Environmental Approval & Compliance Solutions

Cairns Office:
Level 1, 320 Sheridan Street,
PO Box 5678 Cairns QLD 4870
P: 61 7 4034 5300

Townsville Office:
Suite 2A, Level 1, 41 Denham Street,
PO Box 539 Townsville QLD 4810
P: 61 7 4796 9444

www.natres.com.au

NRA Reference: PRCP_land use_L02

6 August 2024

Department of Environment, Science and Innovation
Minerals and Northern Compliance Environmental Services & Regulation
PO Box 7230, Cairns QLD 4870

Via email: Marina.Gibson@des.qld.gov.au; ESCairns@des.qld.gov.au

Attention: Marina Gibson, Senior Environmental Officer (Assessment)

Dear Marina

RE: Mt Carbine Project, EA EPML00956913 – PRCP (Your Ref C-EATPRCP-100440340)

I refer to the:

- Mt Carbine Quarries Pty Ltd (MCQ) proposed Progressive Rehabilitation Closure Plan (PRCP) application submitted to the administering authority (AA) on 26 October 2023
- *Notice – Not Properly Made Application* (NNPMA) received from the AA, dated 9 November 2023
- clarification of the NNPMA provided by the AA (*pers. comm.* Marina Gibson, Senior Assessment Officer, AA, with Tim Anderson, Principal Scientist, NRA, phone conversation 21 November 2023; and *pers. comm*. Marina Gibson, Senior Assessment Officer, AA to Tim Anderson, Principal Scientist, NRA, email dated 21 November 2023)
- meeting with officers of the AA, MCQ and NRA on 16 January 2024 to discuss matters previously detailed (*pers. comm*. Tim Anderson, Principal Scientist, NRA to Marina Gibson, Senior Assessment Officer, AA, email dated 8 December 2023)
- request for extension of time to prepare and resubmit application, including a description of tasks and schedule (*pers. comm.* Tim Anderson, Principal Scientist, NRA to Marina Gibson, Senior Assessment Officer, AA, email dated 17 January 2024)
- response to the AA's information request (regarding TSF4) (*pers. comm*. Tim Anderson, Principal Scientist, NRA to Gus Gonzo, Manager Environmental Services – PRCP Assessment, AA, email dated 18 January 2024)
- agreement to extend response period to 31 October 2024 (*pers. comm*. Marina Gibson, Senior Assessment Officer, AA to Tim Anderson, Principal Scientist, NRA, email dated 24 January 2024)
- response to the AA's information request (regarding TSF3) (*pers. comm*. Marina Gibson, Senior Assessment Officer, AA to Tim Anderson, Principal Scientist, NRA, email dated 24 January 2024; *pers. comm*. Tim Anderson, Principal Scientist, NRA to Marina Gibson, Senior Assessment Officer, AA, email dated 24 January 2024)
- response to the AA's information request (regarding TSF3) (*pers. comm*. Marina Gibson, Senior Assessment Officer, AA to Tim Anderson, Principal Scientist, NRA, email dated 26 February 2024; *pers. comm*. Tim Anderson, Principal Scientist, NRA to Marina Gibson, Senior Assessment Officer, AA, emails dated 26 February 2024 and 28 February 2024)
- working copy void closure plan (provided to the AA by NRA, *pers. comm*. Tim Anderson, Principal Scientist, NRA to Marina Gibson, Senior Assessment Officer, AA, email dated

Natural Resource Assessments Pty Ltd trading as NRA Environmental Consultants. ABN: 77 011 073 135
Certified Integrated Management System: ISO 9001:2015 (Quality), ISO 14001:2015 (Environment), ISO 45001:2018(Safety).

2 April 2024) and comments provided by the AA (*pers. comm*. Marina Gibson, Senior Assessment Officer, AA to Tim Anderson, Principal Scientist, NRA, email dated 30 April 2024)

- meeting with officers of the AA, MCQ and NRA on 21 May 2024 to discuss progress on the response to NNPMA (*pers. comm*. Marina Gibson, Senior Assessment Officer, AA to Tim Anderson, Principal Scientist, NRA, email dated 1 May 2024) (the meeting focused on matters pertinent to TSF3 post mine land use).

With reference to the above communications, a synopsis of the status and intended response to the NNPMA follows:

1. As discussed and then noted at the meeting of 16 January 2024, the non-use management area (NUMA) approach will be adopted for the void and void bund area. This approach will be reflected in the resubmitted PRCP application.
2. Comments received from the AA on the void closure plan will be addressed and the void closure plan incorporated into the resubmitted PRCP application.
3. TSF4 will be discussed in the PRCP Plan, and the area related to mining will be retained in the PRCP Schedule. Rehabilitation commitments will be infrastructure removal, contaminated land survey and geotechnical survey.
4. TFS3 will be discussed in the PRCP Plan and excluded from the PRCP Schedule.
    a. Given the discussions concerning TSF3, and in response to the AA's request for information concerning the genesis of the quarry at Mt Carbine and TSF3 post mine land use (meeting of 21 May 2024), further information is provided herein.

Quarry Genesis and Post Mine Land Use

At the meeting with officers of the AA, MCQ and NRA on 21 May 2024, the AA requested information of the genesis of the quarry operations, as part of its concerns for TSF3 post mine land use.

The contact details for an officer of the Department of Resources (DoR), with whom Gus Gonzo had discussions, were provided to NRA and consultation followed, the outcomes of which are included below (evident in communications presented in **Attachment 1**).

1. The original Pastoral Holding tenure applicable to the Mt Carbine project area commenced in 1964, and was signed in 1965.
    a. The date noted on contemporary records (**Attachment 2**[1]) for the creation of the tenure is 21 October 1995. This date reflects the adoption of the State's new data record management system and is not the creation date of the Pastoral Holding.
2. At the time of the creation of the Pastoral Holding (*ie* in 1964) the areas of mine leases (MLs) (among other things) were specifically excluded from the Pastoral Holding.
    a. Therefore, the authorised use of 'mining' pre-dates that of 'pastoral holding'.
3. The potential for 'waste rock dumps and tailings' to provide suitable construction materials in the region in the future was formally identified in the Decommissioning and Rehabilitation Plan, and then accepted by the AA in 1995 (**Attachment 3**). It appears that progression from a mining operation (cessation of mine operations occurred in the mid-late 1980s associated with market conditions) to a quarry operation occurred circa 1995 (evident by a change of ownership of the relevant MLs from Normandy Minerals Limited to Mt Carbine Quarries Pty Ltd).

[1] Brooklyn (Station) – Lot 13 SP 254833 (Title Reference 17664140, a special condition allows quarry material to be removed; Tenure Reference PH 9/2359).

4. Quarry operations at the Mt Carbine project area occurred pursuant to an 'integrated authority' dated 27 September 2004 (**Attachment 4**). This environmental authority (EA) records 'License without Development Approval' for authorised environmentally relevant activities (ERAs) '20(b) Extracting rock or other material' and '22(b) Screening *etc* material' on Lot 13 Plan RP127355.
    a. The relevant local government authority (*ie* the entity that administers development approvals) reports that 'the ongoing use of this land for extractive industry purposes is an existing right of use, lawfully established under the Mareeba Shire Planning Scheme 2004' (**Attachment 5**).
    b. Schedule I of the September 2004 EA is a map that shows the Mt Carbine project area; this area is consistent with that shown in the current EA for the quarry (*ie* EPPR00438313, dated 16 March 2021) (**Attachment 6**).
5. The EA (for the quarry activity) is inextricably linked to the MLs.
6. Renewal of the tenure (*ie* the MLs), inclusive of access, will proceed pursuant to the requirements of the Queensland *Mineral Resources Act* 1989 (MR Act).
    a. The quarry activity (*ie* MLs and access) is not beholden to a process associated with a 'Sales Permit' under the Queensland *Forestry Act* 1959.
7. Upon cessation of mining activities that occur on the MLs pursuant to EA EPML00956913, dated 19 September 2023, and the requisite decommissioning and rehabilitation tasks necessary for surrender of the EA EPML00956913:
    a. the surrender of the EA (for mining) does not negate nor necessitate the surrender of the MLs
    b. the EA for the quarry that authorises quarry activities will be maintained.

Other than the existence of a resource (which, it is acknowledged, has not been in question), the key point is that the quarry activity is inextricably linked to the MLs, the tenure of which is governed by processes under the MR Act. Therefore, the sustained post mine land use of quarry activities on the MLs is demonstrable.

It is understood that the AA cannot make decisions in the absence of a resubmitted PRCP; however, I trust that the information that has been provided addresses the AA's questions in a way that enables the resubmission to be progressed with confidence. Please contact me on 4034 5300 if you have any questions.

Yours sincerely

NRA Environmental Consultants

Tim Anderson
Director

Encl: Attachment 1: Communications with DoR
Attachment 2: Pastoral Holding Title Search
Attachment 3: Accepted Decommissioning and Rehabilitation Plan
Attachment 4: Quarry Integrated Authority
Attachment 5: Quarry as of Right Use
Attachment 6: Quarry Environmental Authority

CC: Kevin MacNeill, EQR
Natasha Troughton, EQR

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Attachment 1:
Communications with DoR

From: Deanna Holder <Deanna.Holder@resources.qld.gov.au>
Sent: Tuesday, 2 July 2024 2:19 PM
To: Tim Anderson
Cc: Susan Ashley
Subject: FW: Mt Carbine ML relative to Brooklyn PH
Attachments: pdf_upload_r1olt3CVC.pdf; 17664140_400694_title_search.pdf; Ball 1915_Geology Rpt.pdf

Caution! This message was sent from outside your organization. Allow sender | Block sender

OFFICIAL

Hi Tim,

First I apologise for the delay in responding.

I confirm the information outlined below is correct.

Regards

Deanna Holder
A/Manager
Land Services | Land & Surveying Services
Department of Resources

P: 4016 1903 **M:** 0436 698 052
E: deanna.holder@resources.qld.gov.au
A: Canegrowers Building, 88 Rankin Street, Innisfail QLD 4860 | P O BOX 94, INNISFAIL, QLD 4860
W: www.resources.qld.gov.au

From: Tim Anderson <tim@natres.com.au>
Sent: Thursday, June 6, 2024 3:07 PM
To: Deanna Holder
Subject: Mt Carbine ML relative to Brooklyn PH

Dear Deanna

Thank you for your time today to discuss tenure matters relating to Mt Carbine arising from my discussions with Gus Gonzo (DESI).

As discussed, I wish to confirm my understanding of your advice.

1. An attached PDF is a Title Search for Brooklyn (Station) – Lot 13 SP 254833.
    a. The Title Reference is 17664140
    b. Tenure Reference is PH 9/2359
    c. The record of creation is 21/10/1995.

d. Your advice was
    i. The time that this tenure (*ie* the Pastoral Holding) commenced was 1964, with it being signed in 1965.
    ii. The record of creation of '21/10/1995' reflects the adoption of the State's new data record management system and is not the creation date of the Pastoral Holding.
    iii. At the time of the creation of the Pastoral Holding (*ie* in 1964) the areas of Mine Leases (among other things) were specifically excluded from the Pastoral Holding.

2. An attached PDF presents the existing Mt Carbine Project MLs (4867,4949), Lot 13 SP 254833, and historical MLs (granted and applications).
    a. Further resources would be required to resolve the specific spatial details and date of grant of historical MLs.
    b. Existing published State data (Ball 1915 – attached) is evidence of mining activities and that leases existed (other more recent reporting also exists).

Please contact me as required for clarification, otherwise if you could please confirm my understanding of your advice, it would be appreciated.

Rdgs

Tim

Tim Anderson
Director and Principal Scientist - NRA Environmental Consultants

P: 07 40345300
M: 0413 456 174
E: tim@natres.com.au
W: www.natres.com.au

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Current State Tenure Search

Queensland Titles Registry Pty Ltd
ABN 23 648 568 101

Title Reference:	**17664140**	**Search Date:**	26/08/2021 13:03
Date State Tenure Created:	21/10/1995	**Request No:**	38337692
Creating Dealing:			

DESCRIPTION OF LAND

Tenure Reference: PH 9/2359

Lease Type: ROLLING TERM LEASE

LOT 13 SURVEY PLAN 254833
Local Government: MAREEBA

Area: 59000.000000 Ha. (ABOUT)

No Land Description

No Forestry Entitlement Area

Purpose for which granted:
NO PURPOSE DEFINED

REGISTERED LESSEE

Dealing No: 708361442 13/01/2005

AUSTRALIAN WILDLIFE CONSERVANCY A.C.N. 068 572 556

TERM OF LEASE

Term and day of beginning of lease

Term: 30 years commencing on 01/01/1964

Expiring on 31/12/1993

Extended to 31/12/2046

CONDITIONS

```
A126  SPECIFIED CONDITIONS FOR: Term Lease
      PURPOSE: Rolling term lease - pastoral
      ------------------------------------------------------------------------
      STATUTORY CONDITIONS:
      ------------------------------------------------------------------------
      Statutory conditions are the general mandatory  conditions of a lease
      and binds the lessee in accordance with  Part 2 Division 1 of the Land
      Act.
      1. Permitted Use: The lessee must  use the land only for the purpose
         for which the tenure was issued  under the Land Act 1994.
      2. Duty of Care: The lessee has  the responsibility for a duty of
         care, for the land under the  Land Act 1994.
      3. Rent/Instalment: The lessee  must pay the annual rent/instalment
         in accordance with the Land  Act 1994 and the Land Regulation
         2009.
         For further information on  how annual rent is determined, refer
         to the department's website  at www.dnrm.qld.gov.au.
      4. Noxious plants: The lessee  must keep noxious plants on the land
         under control. If the lessee  does not comply with this condition,
         the Minister may bring the  noxious plants under control, the cost
         of which will be recovered  from the lessee.
      5. Information to Minister: The  lessee must give the Minister
         administering the Land Act  1994, information the Minister asks
         for about the tenure.
```

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CONDITIONS (Continued)

6. Monies for Improvements: No money for improvements is payable by the State on the forfeiture, surrender or expiry of this lease but money may be payable if the State receives payment from an incoming lessee or buyer for the improvements on the land. However, the previous lessee may apply to the Minister to remove the improvements that belong to the lessee, within a period of 3 months from the date of the forfeiture, surrender, or expiry of this lease. The lessee may only undertake the removal of the improvements in the presence of an authorised representative of the department, if required by the Minister. The lessee may only remove those improvements if all monies due from the lessee to the department under this lease have been paid.

REGULATORY-CONDITIONS:----------

A regulatory condition relates to a lease , in accordance with the Land Regulation.

1. Indemnity: The lessee indemnifies and agrees to keep indemnified the Minister, and the State of Queensland and its Representatives, (the "Indemnified parties") against all liability, costs, loss and expenses including claims in negligence (including any claims, proceedings or demands bought by any third party, and any legal fees, costs and disbursements on a solicitor and client basis) ("Claim") arising from or incurred in connection with:
   a. the granting of this lease to the lessee;
   b. the lessee 's use and occupation of the land; or
   c. personal injury (including sickness and death) or property damage or loss in connection with the performance (or attempted purported performance or non-performance) of the lease or a breach of the lease by the lessee .

   The lessee hereby releases and discharges to the full extent permitted by law, the Indemnified parties from all actions, claims, proceedings or demands and in respect of any loss, death, injury, illness or damage (whether personal or property and whether special, direct, indirect or consequential financial loss) arising out of the use and occupation of the lease. To the full extent permitted by law, the Minister, the State of Queensland and their Representatives will not be liable to the lessee for any special, indirect or consequential damages, including consequential financial loss arising out of the use and occupation of the lease.
2. Public Liability: The lessee must effect a public liability insurance policy with an insurer authorised under the Insurance Act 1973 (Commonwealth) or, if not so authorised then only with the Minister's approval, which can be given or withheld in the Minister's sole discretion, naming the lessee as the insured covering legal liability for any loss of, or damage to any property and for the injury (including death) to any person arising out of anything done or omitted on or about the land or any improvements thereon and against all claims, demands, proceedings, costs, charges, and expenses whatsoever (including claims in negligence) Such policy must:
   a. be for an amount of not less than $20,000,000.00 and have no per event sublimit or such higher amounts as the Minister may reasonably require.
   b. be effected on a "claims occurring" basis; and
   c. be maintained at all times during the currency of the lease, and upon receipt of any notice of cancellation, the lessee must immediately effect another public insurance policy in accordance with the terms of the lease .

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CONDITIONS (Continued)

The lessee must, as soon as practicable, inform the Minister, in writing, of the occurrence of any event that the lessee considers is likely to give rise to a claim under the policy of insurance effected and must ensure that the Minister is kept fully informed of subsequent actions and developments concerning the claim.
The lessee must renew such policy, at the lessee's expense, each year during the currency of this lease.
The condition will be satisfied if the lessee is the State of Queensland or a statutory authority eligible for cover under the Queensland Government Insurance Fund and is insured and continues to be insured by the Queensland Government Insurance Fund.
This condition will be satisfied if the lessee is the Commonwealth of Australia or a statutory authority eligible for cover under the Comcover Insurance Fund and is insured and continues to be insured by Comcover.

3. Access: The provision of access, further access or services to the land will not be the responsibility of the State.
4. Survey Costs: If the land needs to be surveyed or re-surveyed the lessee must do this at their own cost under the Survey and Mapping Infrastructure Act 2003. This survey plan must be lodged in the land registry within the specified time.
5. Extension: The lease is subject to the extensions of rolling term leases provision of the Land Act 1994 and the Minister must grant an extension of the term of a rolling term lease if the lessee makes an application in the approved form. The extension will be for the original term of the lease and may be given subject to condition changes.
6. Jurisdiction: The lessee is subject to the Land Act 1994 and all other relevant Queensland and Commonwealth legislation.
7. Compliance with Laws - the lessee must comply with all lawful requirements of the -
   a. Local Government; and
   b. any department within the Queensland or Commonwealth governments (including the department administering the Land Act 1994), local authority or statutory instrumentality having jurisdiction over the land, or the development, use and occupation of the land, in regard to its use, occupation and development of the land.

SPECIAL-CONDITIONS:----------

These conditions relate to this lease.
Improvements or development on or to the land

1. The lessee must during the whole term of the lease, to the satisfaction of the relevant authorities, maintain all improvements on the land in a good and substantial state of repair.

Quarry material

1. The lessee must allow any person authorised under the Forestry Act 1959 access to the leased land for the purpose of cutting and removing timber or removing other forest products, or quarry material, or other material from the leased land.
   Except as hereinafter provided the lessee must not interfere with any forest products or remove any quarry material (including any stone, gravel, sand, earth, soil, rock, guano or clay which is not a mineral within the meaning of the Mineral Resources Act 1989) or other material upon the leased land without the permission of the Minister administering the Land Act 1994 except under the authority of and in compliance in every respect with the requirements or a permit, licence, agreement or contract granted or made under the Forestry Act 1959.

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CONDITIONS (Continued)

ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Lease No. 17664140

2. EASEMENT No 707721711 14/05/2004 at 12:47
burdening the land to
COMMON PROPERTY FOR BROOKLYN
VILLAGE ESTATE CTS 31184 OVER
EASEMENT A ON SP154002

3. EASEMENT IN GROSS No 708019404 01/09/2004 at 11:31
burdening the land
ERGON ENERGY CORPORATION LIMITED
over
EASEMENTS R,S AND T ON SP146383

4. NATURE CONSERVATION NOTING No 709705860 22/06/2006 at 16:07
all or part of the within land has been declared a Nature
Refuge under the Nature Conservation Act 1992

5. AMENDMENT OF LEASE CONDITIONS No 715949585 13/08/2014 at 05:00
THE CONDITIONS OF THE WITHIN TENURE ARE HEREBY AMENDED.

6. NATURE CONSERVATION NOTING No 716152687 20/11/2014 at 15:31
all or part of the within land has been declared a Nature
Refuge under the Nature Conservation Act 1992

ADMINISTRATIVE ADVICES

Dealing	Type	Lodgement Date	Status
700305315	WET TROPICS WET TROPICS WORLD HERITAGE PROTECTION AND MANAGEMENT ACT1993	26/10/1994 07:56	CURRENT
710104697	VEG NOTICE VEGETATION MANAGEMENT ACT 1999	16/11/2006 13:05	CURRENT
714762080	NT DETERM NATIVE TITLE ACT 1993 (CTH)	02/11/2012 09:09	CURRENT
718374852	NT DETERM NATIVE TITLE ACT 1993 (CTH)	02/11/2017 16:04	CURRENT
719767646	EXEMPT CONS SEC 322AA LAND ACT 1994	02/12/2019 08:28	CURRENT

UNREGISTERED DEALINGS

NIL

Caution - Charges do not necessarily appear in order of priority

** End of Current State Tenure Search **

Information provided under section 34 Land Title Act (1994) or section 281 Land Act (1994)

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Historical and Current Tenure Mt Carbine

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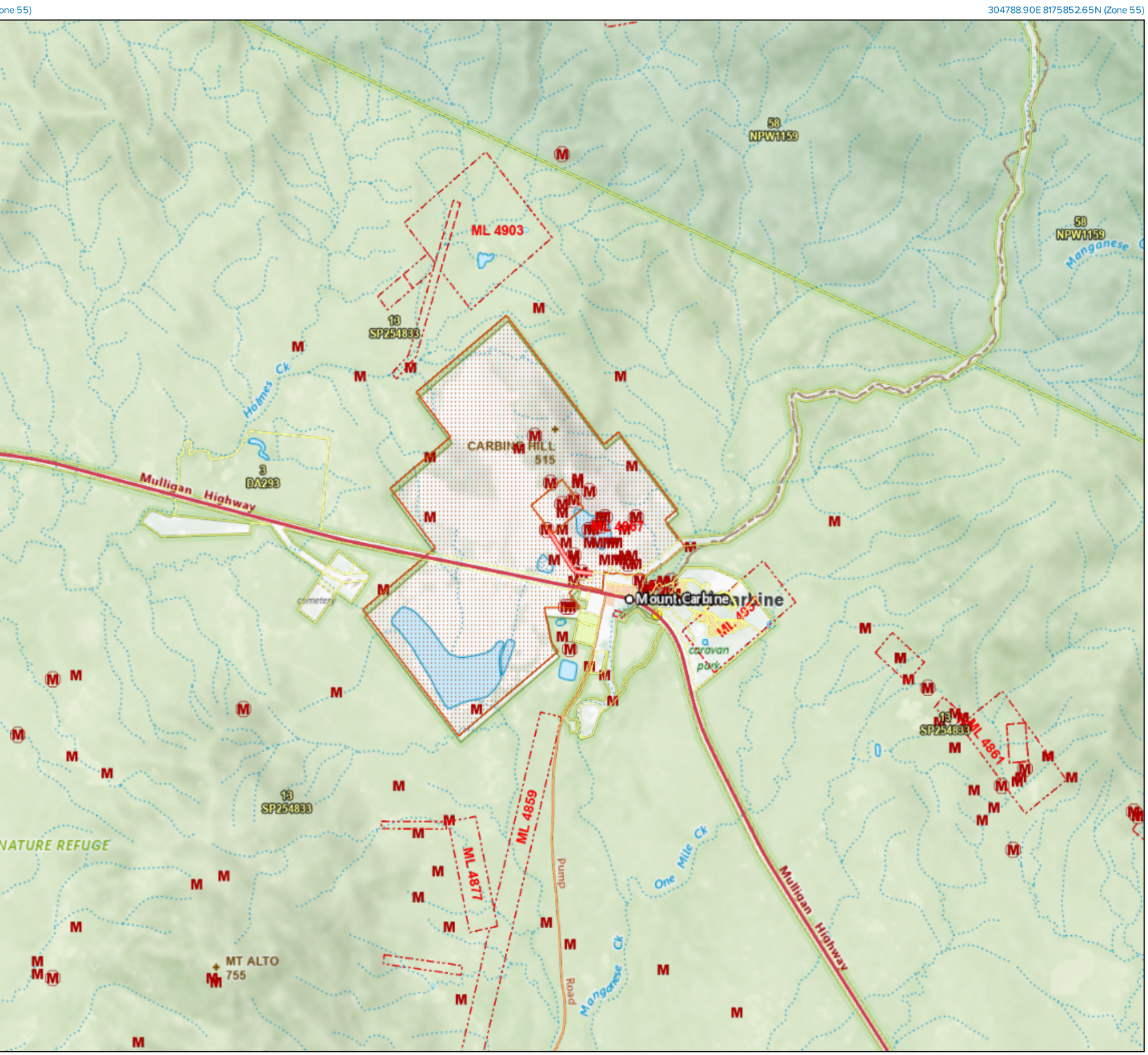

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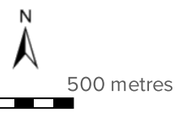

Scale: 1:30093

Printed at: A3

Print date: 6/6/2024

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Queensland Government
Department of Resources

Historical and Current Tenure Mt Carbine

Legend

Historical ML extent

Historical ML surface area

Historical ML access

Historical ML application

Historical ML granted

ML permit application

ML surface area application

ML access application

ML permit granted

ML surface area granted

ML access granted

Land parcel

Parcel

Land parcel - gt 1 ha

Parcel

Land parcel - gt 10 ha

Parcel

Land parcel - gt 1000 ha

Parcel

Land parcel label

Land parcel label - gt 1 ha

Land parcel label - gt 10 ha

Land parcel label - gt 1000 ha

Green bridges

Roads and tracks

- Motorway
- Highway
- Secondary
- Connector
- Local
- Restricted Access Road
- Mall
- Busway
- Bikeway
- Restricted Access Bikeway
- Walkway
- Restricted Access Walkway
- Non-vehicular Track
- Track
- Restricted Access Track
- Ferry
- Proposed Thoroughfare

Bridges

Tunnels

Railway

Railway station

Cities and Towns

Attribution

Maxar

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Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.

(B. DUNSTAN, GOVERNMENT GEOLOGIST.)

PUBLICATION No. 251.

The Wolfram Mines

OF

MOUNT CARBINE,

North Queensland,

With 1 Map, 24 Figures, and 21 Photographs.

BY

LIONEL C. BALL, B.E. (Syd.),

ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE

BY AUTHORITY: ANTHONY JAMES CUMMING, GOVERNMENT PRINTER.

1915.

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The Wolfram Mines of Mount Carbine, North Queensland.

By Lionel C. Ball, B.E., Assistant Government Geologist.

INTRODUCTION.

Mount Carbine was visited by the writer in connection with the preparation of a monograph on the occurrence and mining of rare metals in Queensland. The whole of October and the first half of November, 1912, was spent in the locality, much of the time being devoted to cartography. No laboratory work has yet been attempted, but that the statistical matter might not fall hopelessly out of date, it was thought advisable to publish these field notes in advance of the complete report, first of all in the "Queensland Government Mining Journal" (see issues of February, March, and April, 1912), and now in handier bulletin form.

History.

That the abundant black shoads on Carbine Hill attracted the attention of the early settlers of the district is attested by the appellation of the adjacent watercourse, Manganese Creek, other manganese ore of any variety than the wolfram being conspicuously absent. It cannot have been many years before the true nature of the substance became known, but the want of transport facilities precluded its exploitation until recently and after the more favourably situated deposits at Bamford and Wolfram Camp had received attention. Healy and Althous in 1895 or 1896 sent 28 cwt. of wolfram to Sydney; but, as this was paid for at the rate of only £8 per ton, which just about cleared expenses, nothing much was done till 1897, when a parcel (for which a Wolfram Camp buyer offered £8 per ton) was sent to Sydney for shipment to London in 1898. The returns came back the following year: £90 per ton clear of expenses after leaving Port Douglas; and the price of wolfram in Mount Carbine when the return was received was but £40 per ton!

The subsequent history of the field is something of a blank, the operations having been on too small a scale to be

deemed worthy of record. This may have been true as far as any individual prospector's results were concerned, for very few made more than good wages and few stayed long on any one piece of ground, but in the aggregate the amount of work done was certainly considerable.

The first claim registered at Herberton was the Nil Desperandum (M.C. 7207). This was in 1904; but it would seem that Baird's Bluff, which it adjoined, had been some time previously pegged out.

With the initiation of the Mount Molloy Company's project to connect their copper mines with Biboohra by rail (ultimately consummated in 1908), there was opened a prospect of greatly

PHOTO. 1.—CARBINE HILL, FROM HOSPITAL, SHOWING WORKINGS AND MILL.

reducing the cost of transport to and from Mount Carbine, and as early as 1906 the Irvinebank Company began to acquire control over all the principal holdings, the prospectors being at the end of their resources, as most of the rich surface ore had been rooted out and naturally no reserves of capital had been laid by for sinking and developing the claims. The company has directed most of its attention to the Johnson and Mount Carbine No. 1 leases. Several adits have been driven into the hill, and the backs are now being systematically worked out by overhand stoping, the ore being passed and trucked to an adit which opens directly above the supply bins at the mill. The battery, completed in July, commenced running in August, 1911, after exhaustive test had been made by Mr. F. C. West, the present manager, to determine the average metallic content

of the ore-bodies. The success of the enterprise has been gratifying, and a weekly production of 5 tons wolfram concentrate is being closely adhered to. Just now the company is not working

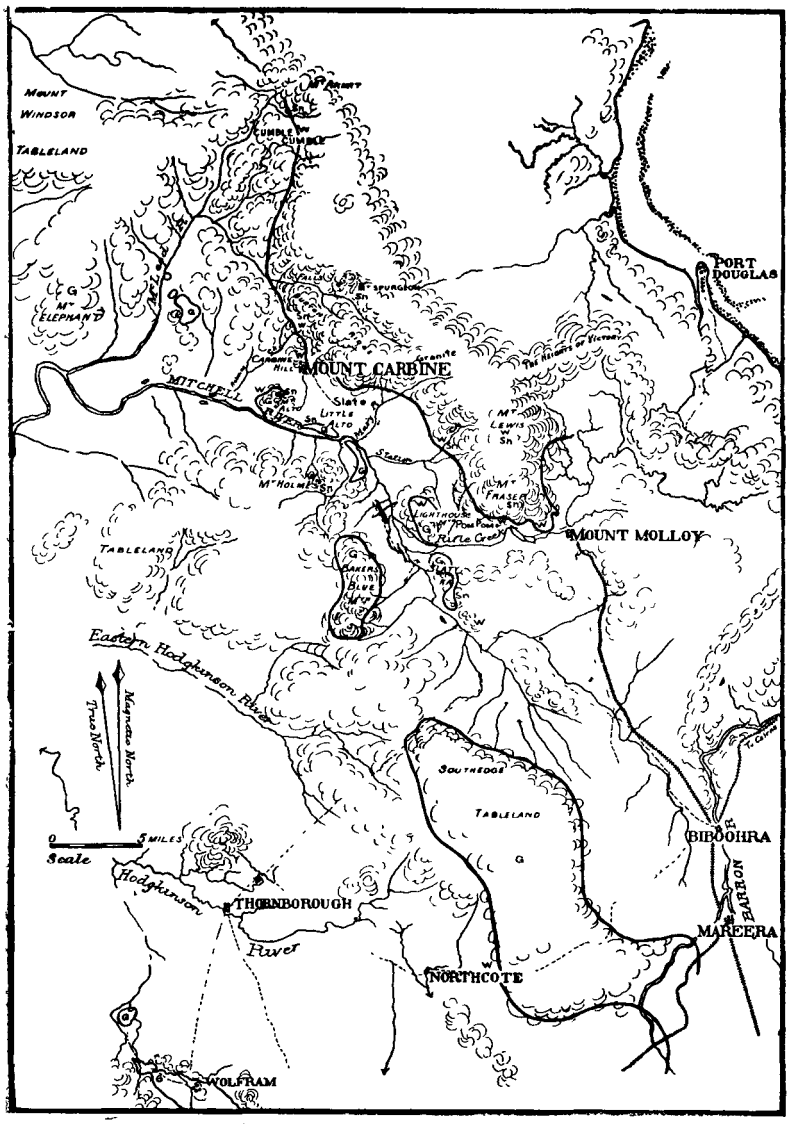

FIG. 1.—LOCALITY SKETCH, ROUGHLY DELINEATING AREAS OF INTRUSIVE GRANITE.

all its leases, but it is by far the greatest of the producers, the output of the five claims worked by parties independently of the company being negligible. The number of men on the com-

pany's pay sheets in the latter part of 1912 was 90, this including 30 miners. There is a regular loss and gain of 10 or 12 men per month, many of these floating units of the population coming to the mine more for experience than for immediate pecuniary gain.

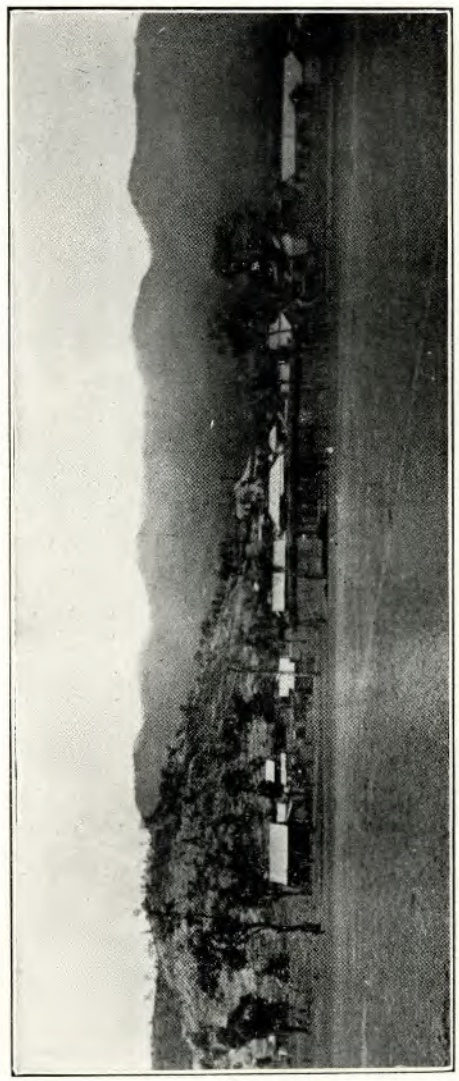

PHOTO. 2.—MOUNT CARBINE TOWNSHIP AND THE SOUTH-EASTERN END OF CARBINE HILL, WITH THE BURTON RIDGE IN THE BACKGROUND.

Early in 1906 the population of the town was 110 people. In 1907 there were employed 150 men in the vicinity; but in the following year the workers had dropped to 40 or 50 men, the

number increasing again in 1909 to 70. In 1910 the total population rose to 350, and culminated in 1911 with 500, for during 1912 it fell again to 400.

Literature.

There has been in the past a somewhat remarkable silence concerning this field, and even now the news filters through with inexplicable slowness.

The subjoined paragraph from Mr. Dunstan's progress report* for the year 1904 is the first official notice of Mount Carbine that I have been able to find. This is part of a résumé of the conclusion drawn from the field work of that year.

"Mount Carbine, a comparatively new and little-known field, is situated about 30 miles in a direct line north-west from the Mareeba Railway Station, but along the road is about 50 miles from Biboohra, *viâ* the Mount Molloy Copper Mines. The wolfram occurs in a large number of quartz lodes, and the prospecting work has indicated the permanence of both the lodes and their wolfram contents. The field is destined to become an important one in future."

Since Mr. Dunstan's visit Mr. Sydney Horsley, Inspector of Mines, has briefly reported on the field on several occasions,† and since July, 1909, the Warden stationed at Herberton has made passing mention in his monthly reports published in the "Queensland Government Mining Journal."

There was a paragraph in the "Australian Mining Standard" of the 29th March, 1911, on this field, and each issue of the Annual Report of the Department of Mines since 1904 has had a passing reference to the locality.

Acknowledgments.

I desire to here express my grateful appreciation of the courtesies extended to me at Mount Carbine by the Irvinebank Company. Mr. J. M. Reid, representing the General Manager, placed the office at my disposal, and his instructions to his officers to give all help required were loyally carried out. The local manager, Mr. F. C. West, besides conducting me over his own mines, spent a good deal of time in the field with me on geological and mine examinations.

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* See Annual Report of the Department of Mines for 1904, page 150.

† See "Queensland Government Mining Journal" for 1906, January, July, and October; and for 1907, March.

Mr. O. H. Woodward, the company's surveyor, kindly prepared tracings of his plan of the chief workings for my use, and I was also given the opportunity to make copies of others of the fine series prepared by him. In the office much assistance was ungrudingly given me by Mr. A. Burton, the accountant, who also acted as my guide on several occasions.

Mention of all others who proffered aid would not be practicable here, but acknowledgment will be made when possible in the body of the report.

GEOGRAPHY.

The want of a large scale topographic map of this district is a serious handicap in the elucidation of its geological structure; and at present we are restricted to the 4-mile sheet published by the Lands Department. This is seriously lacking in detail, and many of the features are incorrectly delineated, as is to be expected of unsurveyed country.

Location.

The wolfram workings cover and penetrate an isolated hill in the valley of the Mitchell River, which hill is now commonly known as Mount Carbine, even though the State 4-mile map so indicates one of the Heights of Victory, quite 8 miles to the east of the workings, and 14 miles west of Port Douglas. Some confusion might be avoided by calling the former Carbine Hill, as below.

PHOTO. 3.—MOUNT CARBINE FROM MOUNT ALTO, WITH INTERVENING DRY VALLEY AND BURTON RIDGE IN BACKGROUND.

Mount Carbine township has been surveyed between the southern flank of the hill and the right bank of Manganese Creek, a small tributary of the Mitchell.* The population of this centre

* Its exact position is, according to the 4-mile map: Lat. 16° 31½′ South and Long. 145° 8′ East.

is about 400, including children and a not inconsiderable floating element. There are three hotels, the usual stores, a school of arts, a church, a school-house, a court-house and a hospital, besides a number of private houses, huts, and tents.

Port Douglas, 16 miles distant in an air line from Mount Molloy, which is 24 miles by road from Mount Carbine, is the natural port for Mount Carbine, and in the early days of the field all supplies came thence *viâ* Mount Molloy, but, with the opening of the Biboohra-Mount Molloy Railway in 1908, Cairns became the distributing centre of the whole of the tableland. From Cairns to Biboohra by the State railway the distance is 41 miles, and from Biboohra to Mount Molloy by the Mount Molloy Company's private line is 20 miles, the total railage being thus 61 miles. The coach road from the terminus to the mines is but a narrow track, much cut up and exceedingly dusty at all times but the wet season, when it becomes correspondingly boggy. The two lines of coaches running back and forth three times a week easily cope with the passenger traffic; but goods are transported by teamsters.*

Physiography.

The valley of the Mitchell above its junction with the McLeod exhibits topographic forms of some complexity—features of juvenile aspect having been superimposed on others decidedly mature. The wide flat floor of the valley and the rounded forms of the hills point to age, but the precipitous faces of the range to the north, with their numerous waterfalls and hanging valleys, are youthful features, as is the absence of meanderings in the river itself. Near the head the valley is without relief, but lower down precipitous slopes are the rule, and the course of the river exhibits many puzzling features, the stream in several places having apparently left a wide flat-bottomed valley and cut its way through high ranges. The key to the situation lies in the geology of the valley, and when it was found that slates form the beds of the streams and that the higher hills and ranges are all granite, the assumption arose that the river is much older than the ranges among which it winds, and that these ranges

* The following are the transport costs and charges per ton of concentrate from Mount Carbine to Cairns :—

	£	*s.*	*d.*
Bags	0	12	6
Bagging	0	1	0
Loading (Mounts Carbine and Molloy)	0	2	0
Cartage (Mount Carbine to Molloy)	2	0	0
Railage (Molloy-Biboohra)	0	8	5
Railage (Biboohra-Cairns)	0	11	6
	£3	15	5

would have long disappeared by denudation had they been built wholly of slate, the surviving mountains owing their preservation to their superior resistance to the agencies of denudation.

The river rises in the sandy flats within a few miles of Mareeba, and for several miles flows northwards parallel to and within two miles of the much larger Barron River.* It then

PHOTO. 4.—MOUNT CARBINE FROM THE NORTH-EAST, WITH MOUNT ALTO IN THE MIDDLE-DISTANCE.

trends off to the north-west, flowing through country of low relief until old Northedge homestead is reached, when it passes among the denuded remnants of an old range (the Slaty) and is thrown slightly out of its course. After a few miles it resumes its even journey to the north-west, with high ranges within a mile or two to the right and left almost to its junction with the Mary River, where it makes another sudden bend to the west-north-west and cuts through still another range (Little Alto). Below this the river is confined by ranges on both sides, yet a little way to the north is a parallel flat-bottomed valley, the elevation of which is not much greater than that followed by the river. (See Photo 3.) The township of Mount Carbine is in this valley.

While I have not spent sufficient time in the field to decide the matter, and, though they are not so shown in the attached

* For notes on the past history of the Barron River, showing that the Upper Barron was probably once the head of the Mitchell, see "Notes on the physiography of North Queensland," by W. E. Poole. Australasian Association for the Advancement of Science, 1909, p. 316.

diagrams, I am inclined to regard the Heights of Victory between Mounts Fraser and Armit as block mountains, evidence of faulting in the ranges themselves being by no means wanting. At the same time the equilatitudinal eminences known as Mount Holmes, Baker's Blue Mountain, and Mount Elephant, might be cited as evidence of a former high-level peneplain; and there is a defined plateau between the valleys of the Mitchell and Hodgkinson

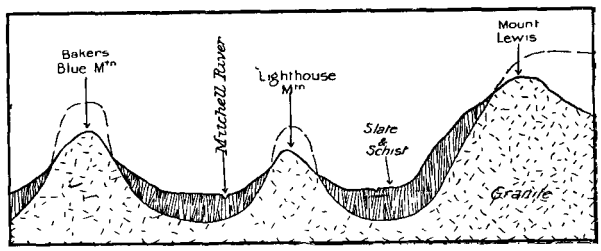

FIG. 2.—DIAGRAMMATIC SECTION ACROSS MITCHELL VALLEY, Between Carbine and Molloy.

Rivers at a slightly lower elevation. The Burton Ridge, to which further reference will have to be made, is a spur of the Heights of Victory overlooking the township of Mount Carbine and separating the valleys of the Mitchell and McLeod Rivers. This, in my opinion, is a slightly down-faulted fragment of the Heights of Victory block.

The isolated mountains are simply mountains of denudation, the slates of the valley having succumbed at a much faster rate than the granites of the hills. The cycle of denudation is just now at an interesting stage, most sections across the valley being of the form illustrated in the diagrams below. In these it will be seen that all the granite hills are lapped round by sedimentaries; and it is believed that a granite peak is still covered by the slates of Mount Holmes. (See Fig. 3.)

ELEVATIONS.

My aneroid measurements indicate the township of Mount Carbine to be a little over 1,000 ft. above sea level—*i.e.*, about 150 ft. below that of Mount Molloy or 200 ft. below Biboohra, the elevation of which is 1,260 ft. above sea level.

Carbine Hill rises 500 ft. above the township, being completely overlooked by the Burton Ridge, which rises to 2,700 ft. above sea level and is itself over-topped by Mount Spurgeon, of which the elevation is 3,500 ft. The summit of Mount Alto is 1,250 ft. above the township.

Water Supply.

During the short periods of flow, that is only immediately after heavy rain, the town supply is drawn from Manganese Creek. A more permanent source is in the sands and gravels of the old bed reached by shafts sunk on the flats near the banks. The company's well above the dam has not yet failed, but the town well below gives out towards the end of the dry season; and, prior to the sinking of the company's well, water had to be carted from the Mitchell River, a distance of four miles.

In order to conserve a supply for the mill the company built a dam across Manganese Creek, but this is rapidly silting up and was practically dry in November last, when the mill was depending on an adjacent well. The dam is of concrete, and a great expense was incurred on its construction, because, though rock crops at the western end, the foundations were 34 ft. deep at the eastern end; and a puddle wall had to be run out into the adjacent flat for a distance of over 4 chains, the average depth of clay and sand being nearly 35 ft.

The Mitchell River is fed by several perennially running streams, including Rifle Creek, Station Creek, and the Mary River, all rising in the coastal ranges; and the flow opposite Mount Carbine is probably over 10 million gallons per day. The cost of pumping water from here to the township would not be excessive, as the difference in elevation is only about 150 ft. Alternatively a supply might be brought in either from the Mary River or from the McLeod. The nearest point of the Mary is five miles from the mill, and the intervening country is not at all rugged, but to obtain a head it would be necessary to continue the pipe line some distance up this river.

The McLeod Falls are four miles north of Mount Carbine, but the line would have to be brought round the end of the Burton Ridge, and the total length of piping needed would be at least eight miles. The top of the falls is not far short of 1,000 ft. above the mill, and, as the stream carries probably 5,000,000 gallons per diem, there is more than sufficient for all requirements, including power production. This is a fascinating proposition, but the capital outlay required could not be justifiably incurred without greatly augmenting the reserves of ore in the mines.

