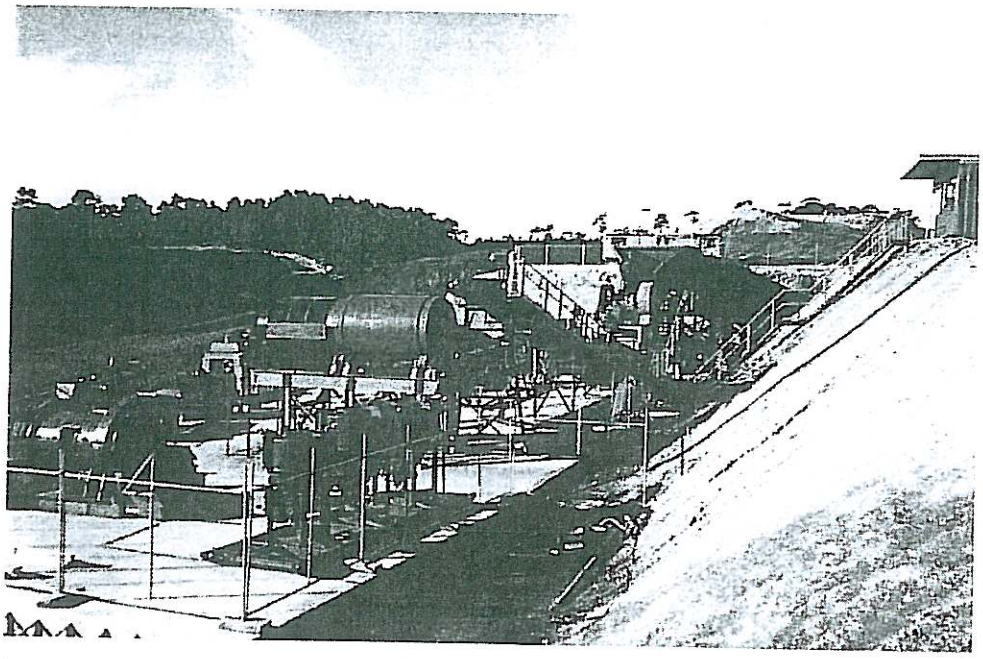
Drawing Title
CROSS SECTIONS
CH 0.000 TO CH 800.000

Acad Name	Issue	
03-2574-10	N	
MX Project Name. TAILINGSMANAGEMENT	Drawing No. 03-2574-10	Rev. P1

Appendix A
Acid Mine Drainage Report

OCEANIA
TASMANIA
Pty Ltd

Acid Mine Drainage Status of the Comstock Waste Rocks & Swansea Tramway Waste Rock Dump



1 December 2003

Qualifications and Disclaimers

Paul Heath has prepared this final report. Paul is currently employed as a geologist at the Comstock Mine for Oceania Tasmania Pty. Ltd, and has a BSc (Hons) in geology that was completed at the end of 1999 from the University of Tasmania. His undergraduate BSc Degree was completed at La Trobe University during 1997. Other qualifications include The Advanced Certificate of Horticulture at Burnley, Victoria (1993). All Allison pit waste rock samples were collected by the author and analysed at Analabs Pty Ltd, Burnie. Thin sections were produced at the University of Tasmania, Geology Department Lapidary.

Paul accepts no liability to any person for errors or omissions, for losses or damages claimed as a result, directly or indirectly, of opinions or data produced in this report.

Contents

Page

Introduction

'Acid rock drainage (ARD) is produced by the exposure of sulphide minerals such as pyrite to atmospheric oxygen and water. The ability to identify in advance any mine materials that could potentially produce ARD is essential for timely implementation of mine waste management strategies for ARD control.' - (AMIRA, 2002, p. A1)

This report focuses on samples obtained between July 1, 2002 to 30 September 2003, from the Comstock Mining Leases held by Oceania Tasmania Pty Ltd, and forms part of a biannual report, in accordance with Permit Conditions (06-07-01) as outlined in the Development Proposal and Environmental Plan (DPEMP – 2001). The parameters listed as required in the Monitoring Schedule include: NAG, NAG pH, and AMD status.

The aim of this report is to summarise the ARD status of the Swansea Tramway Waste Rock Dump (STWRD) and investigate the ARD potential of waste rocks that may be used on the dump in the future.

Metals Produced

Silver, lead and zinc as sulphide concentrates.

Methods

A systematic program to determine ARD of waste rocks was analysed at Analabs Pty Ltd., Burnie, Tasmania. Analyses included: net acid producing potential (NAPP), net acid generation (NAG), net acid generation pH (NAG pH), acid neutralising capacity (ANC % $CaCO_3$), Electrical Conductivity (EC) and Total % Sulphur. Additionally, several thin-sections were cut at the University of Tasmania, Geology Department Lapidary to determine minerals. Results are shown in Table 2.

Three classification systems from Miller (1998), AMIRA (2002) and Environment Australia (1997) have been used as a guide to try and determine the acid generation of samples.

Miller (1998) has proposed a scheme for assessing a rock's propensity to generate ARD. A classification table that uses NAG pH, static NAG values and NAPP categorises individual samples as potentially acid forming, potentially acid forming–low capacity, non-acid forming, acid consuming or uncertain (Table 1).

Table 1. Classification scheme of the potential for acid production (Miller, 1998).

Primary Geochemical Waste Type	Final NAG pH	Static NAG Value (kg H_2SO_4/t)	NAPP (kg H_2SO_4/t)
Potentially Acid Forming	<4.5	>5	Positive
Potentially Acid Forming - Low Capacity	<4.5	≤5	Positive
Non Acid Forming	≥4.5	0	Negative
Acid Consuming	≥4.5	0	Less than –100
Uncertain	≥4.5	0	Positive
	>4.5	>0	Negative

Additionally, AMIRA (2002) have developed a number of procedures to determine acid forming characteristics of mine waste materials. AMIRA (2002) propose the most widely used assessment methods for ARD characterisation are the Acid-Base Account (ABA) and the Net Acid Generation (NAG) test. These methods are referred to as static tests procedures because each involves a single measurement in time. Figures 1 to 3 show ABA and Geochemical classification plots with Comstock samples.

