



SheffieldResources  
LIMITED

ASX and Media Release

14 May 2015

## PRE-FEASIBILITY STUDY CONFIRMS THUNDERBIRD AS NEXT MAJOR MINERAL SANDS PROJECT IN GLOBAL DEVELOPMENT PIPELINE

### HIGHLIGHTS

- PFS confirms Thunderbird is a world class, long life zircon rich project that is anticipated to provide exceptional financial returns and deliver strong margins over an initial 32 year mine life
- Projected and estimated production and financial parameters are as follows:
  - Initial mine life of 32 years, targeting commissioning in 2018
  - Life of mine (LOM) revenue of \$9.5 billion
  - LOM operating cash flow of \$4.3 billion\* (\$163 million per annum for first 10 years of production)
  - Average LOM annual EBITDA of \$120 million (\$148 million per annum for first 10 years of production)
  - LOM revenue to cost ratio of 1.82:1 (2.03:1 for first 10 years)
  - Pre-production capital expenditure of \$367 million, plus \$26 million of contingency
  - Scope remains to reduce pre-production capital expenditure and operating costs
  - Capital payback period of only 3.6 years
- Average annual production of 114,000 tonnes zircon, 439,000 tonnes ilmenite, and 30,000 tonnes of HiTi84 leucoxene
- No perceived impediment to the sale of full production volumes
- Strong leverage to zircon price, with 64% of project revenues derived from zircon
- Significant de-risking of project through feasibility process
- Considerable upside potential to be incorporated in PFS Update scheduled for H2 2015

---

Mineral sands developer Sheffield Resources Limited (ASX:SFX) ("Sheffield" or "the Company") today announced the results of the Pre-feasibility Study (PFS) on its 100% owned Thunderbird mineral sands project, located near Derby in northwest Western Australia (Figure 1).

The PFS results confirm Thunderbird will deliver strong cash margins over an initial mine life of 32 years. As previously announced, the PFS will be updated in H2 2015 to include positive infill drilling results yet to be incorporated and to focus on reducing costs and increasing margins.

Sheffield's Managing Director Bruce McQuitty said: "This PFS has confirmed that Thunderbird will deliver strong financial returns over a very long mine life.

"One of the aspects that sets Thunderbird apart from other mineral sands projects globally is the substantial projected annual production of zircon. The project is highly leveraged to the zircon price and with few major new zircon projects in the global development pipeline, Sheffield is well placed to meet future demand.

"Thunderbird is located in a stable jurisdiction, has an export solution and is well placed to take advantage of expected product supply gaps that are aligned with the initial planned production profile."

\*Excluding taxes & royalties

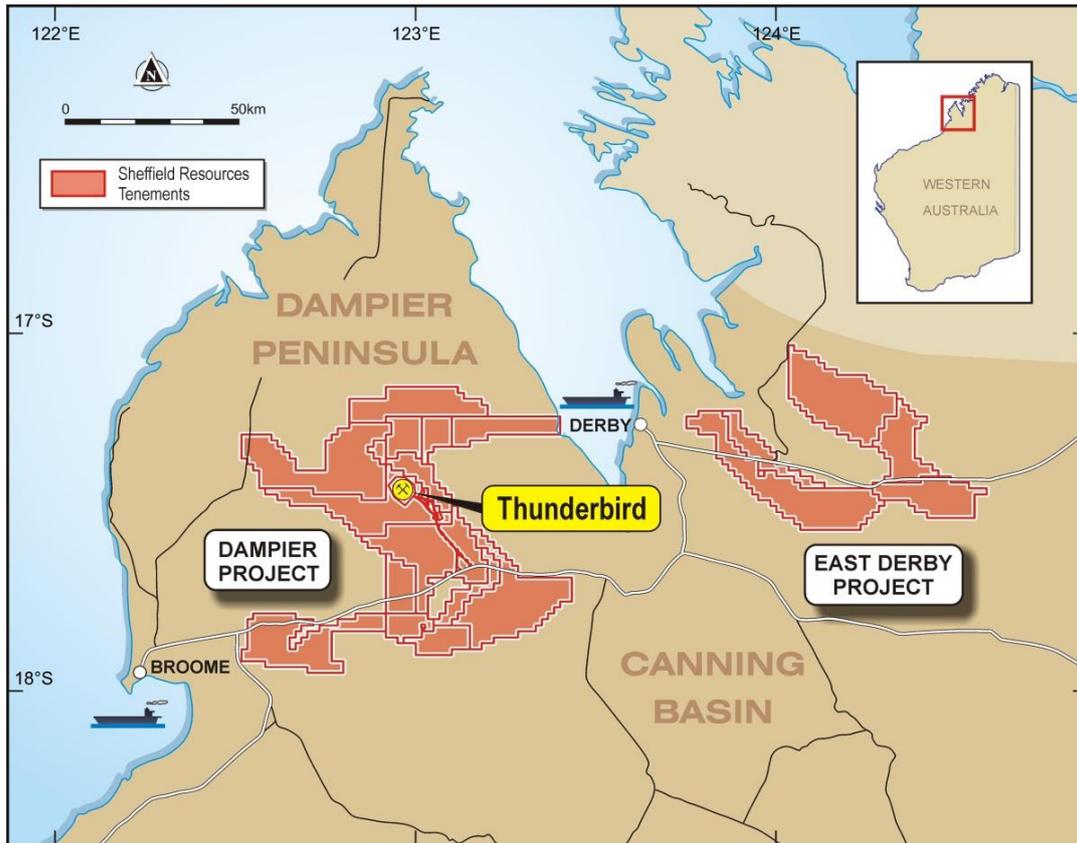


Figure 1: Location of Thunderbird project

## KEY OUTCOMES

The PFS confirms the technical viability, long life and robust economics of the Thunderbird project and strengthens the case for development. The PFS has been completed to a +/-25% confidence level (process engineering -12%+25%).

At a planned mining rate of 18Mtpa (2,430tph) after ramp-up, average annualised production over a 32-year mine life is estimated to be 114,000t of zircon, 439,000t of Ilmenite, and 30,000t of HiTi84 leucoxene.

At assumed pricing of US\$1,375/t for zircon, US\$155/t for ilmenite and US\$580/t for HiTi84 over the life of the mine, and an exchange rate of \$US0.78, the project is anticipated to generate average operating cash flows of \$134 million per annum. The life-of-mine (LOM) revenue is forecast to be \$9.5 billion and C1 cash costs over the life of mine are \$5.2 billion, giving a LOM revenue-to-cost ratio of 1.82:1 and average annual EBITDA of \$120 million.

