Dr Chris Baker
15 August 2018

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Recommendation: BUY

SHEFFIELD RESOURCES LTD (SFX AU, $0.86)

Environmental approval moves Thunderbird one step closer
Exploration of priority resource targets has commenced
Delay of RIO's Zulti South provides positive backdrop for zircon prices which are now trading as high as US$1700/t (premium, CIF)

- There has been plenty of positive news flow from Sheffield over recent months. This has translated to ongoing rerating of the stock. The long-awaited **WA State environmental approval** for Thunderbird was ratified on 13 August. SFX is awaiting a final native title agreement, which is expected within weeks. A negotiated settlement with the Traditional Owners could see the Mining Lease granted shortly thereafter. Federal environmental approvals are also required, but this is thought to be a formality.
- SFX have announced the **recommencement of exploration drilling** of several targets within the mineralised and highly weathered sandstones of the Canning Basin, along strike from the massive Thunderbird discovery. Drilling of the highly prospective Night Train discovery – now underway – we think could yield an inferred resource quite quickly.
- Behind this will be drilling of the Cold Duck and Cisco anomalies, both within a few kilometres of Thunderbird, and several other targets within the northern Canning Basin.
- We remain of the view that the Broome Sandstone could provide the host for a new global zircon-rich mineral sands province. With the recent departure of Iluka from the area, SFX now controls the core of the Basin.
- **The tightness in the global market for zircon has not abated**. Early in the year Tronox increased its premium zircon reference price by around 9.5% to US$1425-1445/t. The Tronox transaction price is currently US$1590-US$1650/t (CIF basis). We have heard from market participants that spot pricing for Tronox material has been trading higher than the transaction pricing and in the region of US$1700/t.
- Iluka's reference price has been pushed from US$1230 to $1410/t from 2Q18. We are awaiting a price adjustment at the end of 3Q18 and expect this to rise significantly.
- Market traders have suggested to us that there is potential to see reference prices move to well over US$1600 and perhaps as high as $2000/t over the next 2 years.
- On top of the social and technical issues faced by mineral sands giant, Rio Tinto, we learned at the company's interim results presentation that **the new Zulti South mine at RBM will not be given the go-ahead until 1H19 at the earliest**. This will continue to tighten zircon markets as grades at the existing operations decline. Last year RBM delivered around 20% of global zircon supply.
- This is providing an increasingly positive backdrop for SFX's 100% owned Thunderbird project. We retain our view that Thunderbird is one of the very few Tier 1 mineral sand assets available for development. **Based on our conservative commodity price assumptions we generate a pre-tax IRR of 30% and an NPV of A$1.79/share at what we consider to be conservative commodity prices. A 20% uplift to zircon prices delivers a 31% increase to our valuation per share.**

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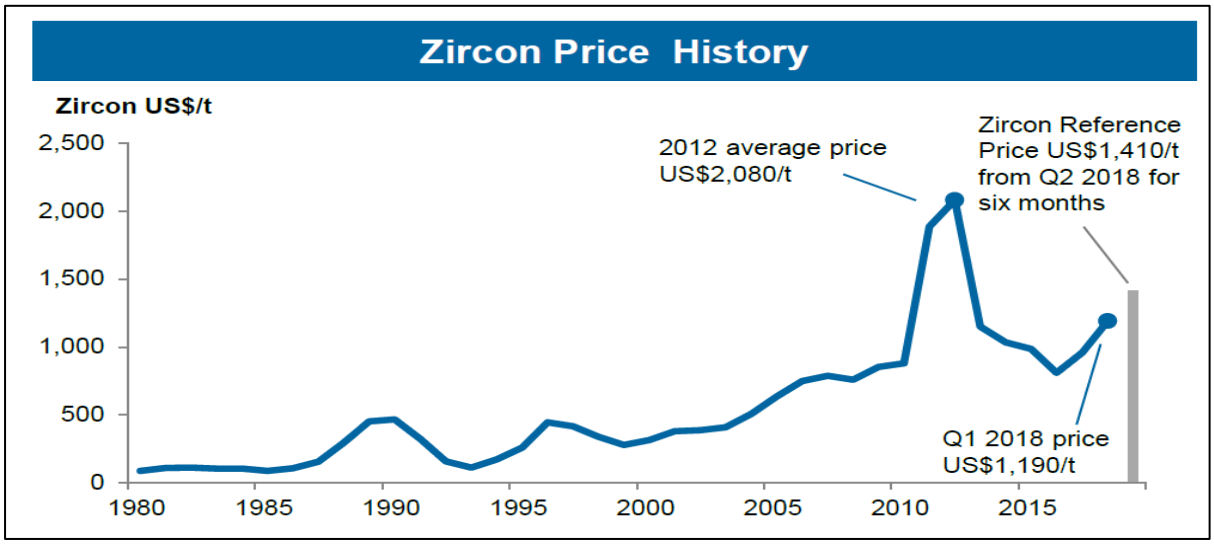
Commodity overview



Source: Iluka presentation, June 2018.