A silver-lead-zinc mine (Cannington) operated by BHP Minerals in Environment Australia (1997) have identified a characterisation process for mine waste materials and has been referred to in Table 2, for a technique used in the determination of the ARD status of waste materials at the Comstock Mine, Zeehan.

Swansea Tramway Waste Rock Dump
During September 2003, mine geologist Paul Heath collected two composite samples from the STWRD for determination of the ARD status (Table 2).

Main Lode - carbonates
During September 2003, mine geologist Paul Heath collected two samples; a talc-silica rock and carbonate rock. The samples were collected to determine acid buffering potential. These rocks are represented as R1 and R2 in Table 2.

Allison's Pit Waste Rock Study
During August 2002, carbonate petrologist Dr Mohammad Adabi and mine geologist Paul Heath collected 12 waste rock samples from Allison's pit that have been planned as overburden to the STWRD.

Additionally, five representative down-hole samples were collected from drillholes SY021 and SY022 (Table 2) as a first pass to characterise the acid forming potential or acid neutralising potential of waste rock from Allison's decline that is proposed to be used during stages 2 to 6 of the Preliminary Waste Management Plan (Appendix 4 of: Comstock Revised Management Plan & Mine Plan, 2002).

Table 2: Acid forming/buffering values of mine waste materials, Comstock Mine.

Sample	Northing	Easting	Type	From (m)	To (m)	Thin sections	NAPP	NAG $Kg\ H_2SO_4$/tonne	NAG pH	ANC % $CaCO_3$	ANC $Kg\ H_2SO_4$/tonne	Total %S	EC US/cm	EC dS/cm	MPA $Kg\ H_2SO_4$/tonne	Environement Australia, 1997	Miller, 1998	Amira, 2002	Rock Name
Swansea Dump (30-9-03)															30.6				
STWRD01	357327	5359994	Grab	N/A	N/A	No	4.1	33.31	2.1	0.1	0.98	2.98	N/A	N/A	91.19	PAF	PAF	PAF	composite*
STWRD02	357329	5359931	Grab	N/A	N/A	No	1.6	31.29	2.3	0.1	0.98	1.11	N/A	N/A	33.97	PAF	PAF	PAF	composite*
Main Lode (30-9-03)																			
R1	357364	5360582	Grab	N/A	N/A	No	3.3	2.52	6.7	0.4	3.92	0.02	N/A	N/A	0.61	NAF	UC (NAF)	Barren	Silica-micrite-tale
R2	357368	5360595	Grab	N/A	N/A	No	-213.3	<0.5	9.8	42.9	420	0.08	N/A	N/A	2.45	NAF	ACM	NAF	carbonate
Allison's open pit (30-8-02)																			
WR1	5360522	357585	Grab	N/A	N/A	No	-1.78	1.96	6.1	0.4	3.92	0.1	220	0.22	3.06	NAF	NAF	NAF	Silica-micrite-tale
WR2	5360524	357586	Grab	N/A	N/A	No	-0.97	2.69	3.3	0.3	2.94	0.29	196	0.20	8.87	PAF-LC	UC (NAF)	UC (NAF)	Silica-micrite-tale
WR3	5360529	357587	Grab	N/A	N/A	No	-1.08	1.47	6.3	0.4	3.92	0.09	287	0.29	2.75	NAF	NAF	NAF	Silica-micrite-tale
WR4	5360536	357585	Grab	N/A	N/A	Yes	-0.20	1.23	4.9	0.3	2.94	0.15	377	0.38	4.59	NAF	NAF	NAF	Silica-micrite-tale
WR5	5360557	357579	Grab	N/A	N/A	No	-6.03	5.64	3.7	0.1	0.98	0.13	471	0.47	3.98	PAF-LC	UC (NAF)	Barren	Silica-micrite-tale
WR6	5360578	357579	Grab	N/A	N/A	Yes	0.50	2.2	6.2	0.2	1.96	0.03	96	0.10	0.92	NAF	UC (NAF)	Barren	Silica-micrite-tale
WR7	5360595	357572	Grab	N/A	N/A	Yes	-0.37	0.74	6.6	0.2	1.96	0.03	91	0.09	0.92	NAF	NAF	NAF	Silica-micrite-tale
WR8	5360603	357575	Grab	N/A	N/A	No	-0.37	0.74	6.7	0.1	0.98	0.03	89	0.09	0.92	NAF	NAF	NAF	Silica-micrite-tale
WR9	5360612	357597	Grab	N/A	N/A	No	-4.98	3.18	3.8	0.1	0.98	0.08	140	0.14	2.45	NAF	UC (NAF)	Barren	Silica-micrite-tale
WR10	5360613	357605	Grab	N/A	N/A	Yes	-2.15	1.96	5.5	0.1	0.98	0.03	84	0.08	0.92	NAF	NAF	NAF	Silica-micrite-tale
WR11	5360613	357617	Grab	N/A	N/A	Yes	-0.78	3.43	5.8	0.1	0.98	0.05	97	0.10	1.53	NAF	NAF	NAF	Silica-micrite-tale
WR12	5360525	357597	Grab	N/A	N/A	No	4.61	102.9	2.4	0.1	0.98	4.35	663	0.66	133.11	PAF	PAF	PAF	shale
Drill Holes (30-8-02)																			
SY021			Drill Core	2	3	Yes	-88.52	<0.5	8.2	11.6	114	1.44	832	0.83	44.06	NAF	NAF	NAF	carbonate
SY021			Drill Core	8	11	No	10.48	88.2	2.4	0.4	3.92	4.28	830	0.83	130.97	PAF	PAF	PAF	shale
SY022			Drill Core	1.3	6.2	Yes	-2.27	1.47	4.1	0.2	1.96	0.12	91	0.09	3.67	NAF	UC (NAF)	Barren	Silica-micrite-tale
SY022			Drill Core	6.2	10.2	Yes	-4.87	<0.5	9.3	1.3	12.74	0.03	116	0.12	0.92	NAF	NAF	NAF	carbonate
SY022			Drill Core	13	14	No	13.18	98.98	2.3	0.3	2.94	4.04	678	0.68	123.62	PAF	PAF	PAF	shale