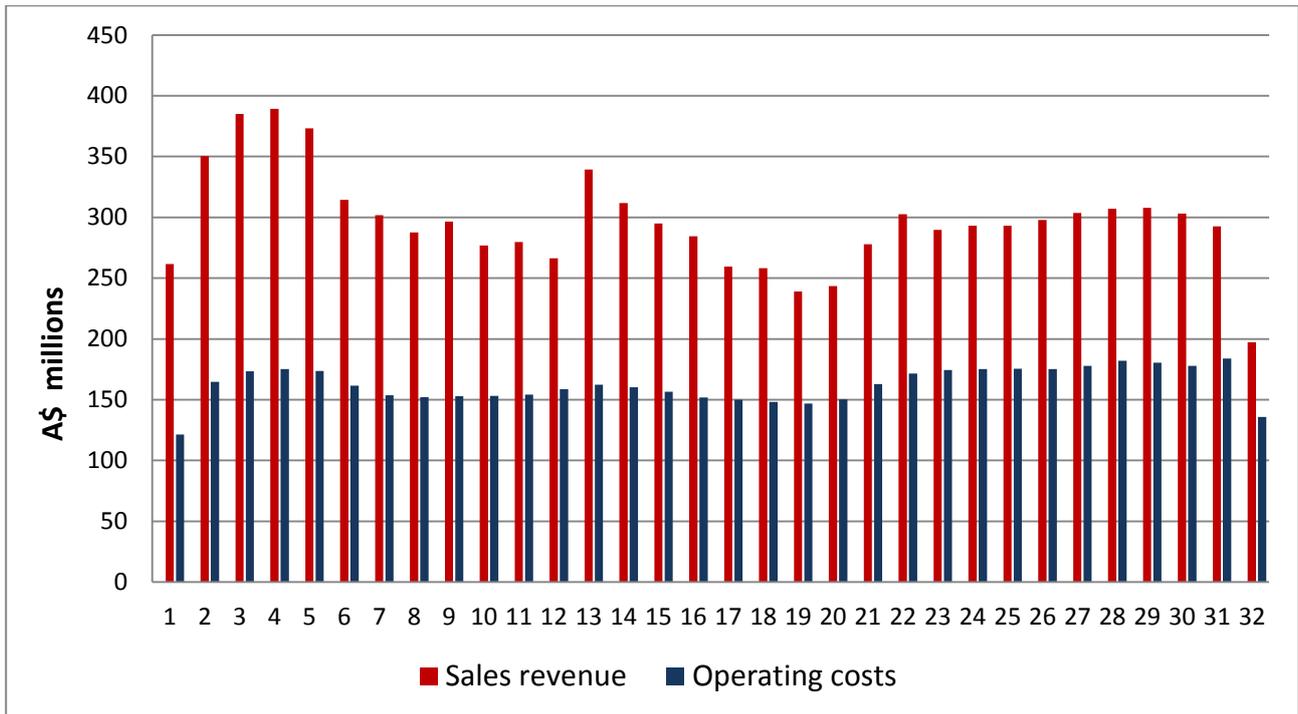
The first 10 years of scheduled mining incorporates higher grade mineralisation with less overburden, resulting in higher cash margins. The revenue-to-cost ratio for the first 10 years is 2.03:1, while the annual EBITDA for that period averages \$148 million.

A robust mine-to-port logistics chain has been identified, with Sheffield granted preferred proponent status for a bulk handling facility and product storage area at Derby port.

Pre-production capital costs total \$394 million, including \$26.2 million contingency, with a payback period of only 3.6 years. The capex total includes a full mineral separation plant at the mine site.

Potential remains for a staged approach to expansion of the project which will be explored further, however the PFS considers a single stage project as a solid foundation that generates

strong cash margins over a very long mine life and provides for an effective and efficient use of capital.



**Figure 2: Annual sales revenue versus operating costs**

### **PRE-FEASIBILITY STUDY TEAM**

Sheffield would like to acknowledge the contributors to the PFS which include:

- ATC Williams – geotechnical investigations
- Entech - pit optimisation & mine scheduling
- Northwind Resources Pty Ltd – financial modelling
- Engineering and Project Management Services (EPMS)
- Pennington Scott – hydrogeological investigations
- QG – resource estimation
- Resource Engineering and Design – infrastructure studies
- RJ Robbins and Associates – engineering
- Robbins Metallurgy Pty Ltd - metallurgy
- TZMI – product assessment and marketing studies

## MINERAL RESOURCES AND MINING INVENTORY

The PFS is based on the Thunderbird Mineral Resource announced on 12 December 2014 which was completed in accordance with the JORC Code (2012 edition) and is summarised in Table 1.

**Table 1: Thunderbird Deposit Mineral Resource<sup>1</sup> Summary**

Resource Category	Cut-off HM%	Mineral Resources		Valuable HM Grade (In-situ) <sup>2</sup>			
		Material Million Tonnes <sup>3</sup>	HM %	Zircon %	HiTi Leucoxene %	Leucoxene %	Ilmenite %
Measured	3.0	75	7.9	0.71	0.21	0.19	2.4
Indicated	3.0	2,550	7.0	0.60	0.19	0.22	2.0
Inferred	3.0	580	5.6	0.47	0.16	0.20	1.5
<b>Total</b>	<b>3.0</b>	<b>3,205</b>	<b>6.8</b>	<b>0.58</b>	<b>0.19</b>	<b>0.21</b>	<b>1.9</b>
Measured	7.5	35	12.7	1.1	0.32	0.27	3.7
Indicated	7.5	920	11.9	0.93	0.29	0.26	3.3
Inferred	7.5	125	10.8	0.83	0.25	0.24	3.0
<b>Total</b>	<b>7.5</b>	<b>1,080</b>	<b>11.8</b>	<b>0.92</b>	<b>0.28</b>	<b>0.25</b>	<b>3.3</b>

The **Mining Inventory** that forms the basis of the PFS is from the northern central portion of the Thunderbird Mineral Resource and comprises **580Mt at 11.7% HM**, with in-situ grades of **0.94% zircon, 0.29% HiTi leucoxene, 0.29% leucoxene and 3.32% ilmenite** (from Measured and Indicated Resources only) (Figure 3).

The mining inventory is based on pit optimisation studies which take into account a range of modifying factors such as mining loss, mineral recovery and pit wall slope. Inferred Mineral Resources were excluded from the optimisation.

The mining inventory equates to 32 years of scheduled production at an 18Mtpa mining rate. Mineralisation remains open beyond the 32-year pit shell outline, mainly in the down-dip direction (Figure 4), with optimisation studies indicating a further 12 years of production at 18Mtpa is possible.

## MINING

The proposed mining technique is a strip mining and backfill method typically used in dry mining operations in the mineral sands industry. Mining commences with excavation of an initial pit to expose the ore. As the pit advances, waste overburden and tails are used to provide a dam wall within the mine void, which is then backfilled with tailings, then contoured and rehabilitated (Figure 5).

At the proposed ROM feed rate of 2,340tph, 6 large dozers will deliver the ore to 3 x 810tph skid-mounted dozer trap mining unit plants (MUPs). A fourth MUP is required (on standby) to minimise downtime during mine face relocation.

<sup>1</sup> Additional detail is provided in the resource tabulation in Appendix 1.

<sup>2</sup> The in-situ grade is determined by multiplying the percentage of HM by the percentage of each valuable heavy mineral within the heavy mineral assemblage.

<sup>3</sup> Tonnes and grades have been rounded to reflect the relative uncertainty of the estimate, thus the sum of columns may not equal.