- As we discussed in our March 2018 report, major zircon producer, Tronox, increased premium zircon prices by around 9.5% to a range of US$1425-1445/t (CIF) from 1 January 2018. In February, Iluka increased its own reference price from US$1250/t to $1410/t, applicable from 2Q18. These actions are reflective of a continuing tight supply/demand outlook for the commodity.
- There is widespread speculation that Iluka will increase its reference price at the end of 3Q18. We note with interest Iluka's comments associated with its recently released June quarterly.

Iluka has received positive feedback from customers for maintaining its Reference Price for a six month period which has provided the market some stability and customers time to adjust downstream prices. Feedback is that participants through the value chain have adjusted to the market environment and higher prices have been accepted by end users with no evidence of substitution although thrifting has become more common in ceramics and foundry.

- The woes within Rio Tinto's Iron and Titanium division continue. There have been at least two instances of significant labour disruptions at the Richards Bay mineral sands operations (RBM) 76% owned and operated by Rio Tinto. In July the death of a security guard was reported.
- This has resulted in the declaration of force majeur on TiO2 deliveries, just one month after a roaster failure caused a halt in slag production. Making matters worse was an unexpected furnace outage at Sorell in Quebec which supplies sulphate quality slag to the pigment industries. This furnace will be out until the end of 2018.
- Rio Tinto then reported (at their annual results in August) that the new Zulti South mine was still under feasibility assessment and a go/no go decision will not be made until 1H19. As we have written many times we remain doubtful that Zulti South will ever get the go-ahead. There is simply too much political risk in South Africa for the RIO board to contemplate investing US$500m in a new project.
- A combination of production disruptions and declining grades is having a dramatic impact on Richard's Bay Minerals (RBM) output, particularly of zircon. The following is from Industrial Minerals, 1/8/18.

RBM zircon customers 'told to expect delays, no guarantees on Q4 volumes'

By Cameron Perks
Published: Wednesday, 01 August 2018

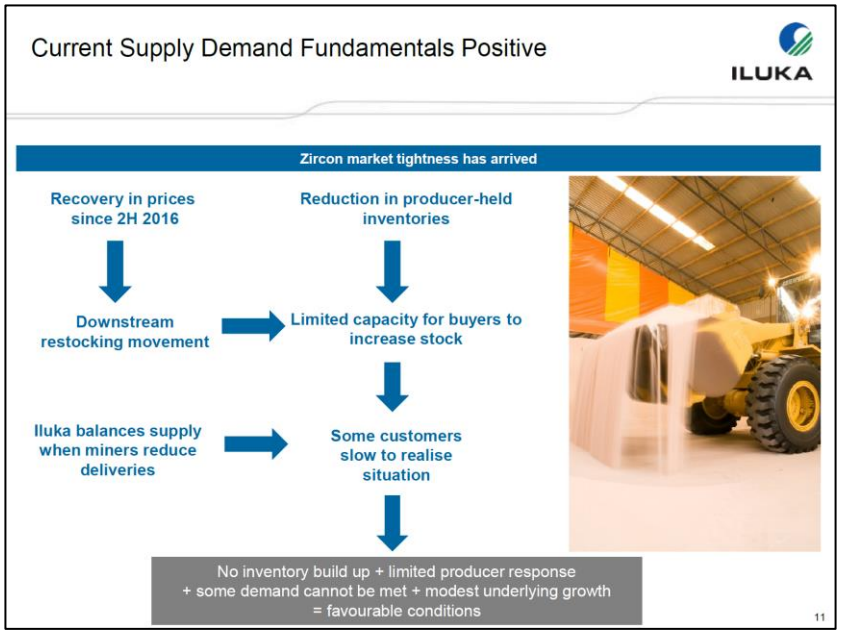
RBM zircon customers claim to have been told that fourth-quarter volumes are not guaranteed and that they should expect delays in receiving orders - still, despite the implications for availability, many market participants believe zircon prices have peaked.