The re-use of a part of the mill water has been rendered possible by the addition of the boiler ashes as a precipitant, but the quantity of wood ash is altogether inadequate for requirements, and at times the water returned to the mill is not so clear as could be desired.

Timber Resources.

The country in the vicinity of the township was never very thickly timbered, but recent demands for fuel are causing almost complete deforestation of parts, consequently the cutters are

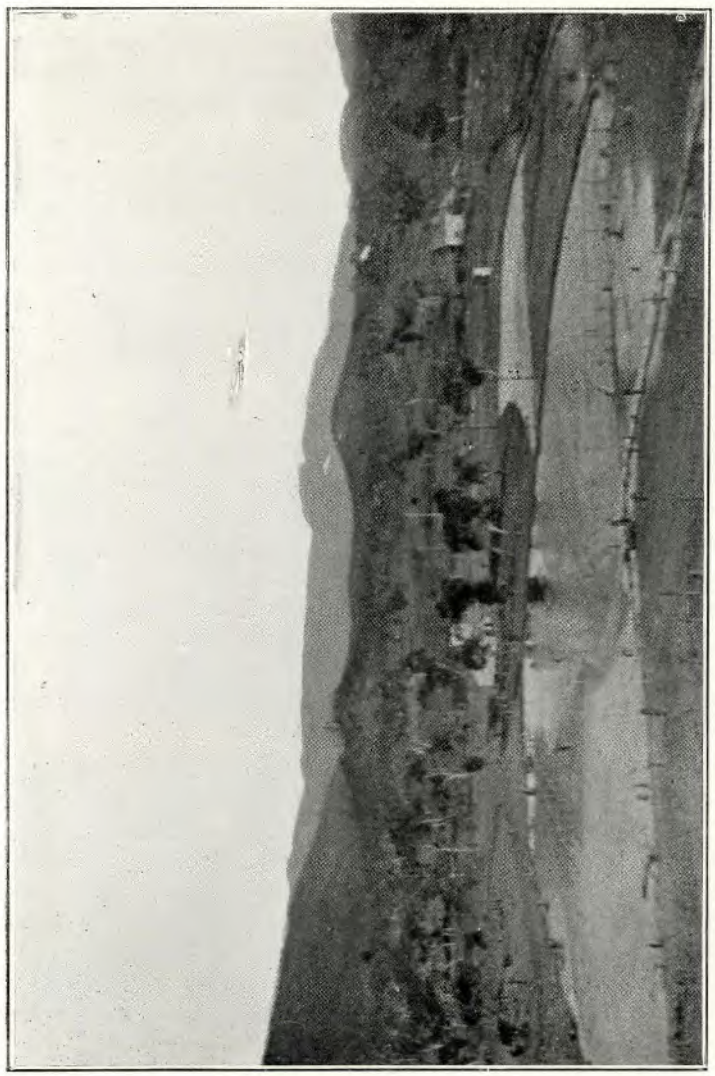

PHOTO. 5.—LOOKING SOUTH FROM THE MILL OVER THE TAILINGS DAM; MOUNT FRASER IN THE DISTANCE, CLOUD-CAPPED.

naturally increasing their distance from the mill, and thereby is caused an all-round increment in the cost of power production. Stunted varieties of box, sandalwood, and beefwood are the most common timber trees on the flats, but they give way on the

ridges to narrow-leaved ironbark and bloodwood. Tea-tree of small size is very abundant in the parts that during the wet season are converted into swamps, and pandanus grows in the beds of most of the creeks. On the sides of higher ranges cypress pine has gained a hold; above this belt casuarina appears, and above that again, on the edges of the highest plateau to the north-east of Mount Carbine (the Heights of Victory) messmate, scented gum, and blackbutt grow to large size, but in localities at present inaccessible to the timber-getter.

The Heights of Victory, owing to their elevation and proximity to the sea, are favoured with constant rains, and so are mostly covered with dense tropical vine scrubs or jungles. They at the same time seem to screen off and deflect the moisture-bearing sea breezes from the ranges across the Mitchell to the south of Mount Carbine, for most of these are completely bare of timber.

A few large river gums grow along the Mitchell River, but the timber trees do not flourish along it to the extent that might have been expected.

AREAL GEOLOGY.

The upper portion of the valley of the Mitchell River is a mineralogical province characterised by the occurrence of tungsten and tin-bearing pegmatites in altered sedimentary rocks near their contact with intrusive granite. The surface distribution of this latter rock is interesting, and when the areas have been mapped they are seen to lie in three nearly parallel lines, along which are strung numerous wolfram and tin workings.

Schist and slate are the enclosing rocks of the ore deposits at Mount Carbine, but the always present intrusive granite approaches within half a mile of the workings, and I anticipate that it will be met in sinking within a few hundred feet of the mill level. It remains to be seen whether the veins carry payable values below the sedimentaries. It is almost certain that the veins will continue some distance into the granite, and they should have been so delineated on the accompanying section. (Fig. 3.)

Slates.

The much altered sedimentary rock of Carbine Hill is fine-grained and from a little distance resembles massive slate, but close examination reveals a laminated schistose structure. The laminations are sometimes exceedingly regular and closely spaced, but at others so widely apart that it is then difficult to decide whether the rock should be designated slate or schist. Crumpling is rare and was noticed only in the vicinity of a few of the fissures. The laminæ are lustrous, owing to the separation of a dark secondary mineral of micaceous habit; and generally the development of the schistose structure has been accompanied by the production of abundant crops of the secondary mineral ottrelite, which, with the incipient augen-structure observable in many places, is evidence in itself of regional metamorphism. That the schistose structure was induced in the slates prior to the deposition of the vein minerals is proved by impressions of the laminæ showing on the sides of the veins, the best case to hand being that of the Ruby United.

Towards the northern end of the field a thin-bedded structure predominates, though even there the schistosity is not altogether absent from certain beds, until in the vicinity of Holmes Creek, where, as for example at the Redcap, the slates become epidotic and massive.

The planes of stratification and schistosity do not, as far as known, differ, their dip approaching the vertical wherever observed and their strike varying seldom more than 20° east and west of north on Carbine Hill.

The Mount Carbine ore deposits do not follow the lines of bedding or schistosity, as might have been expected, but cut obliquely across them. The country in the vicinity of the ore-bodies is, as a rule, quite unaltered, except in a few places of more intense folding, where thin seams of granular quartz may be noticed along the laminations—as in the inner end of the mill adit.

There are nevertheless several zones or areas near Mount Carbine where silicification has been intense, the slate having been changed into a horny or cherty rock, but these are either outside the ore-bearing country (to the south-east or north-west) or else in the poorest parts (to the north-east). The silicification must have been brought about by the agency of capillarity, the silica having been derived from the cooled intrusive emanations. It is therefore likely that wolfram-bearing veins will be found beneath these silicified areas, and the occurrence of manganese ores at Sundets gossan blow lends some support to the theory. The siliceous nature of the schists in the inner end of the mill adit is to be ascribed to this agency rather than to direct impregnation during ore deposition.

Felsite Dykes.

A porphyritic felsite dyke, sometimes showing fluxion structure, extends across the hill from south to north for a distance of a little over a quarter of a mile. The trend is slightly sinuous, so that it cannot be said to follow the bedding of the country, though in places it does not depart far from it. The average thickness is 20 ft. with few constrictions, and it tapers out abruptly at either end. Mr. Hetherington informs me that the Ruby United reefs have been heaved several feet by the dyke—an interesting point that I could not verify because of caving of the workings.

Some five chains beyond the northern end of this dyke there is another outcrop of the same rock, and this extends away to the northwards with great variations in width—in one place it is two chains wide and nearby only six feet. The fluidal structure is so perfect in parts that a perfect fissility has resulted in the rock.

A third dyke of a felsitic rock forms a small peak near the granite contact about a mile to the north-east of Mount Carbine.

These dykes do not seem to have any important bearing on the origin of the wolfram deposits and most likely are younger.

Intrusive Granite.

While examining the wolfram mines a number of hitherto unmapped areas of intrusive granite were observed. There is a possibility of all those in the Walsh and Tinaroo district being of the same age, but for the present it will be advisable to confine the discussion to those of the Mitchell Valley, wherein

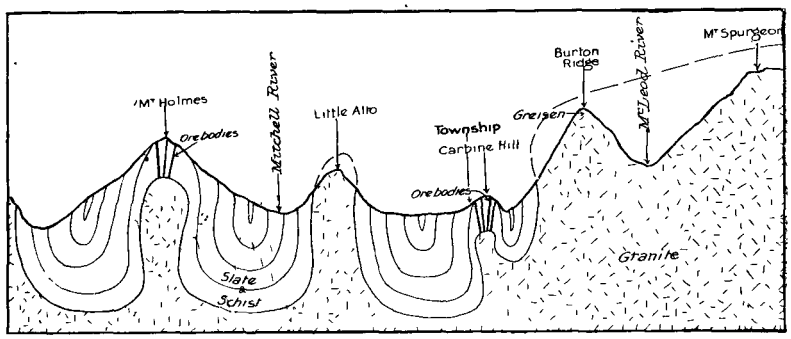

FIG. 3.—DIAGRAMMATIC SECTION THROUGH CARBINE HILL AND ACROSS THE MITCHELL VALLEY.

there are three distinct but parallel lines of outcrops; one along its north-eastern divide, another along the south-western divide, and a third extending along the centre of the valley. The granite in each case stands high above the slates, because of its superior resistance to the weather; but in all cases the foothills are slates as shown in the accompanying sections. This is probably an effect of contact metamorphism, the slightly indurated rock being more resistant than the unaltered slate distant from the contact.

A study of the grouping of the granite outcrops leads to the conclusion that a number of parallel batholiths have been partly exposed, and further that these occupy anticlinal loci in a series of great earthfolds produced by forces acting from north-east and south-west. For the present we are concerned with those of the Mitchell Valley only, but it may here be mentioned that there is evidence of a continuation of the folding far out to the west (to Chillagoe at least). The north-eastern *massif* is well exposed, and all the peaks on the central show, but some of those on the south-western line have not yet been uncovered.

As to the nature of the rock itself, it is a tenary quartz-orthoclase-biotite-granite, of medium texture (varying slightly from place to place) and in many parts exhibiting a well-defined

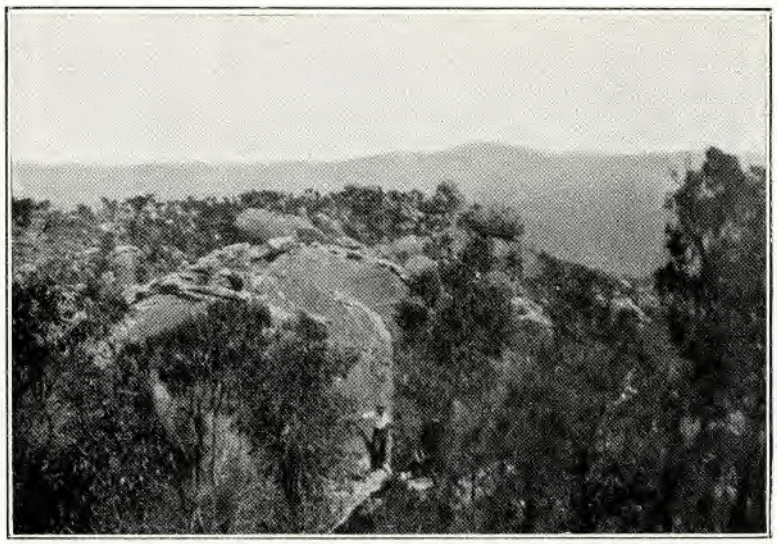

PHOTO 6.—CHARACTERISTIC WEATHERING OF GRANITE, SUMMIT OF MOUNT ALTO.

porphyritic structure. The strong joints by their control of the direction of weathering have resulted in most of the granite areas being strewn with boulders, the undecomposed kernels from between the joint planes.

NORTHERN AREA.

The greatest of the *massifs* is that first mentioned, extending as it does from near Mount Molloy on the south to Mount Windsor on the north, and including Mounts Fraser, Lewis, Spurgeon, and Armit. It stands out as a bold range, rising quite abruptly to an average height of 2,500 ft. above the valley floor. The contact of the granite and slate usually runs along the foothills, and only in a few places does the granite extend out on to the floor of the valley.

A little muscovite-bearing granite caps the Burton Ridge (on the track to Mount Spurgeon and at the Vera Tin Mine) indicating the former existence of a sedimentary cover nearby, but otherwise true greisen has not been formed on the contact of the intrusive and the older sedimentaries. The vicinity of the contact has nevertheless been a favourable locus for the accumula-

tion of tungsten and tin ores. In the fringing sediments wolfram deposits have been opened in the vicinity of Mount Molloy, Pom Pom, Station Creek, Mount Carbine, and Cumble Cumble. In the granite the same ores have been worked at several places, to

PHOTO. 7.—MOUNT ALTO FROM THE GEMS UNITED. THE UPPER HALF OF THE MOUNTAIN IS GRANITE, THE LOWER SLATE.

mention only Mounts Fraser, Lewis, Spurgeon, and Armit, along the summit of the main range; at the Vera on the Burton Ridge; and at Pianto's on Manganese Creek to the north-east of Carbine Hill.

Biotite granite is exposed on the surface within half a mile to the east of the main workings on Carbine Hill, but whether this is an inlier or simply the extremity of a tongue coming down from the Burton Ridge has not yet been determined because of the soil mantle along Manganese Creek and its tributaries. More than a dozen reefs from 1 to 6 ft. in thickness crop out on the surface, most of them consisting of barren quartz, though a little felspar was noticed in one and traces of wolfram and tinstone also are showing.

A quarter of a mile to the north of Pianto's biotite granite again crops, and here also numerous parallel quartz reefs and leaders appear at the surface, some of them carrying traces of wolfram and tinstone. This area is definitely connected on the surface with the great *massif* to the north-east.

SOUTH-WESTERN AREA.

On the south-western line there are only three crops—the South-edge tableland, Baker's Blue Mountain, and Mount Elephant; but there is reason to believe that granite lies at no great depth beneath Mount Holmes, which is on this line and is similar to Mount Carbine in geological features.* Wolfram has been worked near Northcote (on the western side of the tableland), at Mount Holmes and at Mount Elephant, but no discovery has yet been reported from Baker's Blue Mountain.

CENTRAL AREA.

The central line 3 or 4 miles south-west of the Coast Range has six distinct crops, on four of which wolfram and tin have been found—viz., Slaty Range, Lighthouse Mountain, Little Alto, and Mount Alto. Slightly greisenised slate has been exposed in the tin workings along the irregular contact on the northern end of Mount Alto.

* See "Queensland Government Mining Journal," November, 1912 p. 541.

ORE DEPOSITS.

The ore deposits, being tabular in form, are almost the sole representatives of their kind in Queensland. At Torrington,* in New South Wales, pegmatite carries wolfram, but the conditions there are not in any way analogous to those of Mount Carbine.

Nature and Genesis.

The veins are bunched into overlapping and slightly radiating zones, of which at least twelve can be distinguished. Each zone includes fissures, which, while preserving on the whole a rude parallelism, frequently branch and in places converge

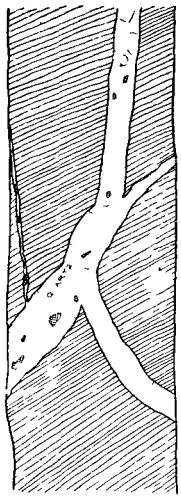

FIG. 4.

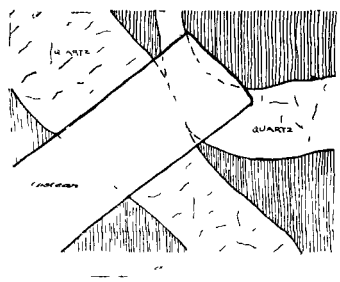

FIG. 5.

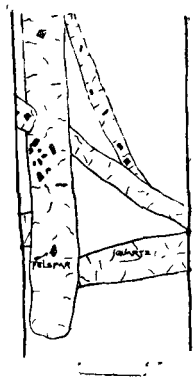

FIG. 6.

FIG. 4.—DETAILS OF BRANCHING VEIN, NO. 2 DRIVE, MILL ADIT, JOHNSON LEASE. FULL WIDTH OF DRIVE.

FIG. 5.—JUNCTION OF TWO VEINS, NIL DESPERANDUM. SURFACE.

FIG. 6.—NATURE OF INTERSECTIONS, 221 N.W. DRIVE, NO. 3 ADIT, MOUNT CARBINE NO. 1. FULL WIDTH OF DRIVE.

sufficiently for anastamosis. The plans of the workings consequently show a network of interlaced parallel veins, as the ore-bodies seldom extend far without branching. Petering out is a constant characteristic of the ore-bodies; but, as an overlapping vein is almost always to be found within a few feet of

* See " Geological Survey of N.S.W. Mineral Resources " No. 15. By J. E. Carne.

the first, a drive may be carried along such a system for hundreds of feet with but few slight variations from the straight line.

They are plainly composite fissure veins or dykes formed in intrusive emanation zones, by which it is meant that the ore-bearing solutions after expulsion from a solidifying granite magma (of which they were residual products) forcibly intruded the overlying rock under disruptive pressure,* and were later precipitated along the fissures resulting therein. The cognate veins in the granite to the north-east of Carbine Hill lie parallel with those of Mount Carbine; but it is noticeable that they do not continue into the overlying slates, which, however, are highly

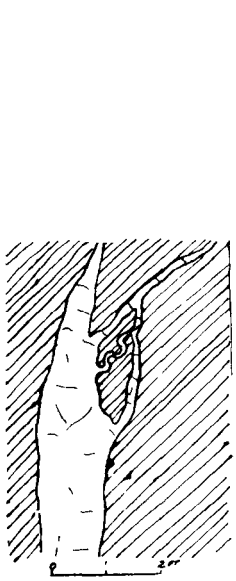

FIG. 7.

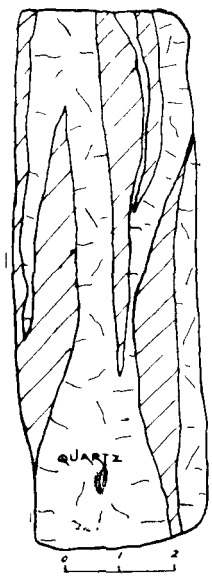

FIG. 8.

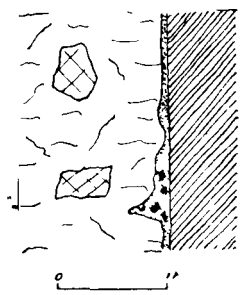

FIG. 9.

FIG. 7.—FRAYING OUT OF VEIN, No. 6 S.E. DRIVE, MOUNT CARBINE No. 1.

FIG. 8.—SPLITTING UP OF VEIN; FACE, No. 2 ADIT, JOHNSON LEASE.

FIG. 9.—MICACEOUS SELVAGE BETWEEN VEIN AND WALL, No. 1 ADIT, MOUNT CARBINE, No. 1.

silicified. The intrusive emanations were presumably here deficient in disruptive power owing to rapid cooling; and the silicification of the overlying slate is to be ascribed to subsequent capillary action.

It is noticeable that where the slate and schist have been much fissured, as is the rule on Carbine Hill, the bedding or

* The Laws of Igneous Emanation Pressure. By Blamey Stevens. Trans. Am. Inst. of Mining Engineers. Bull. No. 64, page 411.

joint planes have never been followed by the solutions. Where, however, as in Scheelite Gully, the fissuring has been imperfect, the veins are located mostly along joint planes, and some spurs also run off between the laminations of the country to which they are tightly "frozen." In general there has been no replacement of country rock, and the pegmatites are everywhere

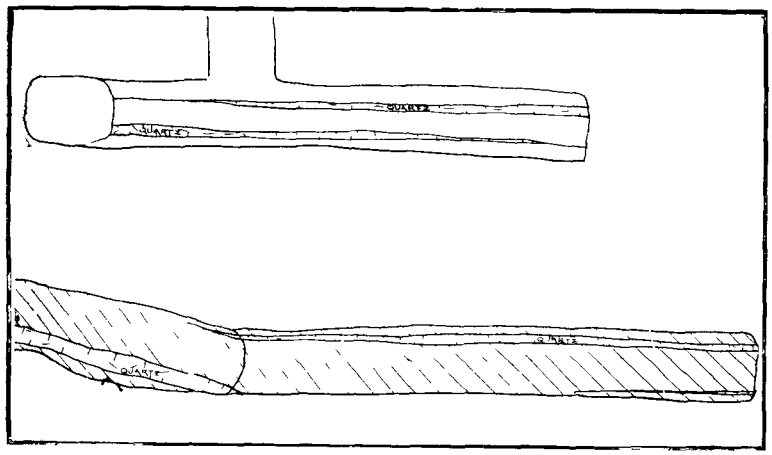

FIG. 10.—OVERLAPPING VEINS IN ADITS ON DAISY UNITED.
(Scale 11 ft. to an inch.)

sharply divided from the walls. Such small quartz leaders as those mentioned above, which have become attached to the walls (owing to replacement of the adjacent rock by silica) are comparatively rare.

The walls have a most distinctive undulatory contour, where not broken by joints and faults. In the D.C.L. stope there are frequent sharp juttings out as though step faulting had occurred, while yet the general surface is a rounded or swelling one.

The fissures are mostly clean, and the lode material free from inclusions, but exceptions to the rule were noticed in several places, particularly in the end of the mill adit and in the overlying 180 E. drive from the No. 3 adit, and also in No. 1 adit and in Cassel's upper working on the Johnson.

Apparent faulting is not at all uncommon (see the Iolanthe, Ruby United, Johnson, &c.), but the heave is never great, and most of the faults or joints are older than the reefs. In one or two cases the proof is demonstrated by the vein following the crosscourse (see the Jubilee); and in still others some veins cut

off on cross-heads while neighbouring ones pass through without injury (see Johnson mill adit). It is believed by some of the claimholders that breaks are more frequently met towards the surface than in the deeper ground.

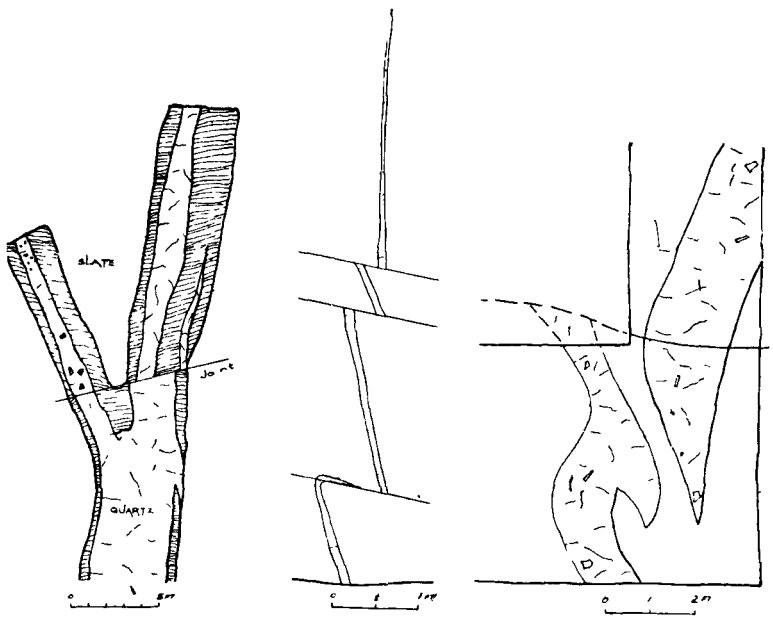

FIG. 11. FIG. 12. FIG. 13.

FIG. 11.—DETAILS OF FAULTING, BRANCHING, AND PINCHING, No. 2 N.W DRIVE, MILL ADIT. FULL WIDTH OF DRIVES.

FIG. 12.—STEP FAULTING, LAST CALL.

FIG. 13.—OVERLAP AND FAULT, SHAFT ON ADIT, NIL DESPERANDUM.

Extent.

The ore-bearing slate country has a length of 1½ miles from south to north and a maximum width of ¼ mile. The veins, however, trend north-west and south-east, or thereabouts, in a parallel direction to the escarpments of the Heights of Victory.

The veins vary in size from mere threads up to bodies 6 ft. wide, but those now being worked are mostly less than 2 ft. thick. They are best developed both as to number, size, and richness in the south-eastern part of the hill between the mill and the felsite dyke. As they near the mill they rapidly thin out into leaderlets (which still carry wolfram); and beyond the dyke they are much less numerous and poorer than on the near side.

Floater Ground.

The " floater " ground is one of the puzzles of Mount Carbine. It is a surface accumulation of quartz fragments derived from the lode crops, but the curious feature is that it does not follow the crops nor yet the gully beds, instead running out in two main streams from opposite sides of the hill, one down and across Bock's Gully and the other down Petersen's Clayey Gully. The fragments are quite angular and without any binding except a little dusty earth, and the only explanation that at all fits the case is that they have been produced by landslips in the distant past. The stripping is sometimes 10 ft. deep, but more commonly bedrock is met within 2 to 5 ft. of the surface.

ORE.

For convenience of discussion the minerals of the ore-bodies will be separately classified as: gangue, here the valueless part; associated metallic minerals, or more properly speaking those being or likely to be worked for their metallic contents; and the tungstates.

The gangue is extremely variable in composition. Some veins are wholly of quartz, and in some parts of others felspar forms the greater part of the ore, but, generally speaking, the vein material is a quartz-felspar rock, in which the amount of quartz is many times greater than that of the felspar.

Wolfram is now the only product, except a little scheelite, for the traces of molybdenite and tinstone found at one or two spots have not been saved.

Gangue.

Quartz is the chief gangue mineral. It is massive crystalline, but distinct crystals are never seen in the main veins. The sole place in which crystals of quartz, drusy in cavities, were observed was on Macdonald's claim in the north-western part of the field, but other conditions are abnormal there also, and it certainly is the case in the producing mines that the mineral is never crystallised. It breaks, as a rule, with extremely sharp edges, which are a constant source of danger to the miner, whose hands are frequently lacerated. The strongly fetid odour emitted by fresh fractures might lead one to expect blood poisoning, but I am assured that, on the contrary, the healing is very rapid. A bluish slightly opalescent variety of quartz is found in a few of the veins, but though it has been known to carry wolfram it is not regarded with favour by the miner.

Scattered through the quartz are allotriomorphic masses of orthoclase (*felspar*) of all shapes and sizes and in all degrees of abundance. Some parts of the veins are chiefly composed of felspar, but frequently it is quite absent; and from end to end it will probably not exceed 10 per cent., while it may be as low as 5 per cent. of the whole gangue. The felspar and quartz are often banded parallel to the walls, and frequently the felspar is concentrated near the central plane of the veins, but more often there is a complete lack of any definite structural arrangement.

Muscovite (*mica*) is present in the body of the quartz in very few of the veins. The most conspicuous case is that of the Bobby Dazzler (in the northern corner of the Johnson lease); and another is that of the tributer's vein on the Little Nell; but the most noteworthy occurrence is that on the main Johnson vein at the face of the south-eastern drive off No. 2 adit. There the gangue consists of quartz with undecomposed felspar and enough muscovite to give it the aspect of greisen. It may here be of the same generation as the pegmatite; but in various other parts of the field a little feathery muscovite may be seen coating the walls of veins (*e.g.* in the Nil Desperandum adit), and in these it is to be regarded as a decomposition product of the felspar, for it is usually accompanied by kaolin, and occurs only high in the zone of oxidation. Along a vein near the inner end of No. 1 adit on the Mount Carbine No. 1, which vein is of quartz with some felspar towards the walls, there is an irregular lining of kaolin and mica up to ½ in. thick, and this carries a little wolfram. Generally also the miners look upon mica-coated walls as a promising indication of the proximity of wolfram-bearing ore. In the upper level of White's workings on the R.S.B., a new vein rich in wolfram was found by driving from an old stope along a mica seam in the country rock.

Tourmaline is not visible in the veins nor in the country, but each week 6 or 7 bags of a very fine brownish acicular crystalline material is obtained as "seconds" on the Luhrig vanners in the mill, and this was first shown by the company's chemists to be tourmaline.

Greenish-grey crystals of *beryl,* associated with flaky laths of wolfram, micaceous kaolinsed felspar and a little chalcopyrite, were found by Mr. West in the molybdenite leader in rising from the mill adit to the No. 3 adit level. Hand specimens containing the minerals were shown me.

Associated Metallic Minerals.*

In the surface portions of the veins the miners always look upon quartz with reddish stains on cracks as favourable gangue for wolfram. These stains have been formed by the oxidation of *pyrite,* which in the deeper ground occurs as extremely thin seams in the quartz associated with wolfram. The actual amount of the mineral is minute, but its manner of occurrence renders it noticeable. Very slight stains of copper carbonate are seen in the

* Mr. Dunstan, who visited the field in 1904, recorded for the Mineral Index, then in course of preparation, that wolfram at Mount Carbine is associated with molybdenite, scheelite, cassiterite, limonite, chrysocolla, etc.

upper levels in places (especially in the D.C.L. and R.S.B. workings on the Bluff vein); and the primary *chalcopyrite,* also in very slight traces, has been detected below (at the Edith and in No. 2 north drive from the mill adit on the Johnson).

Tinstone is showing in quantity in the felspar of pegmatite in one of the cuts on the old Joseph lease, which is a tungsten-bearing area. The mineral accompanies wolfram also in Pianto's workings in the granite to the north-east of Mount Carbine. Tinstone is being recovered from greisen, pegmatite, and quartz at the Vera, which is on the Burton Ridge at the head of Holmes Creek a few miles north of Mount Carbine, but the ore has hitherto been free from wolfram, the place of which is taken by a little arsenopyrite. Alluvial wolfram has, however, been recovered from gullies adjacent to the Vera.

A little *molybdenite* was obtained by Mr. West from the small vein in the rise from the mill adit to No. 1 adit level, but it did not extend beyond the walls of the opening, and I was unable to see it in situ. Subsequently Mr. West detected further traces in the face of the 180-ft. drive, not far from the rise. Traces of the mineral were observed by me in the concentrate from the Edith; it has been noticed at the Triangle; and one very small patch has been located on the Vera tin claim, surrounded by quartz in granite.

Tungstates.

Under this heading are included two tungstates (that of iron and manganese and that of lime), with the ochre, which probably contains hydrated iron tungstate.

WOLFRAMITE.

The wolfram itself, like the felspar, exhibits no regular crystal habit; although in some places radiating elongated laths have been observed, stumpy shapes are the rule. On the Iolanthe and D.C.L. the wolfram is found in divergent blady crystalline forms; but on the Daisy United line it is more frequently acicular, and much of it is concentrated near the walls, from which the crystals tend to project at right angles, this being also a characteristic feature of the ore on the Felsite Knob. Elsewhere there is no distinctive segregation of the wolfram.

It occurs both in the quartz (particularly where iron-stained) and in the felspar, a slight preference being shown for the latter mineral as a host; and the miner, when he strikes a part of the vein rich in felspar, knows that an improvement in the grade

of his ore should follow. A small fragment of ore, shown me at the Little Nell, consisted apparently of small crystals of wolfram in kaolinised felspar, the effect being much that of a breccia. It is known as speckled ore. The very rich ore in the 209 ft. south drive off the No. 3 adit in the Mount Carbine No. 1 lease also had a felspar gangue.

The largest block of wolfram yet uncovered came from the Bobby Dazzler surface workings, where the vein is rich in felspar and contains also much mica. This weighed 6 tons. One 2-ton block was got in the 180-ft. south-east drive from the No. 3 adit on the Mount Carbine No. 1.

It is noteworthy that no wolfram has ever been found in the country rock at Mount Carbine.

The amount of wolfram present in the company's ore, as determined by the weekly runs of the mill during the past 18 months, averages 1¾ per cent.; but a casual inspection of the mine would give no impression of such a content.* Wolfram can seldom be seen in the faces left standing, there having been always a tendency to push ahead as long as metal was showing. The always more or less bunchy occurrence of the ore accounts to some extent also for the poor showing at times, and it is only by keeping a number of faces advancing with the object of sooner or later breaking into all such bunches that the average can be maintained. That the surface stone must have been somewhat richer is proved by the fact that the tails from the sluicing done prior to the erection of the battery contained 1·1 per cent. wolfram as fed into the Huntington mill for re-treatment.

The "gougers" gauge of specific gravity is the 1-lb. tea tin, which is 4¼ in. cube, and the greater the weight of a tin full the higher grade the wolfram is considered, 14 lb. being the maximum. Some of the Carbine wolfram (Iolanthe) is said to weigh only 10 lb. to the tin, but the Little Nell runs 12 lb. It has been also been noticed that the coarser the grain of the concentrate the higher the specific gravity, there being a difference of ½ to 1 lb. per tin in favour of the grains ½ in. in diameter as against fines. Further, Mr. West assures me that the wolfram from the deeper ground is certainly of greater specific gravity than that from the surface. These facts are probably to be accounted for by the perfect cleavage of the mineral resulting in open partings during weathering or crushing.

* That poorer ground than usual was being worked during my inspection was shown by the weekly yield falling to 4 tons (1·37%?), the usual being about 5 tons. Very exceptionally 9 tons (2·85%) had been bagged. Three rich patches were struck simultaneously just before my departure.

Analysis.—For the following analysis of "typical Mount Carbine wolfram concentrate," made by Mr. Alex. Cumming at the Irvinebank Company's assay office, I am indebted to Captain J. M. Reid. From the analysis the composition has been computed of the theoretical pure iron manganese tungstate,† the chemical formula of which should be written (3FeO. MnO) WO_3 the mineral being therefore wolframite nearer ferberite ($FeWO_4$) than hübnerite ($MnWO_4$):—

Insoluble SiO_2, etc.	4·0		
Tungstic acid	71·2	= 74·8	Pure.
Copper	0·2		
Bismuth	0·1		
FeO	18·0	= 18·9	
MnO	6·0	= 6·3	
Undetermined	0·5		
	100·0		

The company's assay books show that during 1911 (when the average was 71·4 per cent.), the company's concentrate sometimes contained as low as 69 per cent. WO_3, but during 1912 the percentage was never below 70, and in some parcels it reached 73·5, the average being 71·6. The hand-treated ore purchased from outsiders, on the other hand, has fallen as low as 65 per cent., but more usually varies between 69 and 72 per cent.

SCHEELITE.

Scheelite was a constant associate of the wolfram obtained from the gullies along the eastern side of the hill, one of which gullies is named after the mineral. Small quantities of the ore are still won by fossickers working intermittently in this gully. One parcel of 4/20 ton was got from the Wayback early in 1911; and the Little Nell and Edith concentrates contain a small but noticeable percentage. A sample of scheelite from Mount Carbine was assayed for Mr. Dunstan in 1905 as below:—

CaO	=	18·8 %
WO_3	=	77·5 %

Recasting this to pure calcium tungstate we get—

CaO	=	19·5 %
WO_3	=	80·5 %

which agrees approximately with the formula $CaWO_4$.

My opportunities for observing the occurrence of the mineral were very few, and no direct evidence was obtained as to whether

† Dana states that in wolframite the rates of Fe : Mn = chiefly 4 : 1 and 2 : 3 but varying from 9 : 1 to 2 : 1, with hubnerite nearly pure $MnWO_4$ and ferberite $FeWO_4$.

it is an original constituent of the veins. As, however, it occurs chiefly crystallised, and as it does not persist in depth, the probabilities are in favour of its being a secondary mineral produced in calcite-bearing country consequent on the decomposition of wolframite.

TUNGSTITE.

The wolfram now being obtained near the surface on the Iolanthe, X-Rays and R.S.B. (that is, in the Iolanthe and Bluff zones) is much stained by tungstic ochre or tungstite, but there is no evidence of large quantities of that mineral having been produced in this locality.

It is most probable that the ochre includes the lately recorded* new mineral ferritungstite (a hydrous iron tungstate) but it has yet to be examined.

* Mineralogical Notes by W. T. Schaler, U.S.G.S. Bull. No. 509, p. 83.

MINING.

The Mount Carbine workings, in comparison with those at Wolfram Camp, cover an insignificant area; and, the wolfram being evenly distributed, the returns were never on the fortune-making scale of the latter place, where many very rich finds were made. Perhaps it is for this reason that the Irvinebank Company has been able to secure a firm footing and to attack the problem of winning the ore in a systematic manner, with the result that the weekly output is now comparable with that of the much older and more extensive field.

The Cairns hinterland is in a chronic state of labour shortage and unrest, and the comparative inaccessibility of Mount Carbine (it being off the railway and naturally in a cul-de-sac) places the employer at a serious disadvantage in securing the necessary complement of men as against more fortunately located mines.

There seems to be no complaint as to working conditions here, beyond that of the slight discomfort caused by the comminution of the ore when broken down; and little trouble is experienced with the older men, whose habitations are beginning to show some signs of permanency. That the younger men, however, find a want of attraction in the township itself is not altogether to be wondered at, and the number of changes in the pay roll each month is an expression of their dissatisfaction with living conditions. Before any great and permanent expansion of the mining industry can take place the management will probably have to look into the question of the housing and general welfare of the employee.

Surfacing.

The earliest mining consisted simply in collecting shoads—a means of gaining a livelihood not yet totally discarded. As showing the ease with which cheques were made in the early days, Mr. West told me how, when he took charge, he set a boy to collect "specimens" (*i.e.*, fragments of quartz showing wolfram), and the stone collected during the first month alone yielded ¾ ton wolfram (about £60 worth). This, it must be remembered, was after scores of men had worked over the ground.

The floater ground is usually tested by taking out a small "paddock" a few yards wide and perhaps half a chain long. The ground is loose enough to be broken down by the pick, but

it is further disintegrated by means of explosives in boreholes put down ahead of the paddock. As the face advances, the larger lumps of more barren-looking stone are built up into a wall 3 or 4 ft. back from the face, and behind it the smaller material (including the fines that carry very little wolfram) is thrown after any " specimen " stone has been set aside for future treatment by bucking board or dolly and jig.

The richest of the ground has long been worked out, but there are still a few men working between Bock's Gully and the township. The stripping is mostly less than 5 ft., but Johnson has a face 10 ft. high, and this he estimates to carry 1 per cent. wolfram.

A not inconsiderable part of the production until recently came from the old mullock tips, which in the case of the richer ground have been turned over and over several times by

PHOTO. 8.—FLOATER GROUND, BOCK'S GULLY.

successive parties. The practice seems to be regarded with some contempt; so it is now seldom resorted to except in case of extreme need, and a new term, " lousing," has been coined for the proceeding. At Mount Carbine all the tips contain a little wolfram; many of them may be confidently expected to yield a minimum of ½ per cent. wolfram; and they will all surely sooner or later be passed through the mill. A great part of the Mount Carbine No. 1 open-cut dumps have already been treated, and

preparations are now being made to put through the No. 1 adit dump, a rise having been put up from No. 3 adit to serve as a pass.

Mining Methods of Prospectors.

The mining methods of the first prospectors were primitive in the extreme, the favourite procedure being to attack the crops on the hillsides as though intending to run a tramway cutting across the hill. By this means hauling was obviated, all waste being run out to the dump on wheelbarrows. Some of the cuts are 20 and 30 ft. deep, but the trenches or cuts are seldom more than 6 ft. wide, most of them being only half that width, for wherever possible the veins were followed and worked out separately even when only a few feet apart. Subsequently shallow shafts were sunk on a few of the claims, and a little stoping was carried out. At the northern end of the field, where the hillside slopes very steeply, a preference was shown for short adits, of which there are several placed both along the reefs and across country.

Development by the Company.

Th Irvinebank Company, after securing the ground, began to open up the reefs in the south-eastern part by means of adits, of which there are six. Nos. 1 and 3 were put in from the south-western side of the hill to intersect the rich zone on M.L. 2,225 (Mount Carbine No. 1). No. 2, on the eastern side of the hill, proves the zones on the Johnson. Cassell's and Hartley's adits are on the same side, but at slightly less elevation. The mill adit runs from the Combination across the Johnson and beyond into the Mount Carbine No. 1, to a point below the end of one of the southern drives from the No. 3 adit, with which it is connected by a rise. The mill adit is also connected by crosscut. and drive (No. 2) with a winze from Hartley's adit; and it is proposed to continue this drive north-westwards for several hundred feet, in order to make a connection with the No. 2 adit and at the same time open up the Johnson ore-bearing zone.

No. 1 adit is only 40 ft. below the crop of the zone, but No. 3 is 50 ft. beneath No. 1 and the mill adit 30 ft. lower still. No. 2 adit is 120 ft. above the mill adit, Cassell's being 10 ft. and Hartley's 40 ft. below No. 2. The mill adit in the deepest part is 200 ft. below the surface, but beyond the Johnson the hill rises still 200 ft. higher.

No sinking has been done below the mill adit with the exception of a winze from the 189 south-east drive off the No. 2 adit. This is 102 ft. deep, and therefore reaches 70 ft. below

the mill adit. The pressing need for further sinking, driving, and crosscutting is fully realised by the management, but the present is a time of drastic retrenchment with the company, and all expenditure not required for the actual mining of ore already blocked out has been forbidden.

RESERVES.

The calculation of ore reserves in deposits of this kind can be no better than approximations, even when the ground is well blocked out; but rough estimations of the amount of "probable ore" may legitimately be made, where a certain amount of work has been done. Thus, on the Mount Carbine No. 1 and Johnson leases, Nos. 1 and 2 adits afford a nearly complete section through the most productive part of the hill, and Hartley's and the mill adits give a parallel section on the same line 400 ft. away. For the computation it is necessary to know the thickness of the veins intersected, and this is found from the plans to be as below:—

	Total thickness.	Over 18 in.
Section at No. 1 and No. 2 adits ..	44 ft.	15 ft.
Section at Hartley's and mill adits ..	23 ,,	12 ,,
Mean	33½ ,,	13½ ,,

The average height of the surface above the mill contour may be taken as 100 ft., this being the extent of the "backs."

Hence we have the total quantity of ore 124,074 tons, but ore in veins over 18 in. thick totals only 50,000 tons. Of this nearly 25,000 tons of 1¾ per cent. stone has been crushed, leaving 25,000 tons reserve, which is sufficient to keep the 10 head battery running for eighteen months. During the last two years the stone crushed has been strikingly uniform in grade, the average wolfram content being 1½ per cent. for each year. Over shorter periods the percentage yield has not departed greatly from the same figure; and there is consequently no reason to anticipate any sudden fall in the grade of the ore yet to be won.

This is distinctly not "ore in sight" as it has not been completely blocked out, to do which would be impracticable; but as all factors have been taken into consideration it may be looked upon as "highly probable."*

The surface workings prove the rich ore to extend far beyond

* The official estimate of reserves of ore above the mill level was given me in October last by Mr. J. M. Reid as 50,000 tons of 2% ore, but it was not stated what extent of the ground held was included in this estimate.

the limits imposed by these sections, and there is little doubt that ordinary developmental work will at least treble the reserves above the mill level in the two leases mentioned above.

It is also noteworthy that there is a distinct increase in the totals " over 18 in." in the lower workings—*i.e.*, No. 3 and the mill adit; but, beyond that the 103-ft. winze below the No. 3 adit level was in good ore to the bottom, we are in darkness as to the value of the deeper ground.

Exploitation by the Company.

The system initiated by Mr. West consists in driving along each and every ore-body averaging more than 20 in. in width. Smaller veins are often followed in developing the mine, but unless they are rich the work is not directly remunerative, and even if of higher grade than usual, a vein 6 in. thick cannot be stoped at a profit. Where two or more of the veins approach within a foot or two of one another they may be taken down in one face, and it so happens that it often pays to include comparatively small leaders under those circumstances. Otherwise the walls are seldom broken into except along the roads; and, as the country stands well, remarkably little timber is needed for supports.

A leading stope is carried close behind the face of the drive, and from it the vein is stoped up to the surface. The rill system, by which the ore from the overhead stopes gravitates to the shoots, is in use throughout the mine, so obviating all need for shovelling, and this is one of the chief factors in the successful reduction of mining costs here. Caving of the honeycombed ground is now being provided against by filling the depleted stopes with material sent down passes from the surface.

All drilling is done by hand, a state of affairs persisted in partly because of the extreme narrowness of most of the stopes, but chiefly because the nature of the ore (friable quartz and felspar) renders the drilling comparatively easy, 11 ft. per shift being attainable by some miners, though 6 ft. is the average aimed at. The amount of ore broken down per day by each man is found to be between 1½ to 1¾ tons (the total number of miners being 30, and the weekly output from 260 to 315 tons of ore).