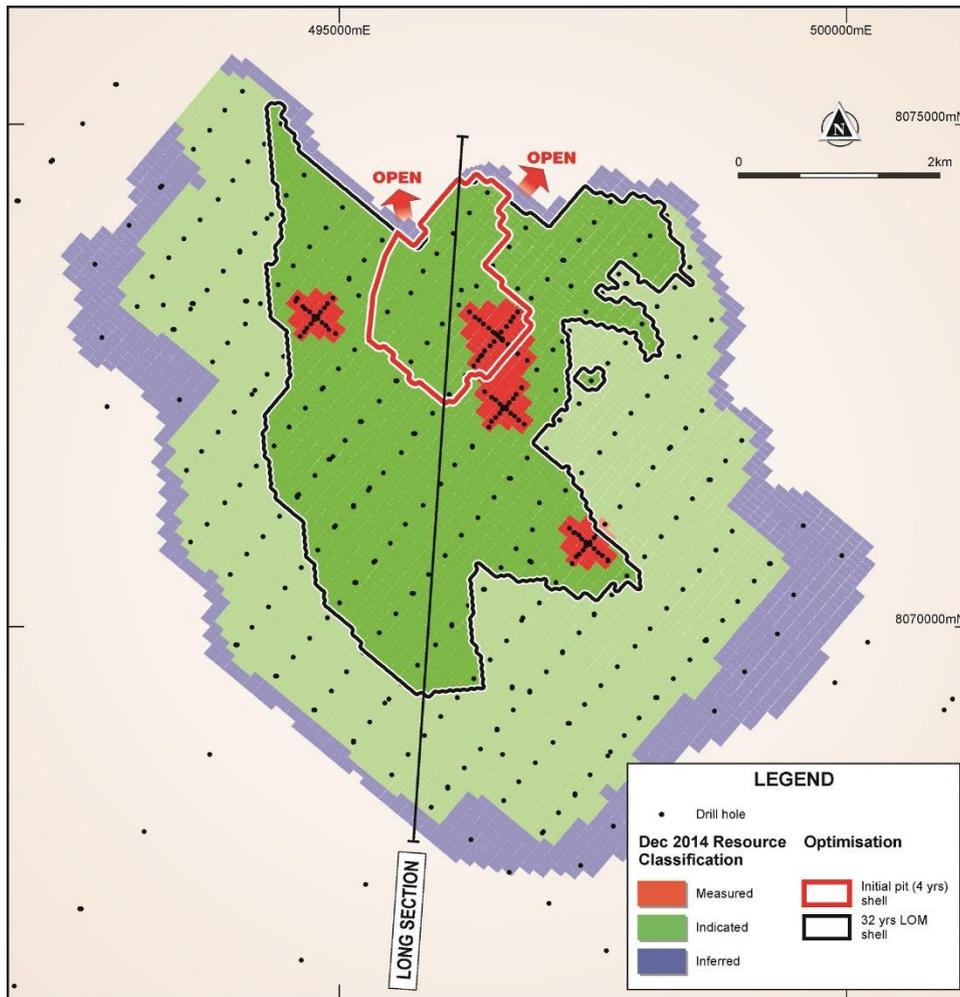


Figure 3: Thunderbird Deposit 32 Year Pit Shell Outline on Mineral Resource Classifications

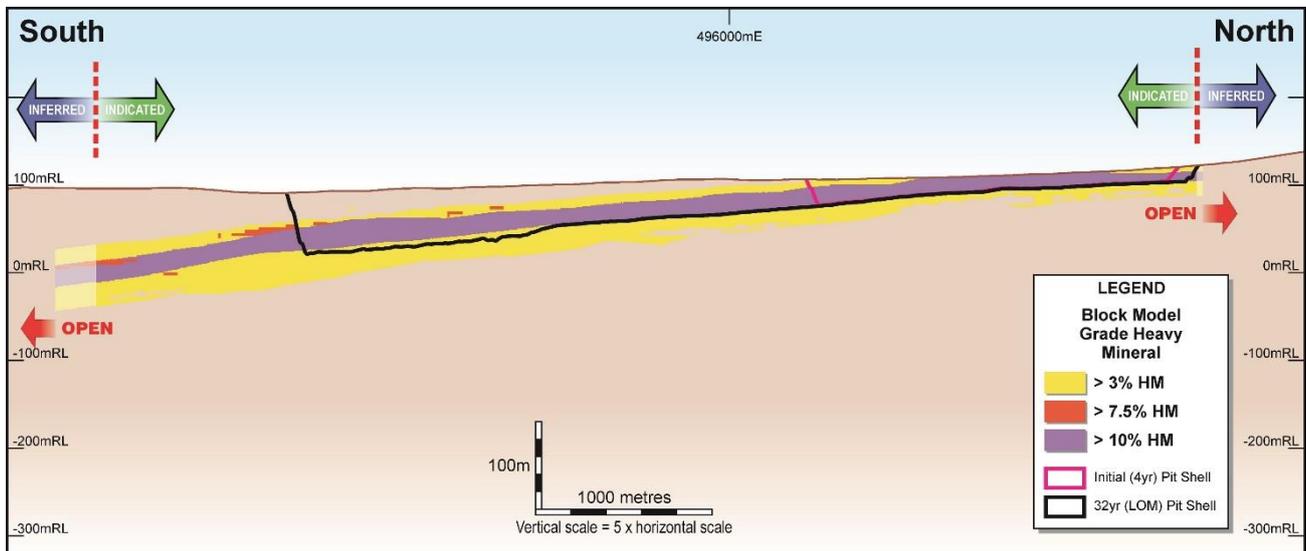


Figure 4: Long-section through the Thunderbird resource block model showing the 32 Year Pit Shell

Ore mining will be supported by a fleet of 3 loaders and 3 x 100 tonne trucks. Waste mining, oversize removal and dam wall construction and rehandle will be carried out using a fleet comprising loaders, trucks, excavators and scrapers. Low strip ratios in the early years will allow the ore mining fleet to also service the waste mining load.

The MUPs will screen coarse oversize, with undersize fed to a scrubber trommel. The undersize from the trommel is slurried and pumped to the Wet Concentrator Plant (WCP).

The mining schedule commences in the northern up-dip region of the deposit, where high grade mineralisation occurs close to surface, then progresses southward following the shallow dip of the high grade zone. The waste-to-ore ratio averages 0.22:1 for the first 10 years of scheduled production and 0.68:1 over the 32-year life of mine.

Maximum pumping distance from the MUPs to the wet concentrator is 2,100m. This will require WCP moves in production years 12, 20 and 28 (Figure 6). The final move in year 28 will allow further mining past the currently optimised 32-year pit shell if supported by global markets at the time.

## PRIMARY PROCESSING

The slurried ore from the MUPs will be combined at the WCP, screened at 2mm and the -2mm fraction then further slurried before being deslimed on dual cyclone clusters.