Customers purchasing zircon from Rio Tinto's South African Richards Bay Minerals (RBM) operations have told to expect delays and that purchased volumes are not guaranteed, they claimed.

One customer was informed that orders were "not guaranteed in terms of volume" and that orders could be delayed by two to three weeks, he told Industrial Minerals. To remedy this, RBM has started to offer standard grades in place of premium grades for some customers, he alleged.

Another customer told Industrial Minerals that fourth-quarter "allocations of zircon would be cut greatly" and that there "could also be no supplies of zircon" during the final three months of the year.

- Spot zircon prices are now over US$1600/t (CIF) into China (source www.ferroalloynet.com). Market commentators are now suggesting prices might breach US$2000/t within 18 months.
- Our modelling of recent mine restarts (especially the Jacinth – Ambrosia mine of Iluka) and declines in producer inventory confirms the view presented by Iluka that the current supply deficit will continue to magnify. This may translate into further price strength for zircon over the next 12-24 months.
- We have re-examined our supply/demand estimates for zircon, and see a supply deficit extending out past 2020, largely driven by declining production from RBM. Our long-term commodity price assumptions for zircon at US$1400/t and premium sulphate ilmenite of US$220/t are unchanged. We believe our zircon price assumptions are conservative.
- With the slow demise of RBM and recommissioning of the Jacinth mine, Iluka is about to become the largest producer of zircon globally. The following slide (from the Industrial Minerals conference in June 2018) provides a strong message to its customers. It is hard to disagree with Iluka's read of the market.



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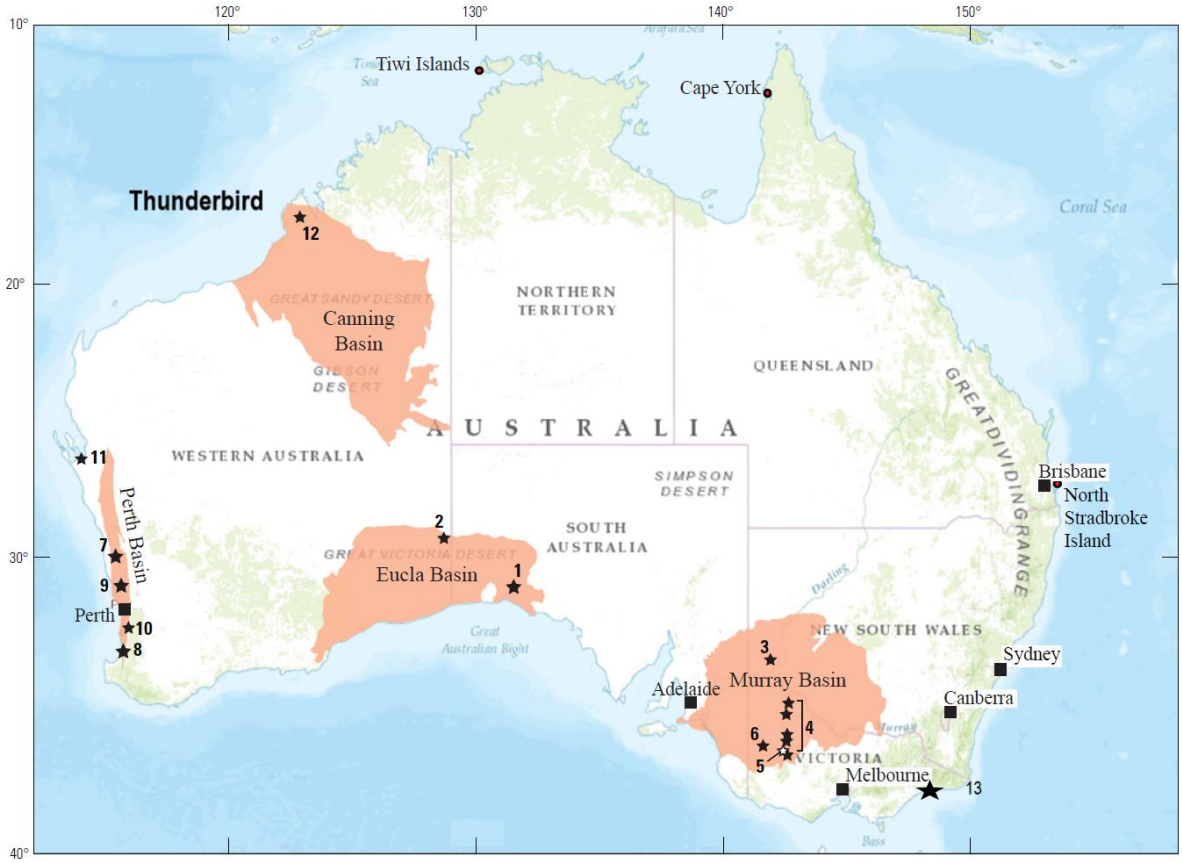
Thunderbird: the first economic discovery of mineral sands in the Canning Basin but probably not the last