The broken ore is trucked along the drives to a storage hopper between No. 3 and the mill adits, and thence it is drawn as required for the supply of the battery.

The substitution of a well-thought-out system of open-cutting for that of stoping is now being considered in order that the ore of veins smaller than 20 in. in thickness—most of which is now lost—may be recovered, so greatly increasing the yield from each given block of ground. Mr. West is confident that at the same time the cost of winning the ore will be reduced to at most 2s. 6d. and possibly to 1s. 6d. per ton.

The extreme dryness of the vein materials is due to the workings being still above ground water level and to the detachment of the veins from the wall rocks. In only one place on the whole field (*i.e.*, Williamson's and Sorensen's shaft on the X-Rays claim) were the walls observed to be wet; but during certain meteorological conditions of low pressure a very slight seepage has been noticed in the deeper workings of the company. There have been some complaints from miners as to this extreme dryness and the dusty nature of the ore being prejudicial to their health, but the splendid ventilation of the company's workings leaves little if anything to be desired.

COSTS.

The total mining costs fell from 19s. 3½d. in February (a wet month) to 13s. 11d. in August last; but the rise in wages coming into force in the following month brought the figure for September to 15s. 3d. per ton. This last is thought to have been otherwise an average month and the following statement of details is interesting as the costs incurred in mining 1,082 tons of ore:—

	Costs per ton.			
	s.	*d.*	*s.*	*d.*
Explosives—				
Gelignite	0	7·8		
Fuse	0	1·3		
Detonators	0	0·5		
			0	9·6
Stores—				
Candles	0	1·0		
General	0	2·0		
			0	3·0
Timbering—				
Stulls	0	1·2		
Wages	0	9·4		
			0	10·6
Smithy—				
Blacksmith	0	0·4		
Charcoal and tool sharpening	0	11·5		
			0	11·9

	Costs per ton.			
	s.	*d.*	*s.*	*d.*
Mining—*				
Wages	8	10·7		
Nippering	0	4·8		
Mullocking	0	8·7		
Trucking	1	2·4		
			11	2·6
Management—				
Local Manager				
Underground Manager	1	1·5		
Office				
			1	1·5
Total			15	3·2

Tributing.

Tributes have been let to some extent both by private claim-holders and by the company. The usual terms are that 10 per cent. of the value of the wolfram won be paid in royalty, the wolfram concentrates being sold by the tributer to the highest bidder. The ore is hand treated by the tributers in all cases, and I was informed by tributers of experience that at the best this means nothing more than good wages for them—say, £4 per week—because of there being no bonanzas in the veins of Mount Carbine.

The system is falling into discredit because of the damage frequently done during the tribute, the tributers being naturally in a hurry to work out the richest ore, and seldom having time to think of the future of the mine. The Irvinebank Company has lately been giving only very short tributes, and in the near future is likely to refuse to let out any of its ground.

* Little or no development done. Driving usually returned as mining, because then breaking down ore. When driving in hard slate cost is understood to have been less than £2 per foot, though contractors are asking much more.

TREATMENT.

The production by primitive methods of treatment has been a negligible quantity since the Irvinebank Company erected its battery and concentrating plant, even though this, contrary to expectations, has not been thrown open for the reception of public stone. Record results are believed to have been attained at this mill, and it is anticipated that still further reductions in costs will eventuate when various additions and alterations have been effected.

Preliminary.

The prospector, like the company, usually brings all lode material to the surface, and there sorts it, poor or barren quartz being thrown over the tip, while any showing rich mineral is broken down to 3 in. size by means of a knapping hammer on an

PHOTO. 9.—PROSPECTOR'S TREATMENT PLANT, SHOWING SPRING DOLLY AND KILN, WITH PILE OF ORE READY TO BE FIRED.

iron plate or anvil (at the Ruby mine this " specimen " stone averages 20 per cent. wolfram), roasted on a kiln of firewood, then pulverised either by spring dolly or by hand, and jigged either by hand or in a box jig. The fines produced during the knapping are roughly hand-seived (½-in. mesh) to eliminate

the coarser barren quartz, sized by throwing onto a 16-mesh screen, and then hand-jigged in a tub, or else in a box jig (as at the Little Nell).

The hand jig consists simply of an ordinary circular sieve agitated by hand in a tub of water. It is stated that at the opening of the field the hand-jigging was done by the miner standing in the running stream, and the loss of wolfram in such circumstances must have been very heavy. The box jig has a tray, 18 in. by 2 ft. in area, suspended from the short arm of a

PHOTO. 10.—BOX-JIG AT LITTLE NELL.

lever and free to move up and down in a rectangular box nearly full of water. This is given a rapid succession of short sharp jerks, which causes the wolfram to sink to the wire bottom, while the gangue floats above it and is periodically skimmed off by the jig-man. The capacity of one of these jigs is nearly 1½ tons of fines per day.

Sluicing gives a product quite 1½ per cent. higher in grade than hand jigging, but water for sluicing is available during very few weeks in the year at Mount Carbine. That the loss by sluicing is ordinarily high may be inferred from the fact that

the Irvinebank Company in its sluicing campaign (undertaken prior to the erection of the battery with a view to determining the value of the ore), made an extraction of only 87 per cent. on the 2 per cent. ore under trial. In all 6,500 tons of ore was removed from the crops, chiefly on the Mount Carbine No. 1, but 77 per cent. of this was discarded after knapping. The remaining 1,500 tons was then sluiced for a yield of 110 tons of wolfram, which is equivalent to 7 1/3 per cent. in the material sluiced, but the tails still contained 1·1 per cent. of wolfram, and, as elsewhere described, these have since been retreated.

There is an idea prevalent among the miners that roasting destroys scheelite, and reduces the yield of wolfram. That there may be a complete loss in the case of the former mineral and a severe loss in that of the latter is true, and this is wholly due to disintegration at the temperature of the kiln and consequent *sliming* in water, after dollying. When an appreciable percentage of scheelite is known to accompany the wolfram, roasting must therefore be omitted to obviate loss. At the D.C.L. claim the fines as they come from the mine are jigged and yield scheelite; but the larger blocks have to be " kilned," and their scheelite is lost in the subsequent jigging.

Milling.

The Irvinebank Company is in the fortunate position of being able to dispense with all preliminary dressing of the ore, the whole of which as broken down is sent to the mill hoppers, for if any were picked out it would have to be knapped by hand and that would cost more than crushing by machine. In any case little of the ore as it comes from the mine is in large blocks, for the cohesiveness of the already friable quartz is further weakened by the disseminated felspar and wolfram, and blasting reduces it to small fragments, so that quite 40 per cent. passes through a ¾-in. screen.

The ore is tipped from the trucks at the mouth of the mill adit into a double V-shaped 20-ton hopper, originally provided with grizzlies let into the bottom, but these gave so much trouble by clogging that they have been dispensed with, and all the uncrushed ore now discharges from chutes onto a central platform, whence it is fed by hand into a 16-in. Hadfield cracker. The capacity of the machine, which requires 4-h.p., is 20 tons per hour; but the weekly capacity of the stampers being only 260 to 315 tons, it is run intermittently and during the day shift alone. The crushed stone falls on to a percussion launder, and is fed into a bucket elevator, which carries it to a 70-ton hopper

above the battery. From this hopper the ore is charged, by means of patent percussion chute-form feeders, into the mortar boxes.

The battery, comprising two units of 5 head of stampers and built by Walkers Limited, has a compound frame of steel

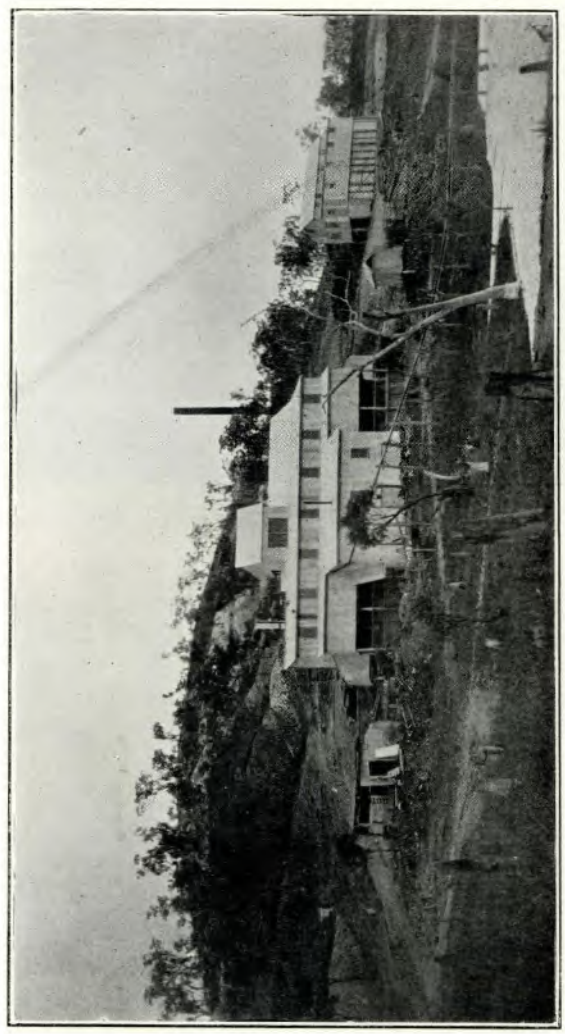

PHOTO. 11.—SOUTH-EASTERN END OF CARBINE HILL, AND THE MILL FROM BELOW.

and timber, the mortar boxes having single discharge, provided with 8-mesh screen. The stampers, each of which weighs 1,200 lb., make 98 drops of 6½ in. per minute; and the duty of each stamp is 5 tons per day of 24 hours. Two further units of 5 head were

in course of erection at the end of the year, and for the filling of the new hopper it was proposed to install a horizontal conveyer from the bucket elevator. The management has hopes that this expansion will be followed by reduced costs per ton, as it is not anticipated that any increase in the present battery crew will be needed to attend to the 20 head.

PHOTO. 12.—THE IRVINEBANK COMPANY'S MILL, MOUNT CARBINE, FROM ABOVE.

For the crushing of 1,500 tons of fines, produced and sluiced by the company prior to the erection of the battery, a 5-ft. Huntington mill was put in temporarily, but, the whole of the fines having been put through at the rate of 80 tons per week (day shift only), the machine has now been again dismantled.

Concentrating.

The pulp from the two separate stamper units is not mixed, but feeds two separate plants, differing only in the design of the Card tables and each comprising a Card, Baby Krupp and Krupp table* with two Luhrig vanners, a Wheeler pan, upward current classifier, and a series of conical settlers.

The pulp from the battery screens gravitates into an upward current classifier, the underflow from which is run onto a Card table, producing a concentrate, seconds (that are recrushed in a Wheeler pan and pumped back to the classifier), and a tail

* Mill men may be interested in the speed at which the tables are run, and it may be mentioned that the improved Card receives 260, the Baby Krupp 360, and the Krupp 380 pulsations per minute.

that goes to waste. The overflow from the classifier passes into a 2-ft. settler, the coarse from which discharges on the Baby Krupp table, producing a concentrate (troughed), seconds (returned to the classifier), and tail. The overflow from the first settler is run into a second (2 ft. 6 in. diam.), the pulp from which feeds the large Krupp table (with products as in the case

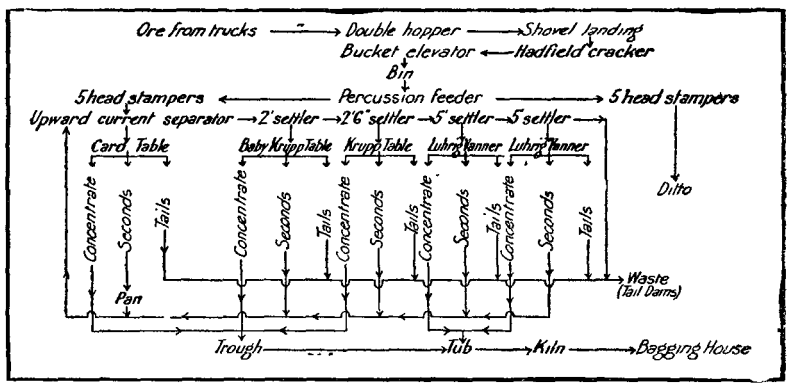

FIG. 14.—FLOW-SHEET, IRVINEBANK COMPANY'S MILL.

of the Baby). The overflow from the second settler is led to a third and a fourth (each 5 ft. in diam.), and the pulp from these feeds the first and second Luhrig vanners, which yield concentrates (tubbed), seconds (pumped back to the classifier), and tails run to waste. The waste water from the last conical settler is run through a number of settlers of various forms,* and then clarified with ashes from the boiler furnace prior to being used over again. The tails run to waste carry 0·2 per cent. wolfram (*fide* Mr. C. West), and the extraction is therefore 87 per cent. of the total content of the ore.

The troughs for cleaning the Krupp concentrate are of the usual pattern, about 10 ft. long and 18 in. in cross section, but the dressing tub has certain special features. It stands 4 ft. high, is 3 ft. across at the top, and is fitted with revolving blades for the agitation of the concentrate, the packing of which below any lighter gangue is ensured by a mechanical knocker actuated by a spring and cam worked off the shaft which causes the blades to revolve.

That part of the mill building occupied by concentrating apparatus is floored with concrete, in accordance with the latest

* Including a set of plunger jigs erected with the battery, but found quite unsuitable for such low-grade ore as that of Mount Carbine.

views on the subject of perfect cleanliness, allowing of hosing down as often as necessary without any loss of concentrate that may have splashed over.

The weekly production seldom varies much from 5 tons of concentrate, falling to 4 tons when poor ground is entered and rising to 9 tons in the exceptional case of several rich patches being entered at one time.

Early in the new year, when the 20 head of stamps are at work, the mill will have to treat double the quantity of pulp, and that it is capable of doing so has already been shown by half the plant taking the whole of the pulp from the 10 head now running. It is recognised that there will be increased liability to loss in the tailings, and that therefore extra attention will be required from the attendants; and it was at first proposed to instal two more Krupp tables.

COSTS.

The cost of crushing and concentrating is believed to be low, but figures are not available for publication.

Power Production.

The steam plant has been adapted, not designed, for the special work. The single acting engine, which came from the old Coolgarra mill, is large enough to drive 40 head of stampers, and therefore much too powerful for this 10-head battery and mill. Constant attention has to be given to the running of the tables, as the control of the engine is difficult, and a very slight variation in its speed suffices to greatly alter the number of pulsations given the tables per minute. Steam is produced in a multitubular wood-fired boiler.

Mill and office are fitted with electric light, current being generated by a Newton dynamo delivering 100 amperes at 105 volts.

A separate vertical boiler is provided for the horizontal double-acting Worthington pump that forces the water from the dam to the mill, the lift to the storage tanks above the intake being 100 ft., and distance of the mill from the dam being 16 chains.

The boilers are dependent on local timber (ironbark and teatree) for fuel, but the quality is inferior and the supplies are becoming increasingly difficult to maintain, as shown by the continually rising cost. In September last, cutting by contract cost 5s. 6d., and carting by the company cost 13s. 3d., a total of

18s. 9d. per cord. The mill boiler consumes about 100 cords a month, and that at the pumping station rather more than half that quantity.

It is not unlikely that before long the present plant, in view of its age and the difficulty of obtaining firewood, will be replaced by suction gas producers, and a further reduction in cost may then be looked for.

Drying.

Prior to bagging, the ore has to be dried, and for this a furnace of special design has been built. In plan it is circular, with an annular feeding space surrounding the central conical furnace chamber and flue. The concentrate is thrown on the cone, and sticks till dry, when it trickles down into receptacles on the bagging floor. The furnace chamber is 4 ft. in diameter and 8 ft. in height (*i.e.*, from floor to floor). The feed spaces rapidly contract below the tubbing floor, and special openings in the walls below allow escape of the steam that would otherwise find its way into the mill. The fuel consumption of the furnace is ½-cord of rejected firewood per week; whence we may assume that its efficiency is satisfactory, allowing that the fuel is waste and of the lowest calorific value; for the amount of concentrate to be dried is 5 tons per week, and the moisture content as fed into the drier may reach 6 per cent. by weight (the air space in the dry concentrate being about 30 per cent. of the total volume).

PRODUCTION.

A complete record of Mount Carbine production does not appear to have been kept, but the Warden's books* at Herberton give the monthly output for 1909 and 1910, with the following totals:—

Year.	Ore.	Concentrates.*	Value.
	Tons.	Tons.	
1909	..	$54\frac{17}{20}$	£4,987
1910	2,695	$179\frac{13}{20}$	£17,326

* As elsewhere stated, the tenor of the Mount Carbine concentrates is seldom below 70% and sometimes reaches 74% WO_3.

Subjoined is a summary of the Irvinebank Company's operations as recorded at the Mount Carbine office:—

Year.	Ore.	Yield.	Grade.	Sales.	Value.
	Tons	Tons cwt. qr. lb.		Tons cwt. qr. lb	£ s. d.
1906 ..	..	..	..	..	97 7 7
1907 ..	..	..	..	17 18 2 16	2,726 3 11
1908 ..	..	..	..	36 11 1 21	1,816 2 8
1809 ..	..	..	..	1 16 0 11	119 1 2
1910 ..	$6,595\frac{5}{20}$	148 4 0 0 =	$2\frac{1}{4}$%	92 10 3 20	9,343 12 2
1911 ..	$1,174\frac{10}{20}$	17 18 2 0 =	$1\frac{1}{2}$%	196 6 3 13	18,631 9 11
1912 ..	16,976	260 7 3 16	$1\frac{1}{2}$%	260 7 3 16	24,191 10 10
1907-12*	..	..	..	60 17 3 4*	*5,780 13 3
Totals..	$24,745\frac{15}{20}$	426 10 1 16	$1\frac{3}{4}$%	666 9 2 17	£62,706 1 6

* Tributers to 1st November.

I have been unable to ascertain even approximately the production of the whole field, but the yield of the claims not now held by the company may have reached 300 tons (the sum of the partial estimates given below is 231 tons), and the grand total would therefore be probably not far short of 1,000 tons.

* Examined in 1911.

MARKET.

The market has hitherto been an extremely unstable one, but tungsten is now of such import to the metallurgist that the demand must gradually increase in firmness, and there need be no fear for the future of the wolfram mining industry on that score.

Buyers.

The Irvinebank Company, besides being the chief producer, is also in the market as a buyer, and formerly made its purchases through a private agent, who also handled the whole of the company's output on commission, but now the buying is done by the company's own officials. Three other large Australian ore-buying firms interested to a slight extent are Lohmann and Co., Dalgety and Co., and Lempriere and Co., each of which is represented by an agent on the field. The ruling price is periodically posted to these agents from the head office, and they are nominally open to buy at any time. The claimholders, however, have an idea that there is seldom much active competition between the firms, who seem to require supplies more or less in rotation, their requirements being easily gauged by the prices they offer.

The whole of the Irvinebank Company's ore is shipped to London, but ultimately, like that of the other buyers, finds its way to reduction works in Germany.

Quotations.

I have been credibly informed that, taking the Carbine claims as a whole, small parties cannot profitably work the reefs with wolfram averaging less than £100 per ton on the field. Such has unfortunately been the state of affairs for the past 18 months, and to it is to be ascribed in part the abandonment of so many of the old holdings.

The Irvinebank Company makes a periodical quotation at Cairns for the information of all its branches, and the price offered at Mount Carbine is £5 less than this, the allowance being made to cover commission, cost of transport, and risk of overestimating the tungstic acid content.*

Attached is a graph showing the fluctuations in the price of wolfram at Mount Carbine† during the five years 1908 to

* The actual allowance made for this risk is less than 1% of the value of the ore.

† This has been prepared fron figures supplied by Mr. A. Burton, of the Irvinebank Company, these including both the Company's own quotations and those of rival buyers; and the price plotted is that on which actual sales were effected.

1912, together with the contemporary quotations in London.* The depression of 1908 is clearly marked, as is also the boom of 1910, and the long period of medium prices closed by the upward tendency of the market towards the end of last year.

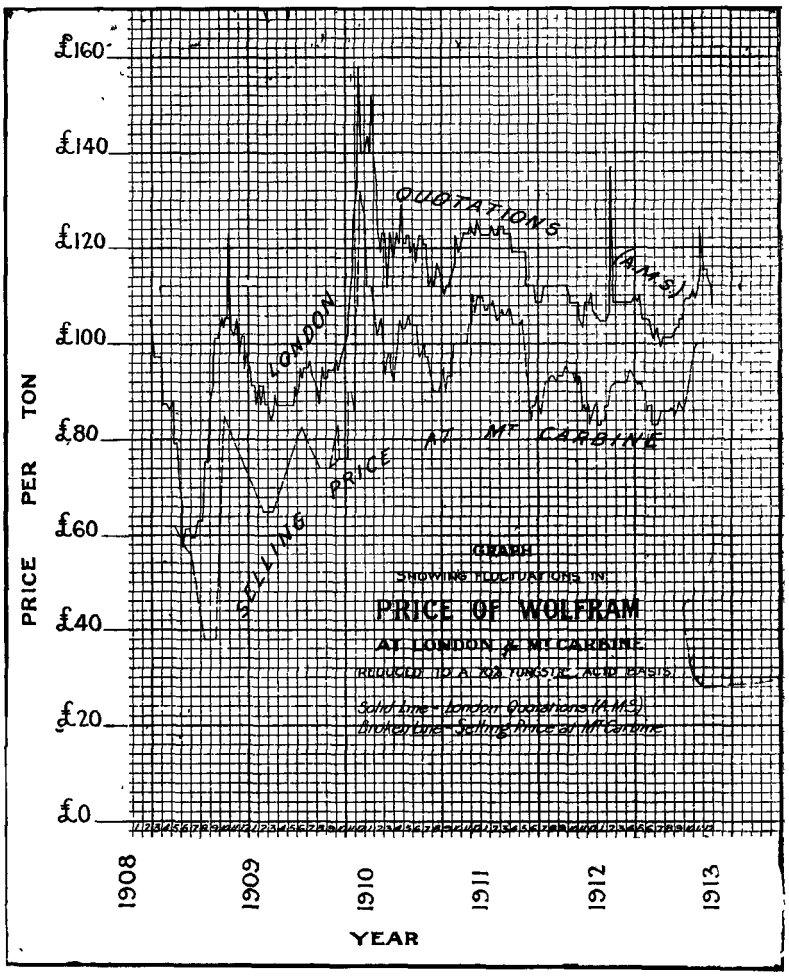

FIG. 15.

The similarity in the local and home curves is striking, and proves that the buyers must minimise the risk of a fall by keeping in closest touch with the European houses; and the £20 margin allowed on the London quotation does not seem excessive considering the instability of the demand and the distance of the mines from the centres of consumption.

* Compiled from weekly cabled quotations given in the "Australian Mining Standard."

REGISTER OF HOLDINGS.*

The Warden's books at Herberton are a blank concerning Mount Carbine for years prior to 1904, but during that and the following years, the state of the industry may be roughly gauged by the number of applications for claims and leases as tabulated hereunder.

——	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.
Claims	21	11	14	28	7	10	12	3
Leases	..	1	..	3	..	1	1	..

It is doubtful if in the earliest days any of the holdings were registered, and even now, unless the wolfram prospector discovers rich ground, he seldom takes the trouble to protect himself, as jumping is a most rare proceeding.

During 1912 there were 8 mining leases in force and 13 claims, besides which 4 unregistered holdings were being worked. Of the leases the Irvinebank Company holds all except the Mount Carbine No. 1, in which it has a controlling interest; and it also holds two of the claims (the Little Nell and the Harp).

* PLANS.—A 20 ch. plan of the mining lease and township allotment boundaries was compiled for my use by Mr. Crosswaite, of the Warden's Office at Herberton, and this served as the groundwork for my topographic sketch map of the hill. A contour plan of the extreme south-eastern end of the hill had already been prepared (on a scale of 5¼ ch. to an inch) by Mr. O. H. Woodward, and his work has been incorporated also. A splendid series of underground plans has been drawn on a large scale by Mr. Woodward, and I was privileged to take tracings of reduced blue prints of these at the mine before beginning my work; and, in addition, Mr. Woodward himself supplied me with tracings of the Johnson and Syndicate lease workings on a scale of 20 and 40 ft. to an inch.

The plans accompanying this report are little more than diagrammatic of those prepared in the field, the publication of which complete would have entailed heavy expense in draughting and printing.

The following is the complete list of holdings in force or being worked:—

Leases.	Claims.	Unregistered.
Combination*	D.C.L.	Fitzgerald's
Dam Site	Edith	Rhodes's
Johnson	Eye Opener	Simpson and Beadles's
Mount Carbine No. 1	Harp	
Polygonic	Iolanthe	
Pump Site	Little Nell	
Rolfe	Lone Hand	
Tungsten	Lucky Hit	
	R.S.B.	
	Ruby United	
	Struggle	
	Triangle	
	X Rays	

* Machine area.

The descriptions below are headed by the name of the holding followed by its registered number, M.L. standing for mineral lease, M.C. for mining claim, and A.C. for alluvial claim. The figure at the beginning of each description is the year in which the holding was registered.

Anderson (M.L. 7244).

1904—Included in Johnson, at southern end.

Australitz (M.C. 7411).

1905—Between Wayback and Iolanthe. Included in Combination.

Baird's Bluff (M.C. 7208).

1904—The first claim pegged out and registered=Mount Carbine No. 1, *q.v.*

Battler (A.C. 9518).

1909—South of Mona on Bock's Gully. Alluvial Ground.

Battler (A.C. 9744).

1910—" West of Harp" on Bock's Gully. Now held by Grogan.

A face from 3 to 6 ft. high is now being carried back from the eastern side of the gully, but as far as known the work is not highly profitable.

Bismarck (M.C. 8388).

1906—Diamond.

Black Bird (M.C. 8693).

1907—North-west of Daisy. Abandoned.

There are a number of shallow holes and trenches on the hill-side between the Daisy and Jack Watson on leaders trending west-by-north; but they are too small to warrant further work. An unusual feature is a cross leader striking north-east that has also been potholed.

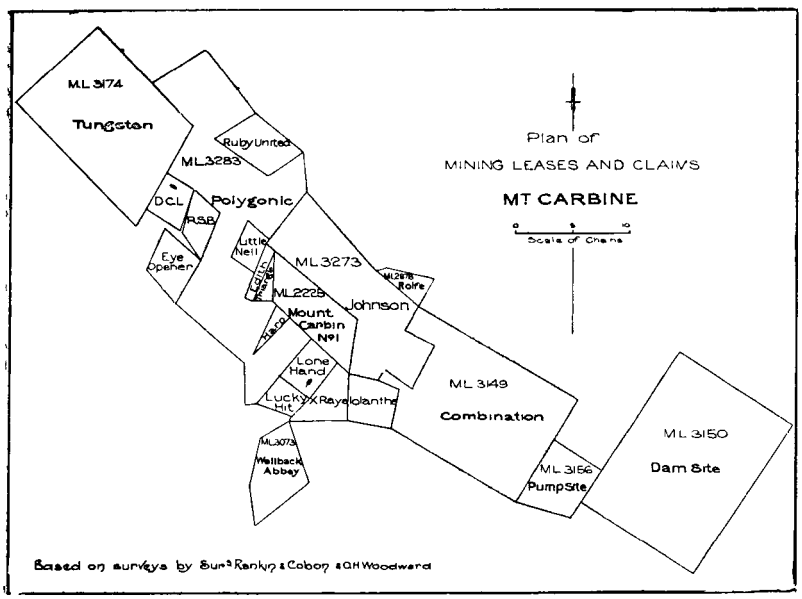

FIG. 16.

Boreham's Iron Blow.

On a spur overlooking the western branch of Holmes' Creek, about ¾-mile north of Sundet's gossan crop—otherwise located 2 miles north-north-west of Carbine Hill.

It has not been pegged out, but is worthy of some attention from the prospector.

This is a silicified crop of quartz and gossan-veined schist, much stained by iron and manganese oxides, and it may possibly be the cap of a low-grade siliceous formation. It has a length of 4 chains and a width of 1½ chains. Its situation is ideal for testing by adits, one of which might be put in at the lower edge of the crop 40 ft. below the crest, and others of moderate length could start from the gully to the north-west to give several hundred feet of backs.

Bonser (A.C. 8360).

1906—North of Rolfe. Abandoned.

A series of short lenticular and branching leaders have been trenched and potholed, but the workings were filled in as the face advanced and the one shaft has caved in. One of the veins is 6 in., another 7 in., and a third (that on which the shaft was sunk) up to 15 in. thick, but they are irregular in their occurrence and presumably could not be profitably followed further.

Caledonia (M.C. 8123).

1906—Jack Watson?

Caledonia (M.C. 9136).

1908—R.S.B.

Carbine Block (M.C. 8372).

1906—Included in Johnson.

Little work has been done on this part of the Johnson, but on it there are several large mullock dumps that will either wholly or in part eventually be put through the mill for their wolfram contents.

Catherine (A.C. 8834).

1907—Between Polygonic, Lucky Hit, and Wellbeck Abbey. Bought by the Irvinebank Company, but subsequently abandoned.

No reefs are known to crop on this ground, but a good deal of surface work has been done, and at the present time two men are working unregistered floater claims on it. Fitzgerald in the northern part is getting fair nuggety wolfram, and Rhodes in the eastern part has been winning wolfram yielding him £2 10s. per week wages. The face of the latter's paddock is 10 ft. wide, and his advance has been 30 ft., while the average depth has averaged 4 ft. Thus the ground carries slightly less than ½ per cent. of wolfram.

Chance (M.C. 8418).

1907—North-west of True Blue. Abandoned.

This claim seems to have been at the north-western end of the True Blue line, where there are numerous caved cuts and shafts on leaders believed to be small.

Combination (M.L. 3149).

1909—Mill site and tailings area at the south-eastern end of the hill. Held by the Irvinebank Company.

The lodes coming down the hill from the north-west have mostly petered out before reaching this ground, but several veins

6 in. to 12 in. in thickness have been trenched in the northern part of the lease (on the continuation of the Nil line) and a few small leaders carrying wolfram have been exposed in excavating for the foundations of the mill.

PHOTO. 13.—ENTRANCE TO MILL ADIT, COMBINATION.

Daisy (M.C. 8176).

1906—See Daisy United.

Daisy United (M.C. 8328).

1906—North-western end of hill. Abandoned.

It is known that the workings on the ridge crest near the summit of Carbine Hill were within the claim, but the position of the claim boundaries cannot now be located.

These workings include two 30 ft. shafts, three adits (one 90 ft. long and the others each 30 ft. long) and a number of trenches. (*See* Fig. 17.)

The vein or vein systems, for they are made up of overlapping lenses, are small (4 to 8 inches in thickness), but one series has been followed for a distance of 6 chains. Some stoping has been done between the adits and the surface and one of the stops is 53 ft. long. The strike of the veins is with exceptions west-north-west, but that of the bedding of the augen-slate country is north-north-west.

To the south-east the veins become more numerous, but they are still mostly small, and no continuous developmental work has been expended on them.

The fossickers were handicapped by the toughness of the lode material, which is due to felspar being absent or present

in only very small proportions. The Daisy United wolfram is somewhat characteristic, being feathery and finely acicular, and besides shows a tendency to segregation near the walls.

Dam Site (M.L. 3150).

1911—Now held by the Irvinebank Company.

This is below the mill, which derives its water supply from a dam thrown across Manganese Creek and from an adjacent well. The building of the dam was a matter of great expense, owing to the depth of alluvial along the eastern side of the creek necessitating a puddle wall 140 ft. long and 30 ft. deep.

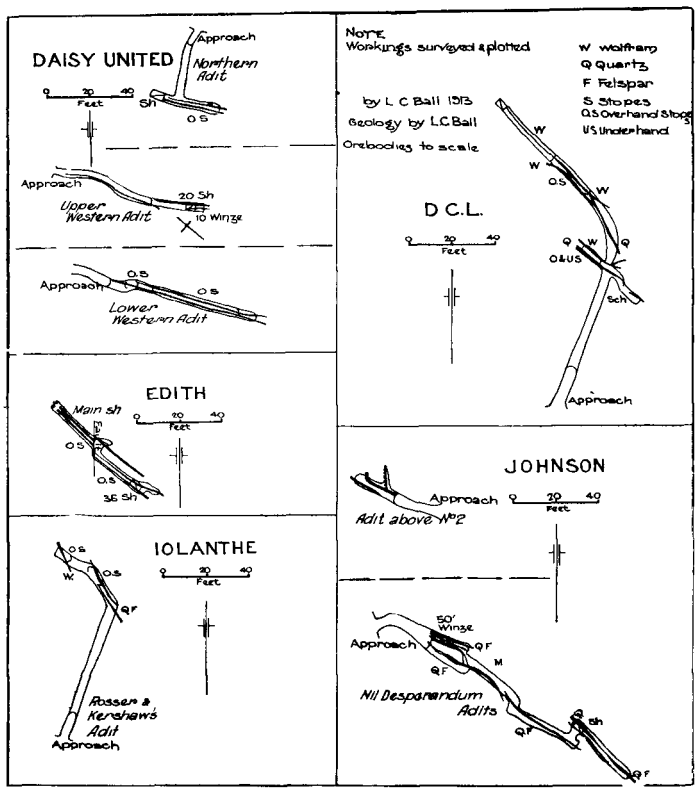

FIG. 17.

Daniel (M.C. 9846).

1911—¼-mile north-north-east of battery, near Scheelite Gully. Abandoned.

A little surfacing has been done at intervals on a narrow floater stream coming out from Scheelite Gully—the ground was probably very poor.

D.C.L. (M.C. 8296).

1906—This lies between the Tungsten, Polygonic, R.S.B., and Eye Opener. It is now held by Brown.

The Bluff is the chief series of reefs worked here, but there are others on either side of it. One of the Bluff veins has been removed by opencut almost from side to side of the claim, and a

PHOTO. 14.—ADITS ON D.C.L.

good deal of work has been done on another of the same series. Up the hillside there are a few trenches, and down the gully below the main line there are two flooded shafts said to be 30 ft. deep.

The main workings are reached by two adits, the lower one

108 ft. from the approach to the stope,* where a system of intersecting veins (3 to 12 in. thick) has been exploited by a stope 30 ft. in length and now open to the surface. At 70 ft. from the mouth of the adit* a system trending north-west was driven on to right and left and beyond that small cross veins were followed to the main line, which also strikes north-west. (*See* Fig. 17.)

Brown is now working on the outer north-west drive, and in the face there are showing three veins respectively 3, 6, and 9 in. thick. The wolfram content is not high, but there is some scheelite and the yield affords wages. When much rich ore shows and market quotations are high, wages men are put on; but just now the claim holder is alone, the fact that the ground stands well and requires no timber having hitherto been in his favour. The workings are, nevertheless, becoming too extensive for the veins to be profitably exploited by one man.

The occurrence of the wolfram is bunchy, and Mr. Brown has noticed that it is to some extent dependent on intersecting cross leaders. A patch of cupriferous gossan on the surface led to this ground being pegged out, but in the lower workings there are only slight stains of malachite and azurite, the sulphides not yet having been reached.

Mr. Brown informs me that during the last six years he has produced a total of 16 tons of wolfram (and scheelite) and during 1912 his production was 1 15/20 ton of the concentrate.

Dead Dog (M.C. 9681).

1910—South of X Rays. Abandoned.

The Dead Dog is believed to be the extreme end of the worked floater ground below (to the south of) the Iolanthe.

Dead Finish (M.C. 7264).

1904—Included in the Dead Finish Amalgamated.

Hobein, the original holder, is said to have cleared £1,100 by surfacing here.

Dead Finish Amalgamated (M.C. 8517).

1907—Between the Harp and Lone Hand. Included in Polygonic.

Much surfacing has been done in the eastern part, and some work has been carried out in the Iolanthe zone in the northern part, this latter including an opencut (mullocked up), a flooded

* In the attached plan [Fig. 17) the approach has been wrongly superimposed on the adit, thereby foreshortening it.

shaft, and an adit that reached the lode a few feet below the old workings. There is 15 to 18 in. of quartz and felspar in the drive at the end of the adit, but it seems to be pinching out towards the north-north-west.

The holding is chiefly of value as giving access to the Mount Carbine No. 1 by No. 3 adit. Part of No. 1 adit dump and the whole of No. 3 adit dump are on this ground.

The Company during 1910 produced 7/20 ton wolfram, valued at £37.

Dead Finish Extended (A.C. 8389).

1906—Included in Dead Finish Amalgamated.

Diamond (M.C. 9297).

1908—Included in Gems United.

At least two veins of the Ruby zone have been exploited here, but they were lost in the broken country on the north-western side of the lease; and two shafts sunk, one of them 40 ft., in search of the reef failed to relocate it. The miners spoke of faulting, but of this there is no certain indication, and it would seem that the main lodes have simply petered out. To the north-west of the Diamond only small and discontinuous leaders have been found on the trend of the Ruby line. The country is much jointed and is so open that the miners consider it "shattered."

Dolly Varden (M.C. 7268).

1904—Included in Dead Finish.

Dolly Varden 1N (M.C. 7433).

1905—Included in Dead Finish.

Dreadnought No. 1 (M.C. 9508).

1909—East of Carbine Hill. Abandoned.

The extent of the claim is unknown but it is thought to have been confined between Scheelite and Fitzgerald's Gullies, on a high northern shoulder of Carbine Hill. The Iron Duke zone, on which it is, comprises at least half a dozen separate and parallel veins, but none of them has been followed far, owing to their lenticular form.

A shaft in the top of the knob has caved in, but the ore at grass shows the vein to have been up to 2 ft. in thickness, and to have consisted of the quartz with a peculiar bluish tinge. The vein is traceable by shoads to the south-east, and, in one

place, where it bulges to 18 in. in thickness, a cut has been opened on it; but work was not continued because the vein pinched below.

Easter Monday (M.C. 7476).

1905—Included in Wayback.

Edith (M.C. 7237).

1904—Surrounded by Polygonic, Johnson, and Triangle. Now held by Petersen and party.

At the northern end of the claim, which is a very narrow one, the Nell zone is being worked, and in the central part some remunerative open cast work has to be done on veins of the Bluff zone.

PHOTO. 15.—EDITH, TRIANGLE, POLYGONIC, HARP, ETC.
VIEWED FROM NORTH-WEST.

Two shafts have been sunk 35 ft. on the Nell zone; an old one near the eastern boundary (*mullocked* up by tributers to within 20 ft. of the surface) and the main shaft on the western boundary, within 12 ft. of the Nell shaft. The two shafts are 50 ft. apart and they are connected by a drive. (*See* Fig. 17.) The workings show two parallel veins, one 10 in. and the other 15 in. thick (connected at the shaft by a 5 in. cross leader) and a third vein, 2 to 15 in. thick, has been broken into midway between the shafts. The mine was let on tribute last year, and

the owners have not in the last two months quite cleaned it up for stoping. The concentrate contains minute traces of molybdenite, and splashes of chalcopyrite are occasionally exposed in the faces.

The claim holders reckon that a total of 30 tons of wolfram has been won from the claim, half of it during the last three years.

Eye Opener (A.C. 9730).

1910—South-west of R.S.B. Now held by Owens.

No reefing has been done on this claim (the leaders in the northern part being barren) and but an insignificant amount of surface work, this being along gullies running down from the R.S.B. and the Polygonic. Preparations are being made, however, by the holder to do some sluicing during the next wet season.

Felsite Knob.

19— —Name of claim unknown, probably unregistered. About a mile and a-half east-by-north from the mill.

In the schists on the south-western side of a large felsite dyke a few quartz leaders have been found, one of which crossed a little wolfram, and this has been trenched in one place near the summit. Other small and discontinuous leaders in less altered slate country further down the hill to the south have been potholed, and one of them was rich in wolfram arranged at right angles to the confining walls.

Flat.

19— —Name of claim is unknown, probably unregistered.

On the low country near Manganese Creek, ½-mile north-east of the mill a little surface work has been done.

The country here is a decomposed porphyritic biotite granite but silicified slate crops nearby (to the north). There are a number of parallel reefs running north-westwards and in size up to 4 ft. thick. They consist of quartz with very little wolfram. The amount of work done is negligible.

Another group of wolfram-bearing quartz veins lies ¾-mile to the north-by-east of the mill in slate country. There is only a trace of wolfram showing and no work has been done on them.

Floater (A.C. 8792).

1907—Locality unspecified—probably Bock's Gully.

Flying Pig.

19— —South of Wolfram Crown?

Gems United (M.C. 9356).

1909—Comprises Pearl and Diamond. Included in Polygonic.

The Ruby United zones run west-north-westwards across this ground; and a good deal of open-cutting and trenching has been done thereon, besides the sinking of several shafts, two of which are 54 ft. deep, a third 43 ft., and a fourth 40 ft.

The company in 1911 produced 16/20 tons wolfram, valued at £78.

Gully (M.C. 7263).

1904—Bock's Gully, below Polygonic. Abandoned.
Floater ground.

Harp (M.L. 8068).

1906—Surrounded by Polygonic and Mount Carbine No. 1. Lately purchased from Rolls' by the Irvinebank Company.

The five old shafts on this ground, all of them flooded, are on the Iolanthe zone. One of the shafts is said to be 50 ft. deep, and a good deal of stoping was done, but the surface has now caved in above it.

Havelock (M.C. 8701).

1907—Included in Pick and Shovel, q.v.

Hit or Miss (M.C. 7243).

1904—Included in Polygonic.

A few shallow filled-in trenches, on the south side of the Little Nell, have been mullocked up, but were probably on small veins.

Hit or Miss (M.C. 8802).

1907—Included in Diamond.

Hit or Miss (M.C. 8865).

1907—South of "Last Chance." Abandoned.

Hopeful (M.C. 8935).

1907—North of Ida. Included in Tungsten.

The leaders here are small and irregular and little work has been done.

Hunter (M.C. 8441).

1907—North-west of Keatings. Abandoned.

Several shallow shafts were sunk on the True Blue zone here, but they have caved in. Simpson and Beadle have lately made an attempt to get into one of the old shafts by driving a short adit.

Huntress (M.C. 8905).

1907—Adjoining Hunter on north-west. Abandoned.

Shallow cuts and shafts were opened on the True Blue zone here, but the reef seems to fray out to the north-west.

Hurry Up (M.C. 7262).

1904—¼-mile south of Keatings. Abandoned.

A shallow trench and a caved cut were opened on lenticular leaders here, but nothing can now be seen of the veins.

Ida (M.C. 8377).

1906—Included in Tungsten. Believed to be the same as Mon Repos.

Iolanthe (M.C. 7410).

1905—South of Mount Carbine No. 1 and Johnson. Included in Iolanthe Extended. Commonly known as Klausen's.

Iolanthe Extended (M.C. 9485).

1909—South of Mount Carbine No. 1 and Johnson. Includes Iolanthe. Now held by Kershaw.

Two of the largest opencuts on the hill are in the north-eastern part of this claim. They are more or less mullocked up, but one end shows the following section:—

3 in.	6 ft.	9 in.	8 ft.	5 in.	18 in.	3 in.	8 ft.	7 in.
Quartz.	Country.	Quartz and Felspar.	Country.	Quartz.	Country.	Quartz.	Country.	Quartz and Felspar.

It is presumed that the veins bulged in the cut, but they must have pinched again, for at the opposite end there are only four leaders showing. These are on the Bluff zone.

A deep cut runs from the north-western corner to the centre of the claim on the Iolanthe zone, which is parallel to and about a chain from the Bluff. This is not now being worked and is caving in, but in different parts there is exposed 14 in. to 16 in. width of quartz and felspar.

The reef was intersected 30 ft. below the surface by an adit 70 ft. long, a drive was opened north-westwards along it, and some stoping was effected between cut and drive; but the vein is not likely to have been very rich as 12 in. quartz and felspar has been left standing in the face (this would otherwise have been broken into). The vein is slightly faulted in two places, and that may have helped to discourage the claimholder. (*See* Fig. 17.)

Kershaw's shaft, which is to be sunk to a depth of 50 ft., had reached 20 ft. below the surface in October last. It is on a 12-in. vein running slightly obliquely to that last mentioned but within 20 ft. of it. It is vertical on the average, but very undulatory besides jumping and curving along every break or head or joint. There is usually a patch of wolfram where these sudden changes take place and such a one is that at the 20-ft. level, where wolfram is showing on a bulge in the reef.

In lieu of any record, the claimholder estimated for me the production of the Iolanthe, the total being 30 tons. This, however, is acknowledged to be little better than a guess.

Iron Duke (M.C. 9004).

1907—Included in Dreadnought No. 1. Abandoned.

Ivy (M.C. 8551).

1907—Included in Huntress. Abandoned.

Jack Watson (M.C. 8799).

