

# **TNT MINES LIMITED**

ABN 67 107 244 039

**RL10/1988**

**MOINA**

**ANNUAL REPORT TO 21 OCTOBER 2014**

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## **ABSTRACT**

A maiden JORC Inferred Resource of 24.6 million tonnes at 16% fluorspar ( $\text{CaF}_2$ ), 0.1% tin (Sn), 0.1% tungstate ( $\text{WO}_3$ ) and 17.2% iron (Fe) was estimated in the 2013 year.

Also in that year a final report on the metallurgical test work conducted at ALS AMMTEC in Burnie and Perth was received from Mintrex. The work demonstrated that a saleable tungsten concentrate could be produced, an acid grade quality fluorspar concentrate could be achieved but would require agglomeration to be saleable and a marginal magnetite concentrate was separated. No recoverable tin was separated.

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## 1.0 INTRODUCTION

### 1.1 Location and tenure

The Moina tenement is located approximately 40km south-west of Devonport, in north-west Tasmania (Figure 1). The 2 km<sup>2</sup> tenement is centred approximately 2 km south-west of the small town of Moina. The tenement area can be found on the Forth (1:100,000) LTIS map sheets.

Topographically the area is of variable relief with patches of rainforest, plantation and farmland. Vehicular access is good with Moina Road running through the tenement and numerous rough tracks giving 4WD access to most of the tenement. The land tenure is a mixture of State Forest and private freehold.

The owner of the tenement is Geotech International Pty Ltd (“Geotech”). That company has entered into an option agreement with TNT Mines (Moina) Pty Ltd, a wholly owned subsidiary of TNT Mines Limited (formerly part of the Minemakers Australia group).