MPA	Maximum Potential Acidity ($Kg\ H_2SO_4$/tonne)=(Total%S)* 30.6
ANC	Acid Neutralising Capacity
ACM	Acid Consuming Capacity
NAPP	Net Acid Producing Potential
NAG	Net Acid Generation
NAG-pH	Final pH of solution following NAG test
UC (NAF)	Uncertain
Barren	No acid generating capacity and no buffering capacity
PAF-LC	Potentially Acid Forming - Low Capacity
***Composite sample**	Mixture of talc, quartz, shale
NAF	Not Acid Forming
PAF	Potentially Acid Forming

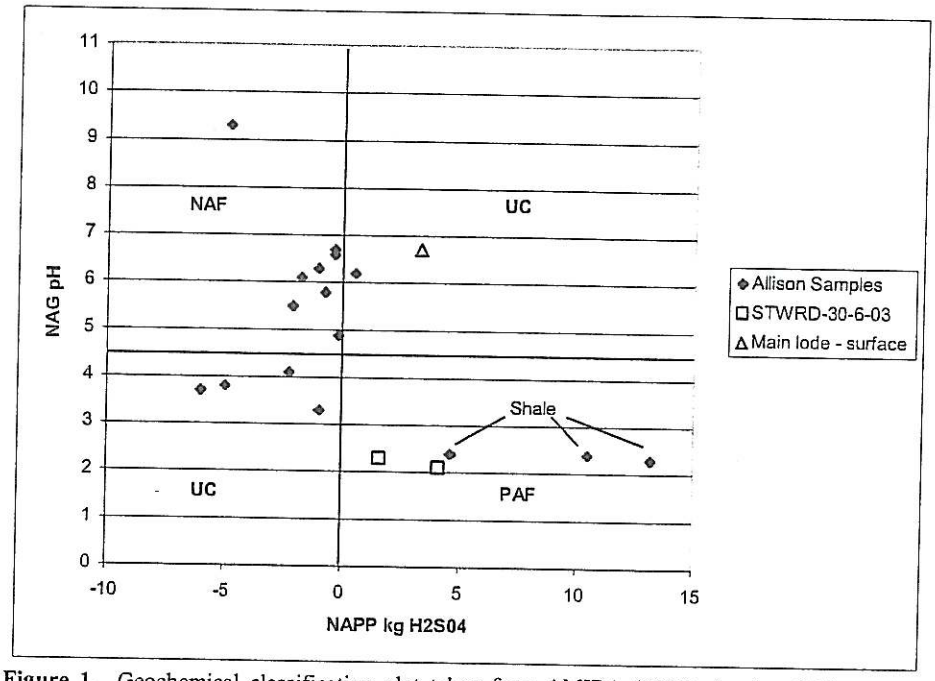


Figure 1. Geochemical classification plot taken from AMIRA (2002) showing fields as non acid forming (NAF), potentially acid forming (PAF) and uncertain (UC). Samples with a NAPP <-10 NAPP kg H_2SO_4 are not shown.

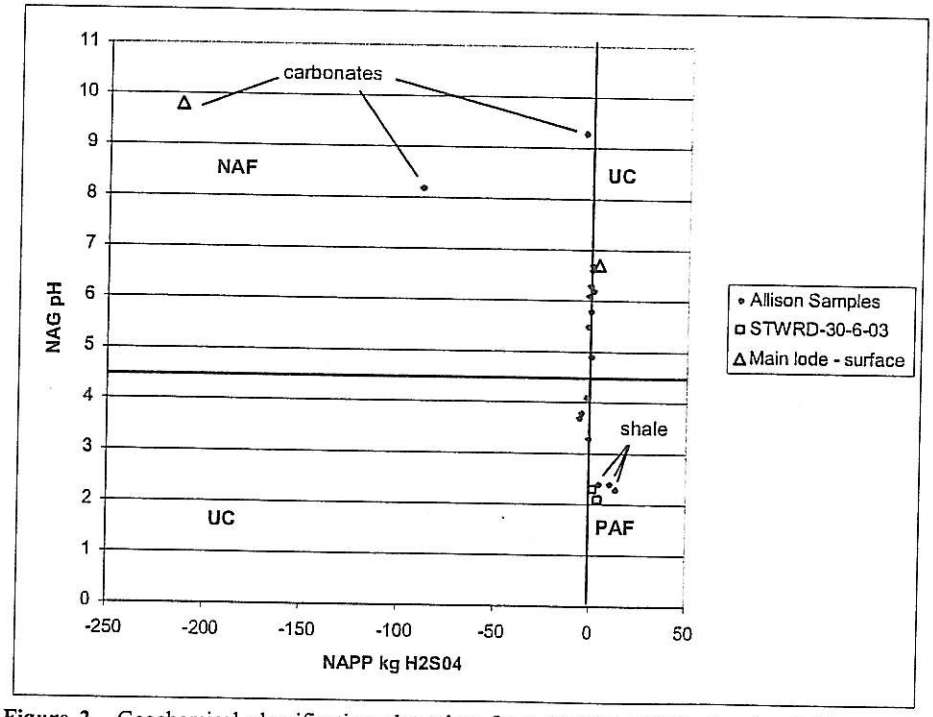


Figure 2. Geochemical classification plot taken from AMIRA (2002) showing fields as non acid forming (NAF), potentially acid forming (PAF) and uncertain (UC). All samples are shown that are represented in Table 2.