Modified from "Deposit model for heavy mineral sand deposits in coastal environments", USGS 2014. See Appendix 1 for key to selected mineral sand deposits

The Thunderbird deposit is geologically unique. Most mineral sand deposits are not very far from their origins, an active coastal fringe, where wave action produces a concentration of the higher density minerals, such as rutile, ilmenite and zircon, within their less dense host (typically quartz sand). The world scale mineral sands projects are typified by the coastal deposits of Eastern Australia, now largely exhausted, or sterilised by coastal development or national parks. Deposits of this type currently being mined are those of east Africa, stretching from the massive Richards Bay and Madagascan deposits controlled by Rio Tinto, and the extensive deposits of coastal India and Sri Lanka. All these deposits are just a million years old, or less.

Older shorelines have also been responsive for world class deposits. Examples would include those of the Perth, Eucla and Murray Basins (perhaps 2-50 million years old) located in Australia and the old coastal deposits of the eastern US (located in North Carolina, Virginia and Florida). These deposits are well explored, and mature. All have seen the best deposits extracted over the past 10-30 years.

We believe the Thunderbird deposit is unusual because of its significant age. It is hosted by the lower Cretaceous sediments of the Canning Basin and very much older than its Perth Basin neighbours: likely around 140 million years.

Enclosed within the so-called Thunderbird Formation (an element of the Broome Sandstone) is an unusually large, continuous, very-high grade (>7.5% HM) zone named the GT Zone. This Zone is up to 43 m thick (averaging 15 m) over an area at least 7.5 km × 4 km, strikes approximately north-south, follows the dip of the Thunderbird

Formation and is open along strike. The GT Zone extends from surface to a maximum modelled depth of 126 m, the average depth to its top is 35 m and the average mineralised thickness is 16 m.

This high grade zone is interpreted to represent an internal structure to the mineralisation, perhaps a channel. The higher grades are not associated with unit thickening or a change in grain size, and are therefore interpreted to result from deposition in higher energy shoals off-shore influenced by inflow directions of heavy minerals source (e.g. rivers, floodplains). There is some thought that Thunderbird was formed in a similar fashion to the WIM150 deposits of the Murray Basin in Victoria.

The heavy minerals in the Thunderbird deposit are comprised of altered ilmenite, ilmenite, pseudorutile, haematite, goethite, leucoxene, zircon, rutile, anatase, and monazite. There are also very minor amounts (<2%), of tourmaline, spinel, staurolite and andalusite. At a median diameter of 57–90 microns, the valuable heavy minerals are finer-grained than most other Western Australian HM deposits. (Source: Boyd and Teakle, 2016)
The rocks themselves are deeply weathered, with minor quantities of the ilmenite having broken down to leucoxene and anatase with the remnant iron precipitated as the various types of hydrated iron oxides. The high proportion of haematite and goethite in the HM suite is predominantly a result of oxidation of titanomagnetite in the original heavy mineral assemblage as well as some contribution from the more recent weathering environment. This does result in some areas of re-precipitated iron oxide, but these are typically narrow and should represent few challenges to the miners. The weathering of the ilmenite has concentrated titanium at the expense of iron, enabling the production of higher grade, and therefore more valuable ilmenite.

Thunderbird is materially large. At a low cut-off grade (3% HM), the deposit contains some 92.6 million tonnes of contained valuable heavy minerals, within a total resource of over 3 billion tonnes. Within this is a higher grade resource (7.5% HM cut-off grade) of 50.4 million tonnes of contained valuable heavy minerals, largely of zircon and ilmenite. The economics of Thunderbird are enhanced with its very low strip ratio.