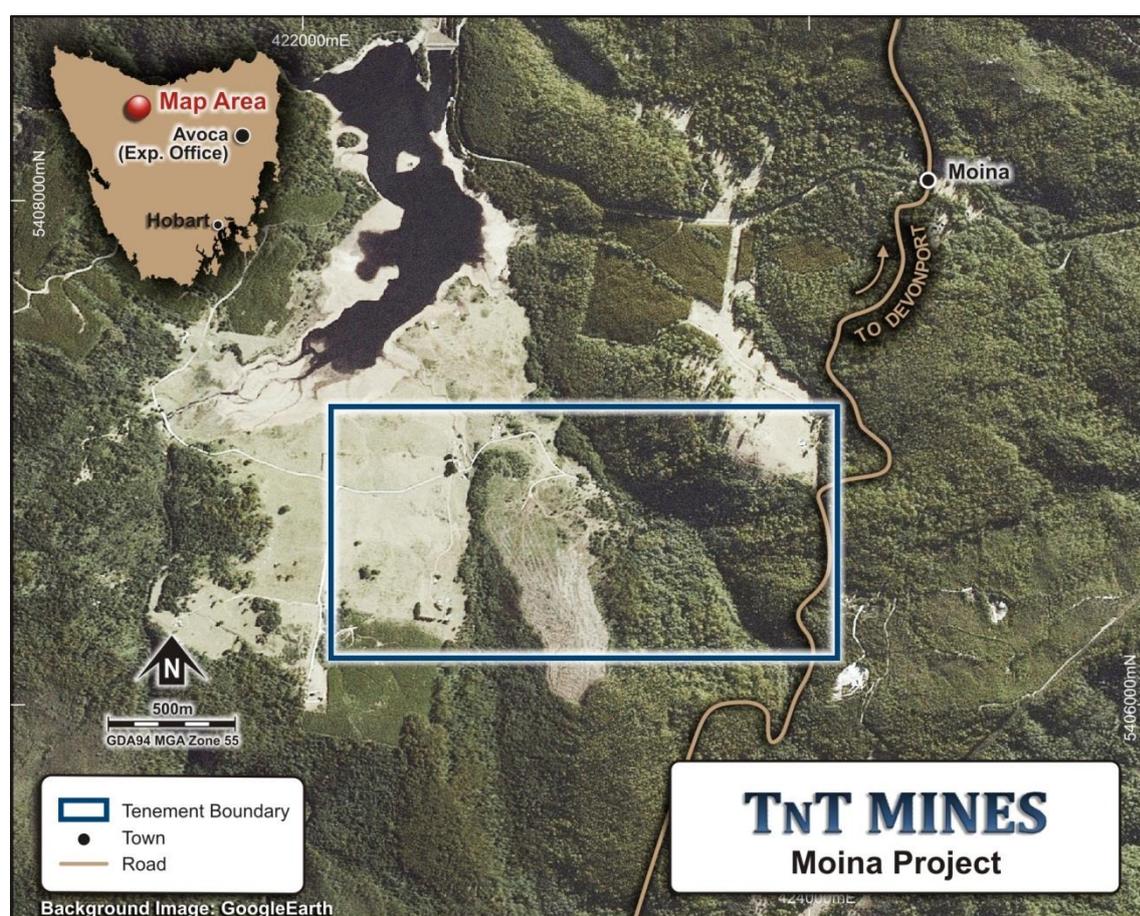


Figure 1: Tenement location plan

### 1.2 Geology

Tenement geology is shown below in Figure 2 and is taken from Map 9 (1:25,000) Geology of the Winterbrook – Moina Area, of the Geological Survey of Tasmania’s Mt Read Volcanics Project 1989.

RL10/1988 is underlain by a thin sequence of Ordovician sediments. The Ordovician sedimentary package is a graded sequence of shallow water marine sediments with Roland Conglomerate at the base, overlain by medium to coarse grained Moina Sandstone, which in turn is overlain by Gordon Limestone. These three formations are conformable, gradational, and relatively thin, typically being in the range 50m to 150m thick. The sedimentary package dips gently north and has been lightly folded with fold axes trending NW sub parallel to the Bismuth Creek Fault. The sediments have been disrupted by a number of NW trending normal faults, principal of which is the Bismuth Creek Fault.

The Ordovician sediments are underlain in part by Cambrian volcanics and were intruded in Upper Devonian times by the Dolcoath Granite. A 2km wide stock of this leucogranite outcrops 3km to the east of Moina with an average composition of 40% orthoclase, 35% quartz, 20% plagioclase and 5% biotite. Gravity data indicates a west trending spine of this granite underlies RL10/1988 at depths of less than 1km. Drilling has revealed that beneath Moina the granite has been metasomatically altered to greisen. A Tertiary erosion surface, characterised by cemented gravels (graybilly) is patchily developed on the Ordovician sediments. Tertiary basalts, which are variably magnetic, cover substantial sections of the tenement area.

A large zone of hydrothermal alteration was associated with this granite spine. It caused dominantly iron and fluorine metasomatism of the Gordon Limestone and of calcareous beds in the Moina Sandstone and resulted in the formation of the Moina Skarn. These fluids were accompanied by variable amounts of tin, tungsten, bismuth, and molybdenum, which were fractionated from the granite; and by some precious metals and base metals either from the granite or leached from the Cambrian volcanics that lie between the sediments and the granite. This metasomatism resulted in a pocket of higher grade metamorphism turning the limestone to marble, the sandstone to quartzite, and indurating the conglomerate.

The Moina Skarn, with its associated tin-tungsten-fluorine veins and greisen, has been deposited in the roof above the Dolcoath Granite where it replaced Ordovician sediments. The skarn occurs as a thick horizontal plate roughly 1km in its longest dimension and up to 100m thick. It is separated from the granite's upper near horizontal contact by about 200m of the Moina Sandstone and replaces parts of the Gordon Limestone. The plumbing system for the mineralizing fluids was probably a series of east-west trending tension fractures, now tin-tungsten-quartz veins, associated with the major NW trending Bismuth Creek Fault and named the Shepherd and Murphy Vein Swarm. Emplacement of the granite was at shallow depths, probably less than 3km.