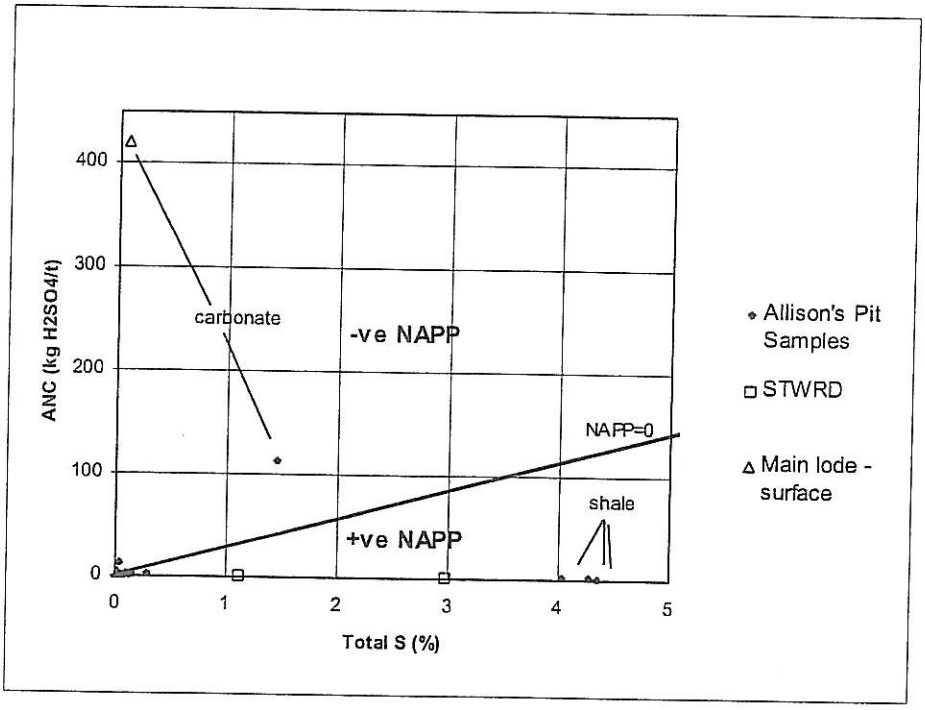


Figure 3. Acid-base account (ABA) plot adapted from AMIRA (2002). The shale and STWRD samples have a positive NAPP and Total S (%) >1 % and therefore have been classified as PAF. Additionally, the carbonates can be classified as non acid forming and may be acid buffering. Note, the remainder of the samples, accept for sample SY021 (2-3m), have a low Total sulphur content of <0.35%.

The techniques used in Miller, (1998), AMIRA, (2002), Environment Australia, (1997) have been used as a guide for the characterisation of the ARD status at the Comstock Mine. The three techniques described in the methods are comparable with the samples in Table 2 classified overall as either PAF or NAF.

Five samples (2 x STWRD & 3 x shale) in Table 2 have been classified as PAF. The remaining 16 samples (3 x carbonate, 13 x talc-silica-micrite) have been classified as NAF.

Samples R1, WR2, WR5, WR6, WR9 and SY021 (1.3m) have been classified as UC in some of the classification schemes. An UC classification is used when there is apparent conflict between the NAPP and NAG results. However, by using both NAPP and NAG tests, the risk of misclassification is significantly reduced and samples with UC classification are highlighted and may reflect organic acidity, rather than sulphide derived acidity (AMIRA, 2002). Additionally, some sulphur may occur as other metal sulphides (e.g. sphalerite, galena), that yield less acidity than pyrite when oxidised, or in some cases, may be non-acid generating or acid consuming. Total sulphur (%) suggests that these can be classified as NAF due to the small amount of Total sulphur (<0.35%). Samples classified as PAF always has significant sulphur contents (AMIRA, 2002), such as samples STWRD01. STWRD02, WR12, SY021 (8-11m) and SY022 (13-14m), that ranges from 1.11% to 4.35% Total sulphur.

Samples R2 and SY021 (2-3m), are shown to be carbonates, and have an acid buffering-consuming capacity indicated by low NAPP (-88 and –213 respectively) and Total sulphur values (0.08% and 0.03%) respectively.

Discussion on STWRD

During June 2000 to September 2003 the STWRD has been the site for overburden from the Allison's decline. The majority of rock moved from Allison's pit has been talc-silica-micrite (overburden outside of ore zone; Table 2, WR1 to WR11), talc-silica-micrite-disseminated pyrite (within Allison's ore zone – see Koehnken, 2001), shale (Table 2 and Koehnken, 2001) carbonate (Table 2) and minor massive pyrite, galena, sphalerite (Koehnken, 2001).

The shale, talc-silica-micrite-pyrite and massive pyrite, show to be PAF (Table 2, Koehnken, 2001) and are probably the cause of ARD shown in samples STWRD01 and STWRD02 (Table 2).

Originally, the removal of talc containing disseminated pyrite within the ore zone was deposited within the centre of the STWRD, with low NAG material partially encapsulating it. However, recent site excavations have mixed these zones to achieve maximum compaction, contouring and access to the base.

Summary of the STWRD

NAG and NAG pH: The majority of the material believed to be present in the dump has a final NAG value of > 5kg H_2SO_4/t and a NAG pH of <4.5 (STWRD01 & STWRD02), resulting the material being classified as "Potentially Acid Forming' based on the classification of Miller (1998), AMIRA (2002) and Environment Australia (1997).