1907—West of Daisy United. Abandoned.

A superimposed opencut and adit, the latter 45 ft. in length, expose little except at the inner ends, where the quartz leader is 2 in. and 3 in. thick. Mr. Simpson tells me that wolfram shoot was 20 ft. long and that 1½ ton of wolfram was got here.

Johnson (M.C. 7240).

1904—Included in Johnson lease.

On the Johnson line there are a great number of interlacing trenches, the majority shallow and most of them filled in, but some are 20 ft. and exceptionally 30 ft. deep, and many of them connect with the stopes beolw. In very few cases are the trenches or cuts more than 6 ft. wide, each leader having been separately followed, even when only 3 or 4 ft. distant from a neighbour. The veins are up to 4 ft. 6 in. thick, and the work done is indicative of a large production.

On the Bobby Dazzler zone one 6-ton lump of wolfram, the largest yet found on the field, was got near the surface; but the vein proved somewhat disappointing where opened below by a drive from No. 2 adit, as the 18 in. of quartz pinched out within 30 ft. of the grass roots. Further work here should locate an overlap. (*See* Fig. 20.)

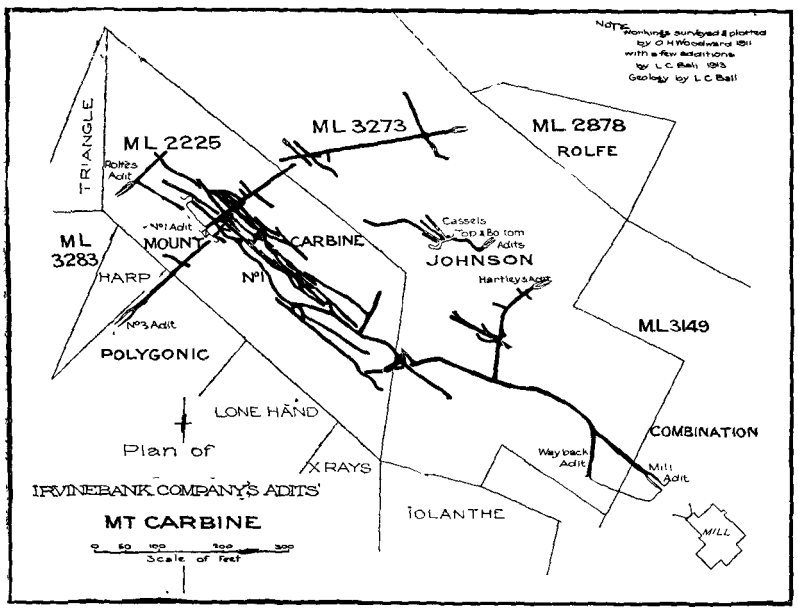

FIG. 18.

The ground has been entered by two adits—No. 2 and Asmus and Fry's—and there is one shaft 36 ft. deep, the last inaccessible. No. 2 adit is nearly 300 ft. long and gives about 50 ft.

of backs. It first intersects the Bobby Dazzler zone, of which one vein, followed 40 ft. south-east and north-west, is from 4 to 18 in. thick. Numerous other leaders were then passed through and 80 ft. back from the face the Johnson zone was entered. The veins of this group are as numerous and erratic in their trend as on the surface, but below ground are of less thickness than above —one, followed for over 100 ft. to the south-east, showing in some places only 3 or 4 in. of quartz and felspar though mostly between 18 in. and 2 ft., and in one place 3 ft. 6 in. wide. (*See* Fig. 20.)

Mr. Johnson informs me that his production from this claim during two years was between 8 and 9 tons of wolfram.

Johnson (M.L. 3273).

1911—Includes a number of claims (Wolfram Crown, Nil Desperandum, Johnson, Johnson and Williams, and Wayback) purchased by the Irvinebank Company.

At least six of the vein zones have been worked on this lease, these including the Natives, Bobby Dazzler, Nil, Johnson, Wayback, and Bluff.

The most extensive of the workings are those on the Johnson zone, the opencuts and trenches extending over a distance of 13 chains. Most of the veins have been separately trenched, but on Cassel's tribute a number were taken out by opencut. As now exposed the veins are mostly of small size, 6 in. to 18 in., but exceptionally they are 4 ft. 6 in. in thickness. They are characterised by the presence of much felspar, which, as elsewhere noticed, is looked on as favourable for the occurrence of wolfram. Some underground work has been done on the Johnson veins, which have been tapped by No. 2, Cassel's and Hartley's adits; but they do not, as a rule, exceed 18 in. in thickness in No. 2 adit, though there is one bunch of 3 ft. 6 in. In Hartley's workings they are still smaller, but in Cassell's stopes the reef has a width of more than 2 ft. over long stretches. (*See* Figs. 20 and 21.)

The Bobby Dazzler was also driven on from No. 2 adit, but was smaller than on the surface.

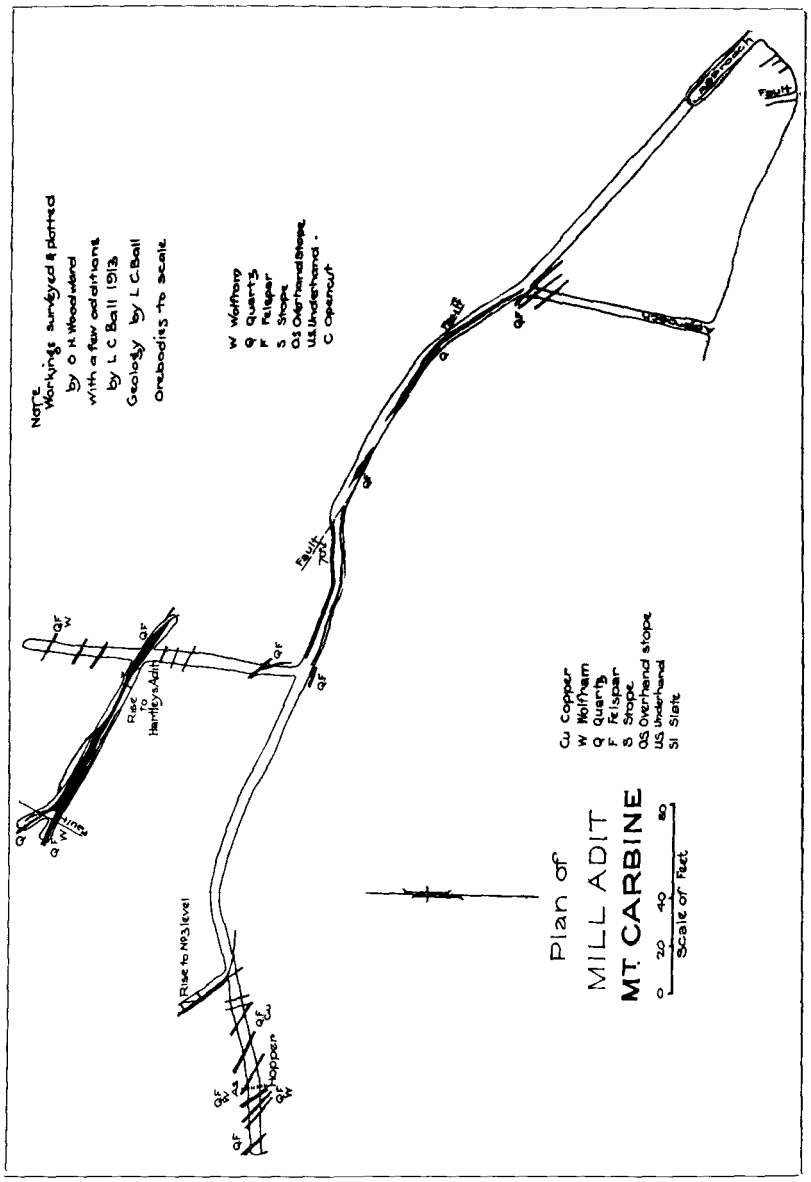

FIG. 19.

The Wayback zone has been deeply opencut and besides has been reached by Hartley's adit and by a crosscut from the mill adit. At this latter level it is proposed to follow the veins northwestwards into the hill and a drive has already been opened for 90 ft. from the crosscut, the reef ranging from 2 ft. to 4 ft. 6 in. in thickness. (*See* Figs. 18 and 20.)

No. 2 adit, in 290 ft., intersects 27 veins of total thickness 17½ ft., including 5 ft. in veins over 18 in. Hartley's adit, in 140 ft., proves a total of 11 ft., two veins being 18 in. in width. The mill adit, in a distance of 220 ft., proves 18 ft. width, of which the veins over 18 in. wide total 10½ ft. The mill adit and Hartley's give a section (not completed) in the southern part of the Johnson, the total exposure being 23 ft., with 12 ft. in veins over 18 in.

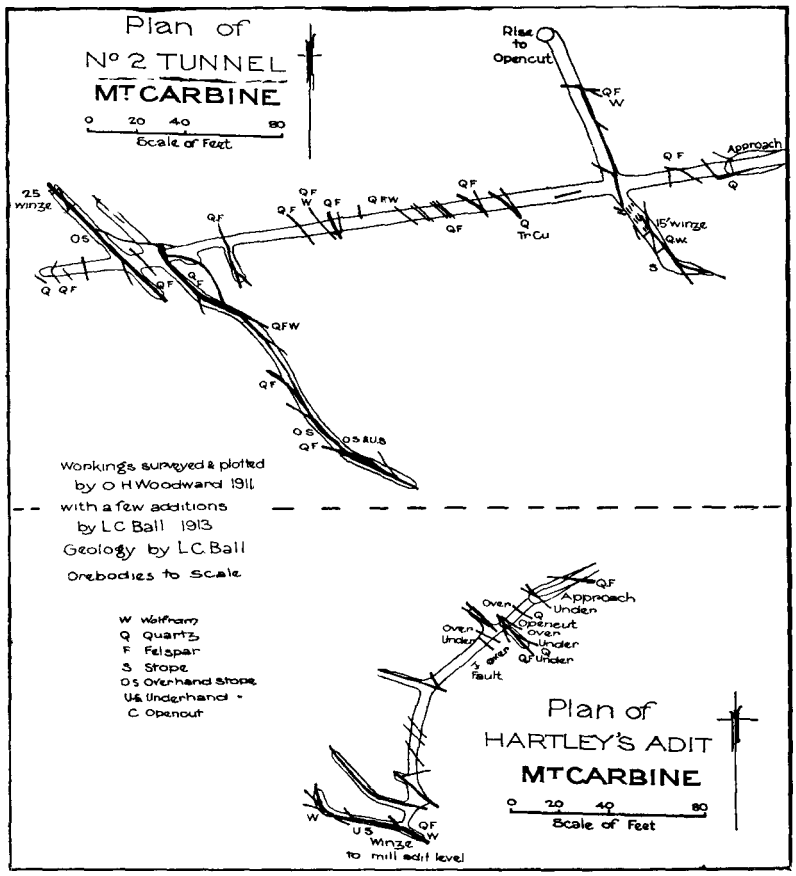

FIG. 20.

A necessarily rough estimate of the amount of "probable ore" on the Johnson lease above the adit level may be made from the data given on my original plan of the surface workings. As exposed on the surface the total width of veins over 12 in. in thickness is 22 ft. (12 ft. on the Bluff and Wayback, 7 ft. on the Johnson, and 3 ft. on the Dazzler; and the respective lengths of crop being 3½, 8, and 4 chains, with 110, 150, and 150 ft.,

the respective elevations above the adit level). This gives a grand total of 60,000 tons without any deduction, for, in omitting all veins under 12 in., of which there are a large number (any of which may become workable in a few feet), sufficient allowance has been made for possible thinning of the veins.

The Company and its tributers between November, 1907, and the end of 1912, produced £5,868 worth of wolfram, the amount being 61 8/20 tons; and the grade of the stone crushed during 1912 was 1½ per cent. The Company at the end of 1912 had mined and crushed 690 10/20 tons of ore from this claim for a yield of 11 6/20 tons wolfram, but the total quantity of wolfram from all sources sold since 1906 amounted to 74 9/20 tons, of a value of £7,166.

Johnson and Williams (M.C. 7241).

1904—Included in Johnson and Williams (M.C. 7611).

Johnson and Williams (M.C. 7611).

1905—Included in Johnson (M.L. 3273).

Most of Cassel's workings and the whole of Hartley's are included in this ground, as well as a great part of the mill adit with No. 1 crosscut and Nos. 1 and 2 drives.

Cassel's workings are on the Johnson zone, as are some of Hartley's, the remainder being on the Wayback and Bluff. The surface workings on both the Johnson and Wayback are extensive, there being large opencuts and numerous trenches.

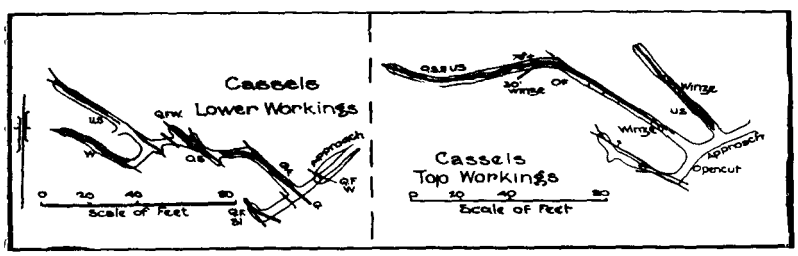

FIG. 21.

Five separate veins have been driven on and stoped from Cassel's adits, thicknesses of 2 ft. 6 in. to 4 ft. 6 in. being not uncommon here. The veins, where cut by Hartley's adit, are much smaller, and little work has been done on them thereabouts below ground.

A Wayback vein has been underhand stoped near the end of Hartley's adit, and connection has been made with the No. 2 N.W. drive from No. 1 crosscut off the mill adit, in which

drive there is up to 4 ft. 6 in. width of pegmatite. The vein is nevertheless very irregular, frequently petering out and branching off; but, as new overlaps come in, the drive is continuously on reef matter. Cross faulting or jointing is also a feature, the reefs showing no consistency of behaviour, some cutting off sharp, while others cross the joints without effect. (*See* Figs. 19 and 20.)

PHOTO. 16.—CASSEL'S TRIBUTE DUMPS, JOHNSON.
BAKER'S BLUE MOUNTAIN, MOUNT HOLMES, AND LITTLE ALTO IN DISTANCE (TO THE SOUTH-BY-EAST).

The Bluff veins thus far exposed in the end of the mill adit are not particularly encouraging though somewhat more propitious in the No. 3 above. The country here is more schistose and crenulated, the veins are more frequently frozen to the walls, and inclusions of country rock are quite unusually abundant. All this is indicative of some change having taken place in the character of the ore-bearing solutions and the conditions of deposition. We are here, however, at the south-eastern end of the Bluff zone, and improvement is to be expected as the drives are pushed out to the north-west. (See Fig. 19.)

Johnsons' output for this claim was 5 tons of wolfram.

John Watson (M.C. 8890).

1907—Jack Watson?

Joke (M.C. 8986).

1907—South-west of Polygonic? Bock's Gully.

Joseph (M.L. 2980).

1907—Included Bonser, Moonstone Natives, and Try Again. North-east of the Johnson and between the Rolfe and Scheelite Gully. Taken up by the Irvinebank Company but abandoned.

PHOTO. 17.—CARBINE HILL, FROM EAST-NORTH-EAST. WITH WORKINGS ON JOHNSON, JOSEPH, ETC.

Three zones (the Iron Duke, Bonser, and Natives) run north-westward across this ground, each comprising numerous separate irregular veins, usually of small size and somewhat erratic in their individual trend, though there is a general rude parallelism. The only work of any extent was done on the Moonstone Natives in the boundary cut that comes from the Johnson.

The stone from this side of the hill is rich in felspar, and besides wolfram carries much scheelite and some tinstone.

Jubilee (M.C. 9713).

1910—Adjoining Dreadnought. North-western end.

Two veins have been opened by cuts and on one of them a shaft was sunk 10 ft. The veins are small (from 3 to 9 in. thick) and have not yet proved to be persistent.

Just-in-Time (M.C. 8561).

1907—Included in Tungsten.

Sutherland's shaft was sunk 20 ft. in a gully near the centre of the Just-in-Time. This is probably on one of the Ruby leaders.

Just-in-Time (M.C. 8642).

1907—North-western end, adjoining the True Blue. Abandoned.

Sundet's adit was put in to test the south-eastern extension of the True Blue zone. The adit has caved and there is little on the surface to give encouragement to further work. Sundet's output was but a few hundredweight of wolfram for six months' work.

Just-in-Time (M.C. 9745).

1910—Included in Tungsten.

Beadle's workings, in the western part of the Tungsten, are on the Ruby zone. The eastern or gully workings comprise several old cuts on small (6 in.) leaders and are said to have yielded 7½ tons wolfram. The western shafts, of which four have been sunk on the underlie, are connected by an adit now caved. The leader is a cross one and only 6 in. thick.

Just-in-Time (M.C. 9289).

1908—Wayback.

Keatings (M.C. 8357).

1906—North-western end. Abandoned and later taken up as True Blue.

The True Blue vein here worked runs north-westwards underlying 70 degrees to north-east. Several opencuts and an old shaft sunk by Keating expose a vein 9 to 12 in. in thickness. The bottom workings have been rendered accessible by two adits, one of which was put in by Simpson after the ground had been abandoned by Keating. (See under True Blue.)

Keating's yield is estimated at between 3 and 4 tons of wolfram.

Last Call (M.C. 9731).

1910—South of McManis cut. Abandoned.

Several old caved trenches and cuts at the south-eastern end of the Daisy United zone expose three parallel leaders not more than 3 in. thick.

Last Call (M.C. 8282).

1906—Included in Combination.

The extreme south-eastern end of the Nil zone of leaders crops herein, and a few trenches have exposed veins 6 in. to 12 in. thick but some costeans beyond them failed to locate ore of any kind.

Last Chance (M.C. 8803).

1907—North of D.C.L. and R.S.B. Exact location doubtful. Included in Polygonic.

Little Hero (M.C. 7408).

1905—Included in Polygonic.

Both the Ruby and the Natives zones crop on this piece of ground. A little shallow trenching has been done and a shaft was sunk 30 ft. on the southern-most vein, which where exposed at the surface is 8 in. thick.

Little Nell (M.C. 7242).

1904—Surrounded by Polygonic. Lately purchased from Clark and party by the Irvinebank Company and now let on tribute to West and party.

Both Bluff and Nell zones have been worked here and in all thirteen separate veins have been trenched.

West and party have been for some months exploiting one of the Nell veins. The shaft now 40 ft. deep is on the same shoot as that worked in the Edith, its length being 60 or 70 ft. The vein exposed in the shaft averages 18 in., and although it is looked upon as one of the best producers on the field, when inspected there happened to be little wolfram showing, but the small stope to the north-west, extending 30 ft. from the shaft at the 20-ft. level, was inaccessible to me because of breaking down being in progress. On the south-east there is little reef left between the Little Nell and Edith shafts.

PHOTO. 18.—LITTLE NELL, ETC., FROM SOUTH-EAST.

The pure white quartz is regarded as barren by the tributers, who look for ironstains and mica on the walls and in the reef as wolfram indicators. "Speckled ore" is preferred to any, blocks of wolfram up to 70 lb. in weight being sometimes found in it.

Clark is said to have won 14 or 15 tons from this claim (of this 3 tons came from the tributers' shaft), but the only amount officially recorded is that of 11/20 ton sold in 1904 for £30. The company's tributers during 1912 treated 353 tons of stone, producing 5 6/20 tons of wolfram, valued at £483. The average wolfram content is thus only 1½ per cent.

Little Nell (M.C. 9751).

1910—North-west of Hurry Up. Abandoned.

A few trenches only have been opened on this ground.

Lone Hand (M.C. 7270).

1904—Between Mount Carbine No. 1, Polygonic, Lucky Hit, and X Rays. Now held by Johnson.

Two veins of the Iolanthe zone have been worked on this claim. On the southern there are two caved cuts and three inaccessible shafts, believed to be 30 ft. deep, between which some stoping has been done.

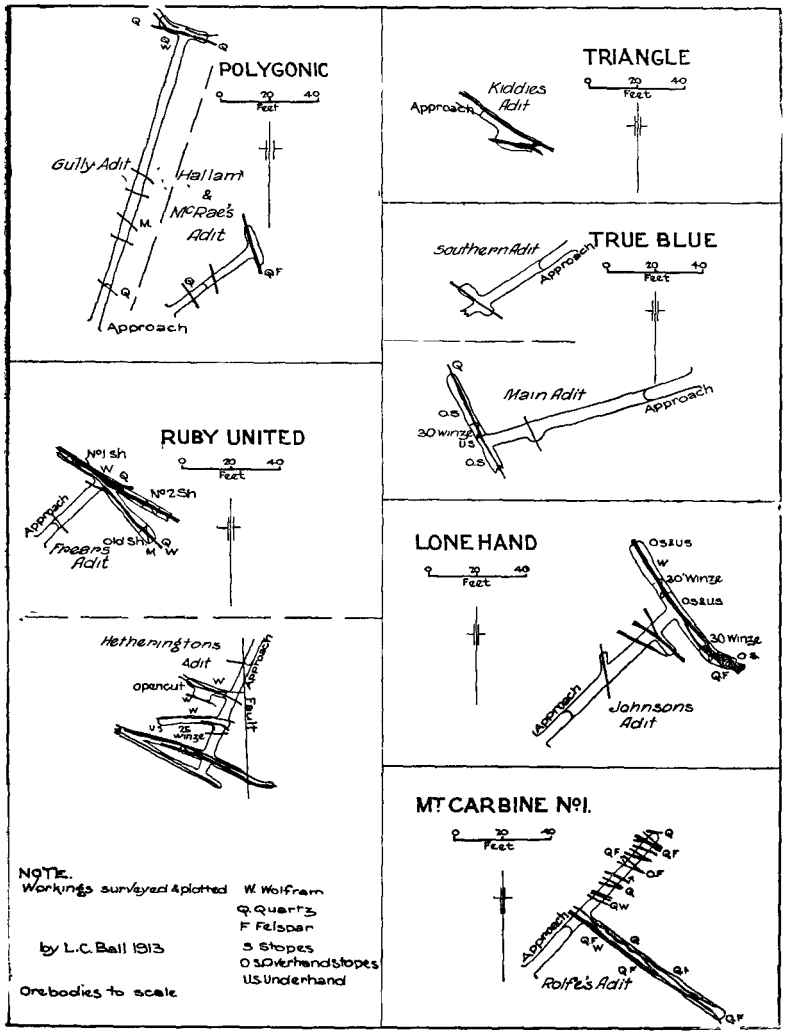

FIG. 22.

The main line is near the northern boundary of the claim and on it five shafts have been sunk. There is also an opencut or underhand stope 40 ft. deep; and the lower workings have been tapped by an adit 80 ft. in length, which crosses in all six veins, the first and last being those already mentioned. The inner workings comprise drives 40 ft. to the north-west and the same distance to the south-east, in each of which is a 30-ft. winze and from the bottom of which a vein from 2 ft. to 3 ft. thick has been stoped over the whole length of the drives. Above the drives also a little stoping has been done. That one man should be doing such work is almost incredible, the only point in his favour being the nature of the ground, which needs little or no supporting timber. Neither in the ore nor on the walls is mica to be seen, but the wolfram-bearing ore is always iron-stained, and the richest is found where the reef bulges near a bifurcation. (*See* Fig. 22.)

Johnson's output for the last four years amounts to 8 tons, most of which came from the surface.

Lorna (A.C. 9480).

1909—Bock's Gully. Abandoned.

Exact location not given, but believed to be below the Polygonic.

Loty Mary (M.C.'7245).

1904—Unlocated. Abandoned.

Lubra (M.C. 9758).

1910—North-western end, ¼-mile west of the Jubilee. Abandoned.

Exact location doubtful, but believed to be on the Paw Paw zone.

Lucky Hit (M.C. 7442).

1905—Between Polygonic and X Rays. Formerly Heyer; now held by Walsh.

No reefing has been done here, but, over the greater part of the claim, the whole surface has been turned over and stripped to a depth of 5 or 6 ft. Just now a wages man is employed stripping 3 to 5 ft. of soil and subsoil in the south-eastern corner, but he reports the ground to be poor.

Macdonald.

19— —¼-mile north-west of the True Blue. Claim not registered. Abandoned.

The few shallow cuts opened on small leaders here have caved in. A shaft has been sunk 20 ft. on a 5-in. leader of iron-

stained crystalline quartz carrying a little wolfram. The veins here are abnormal in trending with the lamination of the schist and also in their drusy cavities.

McManis.

19— —Probably unregistered.

This claim lay on the south-eastern side of the Daisy United, near the summit of Carbine Hill. There are a number of holes and trenches and one caved opencut (with possibly a caved adit). These are on small leaders which as now exposed are not more than 6 in. in thickness and seldom run for more than 10 ft. until they pinch out, but the workings give good sections showing the almost invariable presence of an overlapping vein within a few feet or inches of the one that has petered out.

Mary Jane (M.C. 8675).

1907—D.C.L.?

Mona (M.C. 7287).

1904—Bock's Gully. Included in Polygonic.

The north-western end of the Iolanthe zone is just within this ground. There is an old shaft, in which water now stands 25 ft. below the surface; there are also other old workings filled in during the working over of the old mullock tips. It would seem that the floater ground below the crops was rich, as it has been stripped in one place to a depth of 8 ft. right down to the gully bottom.

The company during 1909, 1910, and 1911 produced 1 11/20 tons wolfram, valued at £154.

Mona's Luck (M.C. 9784).

1910—Included in Polygonic.

Very little work has been done on this part of the lease.

Mon Repos (M.C. 7389).

1905—Included in Tungsten.

Two large caved opencuts have been opened on the north-western end of the Bluff zone, one of them being really a continuation of the D.C.L. cut. The veins are small and taper out within a short distance to the north-west.

Moonstone Natives (M.C. 8762).

1907—On northern boundary of Johnson. Abandoned.

The large cut on the boundary of the Johnson was continued into this holding, where the leaders, several of which are showing,

have thinned down below what could be profitably exploited. Another cut has, however, been carried northwards on what must be a cross vein, as the general trend of the veins hereabouts is north-westwards.

Mount Carbine (M.C. 7152).

1904—Included in Nil Desperandum.

This ground adjoins the Johnson, and on it both the Johnson and Nil zones have been worked, the former by adit and shaft as well as opencut and trench.

Mount Carbine (A.C. 9956).

1911—Unlocated. Abandoned.

Mount Carbine No. 1 (M.L. 2225).

1905—South-eastern end of the hill.

This includes Baird's Bluff, the first ground pegged out on the field. After being forfeited by Baird, the ground was applied for as a lease by a Port Douglas syndicate, and an attempt was made to work it, but without success. Subsequently the Irvinebank Company was approached and given two-thirds interest (later increased by purchase to thirteen-eighteenths) in the

PHOTO. 19.—MOUNT CARBINE NO. 1 DUMPS.
VIEWED FROM D.C.L.

holding conditionally on its erecting a mill, mining, and crushing the ore, and paying one-third of any profits to the syndicate, which retained one-third interest without liability. It is rumoured that £5,000 has been refused by the syndicate for its interest.

The Syndicate lease is now the main source of supply for the company's mill; and all the work done is on Bluff veins, but it is certain that the Nell will also be found in the north-eastern part. Rolfe's adit proves the Bluff veins to be of little value in the western part of the claim, but it has not been driven far enough to intersect the main veins of the Nell. (*See* Fig. 22.)

The opencuts, that in places pass down into as yet unfilled stopes, are a conspicuous feature of the hill. Most of them, though deep, are only a few feet wide, but in some places where the veins have come together the cuts are between 20 and 30 ft. across; and from end to end the great cut has a length of 6 chains. Most of the veins occur within a width of 50 ft., but there are several others to the south of the great cut on which some work has been done.

PHOTO. 20.—MAIN OPENCUT ON MOUNT CARBINE No. 1.
VIEWED FROM NORTH-WEST.

The veins are now being exploited by overhand stoping from drives driven along them off the superimposed adits known as No. 1 and No. 3 (the mouth of the latter being on the Poly-

gonic). These are connected with one another by shafts and stopes, and a rise from the mill adit connects the latter with No. 1. Ventilation is thus much facilitated, and conditions underground are consequently all that could be desired.

No. 1 adit is 172 ft. long, and from it seven drives, with an average length of 35 ft., run north-westwards, and six drives run south-eastwards, their average length being 140 ft. In all, 28 veins are crossed by the adit, the variation in width being between 1 in. and 3 ft. The total thickness is 17½ ft., but only one vein is over 18 in. in thickness. In the drives the veins are as much as

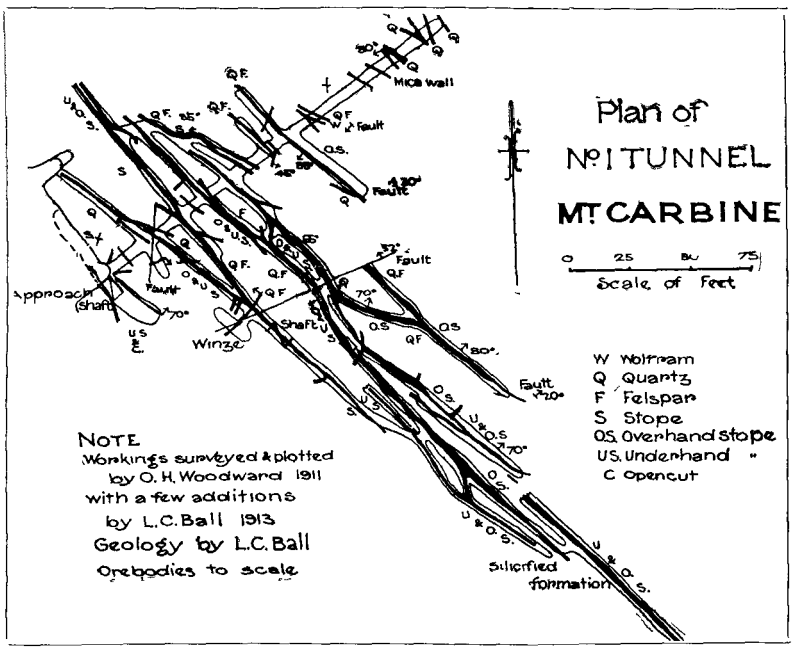

FIG 23.

1 ft. thick. Though much underhand and overhead stoping has been done, there are abundant opportunities for observation of the nature of the veins, their gangues, inclusions, branchings, overlaps, and faultings on joint planes. The dump is known to contain much ore that it would pay to treat, and to get at this a rise is being put up from the No. 3 adit level so that ore can be run directly to the mill. (See Fig. 18.)

No. 3 adit is 245 ft. long with four drives averaging 90 ft. in length on the north-west, and seven drives averaging 200 ft. in length on the south-east. The number of veins crossed, as

in No. 1 adit, is 22, of which the smallest is 1½ in., and the largest 4 ft. The combined thickness is 18½ ft., and omitting those veins under 18 in. wide, there is still a total of 10 ft. There have been great increases in the drives to the south-east. one vein reaching 5 and 6 ft., with 2 ft. 6 in. to 3 ft. averages over long distances. The best faces showing at the time of my visit were those in the stope, 13 ft. above the 180 ft. south-east drive off No. 3 adit, where a vein of quartz and felspar is from 2 ft. to 2 ft. 6 in. thick, and carries 10 per cent. wolfram. Mr. West points out the 209 ft. south-east drive within 50 ft. of the adit as having been the richest part of the mine. The reef there was 3 ft. wide, and for 40 ft. along the drive the stone averaged 11 per cent. wolfram. Underhand stoping has not been initiated here yet, because the reserves between this level and the surface are still being exploited. (*See* Fig. 24.)

A winze has been sunk 100 ft. beneath the adit level from the 189 ft. south-east drive. The reef above was 8 ft. wide, and at 20 ft. below the level it is still 6 ft. wide, consisting chiefly of quartz with some felspar and traces of wolfram. At 48 ft. down it was faulted its own width and tapered slightly. At 58 ft. depth, where the main reef has decreased to 3 ft. 6 in., a second reef, 2 ft. 6 in. wide, came into the winze, and continued to the bottom, the main reef being left in the wall of the shaft. Mr. West informs me the reef was rich in wolfram all the way down the shaft, and he looks upon the development as highly encouraging. Water is now standing at 25 ft. below the adit level, so that was as deep as my observations could go. At the adit level that part of the reef within 6 in. of the footwall carries about 10 per cent. wolfram—a quite unusual showing for this mine.

Myrtle (M.C. 8274).

1906—Included in the Daisy United.

Native (M.C. 7236).

1904—North-west of the True Blue.

This ground or part of it was subsequently applied for at various times as the Hunter, Huntress, Ivy, and Chance. It is on the True Blue zone.

Simpson and Beadle were cleaning out Perret's old shaft, in the bottom of which wolfram is said to have been left.

Nil Desperandum (M.C. 7207).

1904—This, the first claim registered, adjoins the Mount Carbine No. 1 on the north. Included in Johnson.

This includes part of two zones—the Nil and the Johnson. The cuts on the former near the crest of the ridge have caved in, but they do not indicate that the veins worked were of any richness nor of great continuity, the most extensive being about 2 chains long, and 12 to 18 in. wide. A costean to the south-east crosses the junction of two large veins of quartz and felspar, one 2 ft. 6 in. to 4 ft., and the other 10 in. to 2 ft. 3 in. thick, the bulge at their contact being 5 ft. (See Fig. 5.) Further on a shaft has been sunk 20 ft. on the same vein, which on the adjoining claim (the Johnson) was worked opencast.

Three or more distinct veins of the Johnson zone down the slope from the Nil have been worked extensively by opencut, shaft and adit over a distance of 3 chains in the south-eastern corner of the holding (this was part of the original Mount Carbine claim), and others have been worked at intervals to the north-west, where, however, the veins seem to have become impoverished and to be petering out.

The adit affords some interesting exposures showing overlapping, branching, faulting and petering-out of the veins, which run from 6 in. to 18 in. in thickness. It is 135 ft. in length, and in its different bends exposes five separate veins, which are from 5 to 18 in. in thickness, the average of the main vein followed being 12 in. (See Fig. 17.)

The Company during 1910 and 1911 produced 2 5/20 tons wolfram, valued at £214.

Nonentity (M.C. 9729).

1910—About 1 mile north of Mount Carbine leases. Abandoned.

O.K. (M.C. 7246).

1904—Bock's Gully, below Polygonic. Abandoned.

The floater ground is said to have yielded up to 80 lb. of wolfram to the cubic yard, and Mildren is said to have taken £500 worth of mineral from the claim.

Oliver (M.L. 2979).

1907—Dam site. Re-applied for as M.L. 3150.

Pearl (M.C. 8414).

1907—Included in Gems United.

Three distinct parallel veins belonging to the Ruby zone have been worked, chiefly by opencut, though four shafts have

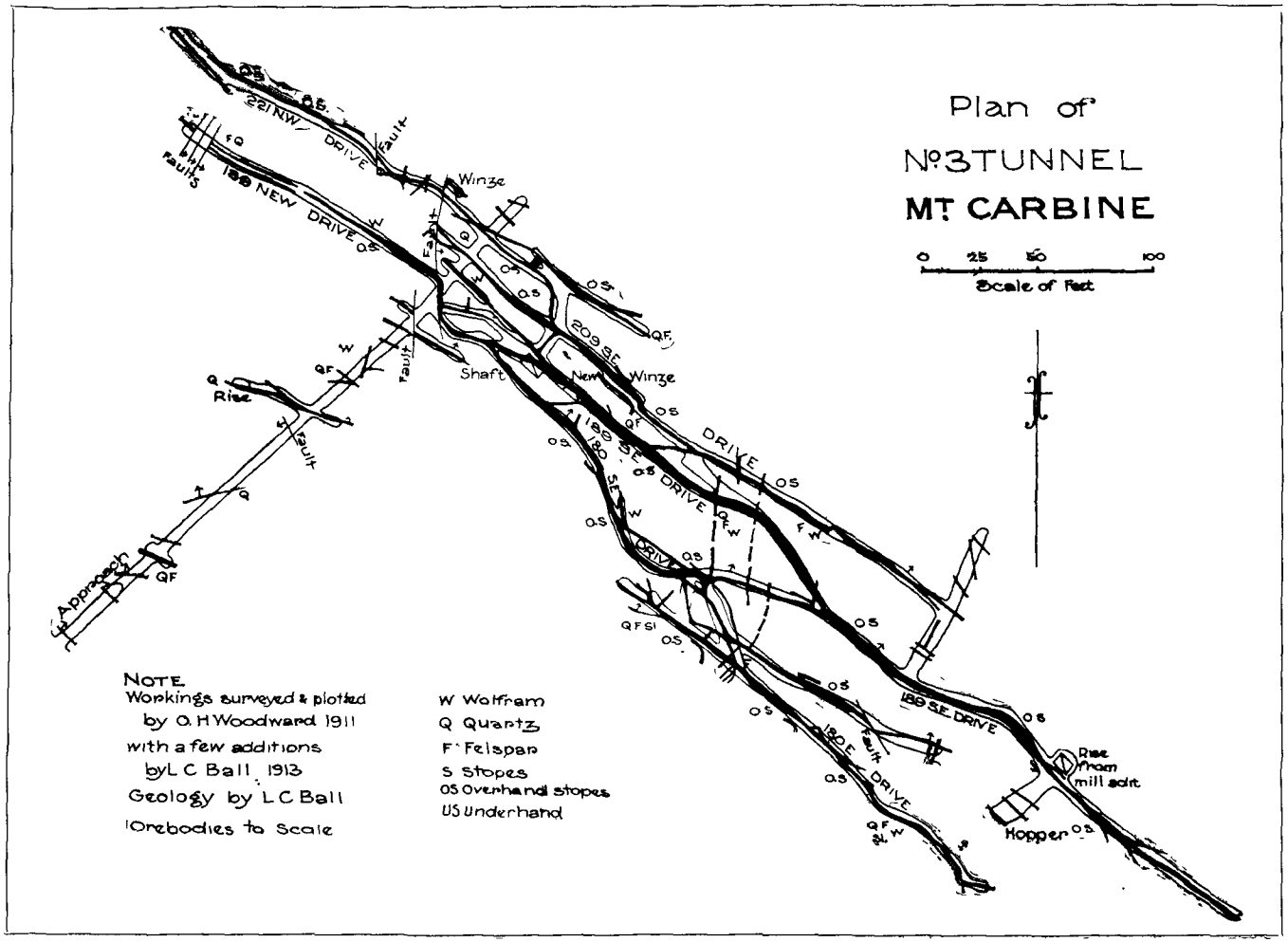
Plan of
No 3 TUNNEL
MT CARBINE
0 25 50 100
Scale of Feet
NOTE.
Workings surveyed & plotted by O. H Woodward 1911
with a few additions by L C Ball 1913
Geology by L C Ball
Orebodies to Scale
W Wolfram
Q Quartz
F Felspar
S Stopes
OS Overhand stopes
US Underhand
221 NW DRIVE
189 NEW DRIVE
Winze
Fault
Shaft
Rise
Approach
209 SE.
New Winze
189 SE DRIVE
180 SE DRIVE
180 E DRIVE
189 SE. DRIVE
Rise from mill adit
Hopper

Fig. 94

been sunk; two of them (Trahey's No. 1 and No. 2) near the Ruby boundary being 54 ft. deep, Trahey's No. 3 being 43 ft. deep, and the Company's tributer's shaft 40 ft. Owing to caving, little can now be seen, but it is patent that the veins were not large.

It is understood that the two 54-ft. shafts are connected by a crosscut and that ventilation was effected by means of a drive that broke into the Ruby workings. From No. 1 a stope was carried 50 ft. north-west and 25 ft. south-east, and similarly there were stopes on either side of No. 2 shaft which has caved in.

Phœnix (M.C. 8811).

1907—" 1 mile north of Mount Carbine." Abandoned.

Pianto's.

1911—Unregistered. Abandoned.

Pianto's workings are in the granite about ½ mile east of the main workings on Carbine Hill. A vein 9 to 12 in. thick is exposed by a shallow opencut. The stone now at grass is barren but presumably some wolfram was got here and traces of the mineral associated with like amounts of tinstone show in adjacent crops.

This vein and the others in the granite hereabouts trend in the same direction as those in the slate and were presumably formed at the same time.

Pick and Shovel (A.C. 9266).

1908—South-east of X Rays and down the slope from the Iolanthe. Now held by Brown.

This is in floater ground with 1 to 3 ft. sinking.

Porkey (M.C. 9792).

1910—Included in Polygonic.

The workings, including a few caved trenches, are apparently on the Johnson zone, here much attenuated, the veins exposed being only 1 to 4 in. in thickness.

Polygonic (M.L. 3283).

1911—Includes a number of claims (Mona's Luck, Little Hero, Lost Chance, Porkey, Hit or Miss, Poverty, Mona, and Dead Finish), lately acquired by the Irvinebank Company.

Most of the vein zones should cross this elongated piece of ground; but only the Ruby and Iolanthe have been worked to

any extent, although rich ore has been won on the R.S.B. and Little Nell on either side. Thus the adit in the gully between the R.S.B. and Ruby United in a distance of 135 ft. cut seven leaders, most of them less than 3 in. thick and only one reaching 12 in. This last carries a little wolfram, and 18 ft. of driving was done on it with little result.

The old Gems United workings (described under other headings) extend nearly across the northern end of the lease; and from the amount of work done, one should judge that the returns were fair.

On the southern part of the lease in the old Mona claim rich shoad ground was worked on Bock's Gully and a little mining was done on the Iolanthe line; and again some surfacing has been done on the old Dead Finish claim, where also one of the Iolanthe reefs has been exploited by opencut, shaft, and adit. The reef in the adit was from 15 to 18 in. wide, and it appears to be worth following to the south-east. (See Fig. 22.)

The company during 1911 and 1912 produced 4 tons wolfram, valued at £391.

Rolfe's adit is about 70 ft. long, and it crosses 17 veins of the Bluff zone, these being 1 in. to 20 in. in thickness. The total reef thickness is 8½ ft., but only two are greater than 18 in. One of these, 10 ft. from the mouth of the adit, has been followed for 90 ft. to the south-east, but the vein gradually thinned out to 6 in. in the face. The other, near the end of the adit, should now be prospected, and the adit itself should be extended to prove the Nell veins ahead.

The company, between May, 1907, and the end of 1912, sold 577 15/20 tons wolfram from this ground, the value being £54,134. Since 1910, there has been treated 23,596 5/20 tons of ore, yielding 408 5/2 tons wolfram, included in the above sum.

Poverty (A.C. 7975).

1906—"East side of Mount Carbine." Abandoned.

Poverty (A.C. 7519).

1905—Bock's Gully. Abandoned.

Red Cap (M.C. 7278.)

1904—" 1½ mile north of Mount Carbine." Abandoned.

The mine is on the western side of a hill ½ mile to the north of Carbine Hill's summit.

The two parallel veins agree in trend with those of Mount Carbine, but the character of the country rock has changed, the slate being here distinctly epidotic in character, this causing it to be extremely hard and difficult to mine. Two shafts have been sunk a little over a chain apart on the main line, and the caved cuts extend a distance of more than three chains, but little can be seen of the occurrence of the reef because of a thick overgrowth of grass and weeds. The stone left at the brace shows that some chalcopyrite occurs with the wolfram here. Though the mine was worked by Boreham for several years, he informed me that the deepest shaft does not reach more than 33 ft. beneath the surface (where, however, he reported wolfram still showing). At the north-western shaft 3 tons of wolfram was got near the surface and 1½ ton in sinking, and from the south-eastern shaft a total of 3 tons was got (1 1/20 tons near the surface). A third shaft on a 6-in. leader 3 chains to the south-west of the above yielded 18/20 ton wolfram.

The total yield from the claim was 12 15/20 tons (*fide* Mr. Boreham).

Rolfe (M.L. 2878.)

1907—Taken up by the Irvinebank Company on the northern side of the Johnson to protect the dump at No. 2 adit.

Only one or two small trenches have been opened.

R.S.B. (M.C. 9426).

1909—Between the D.C.L. and Polygonic. Now held by White.

A number of leaders of the Bluff and perhaps also the Nell and Iolanthe zones have been exploited here.

The Nell workings in the northern part of the claim are unimportant, comprising only a few caved trenches, a cut, and a short adit. The veins are small and do not extend far.

The Iolanthe (?) veins in the southern part have been deeply opencut and trenched, and besides three shafts now caved or flooded have been sunk, while there is also a caved adit along one of the veins. The veins now showing are from 3 to 13 in. thick.