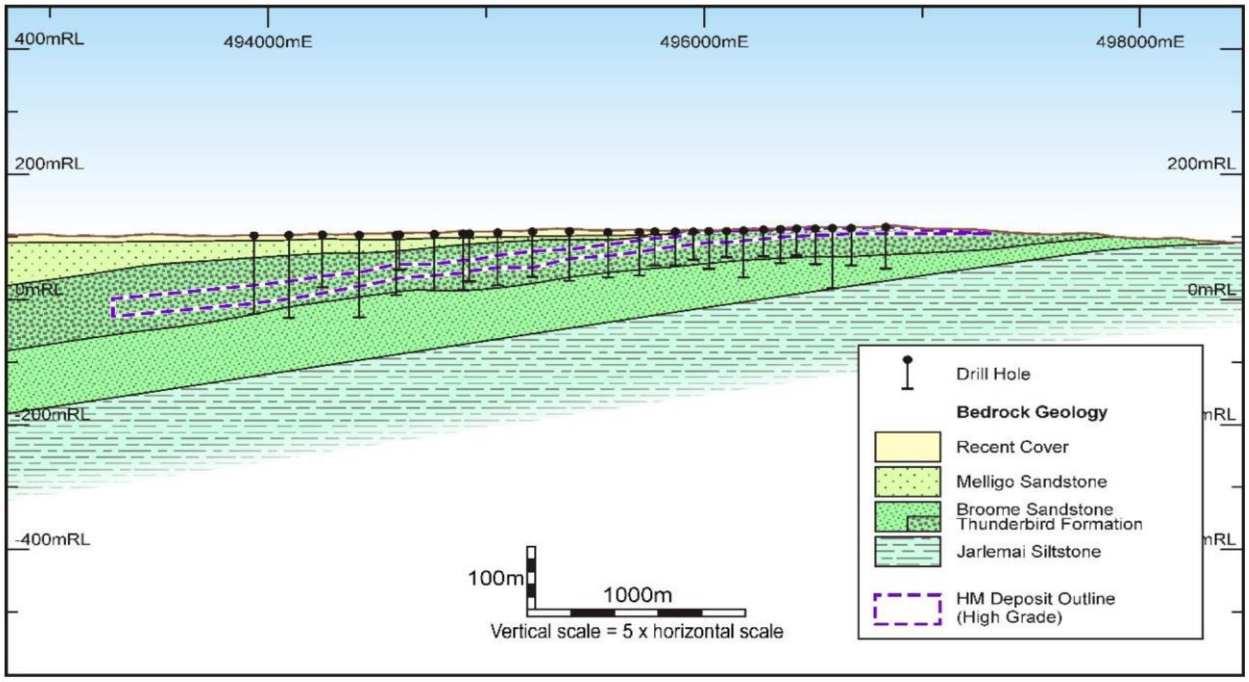


Figure 12-5: Cross-Section Showing Stratigraphic Units Drilled at Thunderbird

The exploration opportunity for Sheffield in the Canning Basin

There are excellent opportunities to identify additional heavy mineral sand deposits around the sub-crop of the Broome Sandstone in the Canning Basin. We are of the view that the Canning Basin will be one of the next global mineral sand provinces. By all measures, the Thunderbird deposit is world class. We see no reason why other satellite deposits will not be discovered in the area. It is certainly a compelling exploration opportunity, and to us it only seems a matter of time before another economic deposit is identified. SFX state that the prospective horizon extends for some 160km.

As highlighted in the documents attached to the Bankable Feasibility study, Sheffield geologists are starting to develop an understanding of the formation of the Thunderbird deposit. Exploration for new targets in the Canning might consider the following features:

- The geological contact between the Broome Sandstone and the overlying Melligo Sandstone, close to what might have been the Cretaceous palaeo-coastline.
- Positioning within the rift valleys (such as the Fitzroy Trough illustrated in the interpretation below), proximal to rocks of the Kimberley craton.
- Near surface concentrations of zircon and monazite. Thunderbird was originally found by radiometric geophysical methods reflecting the anomalous concentration of thorium with the heavy mineral suite.
- Repetitions of the higher-grade channel style mineralisation shown as the so-called GT zone within the massive Thunderbird deposit.
- The potential for high grade strand deposits higher in the stratigraphy.

The following structural interpretation of the north-western section of the extensive Canning Basin, highlights the opportunity to find a sedimentary/geotectonic environment which could be conducive to the accumulation of additional significant heavy mineral sand deposits.