Cyclone underflow will report to two identical gravity circuits comprising eight stages of spiral separators, which will separate sand from the heavy minerals. Cyclone overflow will report to a deep cone thickener for recovery of process water. Thickened underflow (clay slimes) will be pumped initially into an off path tails dam, and later co-disposed with sand tails into the mine void. Tailings co-disposal testwork indicates polymer-treated tails will achieve high consolidation rates, with high water recovery from tailings expected.

The WCP will be a semi-permanent, relocatable plant, built on skids.

Processing water for slurring and the WCP will be supplied by a process water dam near the WCP. A borefield will access the shallow aquifer adjacent to the deposit. Hydrogeological investigations have established adequate quantities of very low salinity water suitable for processing. A 5C application to take water has been lodged with the Department of Water.

The heavy minerals, contained in a concentrate (HMC) will be slurried and pumped to the Mineral Separation Plant (MSP) (Figure 5).

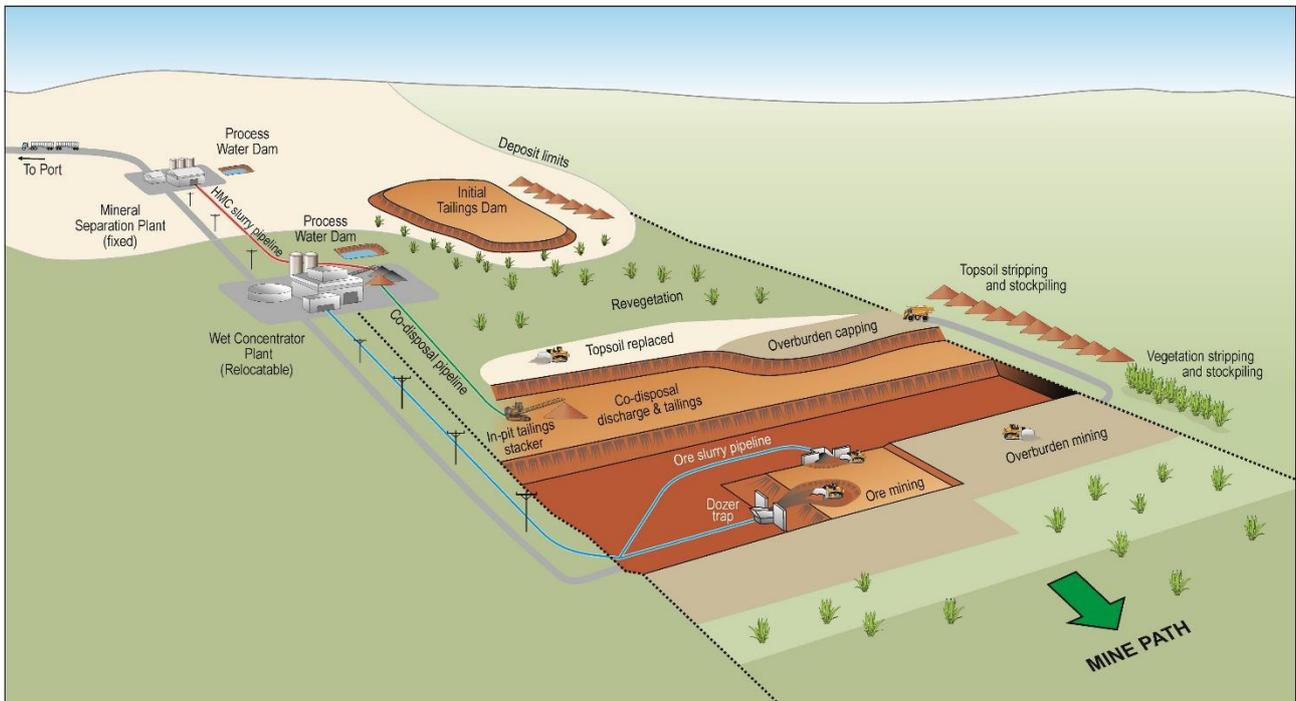


Figure 5: Schematic diagram of the Thunderbird Project operational layout

## MINERAL SEPARATION

Heavy mineral concentrate from the WCP will be received at a Concentrate Upgrade Plant (CUP) at the Mineral Separation Plant site, where it is screened at 850 microns and then undersize separated using magnetic and gravity separation techniques to produce magnetic (ilmenite-bearing) and non-magnetic (HiTi 84 and zircon-bearing) concentrates and tails.

Magnetic concentrate will be pumped to an attritioner to remove surface coatings and then pumped to an Ilmenite Dry Plant (IDP) for drying and further processing.

Non-magnetic concentrate from the WHIMS will be processed through several stages of gravity concentration using spiral concentrators and then pumped to the Hot Acid Leach plant (HAL) for dewatering and storage. Leached non-magnetics report to an attritioner where dilute caustic soda is introduced to neutralise any residual acid, and then to a primary electrostatic circuit where it is further separated over several stages of electrostatic separators, and a magnetic separator to produce conductor (HiTi84-enriched) and non-conductor (zircon-enriched) concentrates. Non-conductor concentrate is further treated via magnetic, electrostatic and gravity circuits to produce a Primary Zircon product. Additional processing of magnetics streams from the Primary Zircon circuit, including batch feeding via a HAL stage will produce Secondary and Special Zircon products.

Conductors from the primary electrostatic circuit will be processed by a second stage of electrostatic separation to produce a HiTi84 (87.7% TiO<sub>2</sub>) product which will be bagged for export.

The magnetics received at the IDP will be dried, screened and then separated, using one circuit of electrostatic separators, to produce ilmenite product and rejects.