The main body of skarn is zoned and consists of:

- A top zone of a granular garnet-pyroxene-vesuvianite-fluorite skarn overlying the other units. This unit is relatively enriched in boron;
- The main skarn ("wrigglite") of fluorite-magnetite-vesuvianite (cassiterite-scheelite- adularia) and having a characteristic, fine grained (less than 0.2mm), rhythmic, finely layered, contorted structure;
- Within and near the base of the main skarn a granular, pale green pyroxene skarn occurs as thin units (less than 5cm) consisting of diopside-hedenbergite with very minor amounts of fluorite and garnet;
- A wollastonite-rich skarn may be present in places and can be a useful marker. It is probably derived from a silty/sandy facies of the limestone and consists of over 80% by volume of wollastonite with small amounts of garnet, pyroxene, vesuvianite and fluorite;
- A basal zone of granular garnet-pyroxene-vesuvianite-fluorite skarn;
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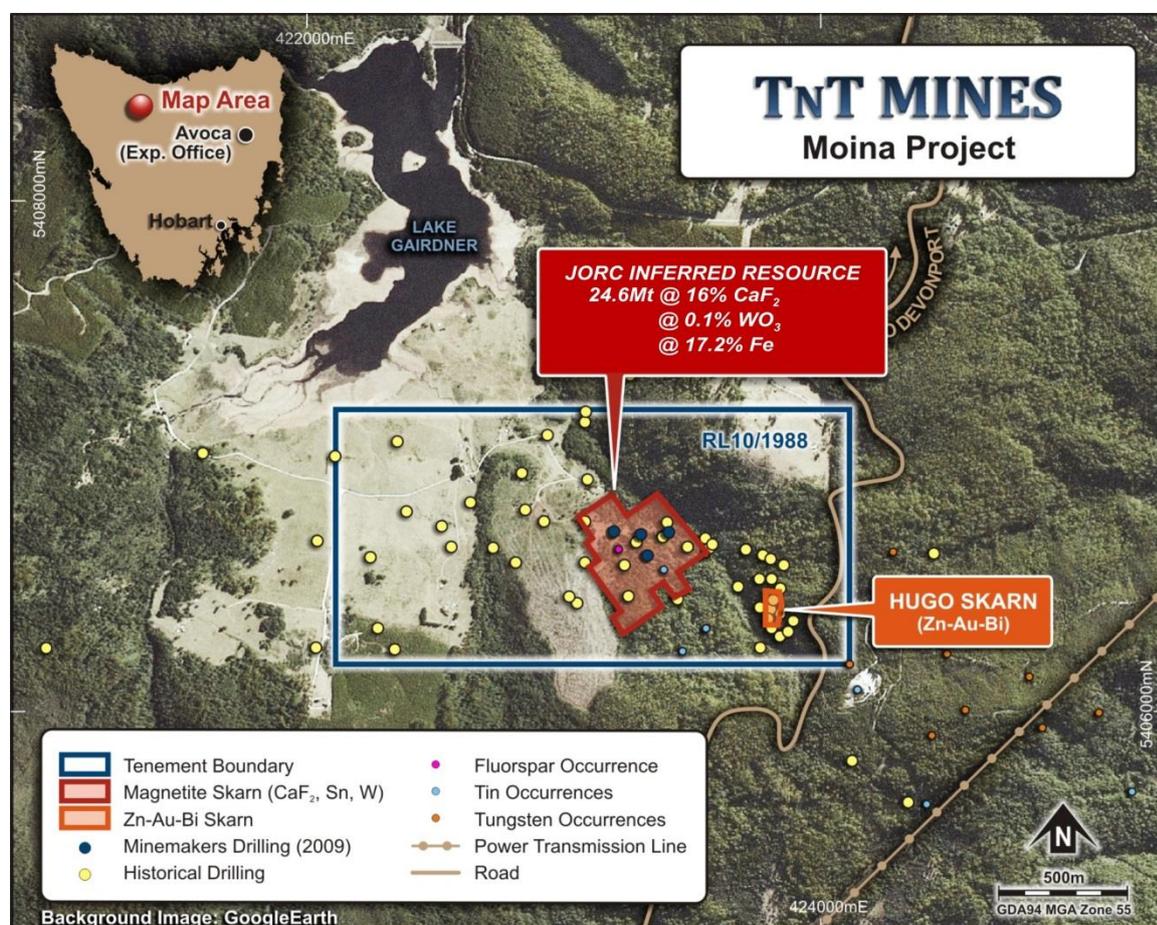
However, the skarn is essentially variable depending on local factors that controlled the metasomatism. A number of distinctly different skarn types are found in limited quantities in other areas where metasomatic conditions varied. The two most notable are the pyrrhotite skarn and the sphalerite skarn. The former consists of medium to fine grained pyrrhotite, magnetite, fine grained