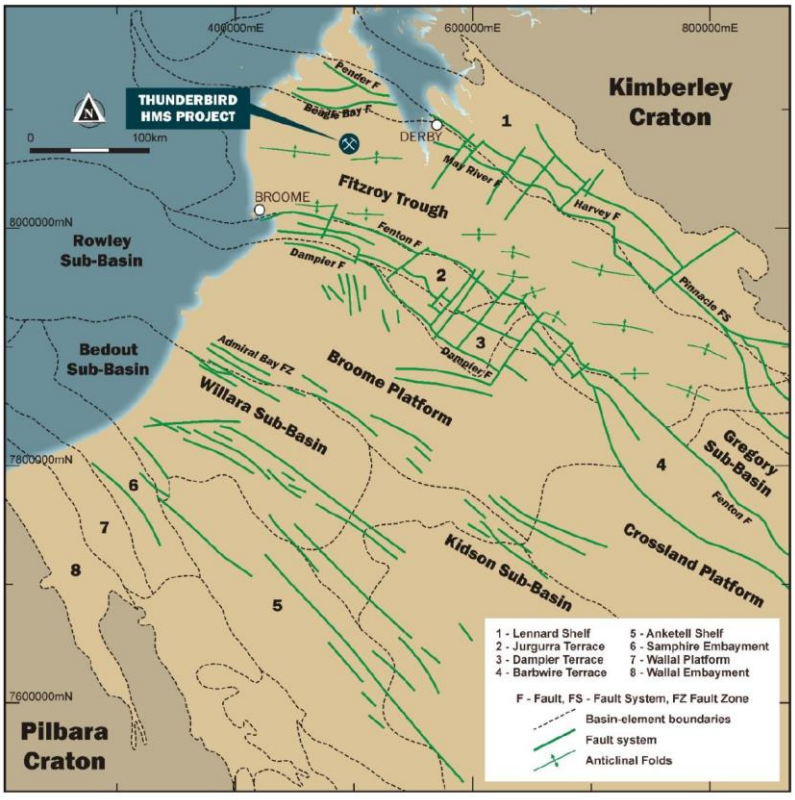


Figure 12-2: Canning Basin Structural Elements (After Parra-Garcia Et Al, 2014)

Source: Thunderbird BFS document 2016

We have been watching the exploration activities of SFX's competitors. Mineral sands-giant, Iluka, has been exploring the southern section of the Canning Basin. Following several encouraging comments made during 2016, and an extensive exploration drilling programme, Iluka announced in 2017 that it would relinquish some 90% of its tenement holdings. We note with interest, that Sheffield has picked up a number of the tenements relinquished by Iluka. To the best of our knowledge, SFX is now the only company exploring for heavy minerals in the Canning Basin.

Sheffield has released a summary of its exploration targets in the Canning Basin (SFX release 1 August 2018) in the lead-up to a reinvigorated exploration programme in the area. As shown in the figure below the activity will mainly be focussed on the mineralised interval of the Broome Sandstone, which hosts the Thunderbird orebody and the recent Night Train zircon discovery. Several of these targets had already been highlighted by SFX. Others are new.