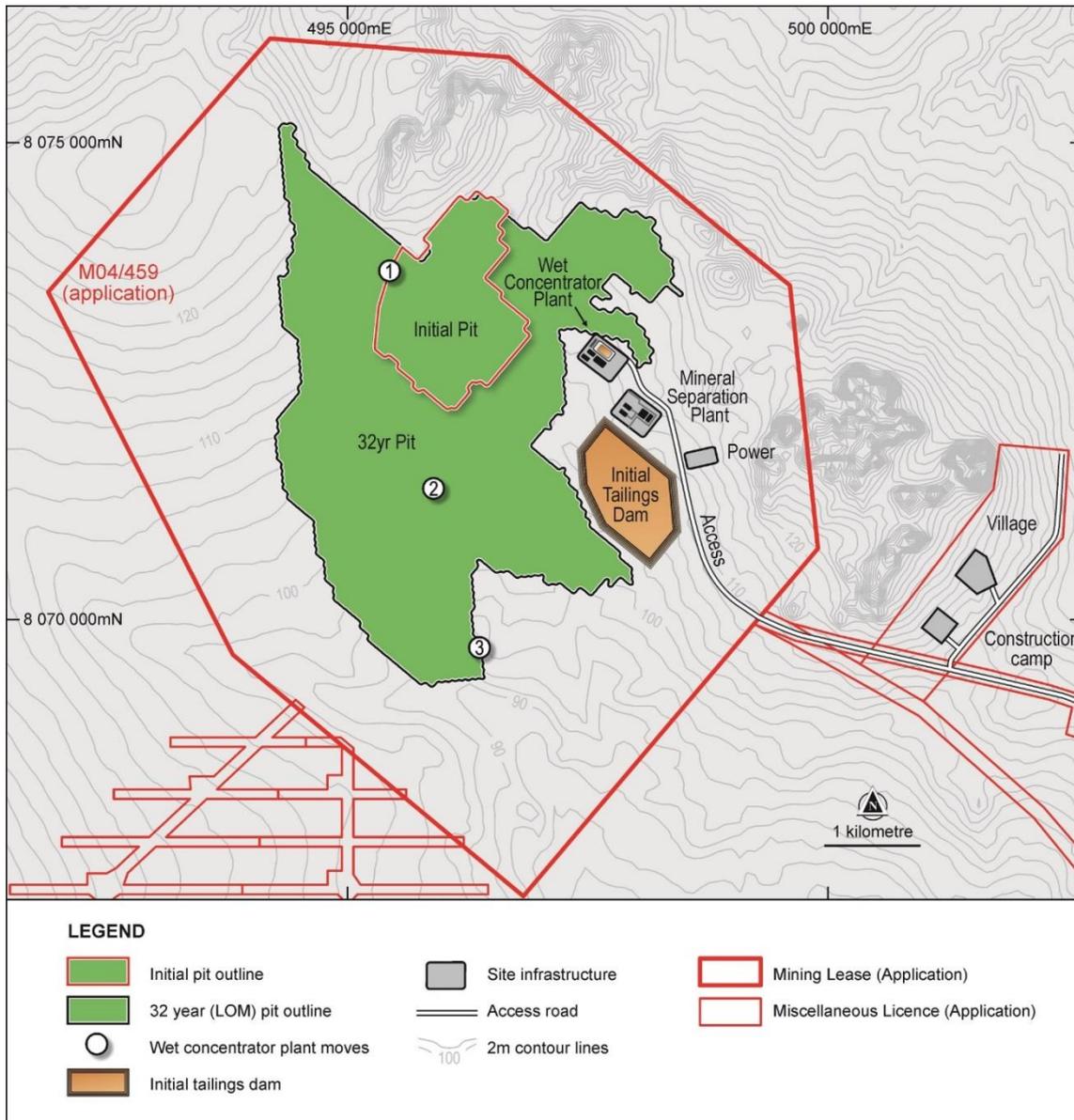
The MSP will be a fixed plant and will be located approximately 500 metres from the initial WCP site for the first 12 years.

The processing flowsheet has been developed by leading mineral sands specialists Robbins Metallurgical Pty Ltd on the basis of metallurgical process development testwork during the Scoping Study, and during the PFS on a 12.5 tonne bulk sample using full-scale and scalable equipment. The product recoveries obtained from this work have been used in the PFS financial model.

Overall zircon recovery, excluding semi-processed and re-circulated streams, is calculated at 67%. The Primary (66.4% ZrO<sub>2</sub>) Zircon comprises 80% of the recovered zircon. A Secondary (65.1% ZrO<sub>2</sub>) and a Special (62.8% ZrO<sub>2</sub>) Zircon were also produced.

The HiTi84 product recovery, excluding semi-processed or re-circulation streams is 37%.

Overall recovery of ilmenite to product is 65%. This product is an ilmenite with 49.1% TiO<sub>2</sub> and is offset by a reduction in recovery to increase the TiO<sub>2</sub> content and reduce Fe<sub>2</sub>O<sub>3</sub> levels, resulting in a higher value product.



**Figure 6: Thunderbird site layout plan**

## **SITE INFRASTRUCTURE**

The permanent Mineral Separation Plant, the initial location of the movable Wet Concentrator Plant, and an initial Tailings Storage Facility will all be favourably located in an 'embayment' in the orebody within optimal pumping distances (Figure 6). This has major operating cost advantages.

A16MW LNG/diesel power station is required and will be located close to the mine and processing facilities.

New and upgraded roads will provide access to processing facilities and the accommodation camp, and all-weather access across flood-prone sections of the Mt Jowlaenga Road and its intersection with the Great Northern Highway.

The construction and permanent accommodation camps will be located approximately 5km southeast from the mine site. It is planned to lease/purchase the accommodation camp buildings over a 5 year term.

The capital cost of local site infrastructure is estimated at \$51.4m.

## PRODUCT QUALITY & MARKETING

Industry experts TZMI completed an assessment of the marketability of final products obtained from the 12.5t bulk sample metallurgical testwork, taking into account product quality and expected production volumes.

TZMI concluded that the primary zircon product is suitable for ceramic applications. The ceramics sector is the largest sector of the zircon market, with China being the largest importing country. TZMI do not see any issue with placing this material in the market due to the progressively growing supply gap beyond 2018. The secondary and special zircon can be sold as high grade concentrates to the zircon chemicals sector or to zircon concentrate processors, most of which are located in China.

The primary ilmenite product (49.1% TiO<sub>2</sub>) is a suitable feedstock for the sulphate-route TiO<sub>2</sub> pigment process, or as a feed for titanium slag manufacture. The low levels of alkalis and chromium also make this ilmenite an attractive feedstock for blending with ilmenite from other deposits with higher levels of these contaminants.

The HiTi84 product (87.7% TiO<sub>2</sub> content) has specifications suited to the welding electrode market, subject to further customer testing. The product may also be suitable for the titanium sponge market subject to further work to reduce slightly elevated tin levels.

Notwithstanding there is ongoing product development, currently there is no perceived impediment to the sale of full production volumes.

## PRODUCT TRANSPORTATION & EXPORT

Infrastructure studies undertaken during the PFS have determined a robust and straightforward mine-to-port supply chain for the Thunderbird mineral products.

The PFS assumes that bulk products will be transported by a fleet of 4 quad road trains from the mine to the Derby Port for storage and export. A storage warehouse facility and administration office will be constructed adjacent to the Derby wharf.



**Figure 7: Derby port and approximate area to be leased (to be negotiated)**

New road, and road upgrades from the mine to the sealed Great Northern Highway are required at an estimated cost of \$10.1m.

Derby Port has previously been used for the export of up to 500,000tpa of base metal concentrates from Western Metal's Lennard Shelf operations and is well suited to the export of mineral sands products.

The Shire of Derby/West Kimberley Council has granted Sheffield preferred proponent status for exclusive use of the bulk commodity handling area at the Derby wharf. The Company has an exclusive 6 month period to negotiate lease area and terms of lease to the satisfaction of Council and Western Australia's Minister for Transport (see ASX release dated 2 March 2015).

Bulk product exports from Derby require barging and transshipment due to the high tidal range at the port. Bulk mineral sands products will be conveyed onto barges using an existing conveyor system and ship loader. Up to 4 barges, each loaded with 5,000 tonnes will be towed by 2 tugs approximately 20 nautical miles to Point Torment for transfer of product to an anchored vessel.

Broome port (140km by road from Thunderbird) is a suitable alternative for the export of Sheffield's bagged products.

## FINANCIAL ANALYSIS

Key physical and financial parameters of the PFS are set out below.