actinolite/chlorite, and minor fluorite; the latter of granular to massive andradite garnet with minor diopside containing conspicuous bands of closely spaced lenses of sphalerite with quartz.

The various skarn units can carry up to 25% (by weight) fluorite; 0.6% tin, 0.5% tungsten, 0.2% beryllium, 27.5% zinc, and 4.5 g/t gold. Tin, beryllium, and iron values increase toward the upper part of the skarn sequence but zinc, copper, and molybdenum values are erratic. Secondary zinc-copper-indium-cadmium-gold-sulphide-amphibole alteration of the primary fluorine-tin-beryllium oxide skarn is related to the Bismuth Creek Fault. When the primary wrigglite skarn is altered, tin is largely lost from that part of the skarn.

The hydrothermal fluids that extensively skarned the Gordon Limestone resulted in the formation of a number of known significant mineral deposits, including:

- The Shepherd & Murphy vein swarm, consisting of a set of east-west near vertical veins containing tin-tungsten-bismuth-molybdenum mineralisation.
- The fluorite-magnetite “wriggite deposit” in the basal section of the Gordon Limestone west of the Bismuth Creek Fault.
- The zinc-bismuth-gold mineralisation in the Hugo Skarn east of the Bismuth Creek Fault where the Hugo Thrust, which strikes E-W and dips north at 30°, has removed the top of the skarn and thrust older sediments over the top of the skarn.
- The auriferous pyrrhotite skarn west of the Shepherd & Murphy Mine.