AMD status: The status of the dump is considered to be actively oxidising with minor amounts of buffering capacity available to neutralise the generated sulphuric acid at this stage. Disseminated pyrite within the shale shows to be the main contributor of ARD to the STWRD.

Reference

AMIRA., 2002. *Project P387A - Prediction & Kinetic Control of Acid Mine Drainage*, AMIRA International.

Environment Australia., 1997. *Managing Sulphidic Mine Wastes and Acid Drainage.* Commonwealth of Australia.

Koehnken, L., 2001. *AMD Status of Central Mine Waste Rock Dump at Oceania Comstock Mine*. Unpublished Report.

Miller, S., 1998. *Assessment of Acid Forming Characteristics*. Environmental Geochemistry International Pty Ltd, p.5 Appendix 10.

Miller, S., 1998. *Predicting Acid Drainage*, Groundwork, Australian Minerals and Energy Environment Foundation, v2, no.1, p 8-9.

Appendix A – Analytical Data

For action:

For information:

File:

Analabs Pty Ltd
ACN 004 591 664

ANALABS

A subsidiary of Scientific Services Limited

RECEIVED
30 AUG 2002

14 Thirkell Street, Burnie, Tasmania 7320
PO Box 929, Burnie, Tasmania 7320
Telephone: (03) 6431 6837 Facsimile: (03) 6431 8890

ANALYSIS REPORT SHEET

To Paul Heath
Oceania Tasmania
PO Box 1603
HOBART TAS 7000

Order No.: 436 Our Reference BU019093

SAMPLE	NAPP	NAG	NAG pH	ANC	%S	
		Kg H_2SO_4/tonne		% $CaCO_3$		
WR01-02	-1.78	1.96	6.1	0.4	0.10	✓
WR02-02	-0.97	2.69	3.3	0.3	0.29	
WR03-02	-1.08	1.47	6.3	0.4	0.09	✓
WR04-02	-0.20	1.23	4.9	0.3	0.15	✓
WR05-02	-6.03	5.64	3.7	0.1	0.13	✓
WR06-02	0.50	2.2	6.2	0.2	0.03	✓
WR07-02	-0.37	0.74	6.6	0.2	0.03	✓
WR08-02	-0.37	0.74	6.7	0.1	0.03	
WR09-02	-4.98	3.18	3.8	0.1	0.08	
WR10-02	-2.15	1.96	5.5	0.1	0.03	
WR11-02	-0.78	3.43	5.8	0.1	0.05	
WR12-02	4.61	102.9	2.4	0.1	4.35	Sheila
SY021 (2-3M)	-88.52	<0.5	8.2	11.6	1.44	
SY021 (8-11M)	10.48	88.2	2.4	0.4	4.28	Sheila
SY022 (1.3-6.2M)	-2.27	1.47	4.1	0.2	0.12	✓
SY022 (6.2-10.8M)	-4.87	<0.5	9.3	1.3	0.03	✓
SY022 (13-14M)	13.18	98.98	2.3	0.3	4.04	Sheila

Mark Good
Laboratory Supervisor

A N A L A B S

Our reference : BU19093A
Your reference : 436
Project code : Submission 158109
Report date : 02/10/02
Report status : Final
Page : 1 of 1

Analabs Pty. Ltd.
ACN 004 591 664
14 Thirkell St, Burnie
Tasmania 7320
Telephone : (03) 6431 6837
Facsimile : (03) 6431 8890

ANALYTICAL DATA

Sample	Conduc					
WR01-02	220					
WR02-02	196					
WR03-02	287					
WR04-02	377					
WR05-02	471					
WR06-02	96					
WR07-02	91					
WR08-02	89					
WR09-02	140					
WR10-02	84					
WR11-02	97					
WR12-02	663					
SY021 (2-3M)	832					
SY021 (8-11M)	830					
SY022 (1.3-6.2M)	91					
SY022 (6.2-10.8M)	116					
SY022 (13-14M)	678					
Method	E1006					
Units	uS/cm					
Detection Limit	1					

Notes: N.A. = not analysed, -- = element not determined, I.S. = insufficient sample, L.N.R. = listed not received