### PHYSICALS

**Table 2: Physicals Summary**

	<b>Years 1-10</b>	<b>LOM</b>
<b>Ore mined (mt)</b>	<b>179</b>	<b>580</b>
<b>Strip ratio (waste:ore)</b>	<b>0.22:1</b>	<b>0.68:1</b>
<b>HMC Produced (mt)</b>	<b>15.6</b>	<b>45.4</b>
<b>Production- Zircon (ktpa)</b>	<b>126</b>	<b>114</b>
<b>Production-HiTi 84 (ktpa)</b>	<b>31</b>	<b>30</b>
<b>Production- Ilmenite (ktpa)</b>	<b>479</b>	<b>439</b>

### CAPITAL ESTIMATES

**Table 3: Capital Cost Estimates (A\$m)**

<b>Port</b>	<b>16.5</b>
<b>Roads</b>	<b>10.2</b>
<b>Borefield</b>	<b>13.0</b>
<b>Other Infrastructure &amp; Services<sup>1</sup></b>	<b>26.3</b>
<b>Mining<sup>1</sup></b>	<b>9.9</b>
<b>Wet Concentrator Plant</b>	<b>97.2</b>
<b>Mineral Separation Plant</b>	<b>115.6</b>
<b>Sub-total direct costs</b>	<b>288.7</b>
<b>Labour, indirects &amp; insurances</b>	<b>10.3</b>
<b>Contingency</b>	<b>26.2</b>
<b>EPCM</b>	<b>52.3</b>
<b>Sub-total indirect costs</b>	<b>88.8</b>
<b>Owners costs (expensed)</b>	<b>16.6</b>
<b>Sub-total owners costs</b>	<b>16.6</b>
<b>TOTAL</b>	<b>394.1</b>

<sup>1</sup>MUPs, mobile equipment, accommodation camp buildings lease-purchased over 5 years

The estimated 32-year LOM sustaining capital, including finance lease balloon payments, is \$241.3m. The project payback period (before financing) is 3.6 years.

## ECONOMIC EVALUATION

**Table 4: Thunderbird PFS Key Project Economic Parameters**

		Years 1-10	LOM
<b>Revenue</b>	<b>A\$m</b>	<b>3,236</b>	<b>9,479</b>
<b>Average Operating Cash Flow (LOM)</b>	<b>A\$m<sup>pa</sup></b>	<b>163</b>	<b>134</b>
<b>EBITDA</b>	<b>A\$m<sup>pa</sup></b>	<b>148</b>	<b>120</b>
<b>EBIT</b>	<b>A\$m<sup>pa</sup></b>	<b>134</b>	<b>100</b>
<b>Unit Revenue</b>	<b>A\$/tonne product</b>	<b>510.16</b>	<b>508.26</b>
<b>Unit Revenue</b>	<b>A\$/tonne MUP feed</b>	<b>18.06</b>	<b>16.34</b>
<b>Cash operating costs (C1 costs)</b>	<b>A\$ tonne product</b>	<b>250.62</b>	<b>279.08</b>
<b>Cash operating costs (C1 costs)</b>	<b>A\$/tonne MUP feed</b>	<b>8.88</b>	<b>8.97</b>
<b>Royalties</b>	<b>A\$/tonne product</b>	<b>25.4</b>	<b>25.4</b>
<b>Revenue:Cost ratio (excluding royalties)</b>		<b>2.03</b>	<b>1.82</b>

Unless otherwise stated all cash flows are in Australian dollars, are undiscounted and are not subject to inflation/escalation factors and all years are calendar years.

**Table 5: Thunderbird PFS Key Assumptions**

<b>A\$:US\$ Exchange rate</b>		<b>0.78</b>
<b>Zircon Price</b>	<b>US\$/tonne</b>	<b>1,375</b>
<b>Ilmenite Price</b>	<b>US\$/tonne</b>	<b>155</b>
<b>HiTi84 leucoxene Price</b>	<b>US\$/tonne</b>	<b>580</b>

The price forecasts quoted for zircon and ilmenite are specific to the Thunderbird planned products and are based on TZMI's price forecast with adjustment made for quality and likely target market placement. The pricing for the HiTi84 product is derived from a combination of industry sources.

Thunderbird is operating cash flow positive even at current "spot" prices<sup>1</sup>, with LOM average annual EBITDA of \$57m and LOM revenue-to-cost ratio of 1.42:1 without altering the mining rate or optimising the mine schedule towards higher grade ore.

## ENVIRONMENT & PERMITTING

Environment and permitting requirements are progressing in parallel with feasibility studies.

Sheffield commissioned environmental consultants *ecologia* to complete comprehensive flora and fauna surveys of the Thunderbird study area. These surveys will assist Sheffield to document and describe the flora and fauna in the region and provide sufficient information to enable an assessment of the project impacts on the environment. Four surveys were completed between June 2012 and April 2014. A number of additional surveys and studies are planned for 2015.

A mining lease application was lodged during the September 2014 quarter. The native title negotiation process has commenced with respect to this application. Miscellaneous licences for access roads and a camp were lodged in December 2014.

The Thunderbird mineral sands project has been assessed and designated a Level 2 Lead Agency Project Proposal by the WA Department of Minerals and Petroleum ("DMP"). The DMP will advise and assist the Company with coordination of approvals across other WA

<sup>1</sup> current spot pricing is sourced from Industrial Minerals and other industry sources: US\$110/t ilmenite, US\$1,100 primary zircon, US\$500/t HiTi.

Government agencies during the pre-submission and submission stages of the Project proposal. The Lead Agency status is an acknowledgement of the significance of the Thunderbird project to the State and the West Kimberley region.

Throughout these processes, Sheffield will continue to place a strong focus on stakeholder engagement.

## DEVELOPMENT SCHEDULE

Sheffield plans to complete a Definitive Feasibility Study in 2016, followed by mine construction commencing in 2017, followed by commissioning in 2018 and the first full year of production targeted for 2019, as per the schedule below.

**Table 6: Thunderbird Development Schedule**

ACTIVITY	2015				2016				2017				2018				2019	
	Q1	Q2	Q3	Q4	Q1	Q2												
Pre-Feasibility Study	█	█																
Pre-Feasibility Update		█	█	█														
Definitive Feasibility Study			█	█	█	█	█											
Permitting	█	█	█	█														
Environmental Approvals	█	█	█	█														
Infrastructure	█	█	█	█	█	█	█	█	█	█	█							
Engineering & Construction									█	█	█	█	█	█	█	█	█	█
Commissioning																	█	█
Production																		█

## UPSIDE POTENTIAL

With the framework of the Thunderbird project largely determined by the PFS, Sheffield will now focus on opportunities to increase cash margins and reduce capital expenditure.

Further work will be undertaken to optimise production throughputs, engineering and mine design and detailed mine scheduling to increase margins through improved efficiencies and reduced operating costs.

The next phase of metallurgical testwork will aim to further improve recoveries and product quality. A key focus will be the upgrading of ilmenite products to suit a wider range of potential markets and to attract higher product prices.