**Figure 2: Tenement geology**

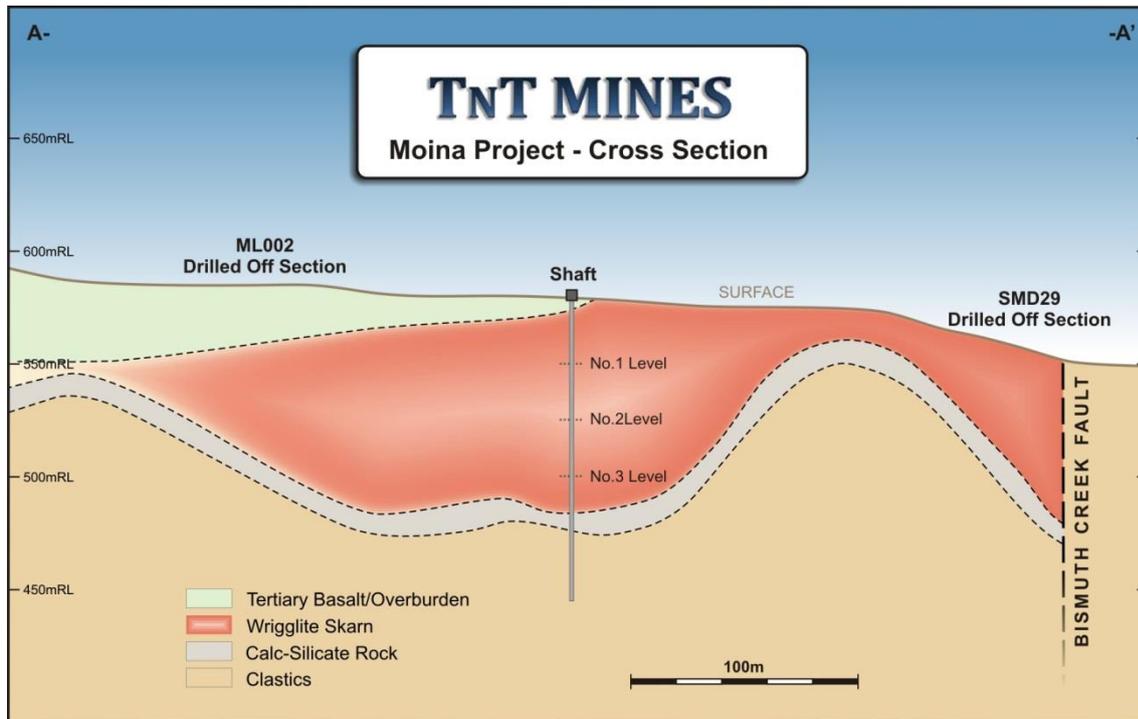


Figure 3: Section through Moina deposit

### 1.3 Exploration Rationale

The Moina fluorspar deposit has been known about for a long time but has remained undeveloped due to the ready availability of cheap, high quality fluorspar. This situation has changed over the past five years or so and the supply of high quality fluorspar has decreased and the price risen significantly.

The Moina fluorspar deposit has a pre-JORC resource estimate of 26.5Mt @ 18% fluorspar, 0.1% tungsten and 0.1% tin. The deposit also contains significant magnetite. Metallurgical test work carried out in the 1970s and 1980s was unable to define a clear pathway to generate a saleable product. TNT Mines believes that advances in processing technologies since then combined with dwindling fluorspar supply and consequent higher prices mean that the potential to develop an economically viable operation at the Moina deposit is now as high as it has ever been.

TNT Mines aims to:

- Undertake the necessary metallurgical test work for optimal circuit design.
- Drill out sufficient of the main deposit to at least JORC-compliant Indicated Resource status and to allow open-pit design optimization for, say, an initial 10 year operation.
- Assess the potential to market the bulk commodities fluorspar, magnetite, tungsten, tin and sulphides.
- Complete bankable feasibility study and, if economic, commission an open-cut mining and processing operation.

## **2.0 REVIEW OF PREVIOUS WORK**

### **2.1 Previous exploration prior to TNT Mines Limited (formerly Minemakers TTT Pty Ltd)**

Historical exploration before TNT Mines is well summarized in the 2011 annual report.

### **2.2 Exploration by TNT Mines Limited**

TNT Mines has completed the following work:

#### 2006-2011

- Review of literature
- Fatal flaw review to determine potential project viability
- Metallurgical test work carried out in Austria by tungsten producer Wolfram Bergbau Material was collected on-site (tailings dump) or from diamond drill core held at the MRT core store in Mornington
- Infill assaying using diamond drill core obtained from the MRT core store
- Davis Tube Recovery work on selected intervals of wrigglyite from diamond drill core held at the MRT core store in Mornington
- Drilling of four PQ/HQ-sized cored holes in 2009 to recover mineralisation for further metallurgy
- Analysis of 274 half PQ-sized core samples from 2009 drilling for F, Al, Bi, Ca, Cd, Cu, Fe, Mg, Mo, Pb, S, Sb, Si, Sn, W and Zn.
- QEMSCAN work. A compositing of selected core samples from the 2009 drilling was sent to SGS Lakefield in Ontario, Canada for QEMSCAN analysis. The purpose of this work was to investigate the mineral distributions, deportment of F and Sn, locking/association and grain size characteristics of the fluor spar, cassiterite, Bi-minerals, scheelite, sulphides and Fe-O oxides, and determine mineralogical parameters such as mineral release and grade recovery. The work has demonstrated that to obtain reasonable recoveries the ore would need to be ground to -20  $\mu$ . At this size, fluor spar would need to be agglomerated to produce a saleable product. The analytical work has also demonstrated that only 48% of the tin is present in cassiterite, the remainder contained in garnet or Sn-Fe oxides. Although the modelling suggested that recoveries, other than tin, would be relatively high at a fine grind it should be recognized that the QEMSCAN system is a 2-D modelling approach and with such fine-grained mineralisation the results should not be seen as conclusive. The modelled maximum recoveries achievable at a 20 $\mu$  regrind are F – 76.4%, WO<sub>3</sub> – 92%, Sn – 36% and Bi – 90%.
- A mining heritage survey was conducted over the area, at the request of MRT, by Gary Vines from Biosis Research. The conclusions drawn from the survey was that the site had significance at state level as an example of a distinctive and rare mining site reflecting a range of mineral extraction and processing technologies. In particular it represents an early example of tungsten production. Although the site is significant the report indicated that there was no impediment to further exploration drilling including track clearing and site preparation provided recommended precautions were observed.