ANALYSIS REPORT SHEET

To: Oceania Tasmania Pty Ltd
PO Box 1603
HOBART TAS 7001

Attention: Paul Heath

Purchase Order No: 522

Our reference: BU019574 Date: 30 September 2003

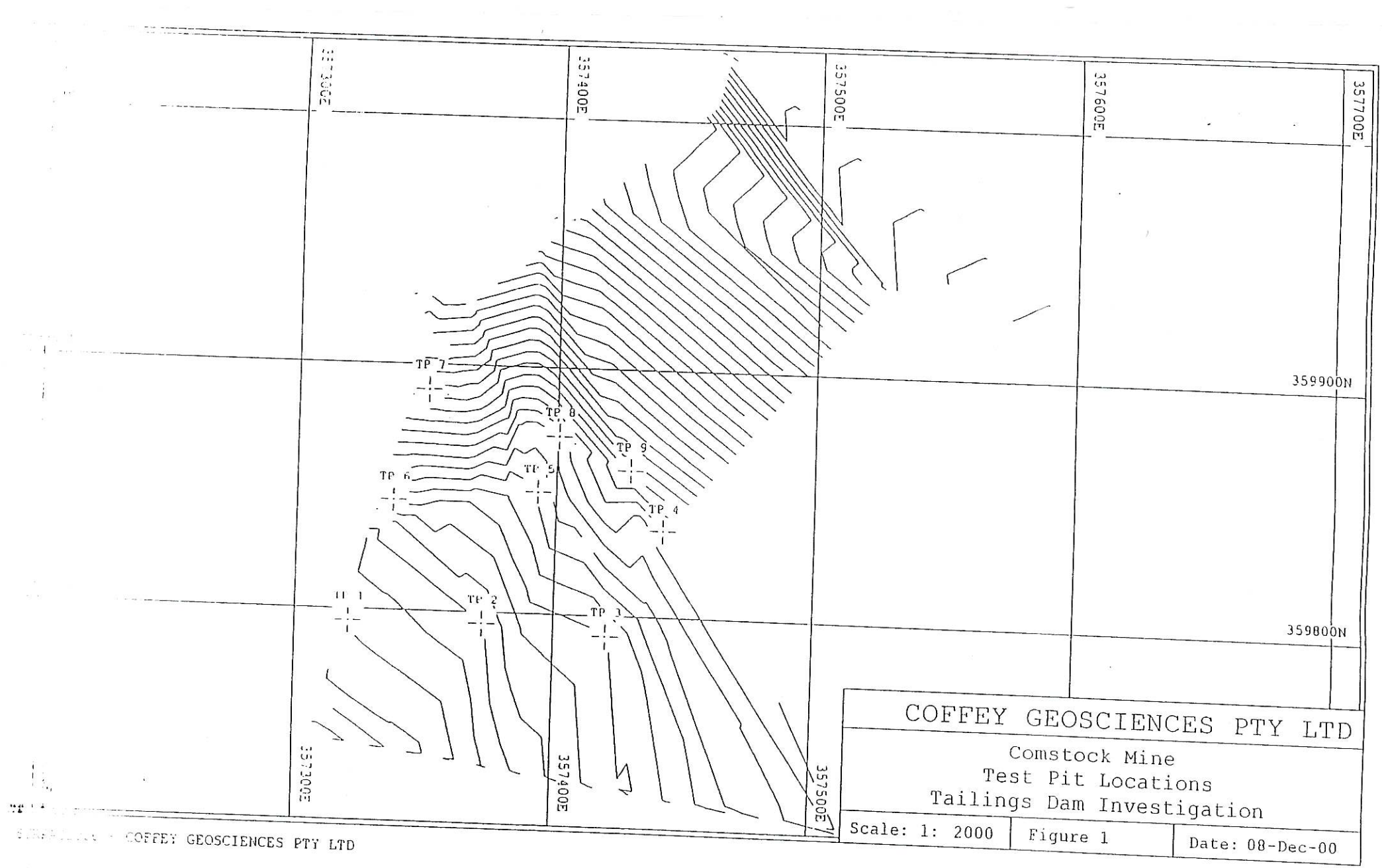
SAMPLE	NAPP	NAG	NAG pH	ANC	%S
		Kg H_2SO_4/tonne		% $CaCO_3$	
STWRD01	4.1	33.31	2.1	0.1	2.98
STWRD02	1.6	31.29	2.3	0.1	1.11
R1	3.3	2.52	6.7	0.4	0.02
R2	-213.3	<0.5	9.8	42.9	0.08

Authorised by .....
On behalf of:

Ricky Gelston
Manager - Tasmania

The results in this analytical report pertain to the samples provided to this laboratory for analysis as requested by the client.

Appendix B
Geotechnical Report



COFFEY GEOSCIENCES PTY LTD

Comstock Mine
Test Pit Locations
Tailings Dam Investigation

Scale: 1: 2000	Figure 1	Date: 08-Dec-00

COFFEY GEOSCIENCES PTY LTD

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP1
Sheet 1 of 1
Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd
Principal: Oceania Pty Ltd
Project: Comstock Mine, Zeehan
Test pit location:

Date started: 23.11.2000
Date completed: 23.11.2000
Logged by: KdeC
Checked by:

equipment type and model: Caterpillar E120B
Pit Orientation:
Easting: 357320.592 m
R.L. Surface: 212.110
excavation dimensions: m long m wide
Northing: 359795.377 m
datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
E					212.0		CL	TOPSOIL: SANDY CLAY; medium to low plasticity, orange-brown, rootlets	M	St		Topsoil
					0.5		CL-GC	GRAVELLY CLAY: medium plasticity, pale grey, angular gravel (5-60mm), some boulders (>200mm)		St-VSt	X	At 0.4m Pocket Penetrometer (PP) measured 100 kPa in Sandy Clay
					211.5							
					1.0						X	At 0.8m PP measured 170 kPa in Gravelly Clay
					211.0							Gravel derived from weathered volcanics (country rock)
					1.5							
					210.5		CL-GC	GRAVELLY CLAY: low to medium plasticity pale grey clay, angular gravel (5-60mm) and angular cobbles (>65mm)				Weathered rock material (angular gravel & cobbles) derived from weathered volcanics
					2.0							
					210.0							
					2.5							
					209.5							
					3.0							
					209.0							
			23/11/00 ▼		3.5			VOLCANICS: pale grey to blue, weathered bedrock				Water ingress into pit at 3.2m
					208.5			Test pit TP1 terminated at 3.5m				Test pit terminated at refusal on bedrock at 3.5m
					4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4
notes on ease ranging to refusal

water
▼ water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fr friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TESTPIT Z13049.GPJ COFFEY.GDT 13.12.00
Form GEO 5 2 Issue 3 Rev 2

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP2

Sheet 1 of 1

Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd

Principal: Oceania Pty Ltd

Project: Comstock Mine, Zeehan

Date started: 23.11.2000

Date completed: 23.11.2000

Logged by: KdeC

Checked by:

Test pit location:

equipment type and model: Caterpillar E120B | Pit Orientation: | Easting: 357372.331 m | R.L. Surface: 213.848

excavation dimensions: m long m wide | Northing: 359795.575 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
E					213.5 / 0.5		CL	TOPSOIL: CLAY; medium to low plasticity, pale brown to pale grey, rootlets and sticks	M	St		Topsoil (0-0.4m)
					213.0 / 1.0		CL-ML	GRAVELLY SILTY CLAY: pale grey to dark grey clay, weathered rock fragments (>100mm) and gravels (5-60mm), some rootlets		St-Fb		
								VOLCANICS: pale grey to blue, weathered bedrock		H		
								Test pit TP2 terminated at 1.1m				Test pit terminated at refusal on bedrock at 1.1m
					212.5 / 1.5							
					212.0 / 2.0							
					211.5 / 2.5							
					211.0 / 3.0							
					210.5 / 3.5							
					210.0 / 4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
A auger

support
S shoring N nil

penetration
1 2 3

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
B bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TESTPIT Z13049.GPJ COFFEY.GDT 13.12.00

Form GEO 5 2 Issue 3 Rev 2

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP3

Sheet 1 of 1

Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd

Principal: Oceania Pty Ltd

Project: Comstock Mine, Zeehan

Date started: 23.11.2000

Date completed: 23.11.2000

Logged by: KdeC

Checked by:

Test pit location:

equipment type and model: Caterpillar E120B | Pit Orientation: | Easting: 357420.163 m | R.L. Surface: 216.897

excavation dimensions: m long m wide | Northing: 359792.017 m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type, plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
E			23/11/00		216.5	0.5		GM	SILTY GRAVEL: dark brown silt with angular quartz gravel (5-15mm), roots and rootlets. Refusal at base of pit (0.1m) on bedrock.	W	Fb		Water infilled hole rapidly on completion of excavation
					216.0	1.0			VOLCANICS: blue-grey, moderately weathered bedrock				Test pit terminated at refusal on bedrock at 0.1m
					215.5	1.5			Test pit TP3 terminated at 0.1m				
					215.0	2.0							
					214.5	2.5							
					214.0	3.0							
					213.5	3.5							
					213.0	4.0							

Sketch

method
N natural exposure
X existing excavation
backhoe bucket
bulldozer blade
ripper

support
S shoring N nil

penetration
1 2 3 4
refusal
ripping to refusal

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
B bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TESTPIT Z13049.GPJ COFFEY.GDT 13.12.00

Coffey

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP4
Sheet 1 of 1
Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd
Principal: Oceania Pty Ltd
Project: Comstock Mine, Zeehan
Test pit location:

Date started: 23.11.2000
Date completed: 23.11.2000
Logged by: KdeC
Checked by:

equipment type and model: Caterpillar E120B
Pit Orientation:
Easting 357441.364 m
R.L. Surface: 222.732
excavation dimensions: m long m wide
Northing 359835.179 m
datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests etc	RL / depth metres	graphic log	classification symbol	material: soil type, plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
E					222.5 / 0.0		GM	TOPSOIL: SILTY GRAVEL, pale brown to orange, angular quartz gravel (5-15mm), rootlets and tree roots	M-D	Fb		
					222.0 / 0.5		CL-GM	SILTY GRAVELLY CLAY: medium plasticity, orange to pale brown, angular gravel (5-60mm) and angular rock fragments (>100mm), some rootlets	M			
					221.5 / 1.0							
					221.0 / 1.5							
					220.5 / 2.0			VOLCANICS: orange, EW (extremely weathered) to less weathered to FR (fresh) at base of pit		H		
					220.0 / 2.5			Test pit TP4 terminated at 2.3m				Test pit terminated at refusal on bedrock at 2.3m
					219.5 / 3.0							
					219.0 / 3.5							
					4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
D bulldozer blade
R ripper
E excavator

support
S shoring

penetration
1 2 3 4

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Form GEO 5 2 issue 3 Rev 2 TESTPIT Z13049.GPJ COFFEY.GDT 13.12.00

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP5
Sheet 1 of 1
Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd
Principal: Oceania Pty Ltd
Project: Comstock Mine, Zeehan
Test pit location:

Date started: 23.11.2000
Date completed: 23.11.2000
Logged by: KdeC
Checked by:

Coffey

equipment type and model: Caterpillar E120B
Pit Orientation:
Easting: 357392.782 m
R.L. Surface: 219.241
excavation dimensions: m long m wide
Northing: 359850.062 m
datum:

excavation information

material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type, plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
E					219.0	0.5		CL-GP	TOPSOIL: GRAVELLY CLAY: low to medium plasticity, orange-brown, angular quartz gravel (<5mm to 25mm), roots and rootlets	M-W	S		
								CL-ML	SILTY CLAY: medium to low plasticity, grey-brown, some rootlets	M	St	x	
					218.5	1.0		CL-SP	SANDY CLAY: medium plasticity clay and fine sand, grey to brown, some rootlets		St-VSt	x	Measured 60 kPa in clay at 0.55 with Pocket Penetrometer (PP) 130 kPa (0.55 to 0.7m with PP)
					218.0	1.5			VOLCANICS: grey, moderately weathered to fresh rock	M-W	St	x	80 kPa (0.7 to 1.3m with PP)
			▼ 23/11/00		217.5	2.0			Test pit TP5 terminated at 1.7m				Inflow of water at 1.7m (bottom of pit) Test pit terminated at refusal on bedrock at 1.7m
					217.0	2.5							
					216.5	3.0							
					216.0	3.5							
					215.5	4.0							

Sketch

TESTPIT Z13049.GPJ COFFEY.GDT 13.12.00

method
N natural exposure
X existing excavation
BH backhoe bucket
D bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4
no resistance
ranging to
refusal

water
water level
on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
C disturbed sample
V vane shear (kPa)
B bulk sample
E environmental sample
W water

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

FORM GEO 2 Issue 3 Rev 2

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP6
Sheet 1 of 1
Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd
Principal: Oceania Pty Ltd
Project: Comstock Mine, Zeehan
Test pit location:

Date started: 23.11.2000
Date completed: 23.11.2000
Logged by: KdeC
Checked by:

equipment type and model: Caterpillar E120B
Pit Orientation:
Easting: 357336.965 m
R.L. Surface: 217.278
excavation dimensions: m long m wide
Northing: 359845.128 m
datum:

excavation information

material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
E					217.0	0.5		CL-GM	TOPSOIL: GRAVELLY SILTY CLAY, low plasticity clay, orange-brown, angular quartz gravel (5-25mm), roots and rootlets	M	St-Fb		
									VOLCANICS: blue-grey, EW (extremely weathered) to MD (moderately weathered) bedrock		Fb-St	X	At 0.3m 40-70 kPa with Pocket Penetrometer in gravelly silty clay
									Test pit TP6 terminated at 0.5m				Test pit terminated at refusal on bedrock at 0.5m
					216.5	1.0							
					216.0	1.5							
					215.5	2.0							
					215.0	2.5							
					214.5	3.0							
					214.0	3.5							
					213.5	4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4
N resistance ranging to refusal

water
water level at date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP7
Sheet 1 of 1
Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd
Principal: Oceania Pty Ltd
Project: Comstock Mine, Zeehan
Test pit location:

Date started: 23.11.2000
Date completed: 23.11.2000
Logged by: KdeC
Checked by:

equipment type and model: Caterpillar E120B
Pit Orientation:
Easting: 357349.91 m
R.L. Surface: 226.566
excavation dimensions: m long m wide
Northing: 359890.135 m
datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
E					226.0 / 0.0		CL-GM	TOPSOIL: SILTY GRAVELLY CLAY; low plasticity, orange-brown clay, angular quartz gravel (5-10mm), abundant roots and rootlets	M	St-Fb		
					226.0 / 0.5		CL-ML	SILTY CLAY: low plasticity, orange, some rootlets		H	540	@ 0.7m (540 kPa)
					225.5 / 1.0		CL-GM	GRAVELLY SILTY CLAY: low to medium plasticity clay with large (10-50mm) clumps of EW rock			310	@ 1.1m (310 kPa)
					225.0 / 1.5			VOLCANICS: EW to MW bedrock			350	@ 1.3m (350 kPa)
								Test pit TP7 terminated at 1.6m				Test pit terminated at refusal on bedrock at 1.6m
					224.5 / 2.0							
					224.0 / 2.5							
					223.5 / 3.0							
					223.0 / 3.5							
					4.0							

Sketch

TESTPIT Z13049.GPJ COFFEY.GDT 13.12.00

Form GLOS 2 Issue 3 Rev 2

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration 1 2 3 4
no resistance
ranging to
refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP8
Sheet 1 of 1
Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd
Principal: Oceania Pty Ltd
Project: Comstock Mine, Zeehan
Test pit location:

Date started: 23.11.2000
Date completed: 23.11.2000
Logged by: KdeC
Checked by:

equipment type and model: Caterpillar E120B
excavation dimensions: m long m wide
Pit Orientation:
Easting: 357400.621 m
Northing: 359873.226 m
R.L. Surface: 221.061
datum:

excavation information: method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
E			23/11/00 ▽		220.6	0.5		ML-CL	TOPSOIL: SILTY CLAY: medium to low plasticity, dark brown to black, abundant tree roots and rootlets	M	S		
					220.0	1.0		GM	SILTY GRAVEL: pale grey, angular gravel (5-60mm) and cobbles (>100mm)	M-W	Fb		0.9 to 1.9m, EW volcanic rock, weathered to gravels, cobbles and rock fragments
					219.5	1.5							At 1.5m water ingress rapidly filling pit @ ~2 litres/min
					219.0	2.0			VOLCANICS: EW to MW bedrock, pale grey to blue	W	H		
					218.5	2.5			Test pit TP8 terminated at 2.1m				Test pit terminated at refusal on bedrock at 2.1m
					218.0	3.0							
					217.5	3.5							
						4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration 1 2 3 4
no resistance
ranging to refusal

water
▽ water level on date shown
▽ water inflow
▽ water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

consistency/density index
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

TESTPIT Z13049.GPJ COFFEY.GDT 13.12.00
Form GEO 5.2 Issue 3 Rev 2

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. TP9

Sheet 1 of 1

Office Job No.: Z13049/1

Client: SEMF Holdings Pty Ltd

Principal: Oceania Pty Ltd

Project: Comstock Mine, Zeehan

Date started: 23.11.2000

Date completed: 23.11.2000

Logged by: KdeC

Checked by:

Test pit location:

equipment type and model: Caterpillar E120B | Pit Orientation: | Easting: 357428.406 m | R.L. Surface: 225.219

excavation dimensions: m long m wide | Northing: 359860.056 m | datum:

excavation information					material substance							
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
E					225.0 / 0.0		GM	TOPSOIL: SILTY GRAVEL: brown, angular quartz gravel (5-25mm), abundant tree roots and rootlets	M	Fb		
							CL-GW	SANDY GRAVELLY CLAY: medium to low plasticity, orange-brown, angular quartz gravel (5-25mm), roots and rootlets		Fb-St		
					224.5 / 0.5							
					224.0 / 1.0			VOLCANICS: extremely weathered rock, orange-brown, angular rock fragments and sandy clay	M-W	D-H		
			23/11/00		223.5 / 1.5							
					223.0 / 2.0			Test pit TP9 terminated at 2.1m	W	H		Water inflow into pit @ 2m
					222.5 / 2.5							Test pit terminated at refusal on bedrock @ 2.1m
					222.0 / 3.0							
					221.5 / 3.5							
					4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency/density index
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- S soft
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- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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