During the PFS an upgraded ilmenite product with a TiO<sub>2</sub> content of 58.3% and low alkali and chromium levels was produced by low temperature roast (requiring increased operating and capital costs). TZMI recommend the end market for this product as sulphate and chloride slag feedstock and estimate that a long term price of US\$199/t may be applicable (i.e. 28% above the ilmenite price used in the PFS financial model). As a sulphate pigment feedstock, TZMI estimate that a long term price of US\$190-199/t may be applicable. The upgraded ilmenite offers both higher pricing and greater market diversity and will be subject to a cost-benefit analysis during the next phase of work.

Sheffield will investigate potential strategic opportunities where Thunderbird could provide long-life offtake to new and/or existing smelters and/or major pigment producers.

In February 2015, Sheffield announced exceptionally high grade results from 51 infill aircore drill holes completed on a 250m x 125m pattern in the up-dip region of the Thunderbird deposit. The results include the following intersections:

- **18m @ 21.3% HM** from 0m (THAC528)
- **15m @ 19.5% HM** from 1.5m (THAC526)
- **12m @ 19.2% HM** from 0m (THAC539)
- **16.5m @ 18.9% HM** from 1.5m (THAC529)
- **12m @ 18.9% HM** from 0m (THAC548)
- **21m @ 18.8% HM** from 7.5m (THAC544)

(>7.5% HM cut-off, refer ASX release dated 9 February 2015 for full details).

These drill results were not available in time for inclusion in the December 2014 resource which forms the basis for the PFS. They have potential to be of significant benefit to the project economics and will be incorporated into resource and PFS updates scheduled for H2 2015.

Further infill drilling is planned during Q3 2015 to complete the 250m x 125m drill pattern in the shallow, high grade portion of the deposit. This will enable more detailed mine scheduling to optimise cash flows in early production years.

The discovery of additional shallow high grade mineralisation would further improve the project economics. This exploration upside will be investigated during the 2015 field season.

### **ABOUT THE THUNDERBIRD DEPOSIT**

The Thunderbird deposit occurs within Sheffield's Dampier Project, located on the Dampier Peninsula about 60km west of Derby, and 25km north of the sealed Great Northern Highway joining Derby and Broome (Figure 1).

Thunderbird is one of the largest mineral sands deposits to be discovered in the last 30 years. It has a total Mineral Resource of 3.2Bt @ 6.8% HM (Measured, Indicated and Inferred) (at 3% HM cut-off), containing 19.3Mt of zircon, 61.1Mt of ilmenite, 8Mt of leucoxene and 6.3Mt of HiTi leucoxene (refer to ASX release dated 12 December, 2014 for additional details of the Resource).

The Resource has a coherent higher grade component of 1,080Mt @ 11.8% HM (Measured, Indicated and Inferred) (at 7.5% HM cut-off) containing 10Mt of zircon, 35.7Mt of ilmenite, 3.1Mt of high-titanium leucoxene, and 2.8Mt of leucoxene (Appendix 1).

The Mineral Resource is based on data from 509 aircore drill holes completed by Sheffield between 2012 and 2014.

Mineralisation occurs as a thick, sheet-like body 8.5km long and between 3.5km and 6.5km wide and remains open in most directions. The mineralised horizon strikes northwest and dips very gently to the southwest, extending from surface to a maximum modelled depth of 155m.

Within the mineralised horizon is a continuous, higher grade zone which has a north-south long axis orientation, oblique to the regional strike. The high grade mineralisation averages 15m thickness and extends from 1m below surface to a maximum modelled vertical depth of 125m. The 32 year optimised pit shell used in the PFS incorporates the high grade zone down to 84m vertical depth.

The Thunderbird deposit is hosted by deeply weathered Cretaceous-aged formations. Its areal extent, thickness, grain size, excellent grade and geological continuity are thought to indicate an off-shore, sub-wave base depositional environment. The main mineralised unit, known as the Thunderbird Formation, comprises medium to dark brown/orange, fine to very fine well-sorted sands.

Geotechnical investigations, including the logging of 20 sonic core holes, undertaken during the PFS by ATC Williams confirm that the mineralised unit comprises 85-90% dense, fine to medium grained sand with occasional extremely weathered fine and medium grained sandstone. Material is expected to be readily excavatable using conventional mining equipment.

Approximately 10% of the sonic core comprises siliceous or iron-cemented hard layers situated above or within the mineralised horizon. These occur in localised domains or as multiple thin discontinuous layers typically less than 2cm thick. These were assessed as “hard digging” or “easy ripping” by ATC Williams (ASX release dated 17 March 2015). Higher mining and materials handling costs for the harder material have been included in the PFS financial model.

Oversize (+1mm) levels are low to moderate, averaging 9-10% of the resource. The oversize consists of granules, and quartz- and iron-cemented aggregates. The percentage of oversize correlates well with the estimated percentage of harder material observed in the sonic core.

The mineral assemblage of the Thunderbird resource at the 3% HM cut-off comprises 43.5% valuable heavy mineral (8.9% zircon, 28% ilmenite, 2.4% HiTi leucoxene and 2.2% leucoxene). The non-valuable “trash” component of the heavy mineral is mostly iron oxides and iron-cemented quartz aggregates, together with a very minor proportion of aluminosilicate and other minerals. The majority of trash minerals are removed during the primary concentration stage. These are accounted for in the stated product recoveries detailed elsewhere in this announcement.

Sizing analyses data indicate the heavy minerals to be fine to medium grained with a median product diameter (d50) of 59-70 microns. Modern processing techniques can recover high density heavy minerals to below 38 microns.

The Thunderbird resource has a moderate slimes content, averaging 15% at the 7.5% HM cutoff. The slimes have favourable characteristics, including a low clay content, and exhibit high settling rates at low flocculant dosage rates (ASX release dated 17 March 2015).

Thunderbird is the first major mineral sands deposit to be discovered in the Canning Basin, which is rapidly emerging as an important new mineral sands province. Sheffield has a large tenement holding totalling 5,800km<sup>2</sup> in the Canning Basin, on which it is exploring for shallow, high-grade mineral sands deposits. A maiden scout aircore drilling program in 2014 resulted in the discovery of 3 new prospects within 30km of Thunderbird (ASX release dated 25 February, 2015). These will be subject to follow-up drilling in 2015.

ENDS

For further information please contact:

Bruce McQuitty  
Managing Director  
Tel: 08 6424 8440

[bmcquitty@sheffieldresources.com.au](mailto:bmcquitty@sheffieldresources.com.au)

Media: Luke Forrestal  
Cannings Purple  
Tel: 08 6314 6303

[lforrestal@canningspurple.com.au](mailto:lforrestal@canningspurple.com.au)

Website: [www.sheffieldresources.com.au](http://www.sheffieldresources.com.au)

## **COMPLIANCE STATEMENTS**

The information in this report that relates to results of Pre-feasibility Studies is based on information compiled by Mr Mark Teakle, a Competent Person who is a Member of the Australasian Institute of Geoscientists (AIG) and the Australasian Institute of Mining and Metallurgy (AusIMM). Mr Teakle is a full-time employee of Sheffield Resources Ltd and has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Mr Teakle consents to the inclusion in the report of the matters based on his information in the form and context in which it appears.