#### 2012

- 2008 DAVIS TUBE RECOVERY WORK REVIEW: A review of Davis Tube Recovery work undertaken in 2008 was carried out by Geos Mining. The review indicated that the DTR work had been carried out under sub-optimal test conditions and only a single stage grind had been used. There was no record of the parameters set for the DTR testing and no analysis of composite head grade. Recoveries of 25% magnetite with grades ranging from

an acceptable 62% in the minus 20 micron fraction to 50% in the 20-53 micron fraction were achieved. Geos Mining used the QEMSCAN modelling to show that, in theory, a much better recovery and grade would be achieved from fine grinding with recoveries of up to 55-65% at acceptable Fe grades. They recommended another round of DRT testing under stringently controlled test conditions using the 2009 core.

- **NEW METALLURGICAL TEST WORK:** A new metallurgical test work program was commissioned in May. This study was carried out at ALS-Ammtec Burnie, and ALS-Ammtec Perth under the management of John Glen. Metallurgical advice and interpretation came from Brian Povey of Mintrex and Ron Goodman. This is the first integrated study to look at producing magnetite, fluorspar, and scheelite concentrates.

The purpose of this first phase work is to determine the recoverability of fluorspar, magnetite and scheelite. Although QEMSCAN work indicated that very good recoveries could be achieved it is generally accepted that QEMSCAN modelling overestimates the likely actual recoveries of mineral constituents by up to 20%. Oxide flotation and gravity work was carried out at Burnie and detailed DTR work was carried out in Perth. Some magnetite separation work has also been carried out at Burnie.

A main composite was made up from core retained from the 2009 drill program and stored in Launceston. Table 1 shows the intervals selected for the composite. Analyses of the metre intervals from which the composites were selected are presented in Appendix 2. This composite was used for fluorspar, scheelite, and magnetite work at both Burnie and Perth laboratories. A second batch of six samples was sent to Ammtec in Perth for variability analysis but unfortunately the samples were composited and run as a single DTR test rather than as six individual tests.

Hole_ID	From	To	Hole_ID	From	To
MODD003	33.20	33.60	MODD001	66.50	66.75
MODD003	36.15	36.45	MODD001	65.85	66.15
MODD003	38.40	38.70	MODD001	62.85	63.10
MODD003	40.50	40.70	MODD001	48.05	48.25
MODD003	42.80	43.00	MODD001	46.20	46.50
MODD003	45.05	45.4	MODD001	41.95	42.25
MODD003	47.40	47.65	MODD001	40.50	40.80
MODD003	49.15	49.50	MODD001	37.15	37.45
MODD003	51.80	52.10	MODD001	34.40	34.75
MODD003	54.45	54.80	MODD001	31.25	31.50
MODD003	55.40	55.75	MODD001	29.70	29.95
MODD003	56.60	56.80	MODD001	27.55	27.80
MODD003	59.30	59.70	MODD001	25.80	26.20
MODD003	46.00	46.40	MODD004	71.60	71.90
MODD003	60.70	61.00	MODD004	69.30	69.55
MODD003	62.60	63.00	MODD004	67.55	67.75
MODD003	64.40	64.70	MODD004	65.60	65.90
MODD003	66.20	66.65	MODD004	64.10	64.40
MODD003	67.65	67.90	MODD004	62.40	62.70
MODD003	69.35	69.80	MODD004	60.50	60.70
MODD003	71.70	72.00	MODD004	59.35	59.65
MODD003	73.80	74.10	MODD004	56.15	56.40
MODD003	76.25	76.45	MODD004	54.60	54.90
MODD001	69.30	69.70	MODD004	53.20	53.40