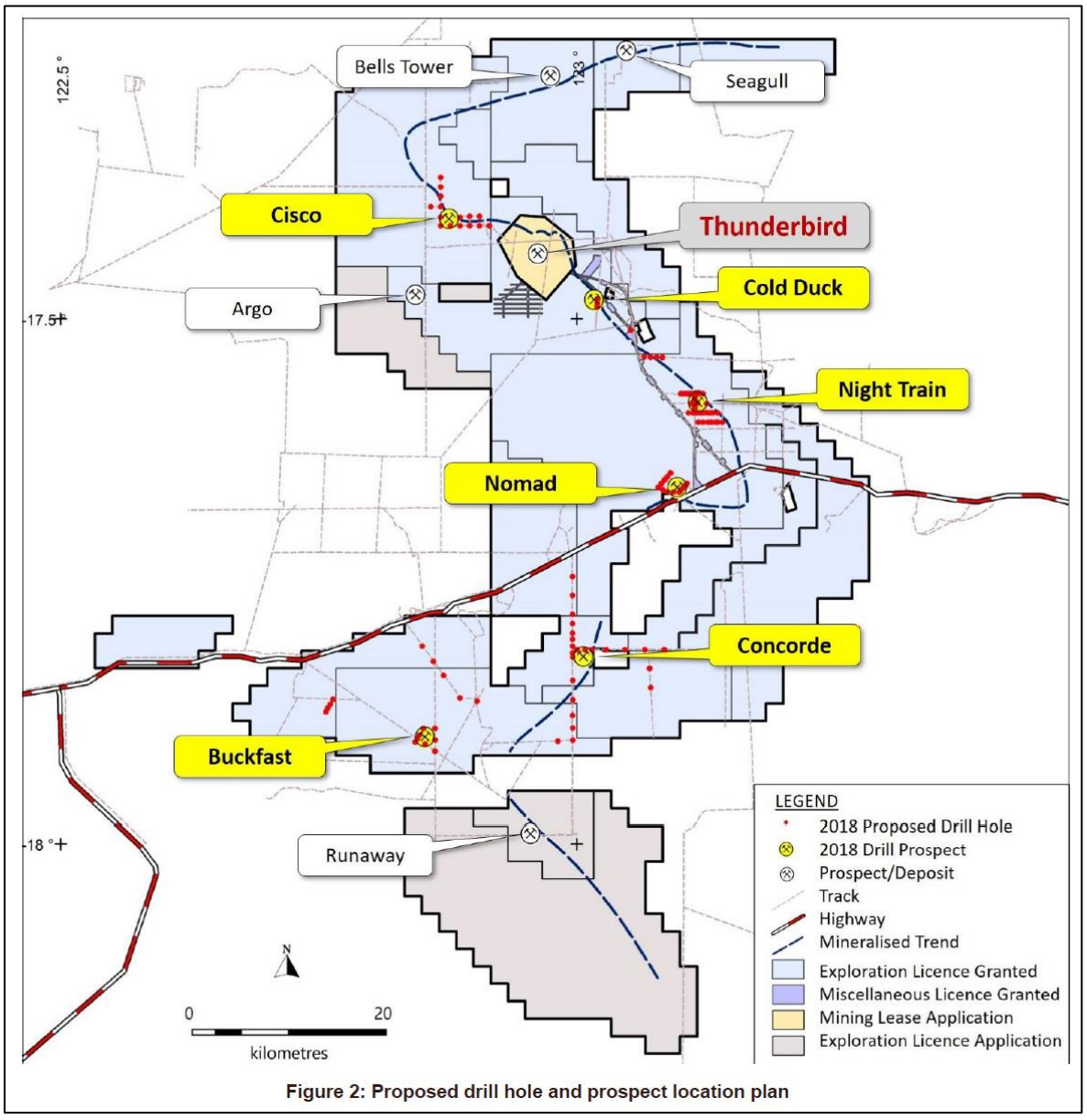


Figure 2: Proposed drill hole and prospect location plan

Highlights of the forthcoming exploration programmes include the following.

Further exploration of the **NIGHT TRAIN**, with drilling already underway. Night train was a blind discovery in 2015 and generated the following drill results.

- 9m @ 6.33% HM from 22.5m (DAAC052), including 7.5m @ 7.23% HM from 24m
- 13.5m @ 5.25% HM from 46.5m (DAAC094), including 7.5m @ 8.23% HM from 48m
- 24m @ 3.33% HM from 37.5m (DAAC093), including 12m @ 5.48% HM from 37.5m

The deposit is zircon rich (ca. 15%) with high levels of leucoxene. The zircon is of premium grade and relatively low uranium/thorium, which would be highly suitable for blending with Thunderbird's zircon product.

While still early days there is a suggestion that Night Train has some size to it. It has been traced in a single traverse suggesting it may be over 1km down dip. It is open in all directions. Assuming a strike length of 2km, 1km down dip and a thickness of 12 metres, its quite possible that the discovery is already 40-50 million tonnes. Assuming success with the drill bit this year, SFX could be looking at a resource estimate within 6 months.

As it appears to be lower grade, Night Train is unlikely to displace Thunderbird ore from the concentrator. However, it could easily provide justification for a small satellite concentrator to increase the production of high quality zircon with a leucoxene by-product.

The **NOMAD** discovery is some 30km south of Thunderbird, adjacent to the main Broome to Derby highway. Initial drilling has identified a thik, but low grade mineralised sequence. Geologists are targeting a Night Train-style deposit adjacent to the lower grade mineralisation identified to date.