White's present workings are on the Bluff zone, here consisting of the usual network of branching and overlapping leaders. The opencuts have been filled in, but one of the two 30-ft. shafts is in use and was descended. At 10 ft. depth drives run off to the north-west, and much stoping has been done for a yield of 10 tons wolfram. At the bottom there are drives north-

west and south-east, respectively 20 and 30 ft., on a 9-in. vein of iron and slightly copper-stained quartz carrying blady laths of wolfram much stained by ochre. The yield from the 35 ft. of driving is 2½ tons of stone, believed to carry 15 per cent. wolfram, which should just about afford wages.

The total production of the claim is estimated by Mr. White at 20 tons of wolfram.

Ruby (M.C. 7261).

1904—Included in Ruby United.

Ruby (M.C. 7876).

1906—Included in Ruby United.

Ruby No. 1 (M.C. 9376).

1909—Included in Ruby United.

Ruby United (M.C. 9587).

1909—At northern end of the Polygonic. Now held by Hetherington and Frear.

Several veins have been tried here all belonging to the Ruby zone, but only two or three have been worked extensively, first of all by open cuts (now caved), then by shafts (of which there are seven, all now inaccessible), and lastly by adits, of which there are two, one on either side of the Hill. These workings extend from end to end of the claim, and the amount of work done by two men in seven years is surprising. The innermost of the adit veins is the most continuous on this claim, it having been followed through the Ruby and also the Pearl. The others are made up of a series of overlapping leases.

The south-eastern part of the claim (formerly the Ruby No. 1) does not give much promise. The cuts which are caved show only small lenticular leaders and the four shafts, the deepest of which is only 20 ft., are inaccessible.

In the north-western part (the original Ruby), where there are three main reefs, the shafts are much deeper, No. 1 being 58 ft., No. 2 54 ft., and No. 3 97 ft. The last is connected with Trahey's No. 1 on the Gems United for ventilation. The mullock tips of this claim are outstanding landmarks; and, as they contain a little wolfram throughout (the exact percentage has never been determined), they will probably be retreated in time to come.

These old shaft workings have now been made accessible by the two adits. Frear's adit is 30 ft. long, and it meets the main reef between No. 1 and No. 2 shafts, where 2 ft. 6 in. thick. In the drives to the north-west and south-east it splits and gradually thins down, but as wolfram is showing in several places more work will be done here in the future. (See Fig. 22.)

Hetherington's adit is 63 ft. long, and four separate drives run off from it; the two outer for 30 ft. to the west, an inner drive for 53 ft. to the west-north-west and 12 ft. to the east-south-east, and the main drive for 80 ft. to the west-north-west and 35 ft. east-south-east. In the outermost drive three small leaders were followed, and being rich in wolfram, were stoped out to the surface. In the next drive two small leaders were followed. The main drive is on two leaders, 3 ft. 6 in. apart, one of them 7 in. and the other 9 to 12 in. thick. Good wolfram was got here, and much of the stoping done has been above and below the north-western drive. (See Fig. 22.)

A stope extends 20 ft. to the south-east of the No. 1 shaft and north-westwards to No. 2, which connects by stope with No. 3 shaft, and this again by a short crosscut at the 66 ft. level with the adit. The reef was 3 ft. wide at the collar of No. 3 shaft, but the average below was 18 in.

Mr. Hetherington estimates the total production of the Ruby United to be between 27 and 30 tons wolfram.

St. Patrick (M.C. 7415).

1905—Included in Catherine, q.v.

Saxon (M.C. 8984).

1907—" Mount Carbine." Abandoned.

Scheelite Gully.

Scheelite Gully is on the eastern slope of Carbine Hill, and lies about a quarter of a mile north of the mill. The name is derived from the fact that much scheelite has been got on the surface here, and a few hundredweight of the mineral was obtained as late as 1912. Of the many alluvial claims pegged out here none seems to have been registered. Fitzgerald did some work on the leaders in the bed and on either side of the gully during 1912.

The veins which belong to the Iron Duke zone are hereabouts extremely irregular both in trend and size, apparently because of their deposition along intersecting joint planes. They are never more than 12 in. thick, and the quartz is associated with so much country that the material is rather " formation " than ore.

One shaft now used as a well has been sunk 30 ft., and some stoping has been done beside it. The cuts have been filled in as worked, and in the ends only small and irregular leaders are showing.

Scottish Queen (M.C. 7271).

1904—Included in the Tungsten.

The above ground is at the north-western end of the Bluff zone, of which three separate veins have been here exploited by cuts or trenches; and on one of them (9 in. thick) two shafts were sunk and some stoping done.

Sloper (M.C. 8516).

1907—Included in Ruby United.

Smoker (M.C. 8945).

1907—" North-east of Mount Carbine." Abandoned.

Struggle (M.C. 9312).

1908—" South-western side of Mona," Bock's Gully. Lately held by Grogan.

This is believed to have been out on the flat to the west of the gully, where much stripping 2 to 5 ft. deep has been done, but where there are still many blocks untouched.

Struggle (M.C. 9756).

1910—Adjoining the Battler, Bock's Gully. Abandoned.

Sundet's Gossan Blow.

19— —Not pegged out

This crop is on the flat at the north-western end of the field 30 ch. west of the Redcap. A shallow hole exposes 3 ft. width of siliceous manganiferous material, including silicified country and traces of rhodonite. It is believed to carry traces of gold and silver, but though there was once a project on foot to sink 100

ft. on it there is little encouragement. As elsewhere noted, the formation is probably due to cooled magmatic solutions such as those that brought in the tungsten, and it is not unlikely that wolfram may occur in depth here.

Tailings (M.C. 9314).

1908—Manganese Creek below township, near recreation reserve. Abandoned.

This was taken up for the retreatment of tailings from a little sluicing done by the company.

Tom Thumb (M.C. 8641).

1907—"Two hundred yards south of Mona." Probably on Bock's Gully. Abandoned.

Triangle (M.C. 7238).

1904—Between Edith, Polygonic, and Mount Carbine No. 1. Now held by Kiddy and party.

The alluvial along Bock's Gully in the lower end of this claim is said to have been very rich in wolfram, as much as 60 lb. to the yard having been reported.

Between 20 and 30 veins of the Nell and Bluff zones have been exposed by shallow cuts on this claim; but the chief workings are in the southern part, where two separate series of veins have been opencut and sunk upon by shaft. One of these shafts is 65 ft. deep and the other 30 ft., but neither was made accessible to me. Mr. Kiddy states that there is a 2-ft. vein at the bottom of the 65-ft. shaft, where, however, it happens to be poor just now. A short adit at the end of one of the southern cuts exposes two veins 7 to 15 in. in thickness, both of which contain good wolfram, but cannot further be profitably underhand stoped. (See Fig. 22.) It is now proposed to put an adit in from one of the lowest cuts, whereby a number of the known reefs will be intersected and backs will be made available.

Of late the claim holders have been doing well, making an average of £5 per man per week. The production of the last eight years Mr. Kiddy estimates as 35 tons, but the yield prior to 1904 is not known.

True Blue Extended (M.C. 9393).

1909—At north-western end of the hill. Included Keating's. Abandoned.

In order to get at the vein worked by Keating (q.v.), Simpson, at a point 60 ft. below the cap, put an adit in 80 ft., then drove 40 ft. north-west and 65 ft. south-east, and then stoped up; but most of the work was unremunerative, as only one rich patch of wolfram (14/20 ton) was struck. Subsequently another party sunk a winze 30 ft. in hard ground for a small return. In the face of the north-western drive the vein is 6 in. thick. (See Fig. 22.)

A second adit, Perrett's, a little more than a chain south of Simpson's, has been partly filled in, but in the outer portion there is a 6-in. vein showing. Perrett is said to have got 9/20 ton of wolfram from this adit.

The total yield for the claim would seem to have been less than 9 tons.

Try Again (M.C. 8148).

1906—"Mount Carbine." Abandoned.

Try Again (M.C. 9960).

1911—North of Johnson. Abandoned.

Small 6 to 12-in. lenticular veins have been deeply trenched, but there is no evidence of rich ore having been got.

Tungsten (M.L. 3174).

1910—North-west of the Polygonic and D.C.L. Includes Scottish Queen, Just in Time, Ida, Hopeful, Mon Repos, Phœnix, and part of Bismark. Now held by the Irvinebank Company.

The Ruby and Bluff zones have been worked but not to a large extent, comprising as the workings do only shallow shafts and a few opencuts, though there are numerous trenches. Owing to the usual caving and filling in little can be seen of the veins, none of which, however, can have been of large size.

Venture (A.C. 8856).

1907—"¼ mile north-west of Mount Carbine." Abandoned.

Vera (M.C. ?).

1912—Includes Crow's Nest. Now held by Asmus and Lovell.

This claim is being worked for tin which occurs chiefly in greisenised country along fissures in intrusive granite; but a little wolfram has been got in neighbouring gullies, and one irregular mass of quartz in the unaltered granite carried a little molybdenite.

Wayback (M.C. 9443).

1909—Included in Johnson.

Four or more separate veins of the Wayback line have been worked by a trench and opencut now caved, the thickness varying between 6 and 18 in. There is showing in the end of Christisen's cut a vertical leader 6 to 12 in. thick, poor in "metal." Also the mill adit passes through the claim exposing three veins respectively 2 in., 6 in., and 2 ft. in thickness.

The Irvinebank Company during 1911 produced 10/20 ton wolfram valued at £48.

Wellbeck Abbey (M.L. 3073).

1908—South of Lucky Hit. Taken up by the Irvinebank Company, but later abandoned.

A little surfacing has been done in the northern part of this ground.

Whistler (A.C. 7457).

1905—"Mount Carbine." Abandoned.

White Elephant (A.C. 8823).

1907—"Included in Eye Opener."

Wolfram Crown (M.C. 9122).

1908—Included in Johnson.

The Dazzler zone failed just on the eastern end of this ground, but there is an offshoot from the Nil zone that has been trenched and potholed almost from corner to corner. This is in one place 18 in. thick, but generally less than 6 in., so is unimportant.

X Rays (M.C. 7463).

1905—Included in X Rays Extended.

X Rays Extended (A.C. 7709).

1905—South of Mount Carbine No. 1. Now held by Johnson and Martin.

The greater part of this claim has been surfaced during periods of high market prices, usually to a depth of only 3 ft For this operation as many as 30 or 40 wages men have been temporarily employed on the claim. Johnson at the end of the year was stripping single-handed 8 to 10 ft. ground near the centre in preparation for the advent of the wet season, when

the whole paddock would be ground sluiced. The claim holder expects a yield of 3 oz. to the dish (equivalent to 1 per cent.), but it is not generally believed that the ground can average ½ per cent.

PHOTO. 21.—STRIPPING FLOATER GROUND ON X-RAYS.

In the northern part of the claim, where one of the Iolanthe veins has been opencut, a tribute party (Williamson and Sorenson) has sunk a shaft 50 ft., and is now engaged in stoping a 15-in. vein. The men are making good wages, the stone when picked averaging 7 per cent. wolfram.

Mr. Johnson estimates the total production of the claim as 40 tons of wolfram.

X Rays East (A.C. 8922).

1907—South-east of X Rays Extended, with which combined.

Brisbane, February, 1913.

ANTHONY JAMES CUMMING, Government Printer, Brisbane.

Attachment 2:
Pastoral Holding Title Search

Current State Tenure Search

Queensland Titles Registry Pty Ltd
ABN 23 648 568 101

Title Reference:	**17664140**	**Search Date:**	26/08/2021 13:03
Date State Tenure Created:	21/10/1995	**Request No:**	38337692
Creating Dealing:			

DESCRIPTION OF LAND

Tenure Reference: PH 9/2359

Lease Type: ROLLING TERM LEASE

LOT 13 SURVEY PLAN 254833
Local Government: MAREEBA

Area: 59000.000000 Ha. (ABOUT)

No Land Description

No Forestry Entitlement Area

Purpose for which granted:
NO PURPOSE DEFINED

REGISTERED LESSEE

Dealing No: 708361442 13/01/2005

AUSTRALIAN WILDLIFE CONSERVANCY A.C.N. 068 572 556

TERM OF LEASE

Term and day of beginning of lease

Term: 30 years commencing on 01/01/1964

Expiring on 31/12/1993

Extended to 31/12/2046

CONDITIONS

```
A126  SPECIFIED CONDITIONS FOR: Term Lease
      PURPOSE: Rolling term lease - pastoral
      ------------------------------------------------------------------------
      STATUTORY CONDITIONS:
      ------------------------------------------------------------------------
      Statutory conditions are the general mandatory  conditions of a lease
      and binds the lessee in accordance with  Part 2 Division 1 of the Land
      Act.
      1. Permitted Use: The lessee must  use the land only for the purpose
         for which the tenure was issued  under the Land Act 1994.
      2. Duty of Care: The lessee has  the responsibility for a duty of
         care, for the land under the  Land Act 1994.
      3. Rent/Instalment: The lessee  must pay the annual rent/instalment
         in accordance with the Land  Act 1994 and the Land Regulation
         2009.
         For further information on  how annual rent is determined, refer
         to the department's website  at www.dnrm.qld.gov.au.
      4. Noxious plants: The lessee  must keep noxious plants on the land
         under control. If the lessee  does not comply with this condition,
         the Minister may bring the  noxious plants under control, the cost
         of which will be recovered  from the lessee.
      5. Information to Minister: The  lessee must give the Minister
         administering the Land Act  1994, information the Minister asks
         for about the tenure.
```

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CONDITIONS (Continued)

6. Monies for Improvements: No money for improvements is payable by the State on the forfeiture, surrender or expiry of this lease but money may be payable if the State receives payment from an incoming lessee or buyer for the improvements on the land. However, the previous lessee may apply to the Minister to remove the improvements that belong to the lessee, within a period of 3 months from the date of the forfeiture, surrender, or expiry of this lease. The lessee may only undertake the removal of the improvements in the presence of an authorised representative of the department, if required by the Minister. The lessee may only remove those improvements if all monies due from the lessee to the department under this lease have been paid.

REGULATORY-CONDITIONS:----------

A regulatory condition relates to a lease , in accordance with the Land Regulation.

1. Indemnity: The lessee indemnifies and agrees to keep indemnified the Minister, and the State of Queensland and its Representatives, (the "Indemnified parties") against all liability, costs, loss and expenses including claims in negligence (including any claims, proceedings or demands bought by any third party, and any legal fees, costs and disbursements on a solicitor and client basis) ("Claim") arising from or incurred in connection with:
   a. the granting of this lease to the lessee;
   b. the lessee 's use and occupation of the land; or
   c. personal injury (including sickness and death) or property damage or loss in connection with the performance (or attempted purported performance or non-performance) of the lease or a breach of the lease by the lessee .

   The lessee hereby releases and discharges to the full extent permitted by law, the Indemnified parties from all actions, claims, proceedings or demands and in respect of any loss, death, injury, illness or damage (whether personal or property and whether special, direct, indirect or consequential financial loss) arising out of the use and occupation of the lease. To the full extent permitted by law, the Minister, the State of Queensland and their Representatives will not be liable to the lessee for any special, indirect or consequential damages, including consequential financial loss arising out of the use and occupation of the lease.
2. Public Liability: The lessee must effect a public liability insurance policy with an insurer authorised under the Insurance Act 1973 (Commonwealth) or, if not so authorised then only with the Minister's approval, which can be given or withheld in the Minister's sole discretion, naming the lessee as the insured covering legal liability for any loss of, or damage to any property and for the injury (including death) to any person arising out of anything done or omitted on or about the land or any improvements thereon and against all claims, demands, proceedings, costs, charges, and expenses whatsoever (including claims in negligence) Such policy must:
   a. be for an amount of not less than $20,000,000.00 and have no per event sublimit or such higher amounts as the Minister may reasonably require.
   b. be effected on a "claims occurring" basis; and
   c. be maintained at all times during the currency of the lease, and upon receipt of any notice of cancellation, the lessee must immediately effect another public insurance policy in accordance with the terms of the lease .

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CONDITIONS (Continued)

The lessee must, as soon as practicable, inform the Minister, in writing, of the occurrence of any event that the lessee considers is likely to give rise to a claim under the policy of insurance effected and must ensure that the Minister is kept fully informed of subsequent actions and developments concerning the claim.
The lessee must renew such policy, at the lessee's expense, each year during the currency of this lease.
The condition will be satisfied if the lessee is the State of Queensland or a statutory authority eligible for cover under the Queensland Government Insurance Fund and is insured and continues to be insured by the Queensland Government Insurance Fund.
This condition will be satisfied if the lessee is the Commonwealth of Australia or a statutory authority eligible for cover under the Comcover Insurance Fund and is insured and continues to be insured by Comcover.

3. Access: The provision of access, further access or services to the land will not be the responsibility of the State.
4. Survey Costs: If the land needs to be surveyed or re-surveyed the lessee must do this at their own cost under the Survey and Mapping Infrastructure Act 2003. This survey plan must be lodged in the land registry within the specified time.
5. Extension: The lease is subject to the extensions of rolling term leases provision of the Land Act 1994 and the Minister must grant an extension of the term of a rolling term lease if the lessee makes an application in the approved form. The extension will be for the original term of the lease and may be given subject to condition changes.
6. Jurisdiction: The lessee is subject to the Land Act 1994 and all other relevant Queensland and Commonwealth legislation.
7. Compliance with Laws - the lessee must comply with all lawful requirements of the -
   a. Local Government; and
   b. any department within the Queensland or Commonwealth governments (including the department administering the Land Act 1994), local authority or statutory instrumentality having jurisdiction over the land, or the development, use and occupation of the land, in regard to its use, occupation and development of the land.

SPECIAL-CONDITIONS:----------

These conditions relate to this lease.
Improvements or development on or to the land

1. The lessee must during the whole term of the lease, to the satisfaction of the relevant authorities, maintain all improvements on the land in a good and substantial state of repair.

Quarry material

1. The lessee must allow any person authorised under the Forestry Act 1959 access to the leased land for the purpose of cutting and removing timber or removing other forest products, or quarry material, or other material from the leased land.
   Except as hereinafter provided the lessee must not interfere with any forest products or remove any quarry material (including any stone, gravel, sand, earth, soil, rock, guano or clay which is not a mineral within the meaning of the Mineral Resources Act 1989) or other material upon the leased land without the permission of the Minister administering the Land Act 1994 except under the authority of and in compliance in every respect with the requirements or a permit, licence, agreement or contract granted or made under the Forestry Act 1959.

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CONDITIONS (Continued)

ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Lease No. 17664140

2. EASEMENT No 707721711 14/05/2004 at 12:47
burdening the land to
COMMON PROPERTY FOR BROOKLYN
VILLAGE ESTATE CTS 31184 OVER
EASEMENT A ON SP154002

3. EASEMENT IN GROSS No 708019404 01/09/2004 at 11:31
burdening the land
ERGON ENERGY CORPORATION LIMITED
over
EASEMENTS R,S AND T ON SP146383

4. NATURE CONSERVATION NOTING No 709705860 22/06/2006 at 16:07
all or part of the within land has been declared a Nature
Refuge under the Nature Conservation Act 1992

5. AMENDMENT OF LEASE CONDITIONS No 715949585 13/08/2014 at 05:00
THE CONDITIONS OF THE WITHIN TENURE ARE HEREBY AMENDED.

6. NATURE CONSERVATION NOTING No 716152687 20/11/2014 at 15:31
all or part of the within land has been declared a Nature
Refuge under the Nature Conservation Act 1992

ADMINISTRATIVE ADVICES

Dealing	Type	Lodgement Date	Status
700305315	WET TROPICS WET TROPICS WORLD HERITAGE PROTECTION AND MANAGEMENT ACT1993	26/10/1994 07:56	CURRENT
710104697	VEG NOTICE VEGETATION MANAGEMENT ACT 1999	16/11/2006 13:05	CURRENT
714762080	NT DETERM NATIVE TITLE ACT 1993 (CTH)	02/11/2012 09:09	CURRENT
718374852	NT DETERM NATIVE TITLE ACT 1993 (CTH)	02/11/2017 16:04	CURRENT
719767646	EXEMPT CONS SEC 322AA LAND ACT 1994	02/12/2019 08:28	CURRENT

UNREGISTERED DEALINGS

NIL

Caution - Charges do not necessarily appear in order of priority

** End of Current State Tenure Search **

Information provided under section 34 Land Title Act (1994) or section 281 Land Act (1994)

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Attachment 3:
Accepted Decommissioning and Rehabilitation Plan

DEPARTMENT OF MINERALS AND ENERGY

i:\mnl\env\docs\lmw\wolff.doc

OUR REF. PJM 20077

YOUR REF.

Contact Officer: Lynn M Whitfield
Telephone: (07) 237 1906
Facsimile: (07) 237 0989

Queensland
Minerals &
Energy Centre
61 Mary Street
Brisbane QLD 4000
G.P.O. Box 194
Brisbane QLD 4001
Telephone: (07) 237 1435
Facsimile: (07) 229 7770

25 May 1995

Mr D Wolff
Mine Manager
Queensland Tungsten
Mail Centre
MT CARBINE QLD 4871

Dear Mr Wolff

I refer to the Decommissioning and Rehabilitation Plan and associated report on Mine Wastes and Contaminated Areas Assessment and Remediation for Mt Carbine minesite and apologise for the delay in responding.

The plan is acceptable to the Department.

However, there are a number of issues which must be addressed;-

- monitoring of stability and rehabilitation of waste dumps should continue
- water quality of seepage from No 1 and No 2 waste dumps, water from No 4 tailings dam, the Return Water dam and the open pit should not be used for stock watering purposes as the quality is currently not acceptable. Access should be restricted to these areas, if not already in place. Monitoring should continue to determine if the quality improves to allow access.

B/c Frank Jones
Regional Manager
MAREEBA

For your information

Lynn Whitfield

25/5/95

Dept. of Minerals and Energy
RECEIVED
23 OCT 1995
MAREEBA

- The contaminated site assessment report indicates that the sulphide dam and the jig tailings sites currently contain levels of cadmium, chromium, copper, arsenic, zinc, nickel and manganese in excess of the environmental and health investigation levels. Similarly there is evidence from the analyses of levels of petroleum based products in excess of investigation levels. These sites should be remediated or contained and managed. Should this area be surrendered or excised from the lease, a Final Rehabilitation Report should be prepared describing measures undertaken to avoid or minimise land contamination and measures to remediate or manage any contaminated land. The report should propose a classification of the site for recording on the Contaminated Sites Register. I attach an information paper on he implications for leaseholders of the Contaminated Land Act. A Management Plan should be developed in conjunction with the landholder and access precluded to the sites. Any seepage from the sites should also be managed.

- The vegetation management plans are satisfactory but a final strategy needs to be implemented and monitored.

If you have any queries you should contact Michael Frankcombe, Regional Environmental Officer, Far North Region, on (070) 924211.

Yours sincerely

Lynn M Whitfield
Principal Environmental Officer
Environment Branch

QUEENSLAND TUNGSTEN

(Wholly owned by Normandy Poseidon Ltd.)

POSTAL ADDRESS
Mail Centre
Mt. Carbine Qld 4871
Tel. 070 943 157
Fax 070 943 150

MINE OFFICE
Mt. Carbine

19th September

Ms L. Whitfield,
Principal Environmental Officer
Department of Minerals and Energy
G.P.O. Box 194
Brisbane
Queensland 4001

Dear Ms Whitfield,

MOUNT CARBINE DECOMMISSIONING PLAN - PJM 20077

We enclose a draft Decommissioning Plan for your information and comment.

We think we have now put together a document that will largely meet with your approval and would appreciate the opportunity to discuss it with you in the near future.

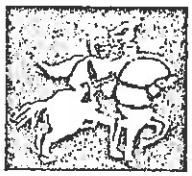
You will note that this time it is submitted without frills or Appendices until we have reached agreement on a final draft.

Our report on the Mine Wastes, which becomes Appendix 10 to the Decommissioning Plan, has not been completed, but this is expected to be ready for presentation soon afterwards.

In the mean time, we look forward to discussing our Plan with you.

Yours sincerely,

D. Wolff
Mine Manager



QUEENSLAND TUNGSTEN

(Incorporated in Queensland)

A Subsidiary of Normandy Poseidon Ltd.

MOUNT CARBINE MINE

Mount Carbine North Queensland

DECOMMISSIONING AND REHABILITATION

OF MINING LEASES 4867 AND 4919

September, 1994

QUEENSLAND TUNGSTEN

(Incorporated in Queensland)

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MOUNT CARBINE MINE

Mount Carbine North Queensland

DECOMMISSIONING AND REHABILITATION

OF MINING LEASES 4867 AND 4919

September, 1994

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REFERENCES

1. Queensland Tungsten (August 1993)

   * Report on Investigations Leading to the Location and Structure of a Protective Wall around the Mt. Carbine Open Pit.

2. Queensland Tungsten (August 1993)

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   * Draft Technical Guidelines for Enviornmental Management for Mining in Queensland.

4. Queensland Tungsten (June 1993)

   * Mt. Carbine Mine Plan of Operations.

5. Department of Mines W.A. (January 1991)

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   * Reports on Mt. Carbine Tailings Samples

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   * Mt Carbine Area Groundwater Investigation.

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* A Report on, and Management Proposals for, Waste Rock and Sand Resources

12. Geological Survey of Queensland (1915

* Publication No. 251 - Wolfram Mines of Mt Carbine North Queensland by Loinel C. Ball

13. Queensland Department of Minerals and Energy (Feb 1994)

* Draft Guidelines for Assessment and Management of Land Contamination

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* Properties of Australian Fly Ashes Relevant to their Agronomic Utilisation. J. Soil Res. 22, 443 - 453.

APPENDICES

1. Analysis Systems
   * Soil and Tailings Analysis (May 1993)

2. Siteplan Landscape Achitects

   * Vegetation Survey Report - Mt Carbine (June 1993)

3. Department of Primary Industries
   * Report on Herbaceous Vegetation of Mt. Carbine Mine Site (June 1993)

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   * Mt. Carbine Mine Water Quality Report (April 1993)

5. Soil Conservation and Environmental Services
   * A Case in Support of Terraced Landforms (August 1993)

6. Letters From Landholder re Water and Dam Requirements

7. Natural Resource Assessments Pty. Ltd.
   * Revegetation Trials Design (December 1993)

8. Natural Resource Assessments Pty. Ltd.
   * Report on Revegetation Trials (June 1994)

9. Office of Inspector of Mines
   * Inspection Report - Ecologist Dept. of Mines (April 1978)

10 Queensland Tungsten
   * Mine Wastes - Preliminary Site Investigations (September 1994)

QUEENSLAND TUNGSTEN
MT. CARBINE MINE

Decommissioning and Rehabilitation Programme

For mining Leases Nos 4867 and 4919

1. INTRODUCTION

In accordance with the requirements of the Mineral Resource Act 1989, a Plan of Operations for the Mt. Carbine mine was submitted to the Department of Resource Industries in June 1992. At that time it was decided that the Plan of Operations be approved for 12 months and that an Environmental Management Overview Strategy (EMOS) be submitted.

Due to continued low tungsten prices and the deterioration of the mine plant, which had been closed on care and maintenance since November 1986, a decision was taken to dismantle and offer for sale all buildings, plant, machinery, associated materials and facilities. As a consequence, a large auction was held on 23rd and 24th February, 1993 and a smaller final auction to clear unsold and residual items and rock resources, on 18th June, 1994.

The currency of the original Plan of Operations, which expired on 31st July 1993, was not renewed. With Department of Minerals and Energy approval, the Plan of Operations and mooted EMOS were deemed to be superceded by this document; being generally a record of the work completed during the course of decommissioning and rehabilitating the Mt. Carbine Mine.

This document seeks approval for the work done.

2. BACKGROUND INFORMATION

2.1 Project Description

Since the discovery of wolframite at Mt. Carbine in about 1895, (Ref Locality Plan Fig 1) Carbine Hill has been mined to a greater or lesser extent, depending on fluctuating metal prices and the interest of lease operators. One such operator, the Thermo Electric Company, ceased work in 1920 and until R.B. Mining Pty Ltd took over all the leases in 1970, mining was carried out in a small way by numerous syndicates who mined underground and left the hill a maze of workings.

From 1970 to 1974, R.B. Mining produced wolframite and scheelite from elluvial material on the southern end of Carbine Hill. October 1974, with the commencement of an open pit, marked the beginning of more hard rock mining and this continued for twelve years to November 1986. During this period, approximately 20 million tonnes of rock were removed.

Originally, the pit benches were four metres high and selective drilling and blasting was parallel to the quartz. Later, drilling and blasting was end-on to the veins. This method placed great reliance upon the experience of loader operators to recognise ore in a broken rock pile. With the advent of M16 photometric ore sorter in 1978 and the development of ancillary X-ray equipment in 1982, much of this guess work was taken out of the mining operations, and any material that could be handled by the crusher from within the ore zone was then delivered to the crusher.

Because of the very low head grades, selective mining and/or sorting in the open pit was always important. Wide bands of waste were transported direct to the dump as oversize rock. The rest of the ore zone material was sent to the crushing facilities for further sorting and crushing. Removal of overburden, which was largely located on the northern side of the open pit, was generally a straight-forward mining process and, apart from pockets of ore, it was all transported to the waste dump.

With the installation of the photometric ore sorting facilities in 1978, the jigging, tabling and magnetic separation facilities were also upgraded and greater production, and improved treatment and concentration resulted. This expansion programme also included the construction of a permanent workers village on a nearby lease.

In June 1985, diminishing open cut ore reserves prompted the start of an underground development programme to gain access to additional resources. By the time the mine was closed and put on care and maintenance, 500 metres of decline development had been completed and equipped with an ore conveyor system connected to the feed preparation section of the existing ore treatment facilitities.

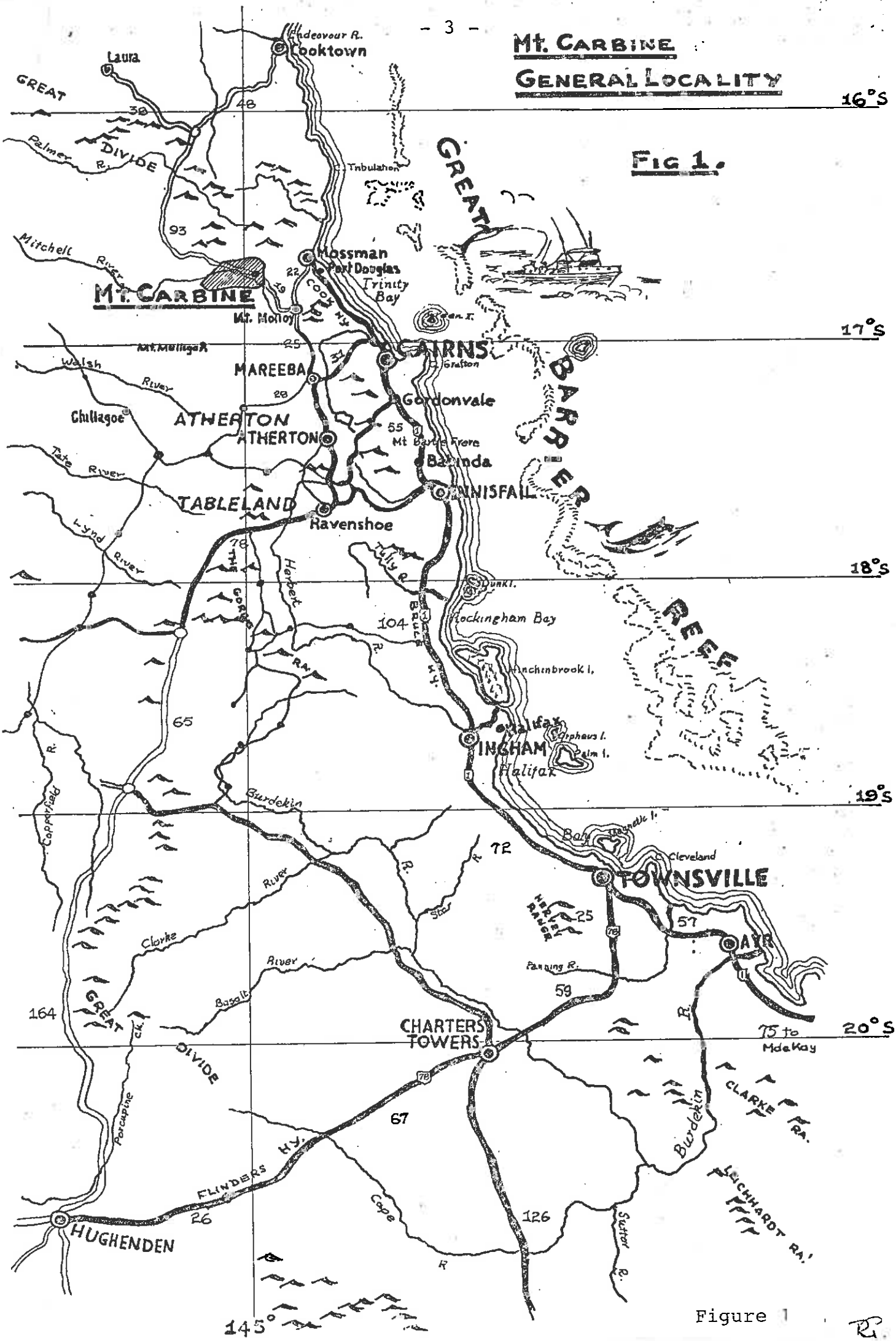

Mt. CARBINE
GENERAL LOCALITY
FIG 1.
16°S
17°S
18°S
19°S
20°S
145°
Endeavour R.
Cooktown
Laura
GREAT
DIVIDE
Palmer R.
Tribulation
GREAT
BARRIER
REEF
Mitchell River
Mossman
Port Douglas
Trinity Bay
Mt. CARBINE
Mt. Molloy
Mt. Mulligan
CAIRNS
Grafton
Walsh River
MAREEBA
Gordonvale
Chillagoe
ATHERTON
ATHERTON
Mt Bartle Frere
Babinda
Tate River
TABLELAND
Ravenshoe
Lynd River
THE GORGE RA.
Herbert R.
Tully R.
Dunk I.
Rockingham Bay
Hinchinbrook I.
Halifax
Orpheus I.
Palm I.
INGHAM
Halifax
Burdekin
Copperfield R.
Bay
Magnetic I.
Cleveland
TOWNSVILLE
HERVEY RANGE
AYR
Star R.
Clarke River
Basalt River
Panning R.
GREAT DIVIDE
CHARTERS TOWERS
75 to Mdekay
CLARKE RA.
Burdekin R.
Porcupine ck.
FLINDERS HY.
HUGHENDEN
Cape R.
Sutter R.
LEICHHARDT RA.
38
48
93
22
19
25
31
28
55
78
104
65
72
25
57
59
164
67
26
126

Figure 1

2.2 Mining Leases

The Mount Carbine operation originally comprised 12 Mining Leases (Table 1). Nine leases were submitted for surrender in 1993, while three are still current, as shown in Table 1. Only the three current leases ML4867, ML4859 and ML4919, are the subject of this decommissioning plan. The lease locations are shown in Figure 2.

Table 1. Current and * Surrendered Lease at Mt Carbine.

New ML No:	Old ML No:	Name	Expiry Date	Lease Area (Ha)	Status
4867	[2523]	Mt. Carbine No.1	31/7/1998	1,033.97	Current
4919	[2888]	New D.C.L.	31/8/1999	7.89	Current
4835 *		Elsmore	31/7/2010	5.00	* Surrendered
4859 *		Nautilus	31/7/2010	97.46	* Surrendered
4874 *		Stannifer Creek	30/6/2010	3.00	* Surrendered
4877 *		Alison	30/9/2010	17.00	* Surrendered
4875 *		Old Mill	30/6/2010	4.00	* Surrendered
4876 *		Tingha	30/6/2010	6.00	* Surrendered
4903 *		Paw Paw	31/3/1993	63.41	* Surrendered
4907 *		Ted Brach	31/8/1993	2.43	* Surrendered
4908 *		Angeline	31/5/1993	2.97	* Surrendered
4937 *		Arcadia	31/12/1995	32.37	* Surrendered

* Submitted for Surrender

2.3 Location of Activities

Of the leases shown in Table 1, the ones most affected by mining or mining-associated activities were -

1. ML 4867 - Mt Carbine No.1
   - Waste rock dumps
   - Open pit excavations
   - Water storage dams
   - Sand stockpiles (tailings dam)
   - Building and steel structures
   - Workers' accommodation
   - Drainage channels

2. ML 4919 - New D.C.L.
   - Waste rock dumps
   - Open cut excavation

3. Ml 4859 - Nautilus
   - Services; powerlines, pipelines and pumps

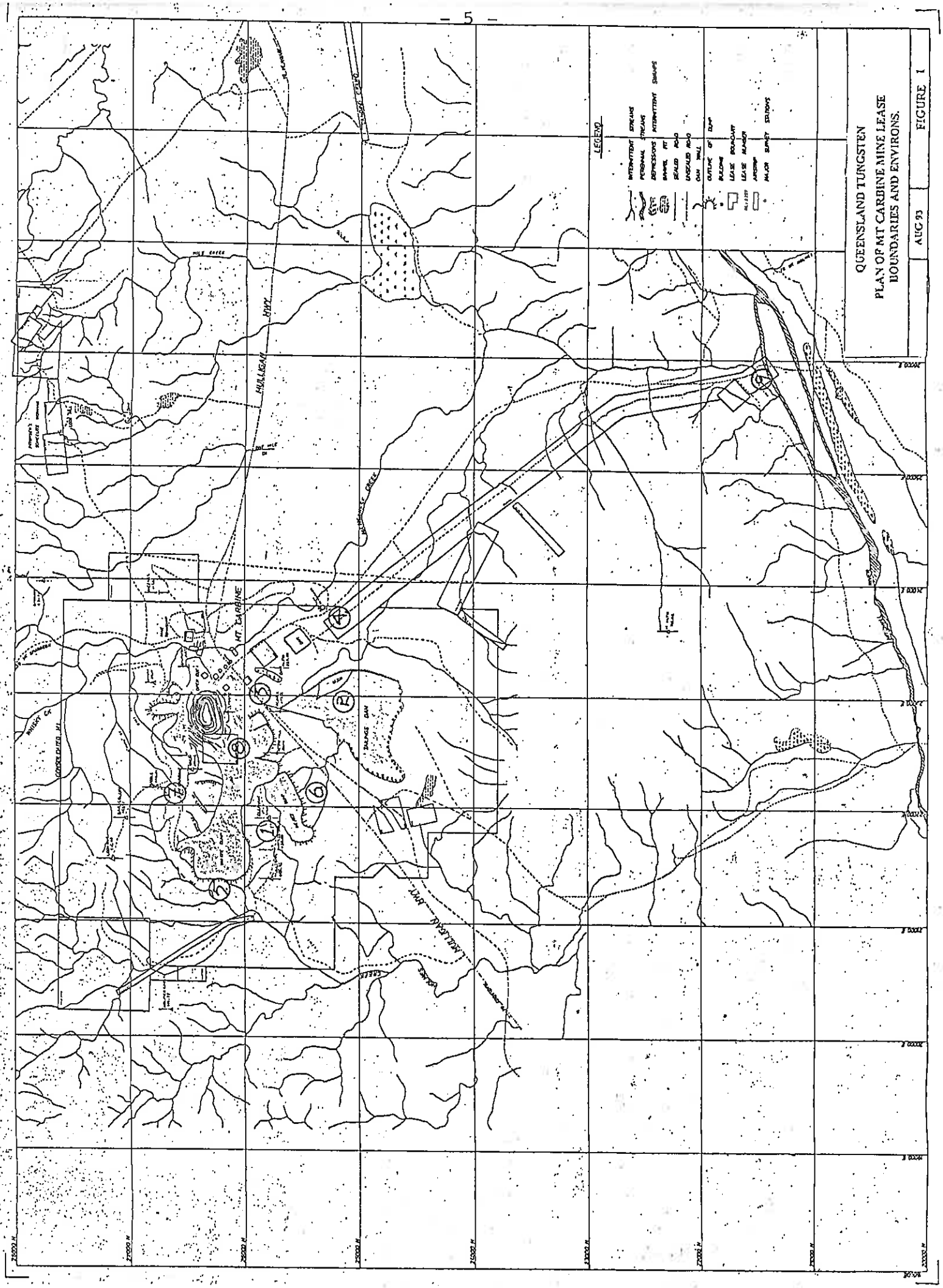

QUEENSLAND TUNGSTEN
PLAN OF MT CARBINE MINE LEASE
BOUNDARIES AND ENVIRONS.
AUG 93
FIGURE 1
LEGEND
HULIGAN HWY
MT CARBINE
MULLIGAN RIVER

Figure 2

2.4 Mineral Resources

The Mt Carbine tungsten deposits consist of several zones of quartz-felspar veins in a N-S trending belt 2.5km long. The veins are hosted by complex deformed metasediments, marginal to, and probably in the roof zone of the Mossman batholith. The mine is centrally located in Hodgkinson Barron sub province of the Siluro-Devonian Hodgkinson sedimentary province. The Hodgkinson province and its borderland have a wide range of minerals including Au, Sn, W, Mo, Bi, Cu, Pb, Zn, Ag and F. In the literature on the province there has been a strong emphasis on relating virtually all deposits, with few exceptions, to hydrothermal activity associated with the Carboniferous-Permian granites.

The remaining useful resources which are on mining leases ML 4867, Mt. Carbine No.1 and ML 4919, New D.C.L. comprise -

- 7,000,000 tonnes of wolframite/scheelite ore in situ averaging about 0.123% WO_3.
- 10,000,000 tonnes of large waste rock.
- 3,000,000 tonnes of small waste rock.
- 1,250,000 tonnes of tailings.

2.5 Land Resources

2.5.1 Pre-Mining Land Capability

The valley of the Mitchell River is almost entirely taken up by beef cattle grazing. The land is not of high quality and supports a variety Brahman at a density of about one head per 20 hectares, outside small areas of improved pasture.

Because of the topography and rockiness of the area mined (Carbine Hill) and the adjacent area used now for dumping rock, land use prior to mining was very limited. Accordingly, classification category VII as per Rosser et al, 1974, would, apply, eg., land which is not suitable for cultivation but on which pastoral use is possible only with caul mangement. Pasture improvement involving the use of machinery is not practicable.

2.5.2 Post-Mining Land Capability

Table 2 details the disturbance types which resulted from mining and milling activity, the pre-mining land capability and the targets set for post-mining land capability on completion of the planned rehabilitation programme.

Restoration of the disturbed land to pre-mining levels is not expected, but some level of recovery will occur in time and with the help of revegetation programmes.

It cannot be said that land recovery will in anyway be inhibited by hazardous substances.

2.5.3 Soils

Topsoils were not stockpiled prior to land disturbances (excavation or fill) and no regional or site - specific data was collected on soil characteristics and quality prior to site disturbances.

However, the dominant soil types appear to be impoverished and heavily leached with low salinity. A fair level of organic material is in evidence. Wet season growth is abundant, but is generally low in nutrients.

Soil sampling and anlysis carried out by Analysis Systems in May 1993 provided the information shown in Table 3. The locations of sample sites is shown in Figure 2. (Appendix 1).