**Table 1: Main composite core intervals**

Hole_ID	From	To
MODD001	30.50	30.75
MODD001	47.40	47.80
MODD003	32.60	32.80
MODD003	33.00	33.25
MODD003	49.60	49.85
MODD003	75.10	75.40
MODD004	64.70	65.00

**Table 2: Second composite core intervals (DTR only)**

A summary of the results obtained in the 2012 year are outline below:

#### *Scheelite*

A significant amount of scheelite is present in veins and gravity separation of the coarser vein scheelite (and vein fluorite) looks good. The finer groundmass scheelite is likely to end up in the fluorspar concentrate. It is likely that a saleable grade of 60-65% WO<sub>3</sub> suitable as APT feedstock will be achieved with an overall recovery of about 45%.

#### *Magnetite*

Basically, the main composite produced results that were not particularly encouraging. Six individual samples that were intended to be processed separately to get a feel for variability were composited, unfortunately, because of a lack of communication between Povey and the Ammtec Perth. This composite produced more encouraging results but probably because it has a higher grade to begin with. The main composite gave a 25% yield to a grade of 58% Fe and the smaller composite gave a 31% yield to a grade of 63% Fe.

John Glen believes that it may be possible to upgrade the magnetite concentrate by floating off some of the silicates that are reporting to the magnetite concentrate (because they contain fine inclusions of magnetite). This work would be carried out in the next phase of met work.

#### *Fluorspar*

Fluorspar flotation has been carried out on the non-magnetics stream and the Burnie lab has achieved a 95% CaF<sub>2</sub> concentrate with 80% recovery in a six cycle float. They are confident that this recovery will push up towards 90%. However, striking the balance between fluorine reporting to the mags and fluorine reporting to the non-mags is a critical factor in overall CaF<sub>2</sub> recovery and this will not be resolved with the current phase of test work. Floating silicates off from the mag concentrate, as discussed above, may significantly increase the overall CaF<sub>2</sub> recovery.

#### *Cassiterite*

It does not look like a saleable tin concentrate will be produced. There is no coarse vein tin and about half of the tin is locked up in garnet (and some in stokesite). Garnet contains up to 1% tin. Whether a garnet concentrate can be separated or not has not been addressed in the current work.

#### *Bismuthinite*

No work has been done on the recovery of the small amount of sulphide present.

- **JACOBS SCOPING STUDY:** Jacobs, a large international engineering company, were engaged to carry out a desktop scoping study on a mining operation at Moina. The study generate CAPEX and OPEX on an 800,000 tonnes per annum open pit mining operation producing magnetite, fluorspar and scheelite concentrates. The Jacobs study assumed a mining rate of 800,000 tonnes per annum with ore production based on the parameters outlined in Table 3.

Mineral	% in feed	Concentrate Grade	Recovery (%)	Dry tonnes per annum
CaF <sub>2</sub>	18.2	94% CaF <sub>2</sub>	68	86,369
Fe <sub>3</sub> O <sub>4</sub>	21.9	67% Fe	70	150,100
WO <sub>3</sub>	0.12	65% WO <sub>3</sub>	58	703

**Table 3: Ore Production Targets**

Jacobs took input from Shaw Contracting, Mining One and Mancala Pty Ltd. for mining studies and used their own expertise for process plant estimation.

They considered three scenarios: Owner Mined and Concentrated, Contract Mining, and Dry Lease of Mining Equipment. The first scenario was the most expensive and the latter two were similar.