## **PREVIOUSLY REPORTED INFORMATION**

This report includes information that relates to Mineral Resources, Exploration Results and Technical Studies which were prepared and first disclosed under the JORC Code 2012. The information was extracted from the Company's previous ASX announcements as follows:

- *"THUNDERBIRD MINERAL SANDS PROJECT UPDATE"*, 17 March, 2015
- *"THREE NEW MINERAL SANDS DISCOVERIES IN CANNING BASIN"*, 25 February, 2015
- *"EXCEPTIONALLY HIGH GRADES FROM INFILL DRILLING AT THUNDERBIRD MINERAL SANDS PROJECT"*, 15 February 2015
- *"THUNDERBIRD HIGH GRADE RESOURCE SURPASSES ONE BILLION TONNES"* 12 December 2014
- *"SCOPING STUDY HIGHLIGHTS THUNDERBIRD'S EXCEPTIONAL FINANCIAL RETURNS"* 14 April, 2014

These announcements are available on Sheffield Resources Ltd's web site [www.sheffieldresources.com.au](http://www.sheffieldresources.com.au).

The Company confirms that it is not aware of any new information or data that materially affects the information included in the original market announcements and, in the case of estimates of Mineral Resources, Scoping and Pre-Feasibility studies that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcement.

## **FORWARD LOOKING AND CAUTIONARY STATEMENTS**

Some statements in this report regarding estimates or future events are forward-looking statements. They involve risk and uncertainties that could cause actual results to differ from estimated results. Forward-looking statements include, but are not limited to, statements concerning the Company's exploration programme, outlook, target sizes and mineralised material estimates. They include statements preceded by words such as "anticipated", "expected", "likely", "should", "scheduled", "intends", "potential", "prospective" and similar expressions.

In this report the term "mining inventory" is used to report that part of the Mineral Resource that has been considered in the Pre-feasibility Study. The mining inventory does not meet the requirements of an Ore Reserve as defined under the 2012 edition of the JORC Code and should not be considered an Ore Reserve. There is no certainty that all or any part of the mining inventory will be converted into Ore Reserves.

## ABOUT SHEFFIELD RESOURCES

Sheffield Resources Limited (**Sheffield**) is a rapidly emerging heavy mineral sands (HMS) company.

ASX Code:	SFX	Market Cap @ 70cps	\$94.0m
Issued shares:	134.4m	Cash: \$6.5m	

Sheffield's projects are all situated within the state of Western Australia and are 100% owned by the Company.

### HEAVY MINERAL SANDS

The Dampier project, located near Derby in WA's northwest, contains the large, high grade zircon-rich Thunderbird HMS deposit. Sheffield's pre-feasibility study shows Thunderbird can generate strong cash margins from globally significant levels of production over a 32 year mine life.

The Eneabba project comprises multiple HMS deposits and is located near Eneabba approximately 140km south of the port of Geraldton in WA's Mid-West region.

Sheffield is also evaluating the large McCalls chloride ilmenite project, located 110km to the north of Perth.

### NICKEL-COPPER

Sheffield has over 2,000km<sup>2</sup> of tenure in the Fraser Range region, including the Red Bull project which is within 20km of Sirius Resources NL's (ASX:SIR) Nova Ni-Cu deposit.

**APPENDIX 1: THUNDERBIRD MINERAL RESOURCE 12 DECEMBER 2014**

**Thunderbird Deposit Mineral Resource<sup>1</sup>**

Resource Category	Cut off (HM%)	Mineral Resources					In-situ HM (Mt)	Mineral Assemblage <sup>2</sup>			
		Material (Mt)	Bulk Density	HM %	Slimes %	Osize %		Zircon %	HiTi Leuc %	Leuc %	Ilmenite %
Measured	3.0	75	2.1	7.9	19	11	6	9.3	2.7	2.7	30
Indicated	3.0	2,550	2.1	7.0	16	9	180	8.9	2.9	3.6	28
Inferred	3.0	580	2.0	5.6	16	9	32	8.8	3.0	4.1	28
<b>Total</b>	<b>3.0</b>	<b>3,205</b>	<b>2.1</b>	<b>6.8</b>	<b>16</b>	<b>9</b>	<b>218</b>	<b>8.9</b>	<b>2.9</b>	<b>3.7</b>	<b>28</b>
Measured	7.5	35	2.2	12.7	18	14	4	8.7	2.6	2.2	30
Indicated	7.5	920	2.1	11.9	15	10	110	7.9	2.4	2.2	28
Inferred	7.5	125	2.0	10.8	14	9	14	7.7	2.4	2.2	28
<b>Total</b>	<b>7.5</b>	<b>1,080</b>	<b>2.1</b>	<b>11.8</b>	<b>15</b>	<b>10</b>	<b>128</b>	<b>7.9</b>	<b>2.4</b>	<b>2.2</b>	<b>28</b>

**Thunderbird Deposit contained Valuable HM (VHM) Resource Inventory<sup>1</sup>**

Resource Category	Cut off (HM%)	Zircon (kt)	HiTi Leucoxene (kt)	Leucoxene (kt)	Ilmenite (kt)	Total VHM (kt)
Measured	3.0	500	200	200	1,800	2,600
Indicated	3.0	15,900	5,200	6,500	50,400	78,100
Inferred	3.0	2,800	1,000	1,300	9,000	14,100
<b>Total</b>	<b>3.0</b>	<b>19,300</b>	<b>6,300</b>	<b>8,000</b>	<b>61,100</b>	<b>94,800</b>
Measured	7.5	400	100	100	1,300	1,800
Indicated	7.5	8,600	2,600	2,400	30,700	44,300
Inferred	7.5	1,100	300	300	3,800	5,400
<b>Total</b>	<b>7.5</b>	<b>10,000</b>	<b>3,100</b>	<b>2,800</b>	<b>35,700</b>	<b>51,500</b>

<sup>1</sup> All tonnages and grades have been rounded to reflect the relative uncertainty of the estimate, thus sum of columns may not equal. <sup>2</sup> The In-situ grade is determined by multiplying the percentage of HM by the percentage of each valuable heavy mineral within the heavy mineral assemblage. <sup>3</sup> Estimates of Mineral Assemblage are presented as percentages of the Heavy Mineral (HM) component of the deposit, as determined by magnetic separation, QEMSCAN and XRF. Magnetic fractions were analysed by QEMSCAN for mineral determination as follows: Ilmenite: 40-70% TiO<sub>2</sub> >90% Liberation; Leucoxene: 70-94% TiO<sub>2</sub> >90% Liberation; High Titanium Leucoxene (HiTi Leucoxene): >94% TiO<sub>2</sub> >90% Liberation; and Zircon: 66.7% ZrO<sub>2</sub>+HfO<sub>2</sub> >90% Liberation. The non-magnetic fraction was submitted for XRF analysis and minerals determined as follows: Zircon: ZrO<sub>2</sub>+HfO<sub>2</sub>/0.667 and High Titanium Leucoxene (HiTi Leucoxene): TiO<sub>2</sub>/0.94.