Table 2 : AREAS DISTURBED AND TARGET POST MINING LAND CAPABILITY FOR ML 4867 AND ML4919

DISTURBANCE TYPE	PRE-MINE LAND USE	PRE-MINE LAND CAPABILITY	AREA DISTURBED (Ha)	TARGET POST MINE LAND CAPABILITY	AREA (Ha)	POST MINE LAND USE
Waste dumps mesa design	LICG LTB	VII	16	VIII VII	2 14	Rock Resource Rock Resource LTB (prospective)
Waste dumps terrace design	LICG LTB	VII	46	VIII VII	6 40	Rock Resource LTB (prospective)
Tailings dams	LICG LTB	VI	36 26	VIII VII Water (VI)	30 6 26	Sand Resource LTB Stock Quality Water
Plant site	LICG LTB	VII	18	VII	9.5 8 8.5	LICG LTB Housing
Roads	LICG LTB	VII	5	VII	5	LICG LTB
Freshwater dam	LICG LTB	VI	3	VI	3	LICG LTB
Sediment dams	LICG LTB	VI	3	Water (VI)	3	Stock Quality
Voids	LICG LTB	VII	30	Water (VI) Perimeter VII	22 8	Stock Quality LTB
Ore stockpiles		VII	2	VII	2	LTB
Fuel, oil areas		VII	0.5	VII	0.5	LICG+LTB
Septic system		VII	0.5	VII	0.5	LICG+LTB
Refuse dump		VII	2.5	VII	2.5	LICG+LTB
Exploration tracks and pads	LICG LTB	VII	0.5	VII	0.5	LICG+LTB
Offices	LTB	VII	0.5	VIII	0.5	Offices

LICG - Low Intensity Cattle Grazing
LTB - Light Timber Bushland

Table 3 Soils - Chemical Characteristics (Locations shown in Figure 2)

	SITE 3 (Adjacent to Highway)	SITE 6 (Adjacent to Highway)	SITE 5 (Adjacent to Waste Dumps)	SITE 4 (Pipeline Easement)	Critical Limit*
Soil Colour	Brown	Brown	Brown	Brown	
Soil Texture	Gravelly Sandy Clay Loam	Gravelly Sandy Clay Loam	Gravelly Sandy Clay Loam	Gravelly Sandy Clay Loam	
pH (1:5 Water)	5.2	5.3	5.7	5.7	5.5-8.5
Buffer pH	6.1	5.9	6.1	6.2	
Organic Carbon %C	1	1.3	1.2	0.6	
Nitrate Nitrogen mg/kg	3.4	2.3	0.5	0.4	
Sulfur mg/kg	65	194	16	4	15
Phosphorous (BSES) mg/kg	41	9	7	7	
Phosphorous (Colwell) mg/kg	7	3	3	4	30
Potassium meq/100g	0.25	0.15	0.21	0.25	0.2-0.3
Calcium meq/100g	1.55	2.83	3.92	1.78	
Magnesium meq/100g	1.31	2.91	2.4	0.53	0.75-1.5
Aluminium meq/100g	0.17	0.03			
Sodium meq/100g	0.36	0.7	0.23	0.07	
Chloride mg/kg	60	85	40	20	<200-600
Copper mg/kg	2.9	0.9	1	0.5	
Zinc mg/kg	3.4	0.3	0.7	0.4	0.5-1.0
Managanese mg/kg	18	8	6	28	0.75-1.5
Iron mg/kg	82	137	44	9	2.4-4.5
Boron mg/kg	0.07	0.1	0.04	0.06	
Liming Requirement 5.5	0.1	0.3			
Liming Requirement 6.5	0.7	1.3	0.7	0.5	
Cation Exch. Capacity meq/1	3.64	6.62	6.77	2.64	
Calacium/ Magnesium Ratio	1.18	0.97	1.63	3.36	
Aluminium Saturation %	4.7	0.5			
Sodium% of cations (ESP)	9.89	10.57	3.4	2.65	
Elec. Conductivity (s.e.) ds/m	1.2	2.3	0.5	0.3	4.8

* For nutrients, Critical Limit is the level below which a plant response to application of the nutrient might reasonably be expected in improved crop and pasture species (Aitken et al 1984). For Cl and Ec the critical value is the level above which, growth maybe retarded.

2.5.4 Flora

The area in the vicinity of Mt. Carbine is not thickly forested and is widely called savannah country. Tea-trees inhabit the swamps and pandanas are common along creeks.

Higher up River supports, cyprus pine is fairly abundant on the Burton Ridge, while the Mitchell River supports plenty of paper barks.

Consultants, Siteplan Landscape Achitects, were engaged to advise on the existing vegetation in the area and to suggest species considered appropriate for revegetation of the tailings and waste rock surface areas Their report is included in Appendix 2. In addition The Department of Primary Industries offered advice on local grasses (Appendix 3).

2.5.5 Fauna

Animal and bird life is varied and plentiful in and around the mining leases and there appears to have been no diminution of activity or numbers over the past twenty five years since mining resumed on a large scale in the area. In fact, the presence of permanent water has enhanced the attraction of the area for all forms of life and in particular water birds and water animals. There are no survey results to support the view that there is an undiminished presence of birds and animals, but comparable habitat, species, and numbers are found in the areas surrounding the mine leases.

2.5.6 Waste Rock - Physical and Chemical Characteristics

At Mt. Carbine the shallow marine sediments occur as three rock units:

- An Arenitic unit with sandstones, greywackes and grits alternating with siltstones, shales and minor cherts.

- A Basic Volcanic Chert unit with interbedded shales.

- An Argillitic unit which is the main host for the Mt. Carbine orebodies and comprises shales and thinly interbedded shales, siltstones and minor chert.

These rocks are also known as chlorite, biotite muscovite quartz-schists.

They are cut by veins of quartz and it is this quartz which acts as host for all minerals, both economic and gangue, that are to be found in Carbine Hill.

The average grainsize of the quartz is probably less than 20 microns,

likewise, the micas occur as a consistent series of incipient strips of aligned micas about equal in volume. Chloritic formation is sporadic as linear bodies following the micas.

Quartz veining is common, mainly monomineralic, and these veins usually cross the schistosity, although showing some evidence of deformation.

The schist contains very occasional sulphide crystals, probably pyrite of sub 0.1mm sizes, and there is a spotting of a finer generation. Altogether, these sulphides would hardly amount to 0.01%S content. (Table 4).

These minerals pose no threat to the environment, either in situ or as leachates. 90% of the main coarse and fine waste dumps consist of fresh unweathered rock. There is some evidence of iron staining, but this is superficial and merely lects the oxidation of some wolframite which escaped collection and treatment.

2.5.7 Tailings - Physical and Chemical Characteristics

- Jig Tailings

Because nearly all Mt. Carbine tailings were produced solely as a result of gravity separation methods, they are free of added chemicals (Table 5).

The jig tailings dams have developed in a similar way to alluvial deposits. The constant washing water line has segregated sections of the dams, not only according to particle size, but also according to density. These dams cover an area of 62 hectares and contain about 1.5 million tonnes of sand.

The first particles to settle out, near the discharge were coarse, dense particles. The particles included coarse free tungsten minerals and quartz composites with large tungsten inclusions. As water flowed towards the ponding zone of the dam, finer particles were deposited until, at the water line, the velocity of the slurry dropped to zero. Here the slimes settled.

Quartz is the main light mineral; heavy gangue minerals are brown tourmaline white flourite, apatite, chlorite, siderite, goethite (oxidised sulphides), iron-stained micas (and micaceous rock fragment). Sulphides include pyrite, chalcopyrite, pyrrhotite, molybdenite and arsenopyrite. A trace of cassiterite is present, and other minerals probably occur sporadically in traces. The tungsten minerals are wolframite and scheelite, and although a few intergrowths are seen, they generally appear to be separate species.

Table 4 Waste Rock - Chemical Characteristics - Ore Sorter Reject

PARAMETER		SAMPLE Ore Sorter Reject
Cadmium (Cd)	mg/kg	<0.5
Chromium (Cr)	mg/kg	<50
Copper (Cu)	mg/kg	54
Arsenic (As)	mg/kg	50
Zinc (Zn)	mg/kg	67
Lead (Pb)	mg/kg	<2
Nickel (Ni)	mg/kg	16
Mercury (Hg)	ug/kg	<25
Iron (Fe)	%	3.07
Manganese (Mn)	mg/kg	410
Phosphorus (P)	mg/kg	525
Sulphur (S)	mg/kg	0.07

Table 5 Jig Tailings - Chemical Characteristics - No.3 Tailings Dam

PARAMETER		SAMPLE No.3 Tailings Dam
Cadmium (Cd)	mg/kg	<0.5
Chromium (Cr)	mg/kg	<50
Copper (Cu)	mg/kg	43
Arsenic (As)	mg/kg	50
Zinc (Zn)	mg/kg	43
Lead (Pb)	mg/kg	<2
Nickel (Ni)	mg/kg	8
Mercury (Hg)	ug/kg	<25
Iron (Fe)	%	2.06
Maganese (Mn)	mg/kg	288
Phosphorus (P)	mg/kg	525
Sulphur (S)	mg/kg	0.03

- Sulphide Tailings

A section of the treatment process did include the use of chemicals in a small way to clean up crude concentrate. As a result, approximately 2,000 tonnes of sulphide-rich tailings were produced and stored on their own in a 50m x 20m "turkey's nest" dam as a result of the table flotation process designed to separate wolframite from sulphide gangue minerals.

These tailings are rich in copper, arsenic and iron, amongst other metals. (Table 6).

Table 6: Flotation Tailings - Chemical Characteristics - Sulphide Dam

PARAMETER	SAMPLE Sulphide Dam
Cadmium (Cd) mg/kg	99
Chromium (Cr) mg/kg	200
Copper (Cu) mg/kg	3400
Arsenic (As) mg/kg	26000
Zinc (Zn) mg/kg	2200
Lead (Pb) mg/kg	205
Nickel (Ni) mg/kg	133
Mercury (Hg) ug/kg	<25
Iron (Fe) %	4.10
Manganese (Mn) mg/	630
Phosphorus (P) mg/	1.10%
Sulphur (S) mg/	7.10

2.6 WATER COLLECTION AND RUN-OFF

Because the land was dry and had no water storages prior to 1970, dams and ponds and bores were established to meet the needs of the mine. Four of susbtance were created -

- Fresh Water Dam
- No.4 Tailings Dam (Superceded No3 Tailings Dam)
- Return Water Dam
- Half Moon run-off dam (Ephemeral)

2.6.1 Fresh Water

This "Turkeys Nest" dam was constructed to hold 73 megalitres of fresh water pumped direct from the Mitchell River. It collected no run-off water and was supplied solely by pumps. It is no longer used.

2.6.2 Run-Off

This was the first dam to be constructed on the mining lease in 1970. It collects seasonal run-off behind an inconspicuous low retaining wall and has generally dried up by October each year.

2.6.3 Process Water

- No4 Tailings Dam

This dam was constructed solely for the purpose of storing tailings, but this also necessitated incorporation of water storage to allow collection for further use in the ore treatment process.

The dam covers an area of 58 hectares, of which an average 25% (15 hectares) is used for water storage. During a normal wet season, this storage of water increases to 35% as run-off from Mt. Alto and Carbine Hill collects around the tailings.

- Return Water

The Return Water dam is small by comparison and covers 1.8 hectares. It is an old tailings dam and is bounded on three sides by walls, while contours on the fourth side help determine the water level which is also governed by a spillway.

A normal wet season ensures it is kept full from Carbine Hill run-off, but in earlier days it was fed by water pumped up from No.4 Tailings dam; being re-usable water from the original ore treatment process.

2.6.4 Open Pit Water

Until the wet season of 1990/91 seepage, rain and run-off water that collected in the open pit was pumped out and discharged to the nearby Maganese Creek drainage system.

From March, 1991, water has been allowed to collect in the bottom of the pit until it is now 6 metres deep.

This is the net result of minor ground water seepage, 1456mm of rain (to April 1994), Carbine Hill run-off and the effects of evaporation.

2.6.5 Drainage

Drainage in the area around Mt. Carbine is dominated by the Mitchell River, to which all mine lease water flows during the wet season. The river's prominence is best described by Lionel Ball who said in part -

"The river rises in the sandy flats within a few miles of Mareeba, and for several miles flows northwards parallel to and within two miles of the Barron River. It then trends to the north-west flowing through country of low relief until old Northedge homestead is reached when it passes through the remnants of an old range (the Slaty) and is thrown slightly off its course. After a few miles it resumes its even journey to the north-west, with high ranges within a mile or two to the right and left almost to its junctions with the Mary River, where it makes another sudden bend to the west-north-west and cuts through still another range (Little Alto). Below this, the river is confined by ranges on both sides, yet a little way to the north is a parallel flat-bottomed valley, the elevation of which is not much greater than that followed by the river. The township of Mt. Carbine is in this valley."

(:Geological Survey of Queensland (1915)
The Wolfram Mines of Mt. Carbine-North Queensland,
by Lionel C. Ball)

2.6.6 Sub - Surface Water

The alluvial sands and gravels of Manganese Creek provided low yields, but good quality permanent water wells and bores, such water being derived from the granites in the catchment area of the Great Dividing Range. These sands are angular and sub-angular and indicate a reasonable degree of permeability and are about eleven metres thick, just as they are at the Mitchell River.

Within the consolidated rocks, ground water occurs within faults and fractures, but it is often brackish and of poor quality.

A number of water bores and wells were drilled and sunk over the years to 1970, but there are no details as to quality.

Ground water was generally good and was in fact, the only source available close to the township; except for Manganese Creek which provided water during the wet season.

2.7 Social, Heritage and Cultural Aspects

2.7.1 Social Considerations

At a meeting of Mt. Carbine residents on 4th April, 1993, a steering committee was formed for the purpose of:-

- Considering what effects, if any, the closure of Normandy Poseidon's mine and the rehabilitation of the mine site might have on the Mt Carbine community.

- Requesting consideration by the mine's management of any changes to its rehabilitation programme that could be seen to have a beneficial outcome for the comunity.

- Advocating the formation of an organisation made up of Mt. Carbine and Maryfarms residents to promote and pursue common interests and objectives that would provide benefits for the people of the district and give them a voice in the planning and development of projects in and around their area.

This action resulted in the formation of the Mt. Carbine-Maryfarms Development Association and as a result of subsequent inspection of the mine site the Association requested consideration of modifications to the rehabilitation programme which would allow them to:-

- Obtain the concrete block laboratory building and older portion of the general administration building for use by the community.

- Maintain access to a look-out on Carbine Hill, Bench 430.

- Maintain the whole of the concrete foundations and retaining walls of what was once the primary crusher installation.

With respect to the buildings; Normandy Poseidon Limited agreed that subject to the approval of the Department of Minerals and Energy and the needs of new lease holders, the concrete block assay building be donated to the Mt. Carbine-Maryfarms Development Association. Consideration would also be given to including the older portion of the administration building provided it was not required for other purposes.

Regarding the access road to the lookout; the Company supported the community view and would have been prepared to erect a safety fence at the lookout. However, following discussions with officers of the Deparment of Minerals and Energy and the land holder regarding public safety and liability, it was decided that public access to the area should be prevented. Accordingly, a decision was taken to block access.

With respect to crusher foundations and concrete lined tunnels; safety was again the major consideration. As a consequence it was decided that:-

- The bin section of the crusher installation would be filled then covered with waste rock. The remaining concrete foundations and structures would be buried with waste rock and contoured to match the adjoining escarpment.

- The entrances to the concrete tunnels would be sealed and the area contoured where appropriate.

2.7.2 Cultural and Heritage Aspects

Discussions with local residents and GuGu Yelanja Aboriginal representatives did not provide any information or indication of areas of interest or value to them within the lease area and covered by the rehabilitation programme.

Although prospecting and mining in the district dates back to 1880 and continued until the end of the First World War when the collapse of the wolfram market resulted in the cessation of organised mining until 1970, there is no evidencs or relics of old workings of any significance in the area.

3. REHABILITATION

The grazing land around Mt. Carbine is not of high quality and rehabilitation to pre-mining standards will not materially enhance its value. Excavated and other disturbed areas cannot practically be returned to their original state. In any case, much of the disturbance is caused by waste rock and tailings dumps and these are regarded highly as useful resources for road construction and other construction projects.

However, a comprehensive decommissioning and rehabilitation programme was undertaken, involving -

- The removal of all buildings and structures (with the exception of a concrete-block assay office and timber framed administration office).
- The excavation and disposal or burial, of every concrete foundation and slab.
- The landscaping and rehabilitation of a large tailings dam (No.3).
- The removal or reshaping of ore and waste dumps.
- Removal of all water and power services.
- Sealing and burial of underground excavations.
- Redirection of drainage
- Construction of, and modifications to, an escarpment around the open pit and construction of a security fence.
- Identification and isolation of hazardous waste occurrences.
- A revegetation programme involving trial plots, tree planting and the spreading of 100,000 cubic metres of poor quality soil.

A brief 1978 report from ecologist Don Kratzing is included in Appendix 9 for information.

3.1 Rehabilitation Costs

The cost of decommissioning and rehabilitating mining leases at Mt. Carbine amounted to $529,000, excluding those costs which will be associated with the ongoing monitoring and maintenance of these leases (Table 7).

TABLE 7 Schedule of Rehabilitation Costs 1993 and 1994

DISTURBANCE TYPE	AREA DISTURBED AS OF 1993 (ha)	COST OF REHAB. 1993 ($)	COST OF REHAB 1994($)	COST OF REHAB. TOTAL ($)
Waste Dumps mesa design	16		4,000	4,000
Waste Dumps terrace design	46	17,000	99,000	116,000
Tailings dams	62	38,000	117,000	155,000
Plant Site	18	111,000	39,000	150,000
Roads	5		3,000	3,000
Freshwater dam	3		4,000	4,000
Sediment dams	3		5,000	5,000
Voids	30	13,000	27,000	40,000
Ore Stockpiles	2		15,000	15,000
Fuel, oil areas	0.5		10,000	10,000
Septic system	0.5			
use dump	2.5	10,000	10,000	20,000
Exploration tracks and pads	0.5		7,000	7,000
		189,000	340,000	529,000

3.2 Rehabilitation of Projects Completed

Decommissioning and rehabilitation work was undertaken generally in accordance with standards approved and agreed by the Department of Minerals and Energy since work began in February, 1993

3.2.1 Open Pit

The Mt. Carbine Open Pit covers and area of approximately 27 hectares and is located on the southern flank of Carbine ridge.

It has a north highwall consisting of 10 metre high benches extending from the pit floor at RL305 to its rim at RL385, then continuation of terraces (benches) up to the slope of the ridge to the Ruby Zone at RL465. The east and west walls are similarly benched to the rim. The east wall slope is 32^0 and the west wall slope 44^0.

The southern boundary also consists of benches of varying height, but is determined by a prominent 70^0 north-dipping structure termed the south wall fault. The average slope of the south wall is 50^0. Apart from the north highwall the perimeter of the pit is surrounded by an escarpment. As the mine site is in a sparsely populated and sparsely stocked area, a 1.2 metre safety factor was considered appropriate for locating a bund wall.

On this basis, a bund wall placed around the pit void in accordance with the foregoing would be located close to the outer (southern) end of the escarpment which now virtually surrounds the pit.

Instead of constructing a rock bund wall at this position, the existing escarpment was modified where necessary to meet the requirements of protecting people and stock from the open pit void.

Modifications to the escarpment included :-

- Removal of three access road ramps.
- Removing and/or re-shaping five rock stockpiles.
- Constructing a bund-type rock wall about 26,000*N* to butt against the rill of an open pit north wall access road at about 26,225*N*.
- Incorporation of concrete pipes to allow drainage water into the pit.

Figure 3 shows :-

- The escarpment boundary marked in blue.
- The theoretical location of a bund-type rock wall, if such were

constructed in accordance with guidelines, marked in red.

Location of the theoretical bund in relation to the pit bench details is also shown in Figures 4 and 5 to indicate that the escarpment is much more substantial and exceeds minimum safety requirements. Plates 1 and 2 give views of the escarpment.

In addition to the escarpment modifications:-

- A suitably constructed fence of four strand barbed-wire was erected at least 10 metres from the base of the escarpment.

- Signs warning of a safety hazard also prohibiting access have been attached to the fence.

- Drainage channels to direct storm run-off water from Carbine Hill and where possible, waste rock areas, into the open pit, have been established.

  A drainage channel at the eastern end of the open pit to control and direct any storm water overflow into Manganese Creek was established.

Based on the effects of drainage, an average annual rainfall of 750mm, and average annual evaporation rate of 1700mm, it is estimated that water accumulating in the open pit will take at least 24 years to overflow.

The location of site and pit drainage channels, pit overflow trench and general site storm water sedimentation ponds is shown in Figure 7.

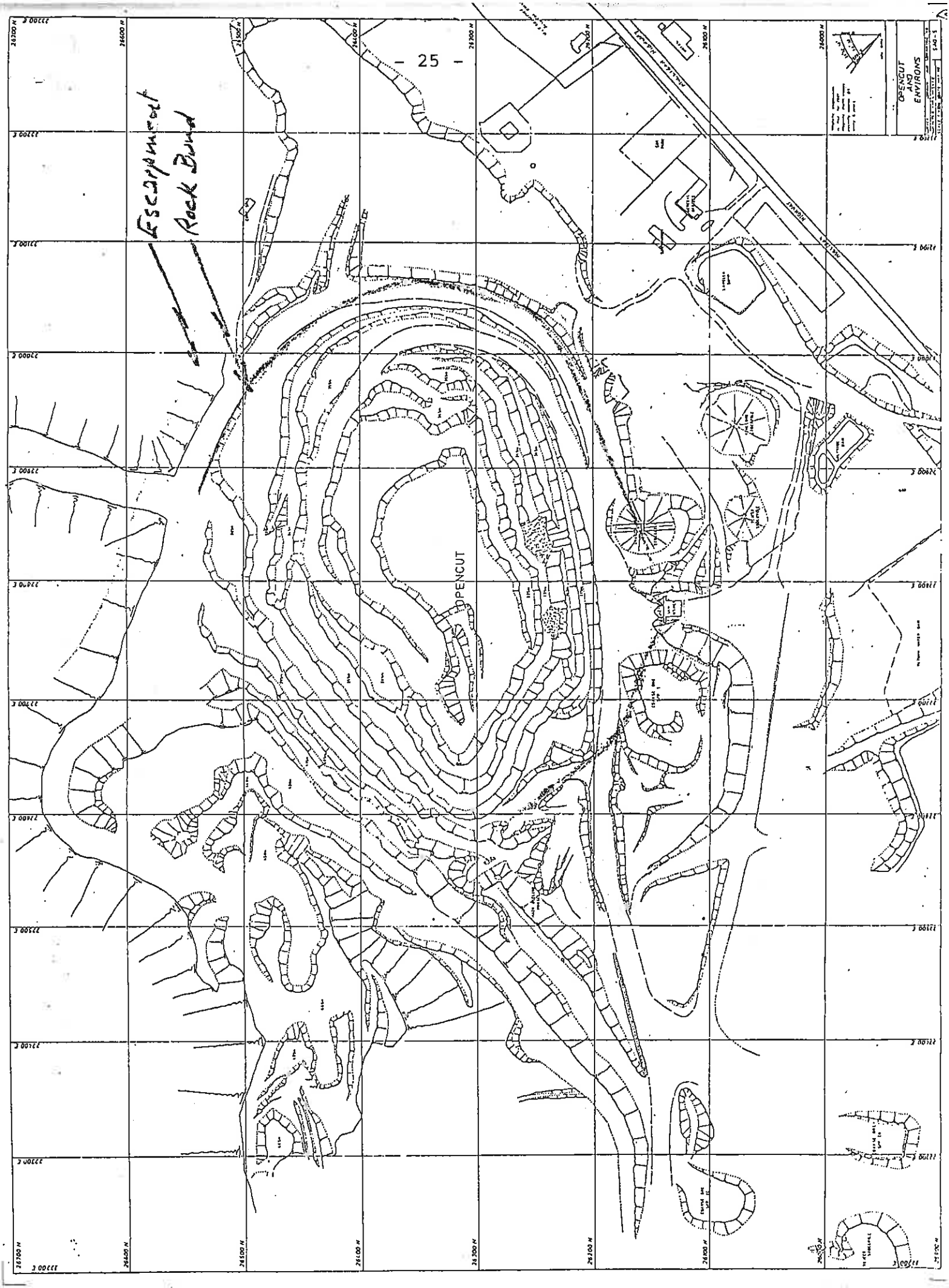
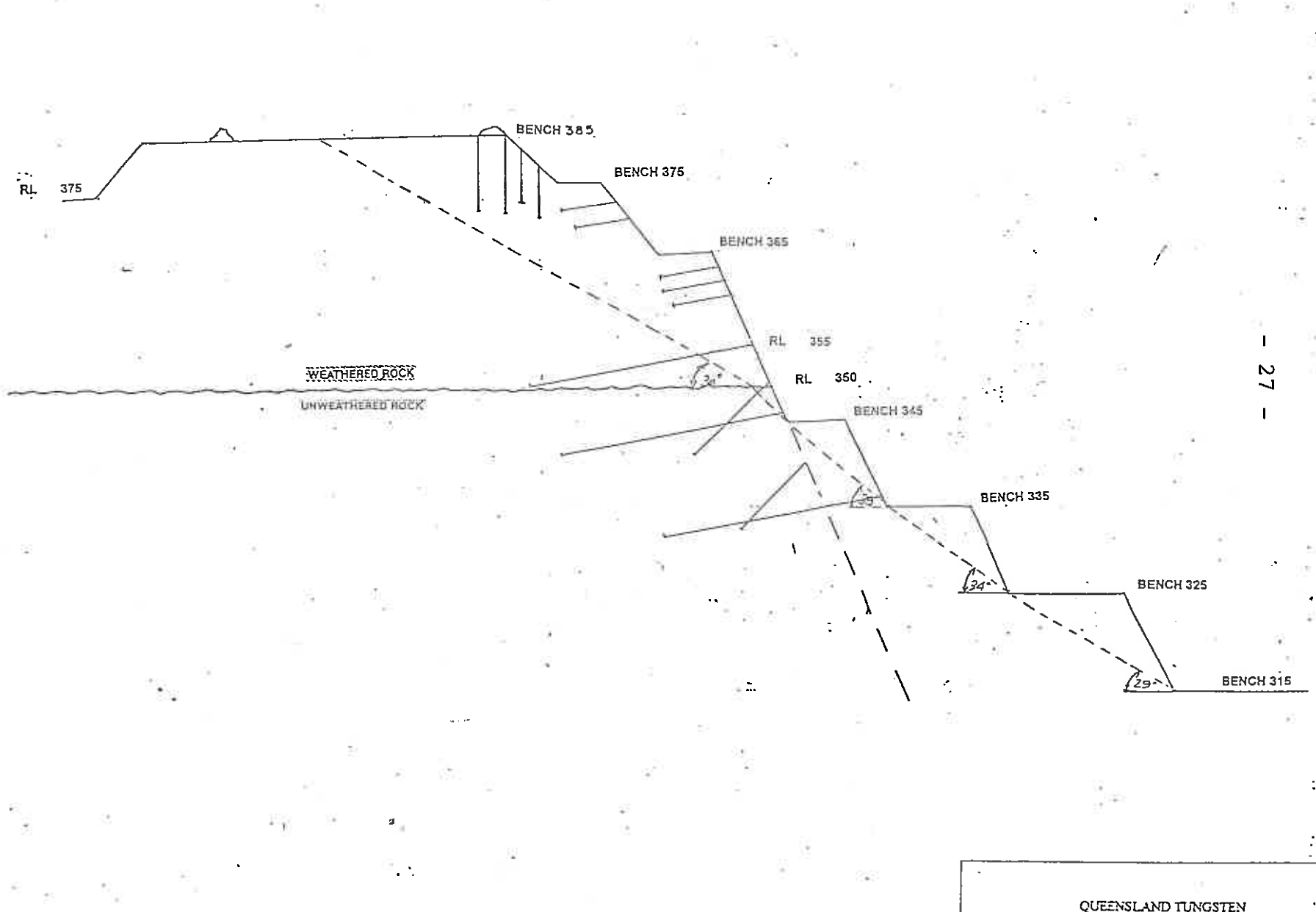


Figure 3

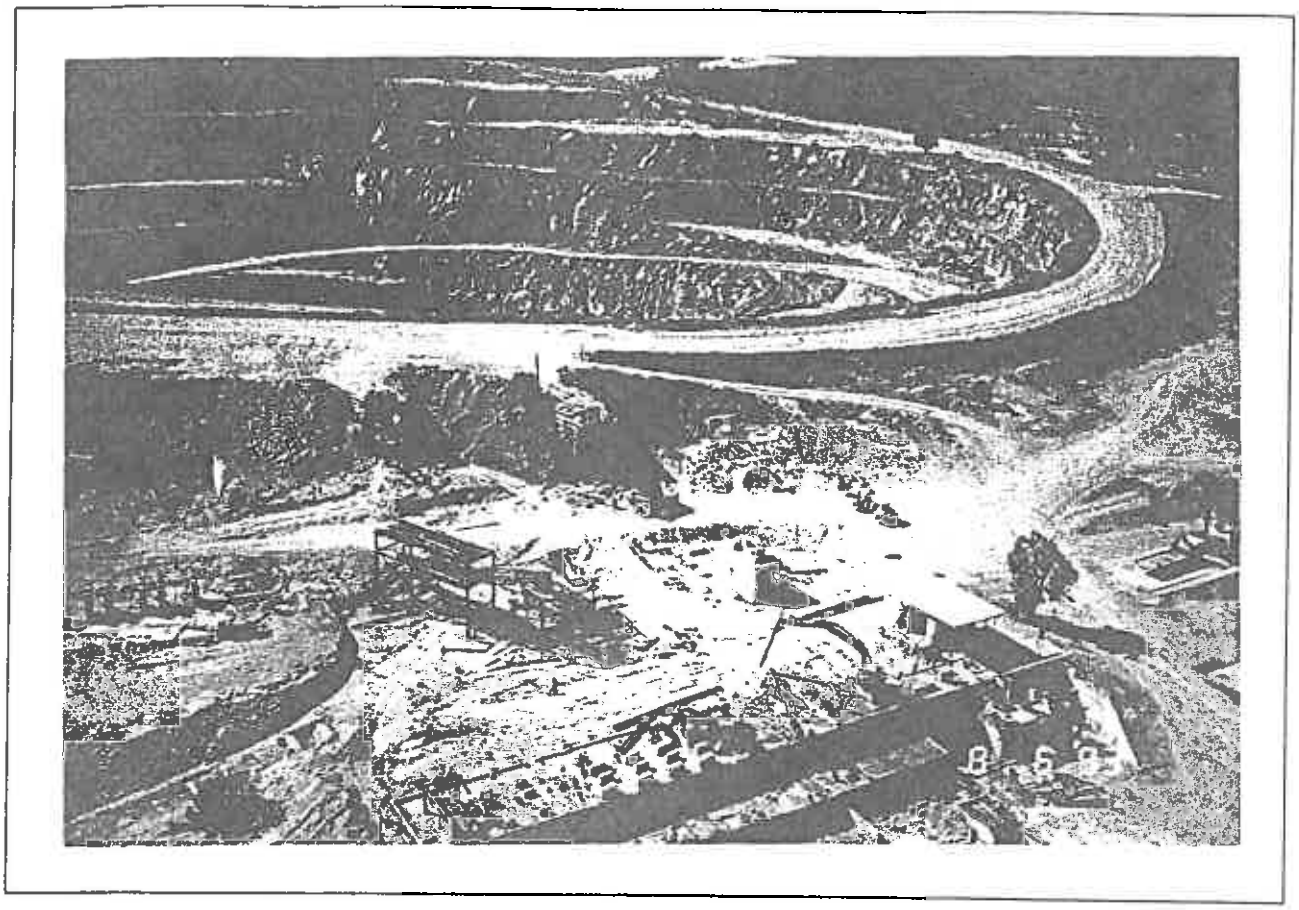


QUEENSLAND TUNGSTEN

SECTION 22680 E

AUG. 93 | FIGURE .2

Figure 5



Escarpment Around Open Pit - Southern Side

Escarpment Around Open Pit - Eastern End

Table 8

Mt Carbine Rainfall

Year	1972	1973	1974	1975	1976	1977	1978	1979*	1980	1981	1982
Month											
January	168	108	559	275	117	172	163	1134	35	408	122
February	366	284	426	91	253	380	100	245	395	481	72
March	487	344	427	80	204	306	15	220	247	17	103
April	10	62	9	80	80	59	50	54	25	36	101
May	3	17	1		9	35	27	2	18	66	7
June	3	2	1	19			3	63	10	8	7
July		1		2	4	6		8	5	1	
August			142	15		11	11		8		34
September	13			43		5				3	4
October		2	200	36	53		2	33	16	11	
November		155	143	36	119	1	17		14	83	1
December		161	128	290	126	65	214	27	23	123	87
Total	1,050	1,136	2,036	967	965	1,040	602	1,786	796	1,237	538

Note: 12 year average to and including 1971 = 1,069mm *Cyclone Peter

Table 8 (cont'd)

Mt Carbine Rainfall

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Month										
January	102	293	187	231	54	7	137	64	357	54
February	40	198	138	129	219	238	144	2	260	125
March	228	16	186	9	79	46	342	200	16	76
April	78	6	62	113	38	24	149	136	3	5
May	55	1	23	10	10	55	44	44	6	41
June	23	14		10	31	6	24	77	1	4
July		8	21	1	22	7		25		2
August	3					1	5			1
September	8			1	9			3		27
October	4	2	64	19		3	7	3		1
November	41	127	124	11	80	89	188		49	9
December	119	84	91	5	192	193	23	133	116	135
Total	701	749	896	539	734	669	1,063	687	808	480

Table 9 - Evaporation Rate: - Daily Averages (mm)

Recorded at Southedge Research Station - Mareeba

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1971	5.2	4.6	7.4	3	4	3.6	3.6	4.6	6.7	7.8	7.4	6.8
1972	6.4	4.6	3.8	4	3.4	3.6	4.4	5.4	5.4	8.2	8.2	8.4
1973	7.7	5.7	5.1	3.9	4.3	3.8	3.9	5.3	5.4	6.8	5.4	4.9
1974	3.4	4.4	3.3	5.2	4.7	3.6	4.8	5.1	5.7	7.2	7.6	8.2
1975	5.9	4.5	5.3	4.4	4.3	4	4.5	4.7	4.8	6.2	7.7	6.3
1976	6	4.1	3.8	3.3	2.9	2.9	3.1	4	5.1	5.6	5.8	5
1977	4.7	3.4	4.1	2.9	3	2.7	3.1	4	4.3	5.7	6.6	6.4
1978	5	4.8	4.6	4	3.3	4.8	3.9	3.9	5.3	5.6	6.4	6.2
1979	3.3	4.1	4.3	3.7	3.1	3	3.2	3.8	5	6.5	6.9	6.6
1980	5.9	5.1	3.6	3.5	3.1	3.2	3.2	3.5	6.3	6.6	7.3	6.3
1981	5	5.5	5.2	4.4	3.3	3.5	3.6	4.9	4.7	5	5.7	6.1
1982	5.5	5.1	4.7	3.7	3.6	3.4	3	3.4	5.1	6.8	6.7	6.3
1983	6.2	6	6.2	4.2	2.9	2.9	3.3	3.5	5.6	6.5	6.1	6
1984	5.1	4.2	4.9	4.3	3.7	3.4	3.7	4.3	5.5	6.2	6.1	5.8
1985	6.4	4.5	4	4.1	3.1	3.1	3.4	4.5	5.2	5.6	6	6.2
1986	4.8	4.7	4.7	3.6	3.8	3.3	3.7	4.1	5.7	6.4	6.9	6.9
1987	6.5	5.4	4.4	3.9	3.6	2.7	4	4.4	5	7.3	6.7	6
1988	5.5	5.1	4.4	1.2	4.4	4.2	3.4	5.9	5.7	7.2	6.2	6.3
1989	5.2	4.9	4.7	4.1	3.4	2.9	3.2	4	5.8	6.6	5.9	6.1
1990	6	6.8	4.3	4.2	3.2	3	3	4.5	5.3	6.4	7.2	6.4
1991	5.2	4.3	5.6	4.4	3.7	3.6	3.9	4.1	6.4	7.3	6.8	6.1
1992	5.6	4.8	5.3	4.1	3.6	3.6	3.3	4.4	5.8	6.8	7.4	6
	5.5	4.8	4.7	3.8	3.6	3.4	3.6	4.4	5.4	6.6	6.7	6.3

Note: Recorded by the Department of Primary Industries at the Southedge Research Station

3.2.2 Waste Rock Dumps

The coarse waste rock dumps collectively cover about 65 hectares. They have been top-dressed with either fine rock (200mm) or tailings and in some areas both (i.e. fine rock with tailings cover). Some tree re-growth has taken place, but almost excluisvely on surfaces with no tailings cover. Evidence of grass on some areas of tailings is noted and also in places that have been covered with fine weathered rock.

Consultants, Soil Conservation and Environmental Services, were commissioned to investigate the long term stability of these waste rock dumps, in order to support a case for maintaining the existing terraced landform (Figure 6). Their report (Appendix 5) concluded that:-

- The existing terraced landform had demonstrated its stability; having given no indication of instability over the past twenty years since dumping of waste rock commenced, and over the past eight years since dumping ceased.

- Disturbance of the existing landform to reduce batter slopes from 33^0 to 18^0 appeared unnecessary and could cost up to $4,000,000.

- Flatter batter angles would reduce a potential land capability class of VI or VII to a capbility class of VIII and add about 5 hectares to the area of land disturbance.

- The broken rock in a terraced landform, lends itself to reclamation (for use as a high grade road building and construction material.).

In addition, the consultant noted that:-

- Rainfall over the dumps was dispersed by infiltration rather than by surface run-off. Consequently, there was no need for weirs or sediment traps on benches.

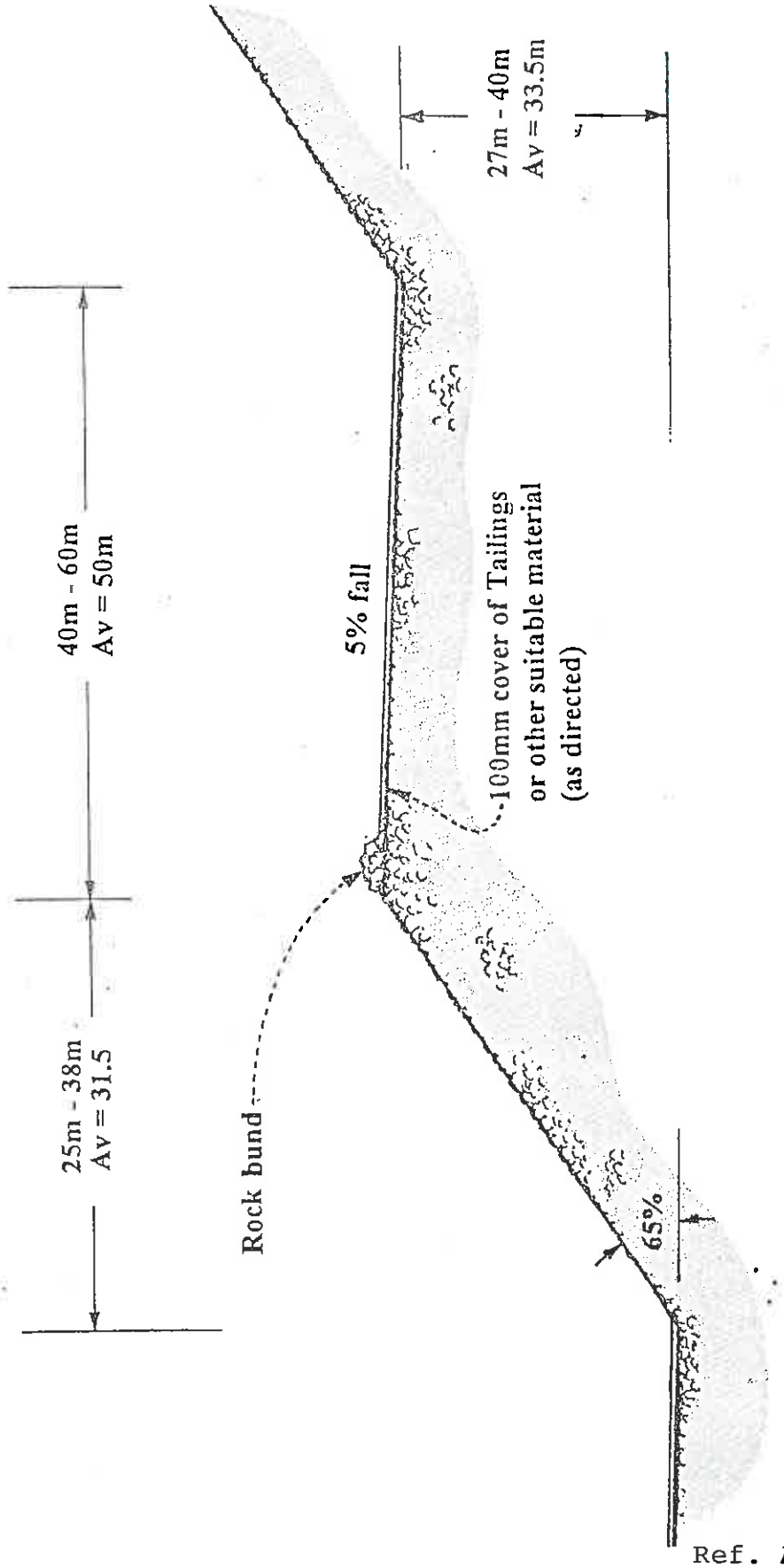
- Waste dumps had a good Durability (Competency) Rating of about SG 7.5.

- Laboratory testing of representative rock samples (metamorphosed sediments of the Hodgkinson formation) of Phyllite revealed that:-

    - The rock was fine grained with a stable texture and was not porous.

    - The small amount of sulphide present was unlikely to cause rock deterioration and thus contamination.

- Especially applicable to the coarse waste dump, was the stability created by the natural stratification of the rock during the dumping



Ref. Appendix 5

SOIL CONSERVATION AND
ENVIRONMENTAL SERVICES
PLANNING, MONITORING AND REHABILITATION
PO BOX 320 RED HILL Q. 4059
3 MUSGRAVE RD RED HILL. Q. 4059
PH (07) 368 2918 FAX (07) 368 3991

QUEENSLAND TUNGSTEN
CROSS-SECTION OF TIIE DESIGN OF
THE PROPOSED TERRACED LANDFORM

AUG 93

FIGURE 2

Figure 6

procedure; with the coarsest sizes forming the base of the 33° batters.

- The nature of the rock and its range of sizes on the surface of the steep batters mitigated against the occurrence of significant erosion on these surfaces.

A terraced landform appeared, theore, to offer benefits, both environmental and commercial, with the result that it was adopted as an acceptable final landform requiring no further rehabilitation work other than to:-

- attempt to establish revegetation (Appendices 7 and 8).

- confirm stability (Section 3.5).

3.2.3 Tailings Dams

Neither of the two remaining jig tailings (Nos 3 and 4) dams has the disadvatages inherent in storages that contain tailings produced from actory ores that rely heavily on chemical and roasting processes for mineral and metal liberation. They are, therefore, largely free of deleterious materials and consist of clean washed sparsely mineralised rock particles (Section 2.5.7). As a consequence, it is not likely that material in these dams will have significant long term adverse effects on the environment. But, as a matter of course, ponded and seepage water associated with these dams will continue to be monitored to ensure that any serious deterioration in water quality will be discovered and thus enable prompt action to prevent consumption by stock.

No.3 Tailings Dam

This dam was used between 1976 and 1980 to take jig tailings from the mill. These tailings were discharged at the southern end where the coarse fractions settled out quickly. The finer fractions gravitated to the northern end where surplus water was decanted off over a weir.

Since 1980, tailings in this dam have been largely mined out and used to dress haul roads, pit benches and the surface of waste dumps. Remaining reserves are clean and dry and completely compounded by earth walls, having now been levelled and graded to provide drainage to the north-end spillway.

The high south, west and east walls have been excavated and reduced from 25 metres to 10 metres in height and used to top dress as much of the waste dump areas as possible in the absence of other soil. Some has been spread over the surface of levelled coarser section of the tailings because it will provide a better medium for the generation of grass and

trees. Grass has long been established on the lower slopes of the dam where the finer tailings have settled out.

No.4 Tailings Dam

This dam was constructed in 1980 and used until 1986 to take jig tailings which were pumped from the mill and discharged centrally. Sand deposition then took place radially from the discharge point; being contained within the boundary of a natural land contour.

Water and fines flowed to the boundary contour, with the water then gravitating to lower contours behind an earth and rock wall which formed the dam's southern boundary. A spillway in the wall allowed overflow from any excessive wet season drainage from the dam catchment area.

In the eight years since 1986, when the mine closed and the dam became redundant, except as a sediment trap and future sand resource:-

- 40% of the surface continues to hold water of varying amounts and quality (Table 10), depending on whether the wet season is "good" or "bad". Recent wet seasons have been poor and the quality of water still impounded by the end the dry season has shown some minor departures from recommended stock quality because of insufficient run-off from catchment areas to dilute remnant process water. Currently, sections of the water storage area are fenced off to prevent stock from becoming bogged when levels get too low.

- 40% of the surface; containing the coarsest fractions has failed to support any plant regrowth (Appendix 8).

- 20% of the surface; being the peripheral areas containing the finest tailings fractions support quite significant grass and tree regrowth and this has been encouraged.

Revegetation trials on this dam, therefore, focused mainly on areas containing the coarse tailings fractions. A quarter-hectare plot was fenced and prepared for trials during February, 1994. Results were poor and suggest that some further investigations might be pursued to produce a more promising outcome (Natural Resource Assessment Report - Appendix 8).

3.2.4 Sulphide Tailings Dam

Some tailings were excavated from the dam and dumped on the ground nearby to facilitate pick-up and re-treatment prior to mine closure in 1986. Remnants of this material have been returned to the dam and the area cleaned up. The dam has been sealed with clay and sand to a

depth of approx 100mm and soil; placed on top to encourage vegetation regrowth.