For contract mining the estimated cost were:

CAPEX	<b>\$96.7M</b>
Mining OPEX	<b>\$12.34/t</b>
Process plant OPEX	<b>\$16.56/t</b>
General and Administration	<b>\$6.00/t</b>

The Jacobs study was the first step in the proposed development of a mine at Moina. The assumptions made, particularly in relation to feed grade and recovery will be modified by the metallurgical test work being carried out at present and this will likely have some effect on the capital cost of plant construction. The mining costs will not be significantly affected by changes in these assumptions as long as the mining rate is unchanged.

### 2013

**MINERAL RESOURCE ESTIMATE:** A maiden JORC Inferred Resource estimate was made by Mick McKeown of Mining One. Historical drill data, including Minemakers 2009 diamond drilling, was used for the estimate. The resource is 24.6 Mt at 16%CaF<sub>2</sub>, 0.1%WO<sub>3</sub>, 0,1%Sn and 17%Fe.

**METALLURGICAL TEST WORK:** A metallurgical test work report was produced by ALS Ammtec summarising the magnetic separation, gravity and flotation work carried out at the Burnie laboratory, a report on the magnetite separation work carried out at ALS Ammtec Perth, and a report summarising the combined test work.

### **3.0 WORK COMPLETED DURING THE REPORTING PERIOD**

#### **3.1 Site Inspections**

Site inspections were undertaken with consulting geologists Russell Fulton and John Nethery

#### **3.2 Review of Data**

Consulting geologists Mr Russell Fulton, Mr John Nethery and Mr Vincent Algar undertook preliminary reviews of historical data, metallurgical reports, scoping study report and the conceptual report.

#### **3.3 Market research**

Further preliminary market research was undertaken by Mr Andrew Drummond on behalf of TNT.

### **4.0 CONCLUSIONS AND FUTURE WORK**

The maiden JORC Inferred Resource for Moina has confirmed the large size of the deposit and the tenor of the mineralisation, albeit with a small decrease in the CaF<sub>2</sub> grade. Any resource category upgrade will require a significant amount of drilling and more rigorous QAQC in regard to analyses of fluorine.

The summary reports and review of the metallurgical test work received this reporting year have essentially confirmed the preliminary results reported last year. The work has defined the style of plant design that will recover the three potentially economic minerals, fluor spar, magnetite and scheelite, and the potential recovery factors. No further test work was carried out this year due to a lack of funds.

Proposed work for next year includes:

- Test work to upgrade the magnetite concentrate through silicate flotation/regrinding and consequent increase in overall fluorine recovery through delivery of more fluor spar to non-magnetic stream. Budget – \$30,000
- Investigation of potential to produce a heavy media product suitable for the coal industry. Budget – \$20,000

Looking to the future, the following work will need to be undertaken:

- Define the magnetite resource by drilling and testing using typical magnetite techniques – magnetic susceptibility and Davis tube testing.
- Improve the fluorite recovery by recovering fluorite from the scheelite tails and the fine grinding magnetite tails
- Improve scheelite recovery at a coarser grind size of 500micron and reduce the losses to slimes.
- Rework the plant capital and operating costs based on the metallurgical recoveries determined by the recent and any future test work.
- Re-model mining costs.
- Conduct marketing studies on the magnetite and the fluorite to ensure that both will be sellable – the magnetite in terms of grade and impurities – and the fluorite in terms of size.

## **5.0 ENVIRONMENT**

No other ground-disturbing exploration work was carried out at Moina during the reporting period. No rehabilitation of previous disturbance relating to mining or mineral exploration was undertaken.

## 6.0 REFERENCES

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**APPENDIX 1 – Moina skarn deposit mineral resource estimate for TNT Mines Limited by Mining One Pty Ltd.**

**APPENDIX 2 – Metallurgical assessment of Moina ore for TNT Mining. Report No: T0728 September 2012. ALS Ammtec Burnie.**

**APPENDIX 3 – Combined Process Testwork on Moina Deposit. Report No:  
P1307 Mintrex.**

**APPENDIX 4 – Summary Project Review, October 2012. Brian Povey - Mintrex.**