3.2.5 Underground Access

The portal was barricaded with a steel support frame decked with heavy logs placed horizontally. The approach gullet was then filled with waste rock to the satisfaction of the Senior Inspector of Mines, J. Greives. Steel work and loose rock in an adjacent excavation has been removed and it now blends in to the hill and pit land form.

3.2.6 Mine Buildings, Plant and Machinery

- Structures.
  With the exception on the concrete-block assay office and timber-framed administration building, all structures, plant, machinery and scrap have been removed from site.

- Concrete
  Concrete foundations and slabs have, in the main, been excavated and removed. Foundations not removed have been covered by 0.5m of rock to blend in with the surrounding terrain. Openings to concrete tunnels beneath one-time rock stockpiles have been sealed with large rocks then covered with appropriate stockpile rock. Primary crusher foundations, retaining wall and bin have not been removed. The foundations and retaining wall have been covered with rock from a remnant ore stockpile while the bin has been filled with tailings and waste rock.

3.2.7 Water-Supply

Pumping facilities from the Mitchell River to the Fresh Water Dam have been removed and these included:-

- Diesel and electric pumps.

- Electric overhead power lines.

- 6km of steel pipe of varying diameters.

- Fuel tanks.

Where applicable, pipeline trenches were filled-in and pipe supports removed.

3.2.8 Carbine Hill

- Water tanks and other evidence of mining activity have been removed.

- Access to roads to benches above RL 375 have been blocked off.

- Drainage to the open pit has been re-established and improved.

3.2.9 Roadways

Roads on the mine lease are generally constructed over fill and surfaced with tailings. Invariably they are free draining and do not allow water to collect. However, where necessary some obsolete roads were ripped to enhance the prospect of natural plant regeneration.

3.2.10 Contaminated Land

As far as possible, contamination has been avoided, but under the Contaminated Land Act (1991), the site had a prescribed "use" and as such it followed that it was "probably" contaminated.

This contamination has been dealt with under the Mineral Resources Act because it occurred on a mining lease; its disturbances being identified and described as:-

- Two refuse disposal areas containing typical domestic household waste and industrial waste of steel and plastic products (1.95 ha).
- One refuse disposal area, contained within waste rock, containing concrete products (foundations and slabs) (0.22ha).

- One site containing sulphide tailings (0.22ha).

- One site, once containing and since removed, 9,000 ltr fuel tank ($30m^2$).

- One site, once used for heavy vehicle servicing ($750m^2$).

- One tailings dam containing fine sand (30ha).

- Sundry waste dumps containing coarse rock (62ha).

- Sundry water storages (34ha).

Three of these areas were considered to contain hazardous substances; being:-

- Sulphides (copper and arsenic), heavy metals (suphide dam).

- Petroleum hydrocarbons, monocyclic aromatic hydrocarbons (underground fuel storage).

- Petroleum hydrocarbons, monocyclic aromatic hydrocarbons (Heavy Equipment Service Bay).

Each has been dealt with separately in order to contain or remove the hazard. Sulphides have been encapsulated in a clay-lined pit, while the underground fuel storage has been removed and the surrounding soil and rock stockpiled for remediation. Similarly, the ground beneath the Heavy Equipment Service Bay has been excavated and stockpiled for treatment also.

These and all other matters dealing with land contamination and remediation are covered in Appendix 10.

3.3 Surface and Ground Water

3.3.1 Fresh Water

The quality of water in the Mitchell River; the only permanent stream in the area likely to be effected by mining activity is regarded as good being suitable for all purposes (Table 11).

Fresh Water Dam

Because the "turkeys nest" Fresh Water Dam relied solely on pumped water for its storage, it ceased to be useful when pumping from the Mitchell River ceased at the beginning of 1993.

An undertaking was made to rehabilitate this dam to the extent of removing pumps and associated equipment and levelling its walls to return the land to as close to its original profile as possible. However, the landholder requested the dam be left intact, except for the removal of pumps and other equipment. (Appendix 6).

3.3.2 Run-Off

A dam immediately south of the mine workings collects wet season run-off. Its storage is thus ephemeral depending for its useful life on the extent of rains and evaporation rates. It serves as a sediment trap and convenient watering place for stock and water fowl.

The quality of water in this half-moon shaped dam is good for all purposes for most of the year. (Table 12). ie until it dries up in about October each year.

3.3.3 Process Water

Water used in the process of recovering wolframite and scheelite from the ore was pumped to waste with the trailings and stored in No.4 Tailings Dam. It was then recovered and returned to another storage (Return Water Dam) for re-use in the treatment process.

After the mine closed in late 1986, the quality of this water changed with each wet season; there being a progressive improvement in quality as the original process water was diluted by wet season rain run-off from Carbine Hill and Mt. Alto, causing the dams to overflow.

Since 1991, however, wet seasons have been so poor that there has been insufficient rains to fill the dams and cause an overflow. Consequently a small deterioration in the water quality has become evident at the end of the dry season. But it does inprove with the onset of the "wet", however poor it may be. (Tables 10 and 13).

Notwithstanding deterioration in water quality towards the end of the dry season, no measures to prevent stock using this water are contemplated; there being no evidence of any harmful effects (. Appendix 6). Rather, stock is in more danger of becoming bogged in mud as water retreats during the course of the dry season. To prevent this happening, fences have been erected in suitable place across the dams.

The Return Water Dam was emptied in November, 1993, before the onset of the wet season, with a view to removing remnants of process water. At the same time, it was fenced to prevent stock from being bogged when water levels fell during the dry season. (Table 13)

This dam, as well as No.4 Tailings Dam and Half Moon Run-Off Dam, is now part of the permanent landscape (by request of the land owner) and apart from serving as sediment traps these dams are valuable stock watering places and habitats for birds and fish. As such, they are included amongst the water resources to be protected.

3.3.4 Open Pit Water

Water in the open pit is the result of rain run-off from Carbine Hill (seepage from the water table is negligible). Pit water has no where to go, so it lies placidly, absorbing salts from the country rock and orebody.

The quality of water is generally suitable for stock except for hardness which slightly exceeds ANZECC recommendations (Table14). In any case, stock rarely, if ever, venture into the open pit and access has been made even more difficult with the construction of a fence outside the pit escarpment.

Like other storages a poor wet season tends to result in this storage developing a higher concentration of some ions.

This water is accumulating at the rate of 4mm for every mm of rain that falls over Mt. Carbine. At this rate and having regard for high evaporation rates the water in the open pit can be expected to take at least 35 years to overflow the eastern rim.

Redirection of drainage from Carbine Hill to collect run-off has been maximised. Rainfall of 750mm is a realistic figure upon which to base calculations, although since 1991, annual falls have been less than 500mm.

3.3.5 Waste Dumps Seepage Water

Waste dump seepage from two outlets collects in two ponds, each within 100 metres of its outlet, and evaporates quickly.

Details of water quality are shown in tables 15, 16 and 17

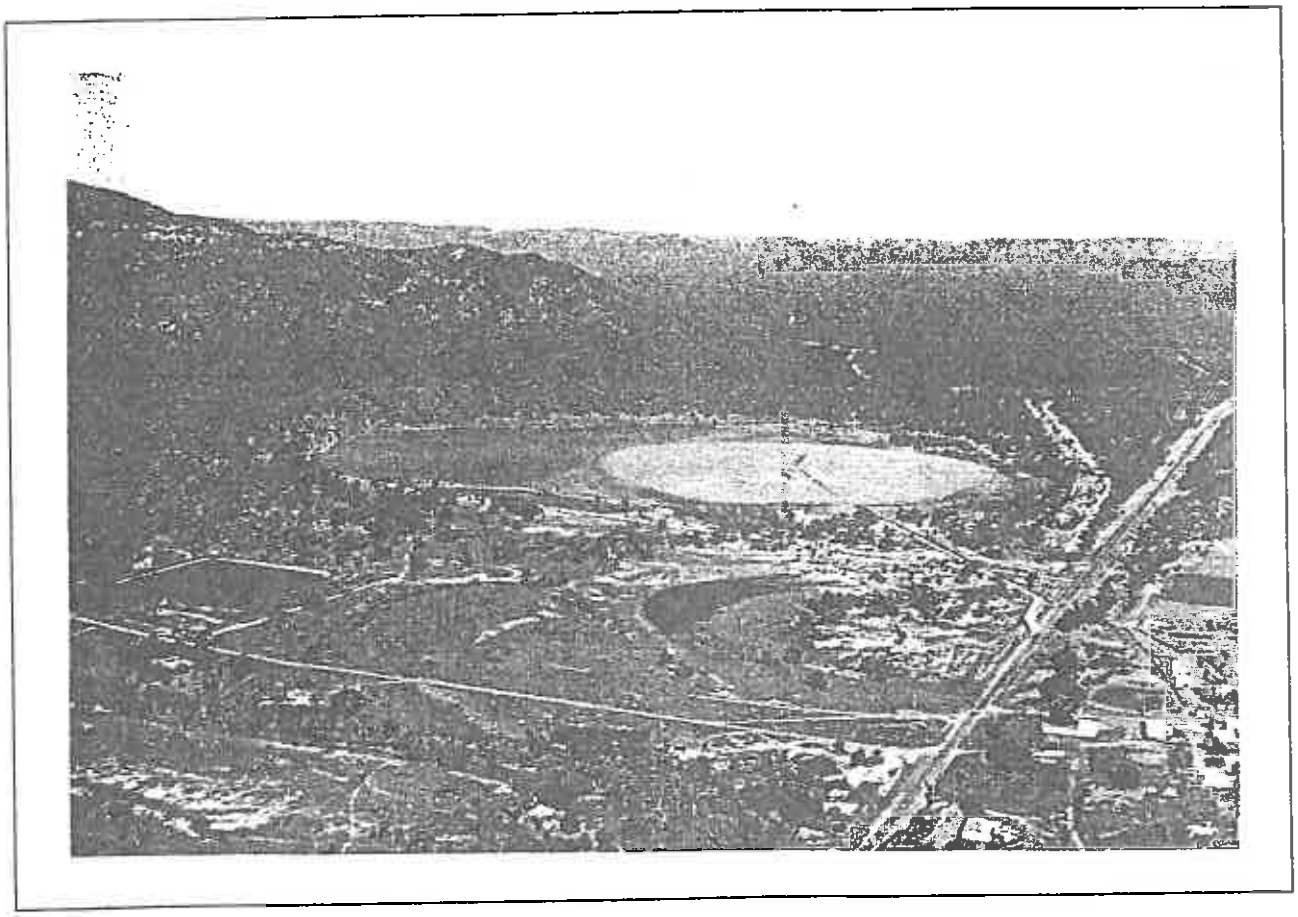
3.3.6 Manganese Creek

Manganese Creek, an ephemeral water course which runs through the Mt. Carbine township was at one time, an important source of domestic and industrial water. Its function as a domestic supply, has largely been replaced by bores.

Flow during the wet season is brief and in recent times of no more than three months duration. Quality of water during this time has always been good. (Table 18).

3.3.7 Ground Water

The quality of subsurface water around the township is variable according to whether it occurs in granite sands or within faults and fractures in the country rock. No where is it found to be unsuitable for stock or effected by mining activity (Table 19).



Aerial View of Tailings Dam and Water Storage Dams

Table 10 Water Quality - No.4 Tailings Dam

PARAMETER	UNITS	SAMPLE 5/4/94	SAMPLE 30/11/93	SAMPLE 10/11/92	ANZECC Standard Potable Water mg/l	ANZECC Standard Stock Water mg/l
Conductivity	uS/cm (25°)	933		2950		
pH	Stand.	7.6		8.9	6.5-9.2	6.5-9.2
Turbidity	NTU[1]	2		5	10,000	
Total Hardness (as $CaCO_3$)	mg/l	480		1170	500	600
Total Dissolved Solids	mg/l	588		2570	1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/l	33.9		119	300	3000
Potassium	mg/l	10.1		36.3		
Calcium	mg/l	141		267	200	1000
Magnesium	mg/l	31		123	150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/l	<5		9		
Bicarbonate (as HCO_3^-)	mg/l	56		37		
Chloride (as Cl^-)	mg/l	13		51	400	
Sulphate (as SO_4^{2-})	mg/l	480		1310	400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/l	<2		<0.1	0.5	30
TRACE ELEMENTS						
Aluminium	mg/l	0.08	0.036	0.003	.2	5.0
Arsenic	mg/l	0.02	0.320	0.043	.05	.5
Boron	mg/l	<0.5	0.177	0.053	1.0	5.0
Cadmium	mg/l	<0.0005	0.005	0.0059	.005	.01
Chromium	mg/l	<0.05	0.004	0.001	.05	1.0
Cobalt	mg/l	<0.05	<0.001	0.0007		1.0
Copper	mg/l	<0.05	0.012	0.0003	1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l	<0.005				
Iron	mg/l	<0.1	2.711	2.33	.3	
Manganese	mg/l	0.05	0.097	0.007	0.1	
Nickel	mg/l	<0.05	0.085	0.079	0.1	1.0
Tungsten	mg/l	0.003		0.152		
Zinc	mg/l	0.05	0.102	0.017	5.0	20.0

Table11 Water Quality - Mitchell River

PARAMETER	UNITS	SAMPLE 5/4/94	SAMPLE	SAMPLE 10/11/92	ANZECC Standard Potable Water mg/1	ANZECC Standard Stock Water mg/1
Conductivity	uS/cm (25°)	51		68		
pH	Stand.	6.6		6.4	6.5-9.2	6.5-9.2
Turbidity	NTU[1]	1.9		6	10,000	
Total Hardness (as $CaCO_3$)	mg/1	13		9	500	600
Total Dissolved Solids	mg/1	35		63	1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/1	7.1		7.9	300	3000
Potassium	mg/1	1.2		0.7		
Calcium	mg/1	2.2		1.0	200	1000
Magnesium	mg/1	1.8		1.5	150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/1	<5		0		
Bicarbonate (as HCO_3^-)	mg/1	11		13		
Chloride (as Cl^-)	mg/1	13		15	400	
Sulphate (as SO_4^-)	mg/1	<5		<2	400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/1	<2		<0.1	0.5	30
TRACE ELEMENTS						
Aluminium	mg/1	<0.05		0.052	.2	5.0
Arsenic	mg/1	<0.02		0.0012	.05	.5
Boron	mg/1	<0.05		0.012	1.0	5.0
Cadmium	mg/1	<0.0005		<0.0001	.005	.01
Chromium	mg/1	<0.05		0.003	.05	1.0
Cobalt	mg/1	<0.05		<0.0001		1.0
Copper	mg/1	<0.05		<0.0001	1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l	<0.005				
Iron	mg/1	<0.1		1.148	.3	
Manganese	mg/1	<0.05		0.004	0.1	
Nickel	mg/1	0.05		0.001	0.1	1.0
Tungsten	mg/1	0.001		0.018		
Zinc	mg/1	<0.05		<0.0001	5.0	20.0

Table 12 Water Quality - Half Moon Dam

PARAMETER	UNITS	SAMPLE	SAMPLE	SAMPLE 5/4/94	ANZECC Standard Potable Water mg/1	ANZECC Standard Stock Water mg/1
Conductivity	uS/cm (25°)			122		
pH	Stand.			8.1	6.5-9.2	6.5-9.2
Turbidity	NTU[1]			1.75	10,000	
Total Hardness (as $CaCO_3$)	mg/1			37	500	600
Total Dissolved Solids	mg/1			82	1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/1			11.7	300	3000
Potassium	mg/1			2.7		
Calcium	mg/1			3.9	200	1000
Magnesium	mg/1			6.5	150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/1			<5		
Bicarbonate (as HCO_3^-)	mg/1			28		
Chloride (as Cl^-)	mg/1			6	400	
Sulphate (as SO_4^-)	mg/1			20	400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/1			<2	0.5	30
TRACE ELEMENTS						
Aluminium	mg/1			<0. 05	.2	5.0
Arsenic	mg/1			<0.02	.05	.5
Boron	mg/1			<0.5	1.0	5.0
Cadmium	mg/1			<0.0005	.005	.01
Chromium	mg/1			<0.05	.05	1.0
Cobalt	mg/1			<0.05		1.0
Copper	mg/1			<0.05	1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l			<0.005		
Iron	mg/1			<0.1	.3	
Manganese	mg/1			<0.05	0.1	
Nickel	mg/1			<0.05	0.1	1.0
Tungsten	mg/1			0.014		
Zinc	mg/1				5.0	20.0

Table 13 Water Quality - Return Water Dam

PARAMETER	UNITS	SAMPLE 5/4/94	SAMPLE	SAMPLE 10/11/92	ANZECC Standard Potable Water mg/l	ANZECC Standard Stock Water mg/l
Conductivity	*u*S/cm (25°)	920		4430		
pH	Stand.	6.9		8.4	6.5-9.2	6.5-9.2
Turbidity	NTU[1]	0.69		11	10,000	
Total Hardness (as $CaCO_3$)	mg/l	4.11		1930	500	600
Total Dissolved Solids	mg/l	598		4140	1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/l	63		220	300	3000
Potassium	mg/l	7.6		40.5		
Calcium	mg/l	80.3		235	200	1000
Magnesium	mg/l	51.0		326	150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/l	<5		8		
Bicarbonate (as HCO_3^-)	mg/l	15		143		
Chloride (as Cl^-)	mg/l	13		71	400	
Sulphate (as SO_4^{2-})	mg/l	500		2430	400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/l	<2		0.1	0.5	30
TRACE ELEMENTS						
Aluminium	mg/l	0.07		0.009	.2	5.0
Arsenic	mg/l	<0.02		0.144	.05	.5
Boron	mg/l	<0.5		0.563	1.0	5.0
Cadmium	mg/l	<0.0005		<0.0001	.005	.01
Chromium	mg/l	<0.05		0.003	.05	1.0
Cobalt	mg/l	<0.05		0.0007		1.0
Copper	mg/l	<0.05		<0.0001	1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l	<0.005				
Iron	mg/l	<0.1		2.158	.3	
Manganese	mg/l	0.05		0.050	0.1	
Nickel	mg/l	<0.05		0.078	0.1	1.0
Tungsten	mg/l	0.003		1.955		
Zinc	mg/l	<0.05		0.032	5.0	20.0

Table 14 Water Quality - Open Pit

PARAMETER	UNITS	SAMPLE 5/4/94	SAMPLE 30/11/94	SAMPLE 10/11/92	ANZECC Standard Potable Water mg/l	ANZECC Standard Stock Water mg/l
Conductivity	uS/cm (25°)	1320		2100		
pH	Stand.	8.0		8.4	6.5-9.2	6.5-9.2
Turbidity	NTU[1]	0.37		<1	10,000	
Total Hardness (as $CaCO_3$)	mg/l	653		684	500	600
Total Dissolved Solids	mg/l	884		1690	1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/l	80		89	300	3000
Potassium	mg/l	4.4		4.9		
Calcium	mg/l	184		165	200	1000
Magnesium	mg/l	47		66	150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/l	<5		1		
Bicarbonate (as HCO_3^-)	mg/l	53		65		
Chloride (as Cl^-)	mg/l	111		210	400	
Sulphate (as SO_4^-)	mg/l	620		460	400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/l	<2		<0.1	0.5	30
TRACE ELEMENTS						
Aluminium	mg/l	<0.05	0.018	0.021	.2	5.0
Arsenic	mg/l	0.26	0.188	0.121	.05	.5
Boron	mg/l	<0.5	0.079	0.072	1.0	5.0
Cadmium	mg/l	<0.0005	0.003	0.0029	.005	.01
Chromium	mg/l	<0.05	0.003	0.003	.05	1.0
Cobalt	mg/l	<0.05	<0.001	0.0004		1.0
Copper	mg/l	<0.05	0.008	0.002	1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l	<0.005				
Iron	mg/l	<0.1	1.469	1.703	.3	
Manganese	mg/l	<0.05	<0.001	0.0001	0.1	
Nickel	mg/l	<0.05	0.023	0.058	0.1	1.0
Tungsten	mg/l	0.011		0.086		
Zinc	mg/l	<0.05	0.035	0.014	5.0	20.0

Table 15 Water Quality - Waste Dump Seepage Water No.1

PARAMETER	UNITS	SAMPLE 5/4/94	SAMPLE 17/3/93	SAMPLE 10/11/92	ANZECC Standard Potable Water mg/l	ANZECC Standard Stock Water mg/l
Conductivity	uS/cm (25°)	2040	1925	644		
pH	Stand.	5.9	6.5	7.2	6.5-9.2	6.5-9.2
Turbidity	NTU[1]	0.9	2	<1	10,000	
Total Hardness (as $CaCO_3$)	mg/l	961	788	136	500	600
Total Dissolved Solids	mg/l	1367	1790	388	1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/l	196	161	65	300	3000
Potassium	mg/l	5.2	5	1.3		
Calcium	mg/l	126	111	16.5	200	1000
Magnesium	mg/l	157	124	23	150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/l	<5	0	0		
Bicarbonate (as HCO_3^-)	mg/l	8	7	17		
Chloride (as Cl^-)	mg/l	30	33	15	400	
Sulphate (as SO_4^-)	mg/l	1140	830	195	400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/l	5	2.8	<0.1	0.5	30
TRACE ELEMENTS						
Aluminium	mg/l	3.5	3.635 0.600	0.031	.2	5.0
Arsenic	mg/l	<0.02	<0.001 <0.001	0.021	.05	.5
Boron	mg/l	<0.5	0.058 0.023	0.030	1.0	5.0
Cadmium	mg/l	0.004	0.001 0.008	0.004	.005	.01
Chromium	mg/l	<0.05	<0.001 0.005	0.001	.05	1.0
Cobalt	mg/l	<0.05	0.002 <0.001	<0.0001		1.0
Copper	mg/l	<0.05	0.011	0.0002	1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l	<0.005	0.002			
Iron	mg/l	<0.10	0.618 0.515	0.095	.3	
Manganese	mg/l	0.09	0.091 0.026	<0.0001	0.1	
Nickel	mg/l	0.10	0.001 0.108	0.004	0.1	1.0
Tungsten	mg/l	0.003	0.011	0.052		
Zinc	mg/l	0.48	0.179 0.521	0.013	5.0	20.0

Table 16 Water Quality - Waste Dump Seepage No.2

PARAMETER	UNITS	SAMPLE 5/4/94	SAMPLE 30/11/93	SAMPLE	ANZECC Standard Potable Water mg/l	ANZECC Standard Stock Water mg/l
Conductivity	uS/cm (25°)	1780				
pH	Stand.	6.6			6.5-9.2	6.5-9.2
Turbidity	NTU[1]	1.25			10,000	
Total Hardness (as $CaCO_3$)	mg/l	932			500	600
Total Dissolved Solids	mg/l	1157			1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/l	126			300	3000
Potassium	mg/l	5.7				
Calcium	mg/l	172			200	1000
Magnesium	mg/l	122			150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/l	<5				
Bicarbonate (as HCO_3^-)	mg/l	17				
Chloride (as Cl^-)	mg/l	26			400	
Sulphate (as SO_4^{2-})	mg/l	1110			400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/l	2			0.5	30
TRACE ELEMENTS						
Aluminium	mg/l	0.53	0.023		.2	5.0
Arsenic	mg/l	<0.02	0.081		.05	.5
Boron	mg/l	<0.5	0.062		1.0	5.0
Cadmium	mg/l	0.002	0.003		.005	.01
Chromium	mg/l	<0.05	0.007		.05	1.0
Cobalt	mg/l	<0.05	0.001			1.0
Copper	mg/l	<0.05	0.004		1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l	<0.005				
Iron	mg/l	<0.1	0.950		.3	
Manganese	mg/l	0.11	0.063		0.1	
Nickel	mg/l	0.05	0.020		0.1	1.0
Tungsten	mg/l	0.002				
Zinc	mg/l	0.27	0.136		5.0	20.0

Table 17 Water Quality - No.3 Tailings Dam Seepage

PARAMETER	UNITS	SAMPLE	SAMPLE	SAMPLE 5/4/94	ANZECC Standard Potable Water mg/l	ANZECC Standard Stock Water mg/l
Conductivity	uS/cm (25°)			520		
pH	Stand.			7.4	6.5-9.2	6.5-9.2
Turbidity	NTU[1]			0.6	10,000	
Total Hardness (as $CaCO_3$)	mg/l			135	500	600
Total Dissolved Solids	mg/l			328	1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/l			68	300	3000
Potassium	mg/l			0.7		
Calcium	mg/l			16.8	200	1000
Magnesium	mg/l			22.7	150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/l			<5		
Bicarbonate (as HCO_3^-)	mg/l			12		
Chloride (as Cl^-)	mg/l			13	400	
Sulphate (as SO_4^{2-})	mg/l			190	400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/l			<2	0.5	30
TRACE ELEMENTS						
Aluminium	mg/l			0.17	.2	5.0
Arsenic	mg/l			<0.02	.05	.5
Boron	mg/l			<0.5	1.0	5.0
Cadmium	mg/l			<0.0005	.005	.01
Chromium	mg/l			<0.05	.05	1.0
Cobalt	mg/l			<0.05		1.0
Copper	mg/l			<0.05	1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l			<0.005		
Iron	mg/l			<0.1	.3	
Manganese	mg/l			<0.05	0.1	
Nickel	mg/l			<0.05	0.1	1.0
Tungsten	mg/l			0.003		
Zinc	mg/l			<0.05	5.0	20.0

Table 18 Water Quality - Manganese Creek

PARAMETER	UNITS	SAMPLE 5/4/94	SAMPLE 7/5/93	SAMPLE	ANZECC Standard Potable Water mg/l	ANZECC Standard Stock Water mg/l
Conductivity	uS/cm (25°)	167	164			
pH	Stand.	6.4	6.9		6.5-9.2	6.5-9.2
Turbidity	NTU[1]	16	11		10,000	
Total Hardness (as $CaCO_3$)	mg/l	32	18		500	600
Total Dissolved Solids	mg/l	109	147		1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/l	21.1	2.3		300	3000
Potassium	mg/l	2.0	1.1			
Calcium	mg/l	7.2	4		200	1000
Magnesium	mg/l	3.3	2		150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/l	<5	0			
Bicarbonate (as HCO_3^-)	mg/l	28	31			
Chloride (as Cl^-)	mg/l	3.5	31		400	
Sulphate (as SO_4^-)	mg/l	18	15		400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/l	<2	<0.1		0.5	30
TRACE ELEMENTS						
Aluminium	mg/l	<0.05	0.368		.2	5.0
Arsenic	mg/l	<0.02	0.061		.05	.5
Boron	mg/l	<0.5	0.012		1.0	5.0
Cadmium	mg/l	<0.0005	<0.001		.005	.01
Chromium	mg/l	<0.05	<0.001		.05	1.0
Cobalt	mg/l	<0.05	<0.001			1.0
Copper	mg/l	<0.05			1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l	<0.005	0.002			
Iron	mg/l	<0.1	2.308		.3	
Manganese	mg/l	0.4	0.009		0.1	
Nickel	mg/l	<0.05	<0.001		0.1	1.0
Tungsten	mg/l	<0.001	0.023			
Zinc	mg/l	<0.05	0.008		5.0	20.0

Table 19 Water Quality - Village Bore

PARAMETER	UNITS	SAMPLE	SAMPLE	SAMPLE 10/11/92	ANZECC Standard Potable Water mg/1	ANZECC Standard Stock Water mg/1
Conductivity	uS/cm (25°)			1030		
pH	Stand.			6.8	6.5-9.2	6.5-9.2
Turbidity	NTU[1]			9	10,000	
Total Hardness (as $CaCO_3$)	mg/1			251	500	600
Total Dissolved Solids	mg/1			580	1000	6000 SHEEP 4000 CATTLE
CATIONS						
Sodium	mg/1			98	300	3000
Potassium	mg/1			1.3		
Calcium	mg/1			56	200	1000
Magnesium	mg/1			27	150	600
ANIONS						
Carbonate (as CO_3^{2-})	mg/1			0		
Bicarbonate (as HCO_3^-)	mg/1			410		
Chloride (as Cl^-)	mg/1			104	400	
Sulphate (as SO_4^-)	mg/1			19	400	1000
MACRONUTRIENTS						
Nitrogen-Nitrate	mg/1			<0.1	0.5	30
TRACE ELEMENTS						
Aluminium	mg/1			0.009	.2	5.0
Arsenic	mg/1			0.010	.05	.5
Boron	mg/1			0.063	1.0	5.0
Cadmium	mg/1			<0.0001	.005	.01
Chromium	mg/1			0.006	.05	1.0
Cobalt	mg/1			0.0001		1.0
Copper	mg/1			<0.0001	1.0	0.5 SHEEP 5.0 CATTLE
Lead	mg/l					
Iron	mg/1			0.365	0.3	
Manganese	mg/1			0.239	0.1	
Nickel	mg/1			0.011	0.1	1.0
Tungsten	mg/1			0.036		
Zinc	mg/1			0.009	5.0	20.0

3.3.8 Drainage

Drainage direction around the mine site is summarised in Figure 7.

As noted, all drainage in the area around Mt. Carbine flows to the Mitchell River during the wet season via Manganese Creek and Holmes Creek.

Wet season run-off from the land about the southern end of the mine and works and Mt. Alto is picked up and channelled into the Return Water Dam, No.4 Tailings Dam and Half Moon run-off dam before overflowing (during good wet seasons) to Manganese Creek, one of the two principle wet season water courses which directly feed the permanently running Mitchell River, six kilometres south of the mine.

Holmes Creek, the other wet season water course directly feeding the Mitchell River, picks up all the drainage and seepage water from the northern end of the mine, including the north end of Carbine Hill and the coarse waste dumps.

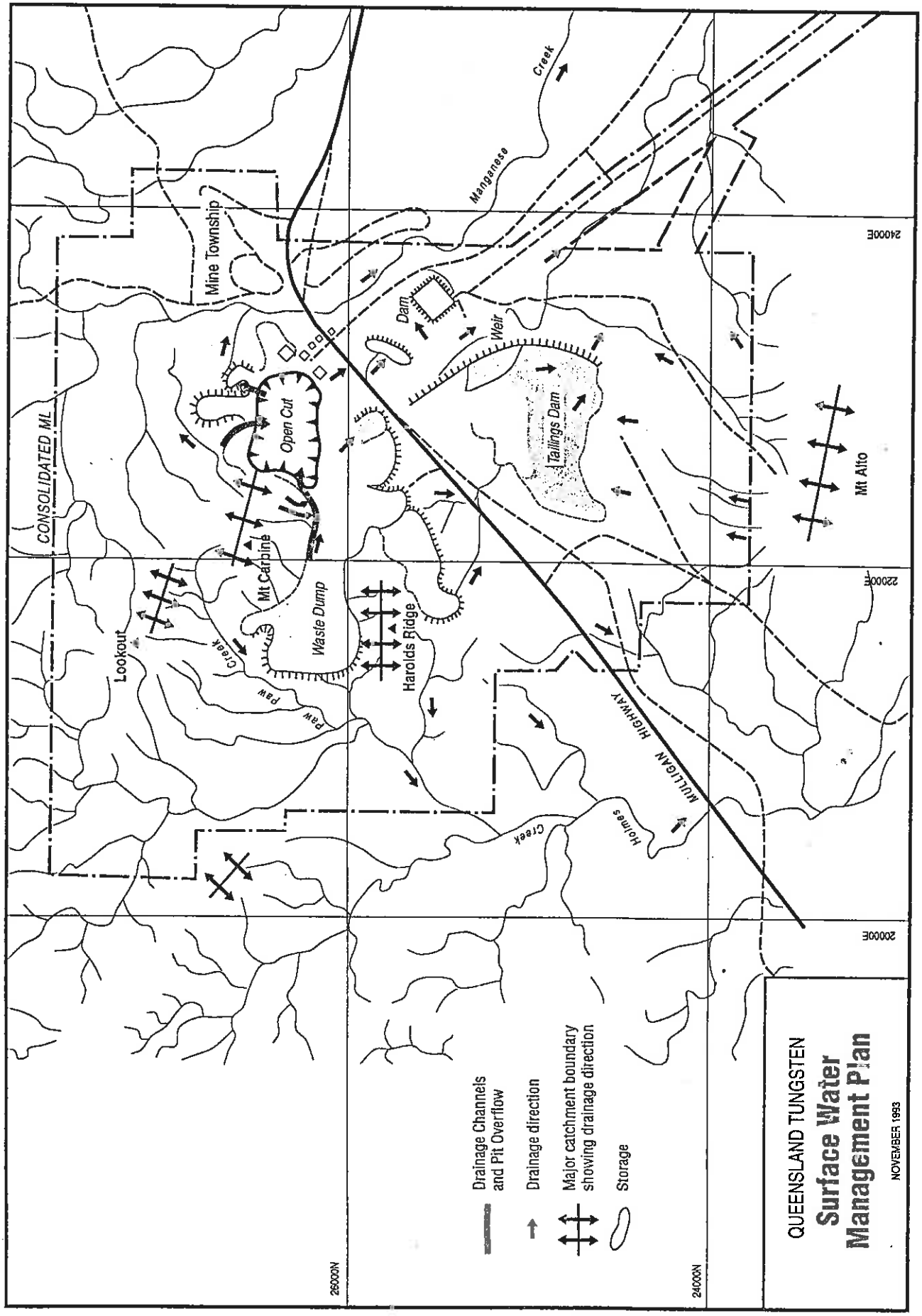

CONSOLIDATED ML
Mine Township
Open Cut
Waste Dump
Mt Carpine
Lookout
Harolds Ridge
Dam
Weir
Tailings Dam
Manganese
Creek
Mt Alto
MULLIGAN HIGHWAY
Holmes
Creek
PAW
PAW
Creek
240000E
220000E
200000E
260000N
240000N
Drainage Channels and Pit Overflow
Drainage direction
Major catchment boundary showing drainage direction
Storage
QUEENSLAND TUNGSTEN
Surface Water Management Plan
NOVEMBER 1993

Figure 7

3.4 Revegetation

The objectives of rehabilitating this site include the achievement of long term land stability through revegetation and thus the promotion of a post-mining land use such as light intensity cattle grazing and the establishment of light timbered bushland.

These objectives are likely to be achieved over some disturbed areas with the passing of time and no special effort, but other areas have been more harshly disturbed and will require help to become revegetated. To this end, Natural Resource Assessments (NRA) were asked to design plots and propose trials to determine whether vegetation could be established on some of the more harshly disturbed areas in particular (Appendix 7).

During February 1994, two plots were established; one of about 0.25 hectares on the sand of No.4 Tailings Dam, and the other, covering about 6 hectares, on the coarse waste dump. On 26th and 27th February, Revegetation Contractors Pty. Ltd. undertook trials, generally as proposed by Natural Resource Assessments in their report of 21st December, 1993 (Appendix 7). This included ground preparation, fertilising and seeding. Work also included hay mulching and hydromulching on both the tailings dam and the waste dump.

Separately, and extending over the following week , 294 trees were planted, as a trial, on the waste dump; care being taken to trial every ground and soil condition available. These trees, propagated in the Red Dome Mine nursery, were mainly eucalypts (E. Cullenii and E. Crebra).

Eight weeks later, on 27th April, 1994, monitoring of these trials took place and was reported by Natural Resource Assessments in May. In general, results were disappointing (except for trees) and are described below as extracts form the NRA report (Appendix 8).

" Tailings Dam Trial

The lack of stored soil water appears to be the limiting factor to plant establishment on the tailing material. The establishment of Japanese Millet on the trial site, natural colonisation of species on areas downslope of the trial, and the results of nutrient analyses, indicate an absence of acute nutrient deficiencies/toxicities.

Natural colonisation is restricted to the periphery of the tailings dam structure. This appears to be directly a function of depth to ground water, as the depth increases upslope, the rate of colonisation declines. (Table 5 Appendix 8).

A trend of increased plant growth (Japanese Millet) was observed in plots having the hay mulch applied. Application of organic matter would be expected to improve soil physical and chemical fertility viz.

Water holding capacity, nutrients, soil structure and reduced surface temperature.

The results of this trial indicate that a single application of hay mulch or alike across the tailings dam surface would not give rise to successful plant establishment in the short term.

Waste Rock Dump

The absence of plant growth on the waste rock trial site was most likely due to an absence of soil-seed contact which is necessary for the germination. The growing medium is competent hard rock having an absence of properties necessary for germination and subsequent growth. The application of hay had no observed beneficial effects in terms of plant growth was observed."

The Red Dome trees which were planted in early March have survived reasonably well; survival rate at the end of May being 88%, despite the harsh environment and lack of rain since they were planted (15.0 mm).

The options, suggested by NRA, for achieving more successful revegetation include:-

- soil amelioration (improve water holding capacity of tailings material).

- passive irrigation (use of ground water as a water supply and establishing a water recycle system) (for No.4 Tailings Dam).

- use of drought tolerant natural colonisers and commercial available species for revegetation work (exploit agricultural techniques for maximising the use of proven genetic material).

- Plant suitable trees to screen site from main thouroughfares (highway).

It should be noted however, that the natural environment provides little or no cattle feed for up to seven months of the year, and this has been especially true over the past fifteen years. It appears theore, that large expenditure on remediation irrigation schemes is not justified.

The lower slopes of tailings dams provide cattle feed for longer than the natural environment because of the fine sand and proximity to water.

Some areas of spread coarser tailings also sustain some growth for as long as the natural environment.

Waste dumps generally, do not support grass but they will accommodate shrubs and trees which have grown up naturally. Now, trial results with sponsored trees are giving encouraging results.

Areas of the lease which have better soil and ground conditions will also promote natural regeneration of grass and trees more quickly. However this is being encouraged with the implementation of a tree planting programme within fenced areas (to protect very young trees).

3.5 Rehabilitation Criteria

3.5.1 Revegetation Criteria

Class VIII

This land capability class includes waste dump batters and tailings dams (areas containing coarser fractions). The proposed post-mining land-use for these areas is "rock resource" and "sand resource" respectively. These land uses do not require a given standard of revegetation, therefore revegetation criteria are not relevant to these categories.

Class VII

This class includes flatter areas of waste dump, areas of the tailings dams (containing the finer fractions) and miscellaneous areas such as roads, the plant site, refuse dump and exploration tracks and pads. The nominated post-mining land-use is light timbered bushland (waste dumps and tailings dams) with limited areas of low intensity cattle grazing (miscellaneous areas).

The target revegetation criteria proposed for these areas are:-

- A tree and large shrub density in excess of 20 stems per hectare (Eucalyptus or Acacia species greater than 2m in height).

- On waste dump and tailings dams a ground cover in excess of 10% achieved during years with average or greater rainfall. On areas where low intensity grazing is specified, a ground cover in excess of 40% achieved during years with average or greater rainfall.

- Demonstration, through reference to scientific literature, that the vegetation association achieved possesses characteristics that predispose to long-term stability, namely self-sustainability, tolerance of fire and resistance to grazing, drought and pests.

- Demonstration that the natural soil micro-organisms, in particular mycorrhizas and nitrogen cycling bacteria, have begun to colonise rehabilitated sites, via
  1) survey of mycorrhizal establishment on the roots of trees and grass species, and
  2) measurement of growth media organic matter content.

The lower percent cover specified on the waste dumps and tailings dams is in recognition of the fact that the main limitation to growth on these media is available water capacity (Appendix 8). With the establishment of nutrient cycling bacteria, it can be expected that soil organic matter on these sites will gradually increase, together with moisture holding capacity and plant production.

3.5.2 Site Stability

Rehabilitation strategies will achieve landforms that are resistant to erosion processes and mass movement. Specifically:-

- On land that has a designated post-mining land-use of "light timber bushland" or "low intensity cattle grazing", a target soil loss of less than 40t/ha/year for a cumulative three month wet season greater than 0.2 AEP will be adopted.

- On waste dump batters, with a designated land-use of "rock resource" erosion will not be signficant due the compentency of the exposed waste rock (Appendix 5). Mass movement (slumping) may be more important. The stability of the dump landform will be assessed by the survey of selected boulders annually (a minimum of 6 points around the main waste dump). Site stability requirements will be considered to have been met if mean rock movement is less than 1mm/year.

- On coarse tailings areas, with a designated land-use of "sand resource", erosion is not a significant issue as there is no requirement to maintain a depth of growth media. It is likely that these areas will receive ongoing disturbance from sand reclamation activity.

3.6 Waste Rock Dumps and Tailings - Resource Management

3.6.1 Regional Importance

Apart from having significant reserves of in situ wolfram ore, Mt. Carbine has a large resource of broken waste rock that has long been its most valuable asset. It is probably the most valuable single resource of its kind north of Townsville, containing about 14,000,000 tonnes.

The resource has qualities that are likely to meet most, if not all, road building, building construction and other civil engineering project specifications. For these reasons and because of the growing scarcity of suitable construction materials in the region, every effort has been made to preserve this resource for future development. Needless to say, the rehabilitation programmes has been tailored to suit.

3.6.2 Royalty Conditions

In August 1983, quartz and schist were declared to be minerals by Order in Council, and thus since then, sales of rock and tailings have been subject to the payment of royalty in accordance with the Minerals Resources Regulations, 1990 - Schedule 1.

3.6.3 Nature of the Resource

There are three types of waste rock; each with different properties:-

- Coarse Waste.
- Reject Waste.
- Tailings.

Although each emanates from the same pit source and each is regarded as quartz schist, they have some different physical and chemical characteristics as a results of the exigencies of bènefication.

- Coarse Waste (+200mm to 3,000mm) is typical of the rock taken directly from the open pit and dumped. The mining process was largely selective and this called for the separation of quartz-rich ore from zones that were barren of quartz or poorly endowed. The barren and low-quartz rock was sent to the coarse waste dump.

- Reject Waste (largely +25mm -200mm) is the waste product of photometric ore sorting. It has, generally a very low quartz to schist ratio, since the quartz-rich rock was diverted in the ore sorting process for further beneficiation.

- Tailings (-12mm) is the end waste of the whole ore treatment process. It has a very high quartz content as a result of the concentration process which separated the quartz-rich material, (and as a consequence the valuable tungsten minerals which are hosted by the quartz) from all other material until it could be finally separated from its tungsten minerals of wolframite and scheelite, and pumped to a storage dam.

Notwithstanding the basic differences in quartz content, the physical (particle size, hardness, porosity) and chemical properties of these waste products make them potentially most valuable.

3.6.4 Size and Location of Stockpiles

There are three main waste rock and sand dumps. Two, west of the open pit and one (tailings) south of the open pit (Locality Plan - Figure 1). Each dump's recoverable size and volume is conservatively considered to be:-

- Coarse Waste	21.0 hectares	10.0m tonnes
- Reject Waste	13.5 hectares	3.0m tonnes
- Tailings	30.0 hectares	1.25m tonnes

3.6.5 Management Plan

Notwithstanding the outcome of attempts to sell broken rock, and tailings, management of these reserves includes not only the short term achievement of environmental goals, such revegetation, drainage and final landform, but continuing achievement of goals until new owners of the waste rock and tailings take over environmental responsibility, or, if there is no sale, until this Company decides to relinquish the leases after having met its objectives.

3.7 Milestones and Target Dates

Rehabilitation work commenced early in July 1993 and with the exception of ongoing revegetation considerations, is now complete.

The completion date applicable to each stage is as follows:-

1.	Completed preparation of revegetation trial plots.	by 31st February, 1994
2.	Completed preparation of selected surface areas for seed and seedling beds and commenced trial rehabilitation programme.	by 31st February, 1994
3.	Completed lansdcaping and general site rehabilitation.	by 31st May, 1994
4.	Completed site drainage system.	by 31st May, 1994

The sale of broken rock reserves/leases, or their submission for surrender is expected to be completed by 31st December, 1994.

Similarly, revegetation of selected surface areas with trees is expected to be completed by 31st December, 1994.

3.8 Post Decommissioning Management

The site manager, Dayrell Wolff, will maintain close contact with Departmental officers and keep them informed of work progress. Following completion of the rehabilitation work Dayrell has been retained in a consulting capacity for a period of 18 months. His function is to assess the effectiveness of longe term objectives which include:-

- maximising on-lease safety for public and stock.

- erosion control.

- maintenance of potable water quality in off-site water courses;

    - Manganese Creek (Ephemeral).
    - Holmes Creek (Ephemeral).
    - Mitchell River.

- achievement of stock water quality (at least) of:-

    - mine site catchments.
    - mine site water storages.

The monitoring and maintenance work to be carried out will include the following:-

3.8.1 Water Quality

- Recording rainfall.

- Collecting water run off samples and arranging for testing.

- Observing water flow directions and where appropriate, organising corrective action where necessary.

- Collecting water samples from dams and the pit following rain run-off.

- Maintaining records of water sample test results.

3.8.2 Revegetation Trials

- Monitoring revegetation test plots and recording progress.

- If necessary, seeking additional professional advice and assistance to ensure
that efforts to achieve the desired result is maximised.

- Advising the Department of Minerals and Energy of action taken and reporting on results achieved.

3.8.3 Overall Site Revegetation and Dump Stability

- Organising site maintenance work including fencing and storm damage repair.

- Inspecting rock dump walls and if necessary organise additional testing to ensure that stability is being maintained.

- Where appropriate, arrange for re-ripping of areas to encourage natural vegetation where seeding was not appropriate or has been unsuccessful.

Overall, it is expected that the work required will involve approximately 5 days per month and will extend over at least an 18 month period. However, if experience indicates that additional time is required, the period will be extended. (Tables, 20, 21).

Table 20 Environmental Monitoring Programme

Type	Aim	Monitoring Schedule/ Review Milestones	Reporting
Waste Dumps (Water seepage)	To determine water quality	End dry season End wet season	Annual
Waste Dumps (Ground Movement)	To measure stability of steep dump slopes	Annual	Annual
Erosion	To detect failure of water diversion banks and waterways	Continuous	Annual
Surface Water (Sediment Traps)	To monitor success of controls for limiting loss of contaminants from site.	Wet season run-off	Annual
Surface Water (Sediment traps)	To monitor quality of stock water	End wet season End dry season	Annual
Surface Water (Permanent streams)	To determine water quality	Annual	Annual
Surface Water (Open Pit)	To measure depth of water stored	Continuous	Annual
Vegetation (Trial Plots)	To measure grass cover and tree density	End wet season	Annual
Vegetation (General Site)	To measure grass cover and tree density	End wet season	Annual
Contaminated Land	To ensure compliance with Contaminated Lands Act	Continuous	Annual

Table 21 Estimated Cost of Monitoring and Maintenance Work

	1994		1995		
	Monitoring $	Maintenance $	Monitoring $	Maintenance $	Total $
Safety	1,000	1,000	1,000	-----	3,000
Ground Stability	2,000	-----	2,000	-----	4,000
Erosion Control	1,000	4,000	1,000	3,000	9,000
Revegetation	2,000	4,000	1,000	2,000	9,000
Water Quality	2,000	5,000	1,000	2,000	10,000
Total	**8,000**	**14,000**	**6,000**	**7,000**	**35,000**

Attachment 4:
Quarry Integrated Authority

ENVIRONMENTAL PROTECTION ACT 1994

Queensland Government
Environmental Protection Agency
Queensland **Parks and Wildlife Service**

Cairns District Office
PO Box 2066 CAIRNS QLD 4870
Phone: (07) 4046 6602 Fax: (07) 4046 6606
www.env.qld.gov.au ABN: 87221158786

Integrated Authority No. FN0671

Section 311 *Environmental Protection Act 1994*

This integrated authority, issued in accordance with section 311 of the Environmental Protection Act 1994 (the EP Act), provides for the carrying out of different Environmentally Relevant Activities or Environmentally Relevant Activities at different places managed in an integrated way. This integrated authority comprises one or more type of environmental authority in accordance with sections 86, 93, 95, 104, 113 and 311, of the EP Act, and this integrated authority details the conditions that are relevant to each stated type of environmental authority.

Under the provisions of the *Environmental Protection Act 1994* this integrated authority is issued to:

Mt Carbine Quarries Pty Ltd
9 Main Street
MOUNT MOLLOY QLD 4871

in respect of carrying out the Environmentally Relevant Activities (ERAs) at the same place and under the type of environmental authority described in the following parts.

This integrated authority is subject to the conditions set out in the attached schedules for each part.

The anniversary date of this integrated authority is 27 September 2004 each year.

This integrated authority takes effect from 27 September 2004.

S D Cameron
Signed

27 September 2004
Date

Stuart Cameron
Acting District Manager
Cairns District, Northern Region
Delegate of Administering Authority
Environmental Protection Act 1994

Note: This document is not proof of the current status of the authority. The current status of the authority may be ascertained by contacting the Environmental Protection Agency.

THIS INTEGRATED AUTHORITY CONSISTS OF THE FOLLOWING PART(S):

Each part consists of conditions relevant to various issues.

Licence Without Development Approval (Section 93)

20(b) Extracting rock or other material - Extracting rock (other than rock mined in block or slab form for building purposes), sand (other than foundry sand), clay (other than clay used for its ceramic properties, kaolin or bentonite), gravel, loam or other material (other than gravel, loam or other material under a mining authority) from a pit or quarry using plant or equipment having a design capacity of 5 000 t or more, but less than 100 000 t, per year

22(b) Screening etc. materials - Screening, washing, crushing, grinding, milling, sizing or separating material extracted from the earth (other than under a mining authority) or by dredging using plant or equipment having a design capacity of 5 000 t or more, but less than 100 000 t, per year.

at premises / place described as:

Lot 13, Plan RP127355

located at:

Peninsula Development Road

MOUNT CARBINE QLD 4871

The aforementioned description of the ERA(s) for which this authority is issued is simply a restatement of the ERA(s) as prescribed in the legislation at the time of issuing the authority. Where there is any conflict between the above description of the ERA(s) for which this authority is issued and the conditions as specified in this authority as to the scale, intensity or manner of carrying out of the ERA(s) then such conditions prevail to the extent of the inconsistency.

The authority is issued subject to conditions as set out in the schedule(s) attached that form part of the integrated authority.

Licence Without Development Approval (Section 93)

This part is for the carrying out of a level 1 environmentally relevant activity without a development approval, under chapter 4, part 3, division 2, subdivision 1 of the Environmental Protection Act 1994.

Schedule A - Activity

Prevent and /or minimise likelihood of environmental harm

(A1-1) In carrying out the environmentally relevant activities, you must take all reasonable and practicable measures to prevent and / or to minimise the likelihood of environmental harm being caused. Any environmentally relevant activity, that, if carried out incompetently, or negligently, may cause environmental harm, in a manner that could have been prevented, shall be carried out in a proper manner in accordance with the conditions of this authority.

NOTE: This authority authorises the environmentally relevant activity. It does not authorise environmental harm unless a condition contained within this authority explicitly authorises that harm. Where there is no condition or the authority is silent on a matter, the lack of a condition or silence shall not be construed as authorising harm.

Maintenance of measures, plant and equipment

(A2-1) The holder must:

- install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority; and
- maintain such measures, plant and equipment in a proper and efficient condition; and
- operate such measures, plant and equipment in a proper and efficient manner.

Site based management plan

(A3-1) From commencement of the activity, a Site Based Management Plan (SBMP) must be implemented. The SBMP must identify all sources of environmental harm, including but not limited to the actual and potential release of all contaminants, the potential impact of these sources and what actions will be taken to prevent the likelihood of environmental harm being caused. The SBMP must also provide for the review and 'continual improvement' in the overall environmental performance of all Environmentally Relevant Activities that are carried out.

The site based management plan must address the following matters:

- Environmental commitments - a commitment by senior management to achieve environmental goals.
- Identification of environmental issues and potential impacts.
- Control measures for routine operations to minimise likelihood of environmental harm.
- Contingency plans and emergency procedures for non-routine situations.
- Organisational structure and responsibility.
- Effective communication.
- Monitoring of the contaminant releases.
- Conducting environmental impact assessments.
- Staff training.
- Record keeping.
- Periodic review of environmental performance and continual improvement.

Records

(A5-1) Record, compile and keep all monitoring results required by this document and present this information to the administering authority when requested, in a specified format.

END OF CONDITIONS FOR SCHEDULE A

Schedule B - Air

Dust nuisance

(B2-1) The release of dust and/or particulate matter resulting from the activity must not cause an environmental nuisance at any dust sensitive place.

(B2-2) Excedence of any of the following levels when measured at any dust sensitive place is an environmental nuisance for the purposes of condition B2-1.

- Dust deposition of 120 milligrams per square metre per day, when monitored in accordance with Australian Standard AS 3580.10 of 1991; OR
- A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 150 micrograms per cubic metre over a 24 hour averaging time, at a dust sensitive place downwind of the site, when monitored in accordance with:
  - Australian Standard AS 3580.9.6 'Ambient air - Particulate matter - Determination of suspended particulate PM10 high-volume sampler with size-selective inlet - Gravimetric method'; or
  - any alternative method of monitoring PM10 which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority.

(B2-3) When requested by the Administering Authority, dust and particulate monitoring must be undertaken to investigate any complaint of environmental nuisance caused by dust and/or particulate matter, and the results notified within 14 days to the administering authority following completion of monitoring. Monitoring must be carried out at a place(s) relevant to the potentially affected dust sensitive place and at upwind control sites and must include:

- for a complaint alleging dust nuisance, dust deposition; and
- for a complaint alleging adverse health effects caused by dust, the concentration per cubic metre of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere over a 24hr averaging time.

END OF CONDITIONS FOR SCHEDULE B

Schedule C - Water

Erosion protection measures and sediment controls

(C2-2) Prevent the release of sediment to waters or a build up of sediment in any stormwater drain.

Release to waters

(C3-1) Contaminants must not be released from the site to any waters or the bed and banks of any waters.

END OF CONDITIONS FOR SCHEDULE C

Schedule D - Noise and vibration

Noise nuisance

(D1-1) Noise from activities must not cause an environmental nuisance at any noise affected premises.

(D1-2) All noise from activities must not exceed the levels specified in Schedule D - Table 1 at any noise affected premises.

Schedule D - Table 1 (Noise limits)

Noise level dB(A) measured as	Monday to Saturday			Sundays and public holidays		
	7am - 6pm	6pm - 10pm	10pm - 7am	9am - 6pm	6pm - 10pm	10pm - 9am
	Noise measured at a 'Noise sensitive place'					
$L_{A10, adj, 10 mins}$	55	50	40	55	50	40
$L_{A1, adj, 10 mins}$	60	55	45	60	55	45
	Noise measured at a 'Commercial place'					
$L_{A10, adj, 10 mins}$	60	55	45	60	55	45
$L_{A1, adj, 10 mins}$	65	60	50	65	60	50

Noise monitoring

(D2-1) When requested by the Administering Authority, noise monitoring must be undertaken to investigate any complaint of noise nuisance, and the results notified within 14 days to the administering authority. Monitoring must include:

- $L_{A\ 10, adj, 10 mins}$
- $L_{A\ 1, adj, 10 mins}$
- the level and frequency of occurrence of impulsive or tonal noise;
- atmospheric conditions including wind speed and direction;
- effects due to extraneous factors such as traffic noise; and
- location, date and time of recording.

(D2-2) The method of measurement and reporting of noise levels must comply with the latest edition of the Environmental Protection Agency's Noise Measurement Manual.

END OF CONDITIONS FOR SCHEDULE D

Schedule E - Waste

Waste handling

(E5-1) All regulated waste removed from the site must be removed by a person who holds a current authority to transport such waste under the provisions of the *Environmental Protection Act 1994*.

END OF CONDITIONS FOR SCHEDULE E

Schedule F - Land

Land rehabilitation

(F1-1) The authorised place must be rehabilitated (including all disturbed areas such as slopes, borrow pits, stockpile and screening areas) in a manner such that:

- suitable native species of vegetation are planted and established;
- potential for erosion of the site is minimised;
- the quality of stormwater, water and seepage released from the site is such that releases of contaminants such as suspended solids, turbidity, total dissolved salts, pH, total iron, total aluminium, and total manganese are not likely to cause environmental harm;
- the likelihood of environmental nuisance being caused by release of dust is minimised;
- the water quality of any residual water bodies meets criteria for subsequent uses and does not have potential to cause environmental harm;
- the final landform is stable and not subject to slumping; and
- any actual and potential acid sulfate soils in or on the site are either not disturbed; or, submerged, or treated so as to not be likely to cause environmental harm.

Preventing contaminant release to land

(F3-1) Contaminants must not be released to land.

(F3-2) Spillage of all chemicals and fuels must be contained within an on-site containment system and controlled in a manner that prevents environmental harm.

NOTE: All petroleum product storage's must be designed, constructed and maintained in accordance with AS 1940 - Storage and Handling of Flammable and Combustible Liquids.

END OF CONDITIONS FOR SCHEDULE F

Schedule G - Community

Complaint response

(G1-1) All complaints received must be recorded including investigations undertaken, conclusions formed and action taken. This information must be made available to the administering authority on request.

END OF CONDITIONS FOR SCHEDULE G

Schedule H - Definitions

Words and phrases used throughout this licence or development approval are defined below:
Where a definition for a term used in this authority is sought and the term is not defined within this authority the definitions provided in the *Environmental Protection Act 1994*, its regulations, and Environmental Protection Policies shall be used.

Word Definitions

"administering authority" means the Environmental Protection Agency or its successor.

"you" means the holder of this Environmental Authority or owner / occupier of the land which is the subject of this Development Approval.

"site" means the place to which this environmental authority relates or the premises to which this development approval relates.

"authorised place" means the place authorised under this environmental authority/development approval for the carrying out of the specified environmentally relevant activities.

"this authority" means this environmental authority/development approval.

"authority" means level 1 licence (without development approval), or level 1 approval (without development approval), or level 2 approval (without development approval) under the *Environmental Protection Act 1994*.

"dust sensitive place" means -

- a dwelling, mobile home or caravan park, residential marina or other residential place;
- a motel, hotel or hostel;
- a kindergarten, school, university or other educational institution;
- a medical centre or hospital;
- a protected area;
- a park or gardens; or
- a place used as an office or for business or commercial purposes.

and includes the curtilage of any such place.

"dwelling" means any of the following structures or vehicles that is principally used as a residence-

- a house, unit, motel, nursing home or other building or part of a building;
- a caravan, mobile home or other vehicle or structure on land;
- a water craft in a marina.

"nuisance sensitive place" includes -

- a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or
- a motel, hotel or hostel; or
- a kindergarten, school, university or other educational institution; or
- a medical centre or hospital; or
- a protected area under the Nature Conservation Act 1992, the Marine Parks Act 1992 or a World Heritage Area; or
- a public thoroughfare, park or gardens; or
- a place used as a workplace, an office or for business or commercial purposes.

and includes a place within the curtilage of such a place reasonably used by persons at that place.

"$L_{A\ 10,\ adj,\ 10\ mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10 minute measurement period, using Fast response.

"$L_{A\ 1,\ adj,\ 10\ mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 10 minute measurement period, using Fast response

"$L_{A,\ max\ adj,\ T}$" means the average maximum A-weighted sound pressure level, adjusted for noise character and measured over any 10 minute period, using Fast response.

"noise affected premises" means a "noise sensitive place"or a "commercial place"

"noise sensitive place" means -

- a dwelling, mobile home or caravan park, residential marina or other residential premises; or
- a motel, hotel or hostel; or
- a kindergarten, school, university or other educational institution; or
- a medical centre or hospital; or
- a protected area; or
- a park or gardens.

and includes the curtilage of such place.

"commercial place" means a place used as an office or for business or commercial purposes.

"intrusive noise" means noise that, because of its frequency, duration, level, tonal characteristics, impulsiveness or vibration -

- is clearly audible to, or can be felt by, an individual; and
- annoys the individual.

In determining whether a noise annoys an individual and is unreasonably intrusive, regard must be given to Australian Standard 1055.2 - 1997 Acoustics - Description and Measurement of Environmental Noise Part 2 - Application to Specific Situations.

"protected area" means -

- a protected area under the Nature Conservation Act 1992; or
- a marine park under the Marine Parks Act 1992; or
- a World Heritage Area.

"waters" includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water natural or artificial watercourse, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater and any part-thereof.

"land" in the "land schedule"of this document means land excluding waters and the atmosphere.

"regulated waste" means non-domestic waste mentioned in Schedule 7 of the Environmental Protection Regulation 1998 (whether or not it has been treated or immobilised), and includes:

- for an element - any chemical compound containing the element; and
- anything that has contained the waste.

"licensed vehicle" means a vehicle authorised to be used under the licence to transport regulated waste.

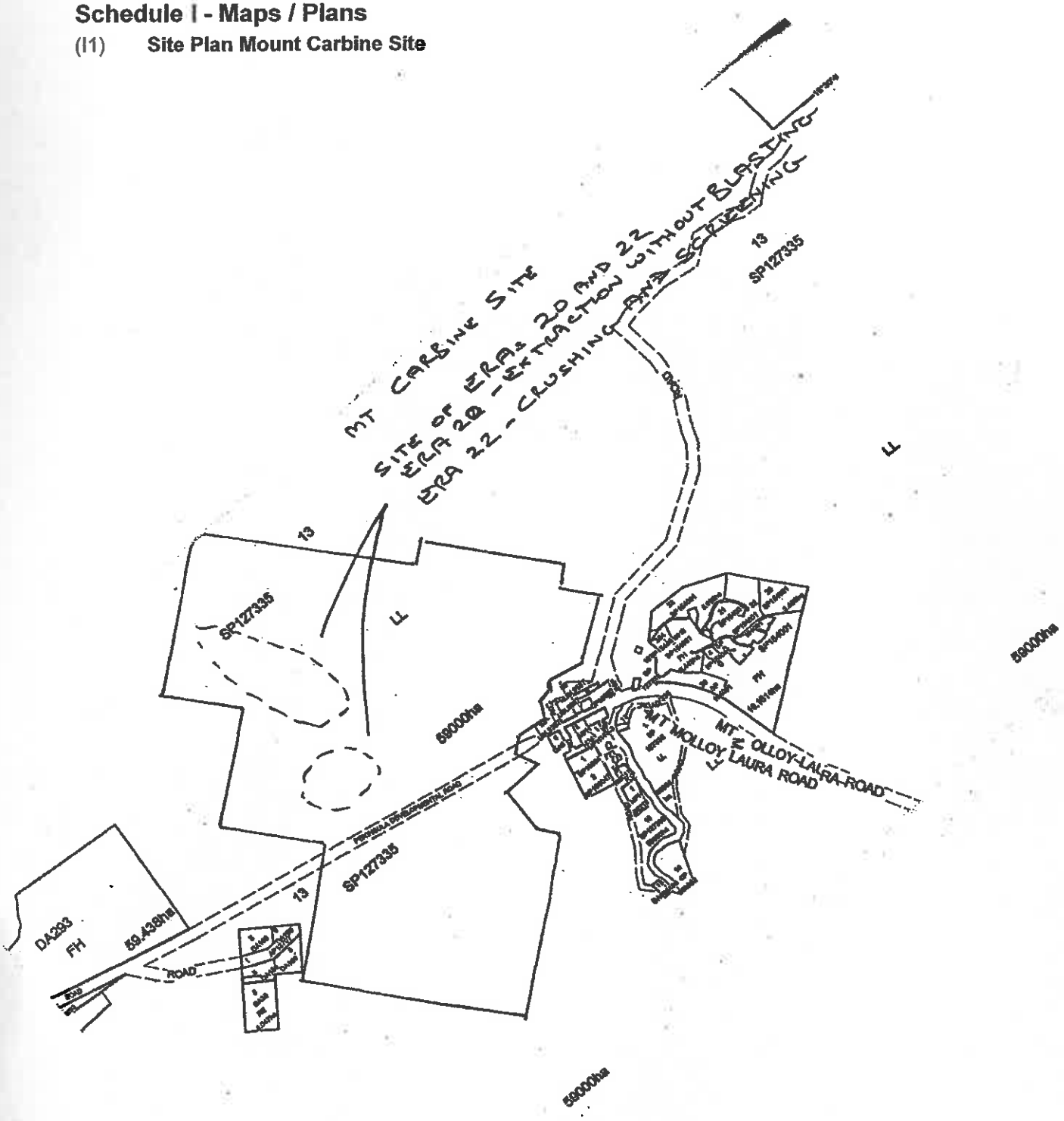
"registered vehicle" means "licensed vehicle"

"annual return" means the return required by the annual notice (under section 316 of the Environment Protection Act, 1994) for the section 86(2) licence that applies to the development approval.

END OF DEFINITIONS FOR SCHEDULE H

Schedule I - Maps / Plans

(I1) **Site Plan Mount Carbine Site**



END OF CONDITIONS FOR SCHEDULE I

END OF INTEGRATED AUTHORITY

Attachment 5:
Quarry as of Right Use

Mareeba
SHIRE COUNCIL

65 Rankin Street
PO Box 154 MAREEBA QLD 4880

P: 07 4086 4657
F: 07 4092 3323

W: www.msc.qld.gov.au
E: info@msc.qld.gov.au

3 May 2016

Council Ref: URP-MCU
Our Ref: BM:nj
Your Ref:

Geoffrey Nicholson
Director
Mt Carbine Quarries Pty Ltd
PO Box 3
MOUNT MOLLOY QLD 4871

Dear Sir

MT CARBINE QUARRIES EXTRACTIVE INDUSTRY - ML 4867 AND ML 4919

I refer to our recent discussions regarding your continuing extractive industry operations on land described as part of Lot 13 on SP254833 being mining leases ML 4867 and ML 4919, as indicated on the attached plan.

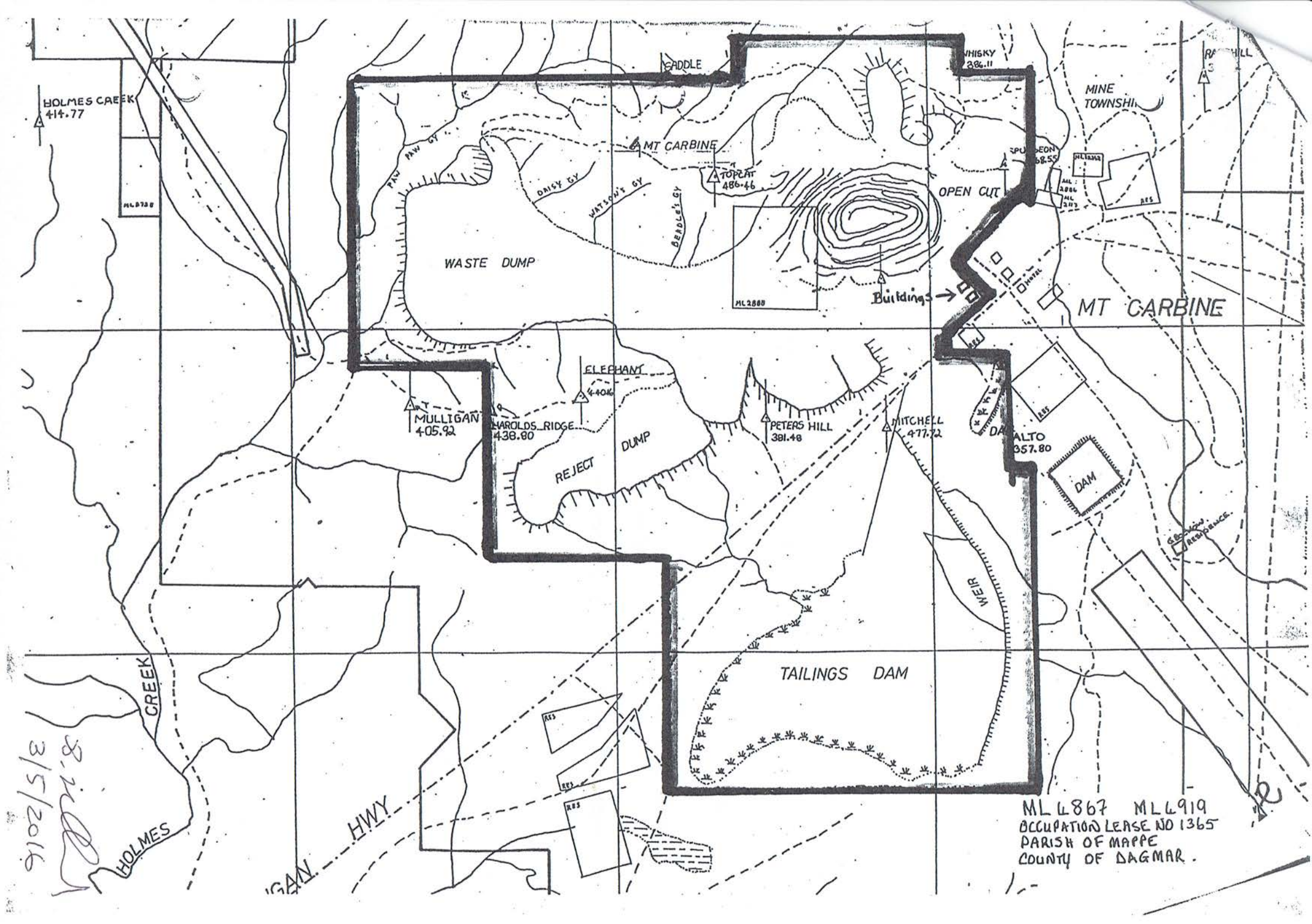
The ongoing use of this land for extractive industry purposes is an existing right of use, lawfully established under the Mareeba Shire Planning Scheme 2004.

Should you require any further information, please contact Council's **Senior Planner Brian Millard** on the above telephone number.

Yours faithfully

B. Millard

BRIAN MILLARD
SENIOR PLANNER


HOLMES CREEK
414.77
ML 8738
SADDLE
WHISKY
386.11
MINE
TOWNSHI
MT CARBINE
TOPCAT
486.46
PAN PAW GY
DAISY GY
WATSON'S GY
BENDLE'S GY
OPEN CUT
SPURGEON
WASTE DUMP
ML 2888
Buildings
MT CARBINE
ELEPHANT
MULLIGAN
405.92
HAROLDS RIDGE
438.80
REJECT
DUMP
PETERS HILL
381.48
MITCHELL
477.72
ALTO
357.80
DAM
WEIR
TAILINGS DAM
CREEK
HOLMES
HWY
RES
ML 4867 ML 4919
OCCUPATION LEASE NO 1365
PARISH OF MAPPE
COUNTY OF DAGMAR.
31/5/2016

Attachment 6:
Quarry Environmental Authority

Permit

Environmental Protection Act 1994

Environmental authority EPPR00438313

This environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

Environmental authority number: EPPR00438313

Environmental authority takes effect on 16 March 2021

Environmental authority holder(s)

Name(s)	Registered address
MT. CARBINE QUARRIES PTY. LTD.	Suite 1 Level 17 500 Collins St MELBOURNE VIC Australia

Environmentally relevant activity and location details

Environmentally relevant activity/activities	Location(s)
ERA 16 - Extraction and Screening 3: Screening, in a year, the following quantity of material (b) more than 100,000t but not more than 1,000,000t	Lot 13 on SP254833
ERA 16 - Extraction and Screening 2: Extracting, other than by dredging, in a year, the following quantity of material (b) more than 100,000t but not more than 1,000,000t	Lot 13 on SP254833

Additional information for applicants

Environmentally relevant activities

The description of any environmentally relevant activity (ERA) for which an environmental authority (EA) is issued is a restatement of the ERA as defined by legislation at the time the EA is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an EA as to the scale, intensity or manner of carrying out an ERA, the conditions prevail to the extent of the inconsistency.

Queensland Government

An EA authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the EA specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the *Environmental Protection Act 1994* (EP Act).

Contaminated land

It is a requirement of the EP Act that an owner or occupier of contaminated land give written notice to the administering authority if they become aware of the following:

- the happening of an event involving a hazardous contaminant on the contaminated land (notice must be given within 24 hours); or
- a change in the condition of the contaminated land (notice must be given within 24 hours); or
- a notifiable activity (as defined in Schedule 3) having been carried out, or is being carried out, on the contaminated land (notice must be given within 20 business days);

that is causing, or is reasonably likely to cause, serious or material environmental harm.

For further information, including the form for giving written notice, refer to the Queensland Government website www.qld.gov.au, using the search term 'duty to notify'.

Take effect

Please note that, in accordance with section 200 of the EP Act, an EA has effect:

a) if the authority is for a prescribed ERA and it states that it takes effect on the day nominated by the holder of the authority in a written notice given to the administering authority-on the nominated day; or

b) if the authority states a day or an event for it to take effect-on the stated day or when the stated event happens; or

c) otherwise-on the day the authority is issued.

However, if the EA is authorising an activity that requires an additional authorisation (a relevant tenure for a resource activity, a development permit under the *Planning Act 2016* or an SDA Approval under the *State Development and Public Works Organisation Act 1971*), this EA will not take effect until the additional authorisation has taken effect.

If this EA takes effect when the additional authorisation takes effect, you must provide the administering authority written notice within 5 business days of receiving notification of the related additional authorisation taking effect.

If you have incorrectly claimed that an additional authorisation is not required, carrying out the ERA without the additional authorisation is not legal and could result in your prosecution for providing false or misleading information or operating without a valid environmental authority.

Clancy Mackaway
Department of Environment and Science
Delegate of the administering authority
Environmental Protection Act 1994

Date issued: 16 March 2021

Enquiries:
Extraction, Energy and Chemical Industries Assessment
Department of Environment and Science

Phone: 1300 130 372
Email: palm@des.qld.gov.au

Obligations under the *Environmental Protection Act 1994*

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319)
- duty to notify environmental harm (section 320-320G)
- offence of causing serious or material environmental harm (sections 437-439)
- offence of causing environmental nuisance (section 440)
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG)
- offence to place contaminant where environmental harm or nuisance may be caused (section 443)

Conditions of environmental authority

The environmentally relevant activity(ies) conducted at the location as described above must be conducted in accordance with the following site specific conditions of approval.

Schedule A: General	
Condition number	**Condition**
A1	Any activity operating under this environmental authority must not be conducted contrary to any of the following limitations: 1. Extractive activities are limited to the Quarry areas shown in Figure 1 — Extent of extractive activities and the coordinates shown in Appendix A — Extent of extractive activities coordinates. 2. No ore or waste rock characterised as having acid forming potential is to be stored within the quarry areas shown in Figure 1 - Extent of extractive activities and the coordinates shown in Appendix A — Extent of extractive activities coordinates. 3. Quarry material must not contain any ore or waste rock characterised as having acid forming potential.
A2	In carrying out the environmentally relevant activities, you must take all reasonable and practicable measures to prevent and / or to minimise the likelihood of environmental harm being caused. Any environmentally relevant activity, that, if carried out incompetently, or negligently, may cause environmental harm, in a manner that could have been prevented, shall be carried out in a proper manner in accordance with the conditions of this authority. *Note: This authority authorises the environmentally relevant activity. It does not authorise environmental harm unless a condition contained within this authority explicitly authorises that harm. Where there is no condition or the authority is silent on a matter, the lack of a condition or silence shall not be construed as authorising harm.*
A3	The holder must: • install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority; • and maintain such measures, plant and equipment in a proper and efficient condition; and • operate such measures, plant and equipment in a proper and efficient manner.
A4	From the commencement of the activity, a Site Based Management Plan (SBMP) must be implemented. The SBMP must identify all sources of environmental harm, including but not limited to the actual and potential release of all contaminants, the potential impact of these sources and what actions will be taken to prevent the likelihood of environmental harm being caused. The SBMP must also provide for the review and 'continual improvement' in the overall environmental performance of all Environmentally Relevant Activities that are carried out.

	The site based management plan must address the following matters: • Environmental commitments — a commitment by senior management to achieve environmental goals • Identification of environmental issues and potential impacts • Control measures for routine operations to minimise likelihood of environmental harm • Contingency plans and emergency procedures for non-routine situations • Organisational structure and responsibility • Effective communication • Monitoring of the contaminant releases • Conducting environmental impact assessments • Staff training • Record keeping • Periodic review of environmental performance and continual improvement The SBMP is to be updated within one year (1) year of the commencement of this authority; thereafter annually reviewed and updated every three (3) years.
A5	All records must be kept for a period of at least five years and provided to the administering authority upon request.
Schedule B: Air	
Condition number	**Condition**
B1	The release of dust and/or particulate matter resulting from the activity must not cause an environmental nuisance at any dust sensitive place.
B2	Exceedence of any of the following levels when measured at any dust sensitive place is an environmental nuisance for the purposes of condition B1. • Dust deposition of 120 milligrams per square metre per day, when monitored in accordance with Australian Standard AS 3580.10.1 of 2003; or • A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 150 micrograms per cubic metre over a 24 hour averaging time, at a dust sensitive place downwind of the site, when monitored in accordance with: o Australian Standard AS 3580.9.6 'Ambient air — Particulate matter — Determination of suspended particulate PM10 high-volume sampler with size selective inlet — Gravimetric method'; or o Any alternative method of monitoring which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority.

B3	When requested by the administering authority, dust and particulate monitoring must be undertaken to investigate any complaint of environmental nuisance caused by dust and/or particulate matter, and the results notified within 14 days to the administering authority following completion of monitoring. Monitoring must be carried out at a place(s) relevant to the potentially affected dust sensitive place and at upwind control sites and must include: • For a complaint alleging dust nuisance, dust deposition; and • For a complaint alleging adverse health effects caused by dust; the concentration per cubic metre of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere over a 24 hour averaging time.
Schedule C: Water	
Condition number	**Condition**
C1	Erosion and sediment control measures must be implemented and maintained to minimise erosion and the release of sediment.
C2	Stormwater runoff from disturbed areas of the site, generated by (up to and including) a **24 hour storm event with an average recurrence interval of 1 in 5 years** must be retained on site or managed to remove contaminants prior to release.
Schedule D: Noise	
Condition number	**Condition**
D1	Noise from activities must not cause an environmental nuisance at any noise sensitive place.
D2	All noise from the activities must not exceed the levels specified in Schedule D — Table 1 at any noise sensitive place.

Schedule D - Table 1 Noise limits

Noise level dB(A) measured as	Monday to Saturday			Sundays and Public Holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
$L_{A10, adj, 10 mins}$	BG+5	BG+5	BG+3	BG+5	BG+5	BG+0
$L_{A1, adj, 10 mins}$	BG+10	BG+10	BG+5	BG+10	BG+10	BG+5

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	Note: in the event that the measured background noise level (BG) is less than 35 dB(A), then 25 dB(A) can be substituted for the measured background level.
D3	When requested by the administering authority, noise monitoring must be undertaken to investigate any complaint of noise nuisance, and the results notified to the administering authority. Monitoring must include: • LA 10, adj, 10 mins; • LA 1, adj, 10 mins; • the level and frequency of occurrence of impulsive or tonal noise; • atmospheric conditions including wind speed and direction; • effects due to extraneous factors such as traffic noise; and • location, date and time of recording.
D4	The method of measurement and reporting of noise levels must comply with the latest edition of the administering authority's Noise Measurement Manual.
Schedule E: Waste	
Condition number	**Condition**
E1	Unless authorised under another condition in this environmental authority, all waste generated in carrying out the activity must be reused, recycled, or removed to a facility that can lawfully accept the waste.
E2	Concrete waste and non-acid-forming residual waste rock generated in carrying out the authorised activity may only be stored within the Quarry areas shown in Figure 1 — Extent of extractive activities and the coordinates shown in Appendix A — Extent of extractive activities coordinates.
Schedule F: Land	
Condition number	**Condition**
F1	As soon as practicable after completion of operational work, land disturbed by the activity must be rehabilitated to achieve the following: • the land is safe for humans and fauna; • the land has no subsidence or erosion gullies following completion of the rehabilitation; • there is no ongoing contamination to waters; and

	• the maintenance requirements for the land are no greater than for the land before it was disturbed.
F2	Contaminants must not be released to land.
F3	Spillage of all chemicals and fuels must be contained within an on-site containment system in accordance with AS 1940 — Storage and handling of flammable and combustible liquids.
Schedule G: Community	
Condition number	**Condition**
G1	All complaints received must be recorded including investigations undertaken, conclusions formed and action taken. This information must be made available to the administering authority on request.

Definitions

Words and phrases used throughout this approval are defined below. Where a definition for a term used in this authority is sought and the term is not defined within this authority the definitions provided in the *Environmental Protection Act 1994*, its regulations, and Environmental Protection Policies shall be used.

Word definitions

"administering authority" means the Department of Environment and Science or its successor.

"site" means the place to which this environmental authority relates or the premises to which this approval relates.

"authorised place" means the place authorised under this environmental authority for the carrying out of the specified environmentally relevant activities.

"commercial place" means a place used as an office or for business or commercial purposes.

"dust sensitive place" means:

- a dwelling, mobile home or caravan park, residential marina or other residential place;
- a motel, hotel or hostel;
- a kindergarten, school, university or other educational institution;
- a medical centre or hospital;
- a protected area;
- a park or gardens; or
- a place used as an office or for business or commercial purposes and includes the curtilage of any such place.

"dwelling" means any of the following structures or vehicles that is principally used as a residence:

- a house, unit, motel, nursing home or other building or part of a building;
- a caravan, mobile home or other vehicle or structure on land; or
- a watercraft in a marina.

"essential habitat" and as defined in section 20AC(2) of the *Vegetation Management Act 1999*

"intrusive noise" means noise that, because of its frequency, duration, level, tonal characteristics, impulsiveness or vibration

- is clearly audible to, or can be felt by, an individual; and
- annoys the individual.

In determining whether a noise annoys an individual and is unreasonably intrusive, regard must be given to Australian Standard 1055.2 — 1997 Acoustics — Description and measurement of environmental noise Part 2 — Application to specific situations.

"$L_{A\ 10,\ adj,\ 10\ mins}$" means the A-weighted sound pressure level (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10 minute measurement period, using Fast response.

"$L_{A\ 1,\ adj,\ 10\ mins}$" means the A-weighted sound pressure level (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 10 minute measurement period, using Fast response.

"$L_{A, max\ adj, T}$" means the average maximum A-weighted sound pressure level, adjusted for noise character and measured over any 10 minute period, using Fast response.

"noise affected premises" means a "noise sensitive place" or a "commercial place"

"noise sensitive place" means - a dwelling, mobile home or caravan park, residential marina or other residential premises; or - a motel, hotel or hostel; or - a kindergarten, school, university or other educational institution; or -a medical centre or hospital; or - a protected area; or -a park or gardens and includes the curtilage of such place.

"nuisance sensitive place" includes:

- a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or
- a motel, hotel or hostel; or
- a kindergarten, school, university or other educational institution; or
- a medical centre or hospital; or
- a protected area under the *Nature Conservation Act 1992*, the *Marine Parks Act 2004* or a World Heritage Area; or
- a public thoroughfare, park or gardens; or
- a place used as a workplace, an office or for business or commercial purposes and includes a place within the curtilage of such a place reasonably used by persons at that place.

"Ore or waste rock characterised as having acid forming potential" means any rock with either a Net Acid Producing Potential of greater than 5 kg of H2SO4/tonne or a Net Acid Generation oxidation pH of less than 4.5 (pH unit).

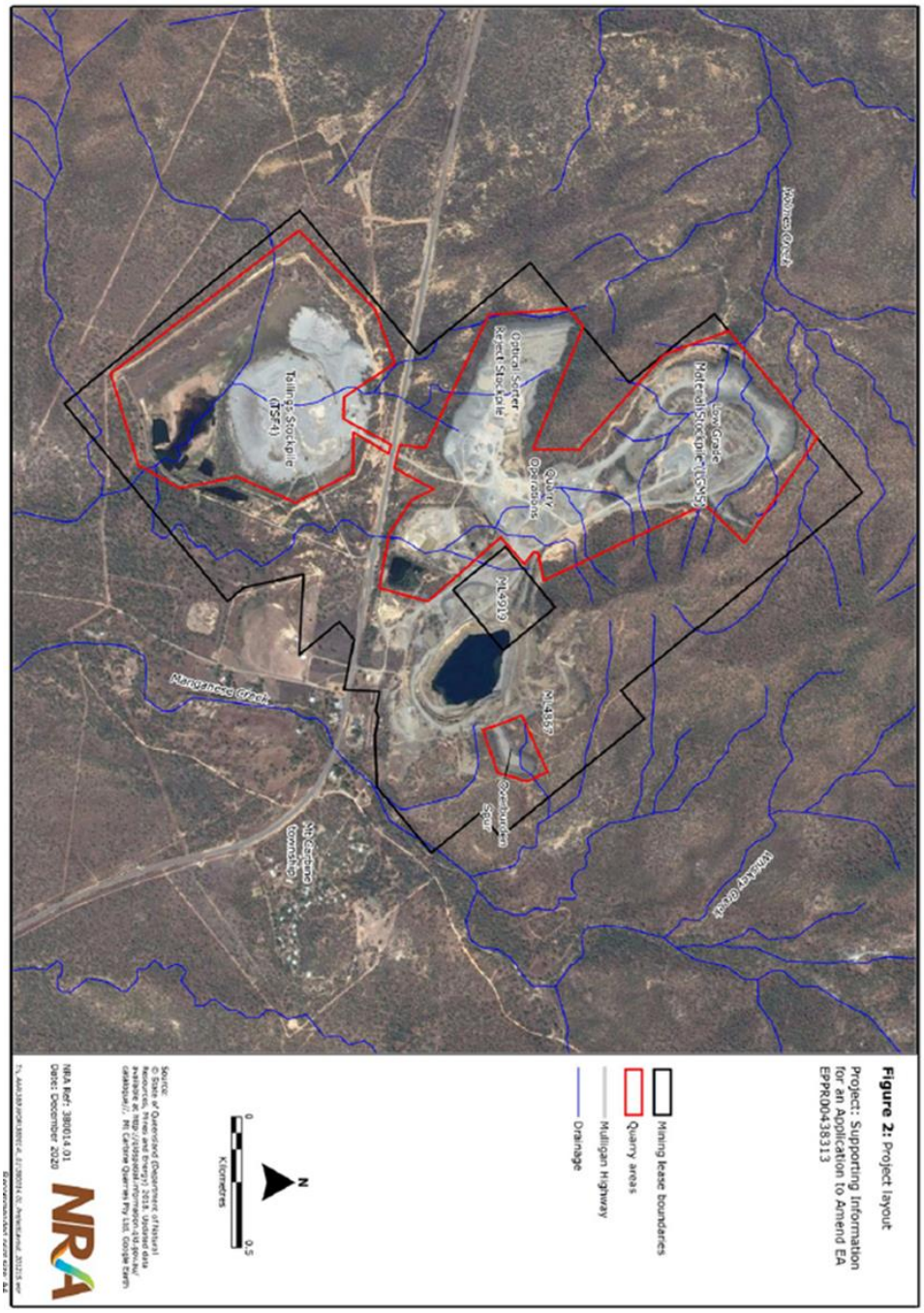
"protected area" means

- a protected area under the *Nature Conservation Act 1992*; or
- a marine park under the *Marine Parks Act 2004*; or
- a World Heritage Area.

"waters" includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined natural or artificial watercourse, bed and bank of any waters, dams, non-tidal and tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater and any part thereof.

"you" means the holder of this Environmental Authority or owner / occupier of the land which is the subject of this approval.

Figure 1 — Extent of extractive activities



Appendix A — Extent of extractive activities coordinates

WGS84 GDA94	
Latitude	**Longitude**
145.1337	-16.52247543
145.1357	-16.52159401
145.136	-16.5223021
145.1357	-16.52332132
145.1342	-16.52382554
145.134	-16.52326998
145.1337	-16.52247543
145.124	-16.52687893
145.123	-16.52851134
145.1223	-16.52847558
145.1211	-16.52672329
145.1192	-16.52738241
145.1163	-16.52997624
145.1214	-16.53651301
145.1246	-16.5355924
145.1255	-16.53416067
145.1251	-16.53218539
145.126	-16.53019324
145.1249	-16.52819737
145.1235	-16.5281702
145.1243	-16.52696815
145.124	-16.52687893
145.1192	-16.5207431

Latitude	Longitude
145.1198	-16.52023319
145.1242	-16.52199838
145.1242	-16.5203932
145.1209	-16.51745707
145.12	-16.51527174
145.1239	-16.51225215
145.1276	-16.51478544
145.1262	-16.5161333
145.1289	-16.52168394
145.1279	-16.52184782
145.1279	-16.52202017
145.1283	-16.52234062
145.1273	-16.52313803
145.1296	-16.52566261
145.1291	-16.52732786
145.1272	-16.52697215
145.126	-16.52618431
145.1256	-16.52542533
145.1248	-16.52678566
145.124	-16.52656961
145.1241	-16.52570102
145.1194	-16.5234867
145.1192	-16.5207431

END OF ENVIRONMENTAL AUTHROITY

Environmental Approval & Compliance Solutions

Cairns Office:
Level 1, 320 Sheridan Street, PO Box 5678 Cairns QLD 4870
P: 61 7 4034 5300

Townsville Office:
Suite 2A, Level 1, 41 Denham Street, PO Box 539 Townsville QLD 4810
P: 61 7 4796 9444

www.natres.com.au • nra@natres.com.au

Natural Resource Assessments Pty Ltd trading as NRA Environmental Consultants. ABN: 77 011 073 135
Certified Integrated Management System: ISO 9001:2015 (Quality), ISO 14001:2015 (Environment), ISO 45001:2018 (Safety).