The **COLD DUCK** anomaly is based on a single Rio Tinto drill hole (as was Thunderbird). It also has a modest radiometric anomaly. Again, it has not been followed up by SFX which in recent years has been focussed on Thunderbird. It is only a few kilometres SE of Thunderbird, lying within the projected location of the mineralised portion of the Broome sandstone.

A few kilometres to the north-east is the **CISCO** prospect, located up-dip of mineralisation originally identified at depth by Rio Tinto at the Central Zone/Stingray. It is a reasonably thick zone of low grade, but leucoxene enriched sand with zircon. Again, it has a modest radiometric geophysical signature in the projected up-dip near surface target zone.

Further to the south, but inferred to be associated with the mineralised Broome Sandstone are the **CONCORDE** and **BUCKFAST** anomalies. **CONCORDE** has an associated radiometric anomaly and heavy minerals can be panned at surface. Neither have been drilled.

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Valuation of Thunderbird –$1.79/share

Our valuation for SFX is A$1.79/share. This is based on the following assumptions:

- Critical commodity price assumptions of US$1400/t for premium zircon and US$220/t for sulphate ilmenite.
- A$/US$ of 0.75.
- Stage 1 capex of A$360m, with LOM capex of A$555m (excluding sustaining capex).
- First production in mid 2020.
- Project level gearing of 60%. We had previously assumed 50%, but we believe that nature of the Taurus facility will allow the project to take on higher gearing levels.
- No sell-down at the project level. We have changed our base case to assume that SFX will retain 100% of the project. A sell-down remains a possibility, but it will be contingent on price achieved.
- A final equity raise of around A$140m. Here we have assumed 100% of the equity raise will be issued at A$0.80/share.

Thunderbird (NPV10), post tax	A$m	$ 519.0	
Add back capex	A$m	$ 350.0	
Less working capital		-$ 20.0	
Thunderbird (NPV10)	A$m	$ 849.0	Unfunded NPV
Mine site exploration	A$m	$ 10.0	Notional
Equity NPV	A$m	$ 859.0	
Project debt	A$m	-$ 210.0	60% debt/equity
NPV less debt	A$m	$ 649.0	
Ownership by SFX	A$m	100%	
Implied SFX equity	A$m	$ 649.0	
Cash	A$m	$ 31.6	Current
PV of corporate costs	A$m	-$ 100.0	Estimate
Other exploration	A$m	$ -	
Corporate NAV	A$m	$ 580.6	
Number of shares, current	m	228.3	
New equity required	A$m	$ 140.0	Estimate
Number of new shares	m	175.0	
Total number of shares	m	403.3	
NAV adding new cash	A$m	$ 720.6	
NAV/share	A$	$ 1.79	

Sensitivities

It is possible to evaluate SFX's valuation under a variety of commodity price assumptions. However, zircon delivers around 60% of Thunderbird's revenue, and in our view offers the greatest upside potential. A 20% uplift to zircon prices delivers a 31% increase to our valuation per share.

		Project (pre-tax)		Corporate	
Zircon price (premium, US$/t CIF)		NPV(10), A$m	IRR (%)	Fully funded NPV (A$)	
Base case	$1,400	807	30	1.79	per share
+10%	$1,540	1044	33	2.07	per share
+20%	$1,680	1280	36	2.35	per share
-10%	$1,260	656	27	1.51	per share
-20%	$1,120	504	23	1.23	per share

Where to for Sheffield after project 'go-ahead?

We see a number of opportunities for ongoing value enhancement for Sheffield following the commencement of construction. These include:

- Finalisation of product offtake agreements.
- Further optimisation of the Thunderbird project including the possibility of bringing forward the Stage 2 expansion. Recall that the BFS was conducted using now very conservative commodity price assumptions (zircon at US$1250 and ilmenite US$183/t). The cashflow impact at higher commodity prices is dramatic and could pave the way for a financial decision to proceed with Phase 2 earlier than has been proposed.
- Incremental premium zircon tonneage from, for example, Night Train.
- Exploration initiatives in the Eucla and Perth Basins

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Appendix 1

Key to mine/prospect names for chart on page 3

1. Jacinth-Ambrosia (Iluka)
2. Cyclone, Cyclone Extended and Monsoon (Diatreme Resources)
3. Ginkgo and Snapper mines (Cristal)
4. Elongate district with several mines, now closed, including Kulwin, Woomack, Rownack (Iluka)
5. Donald (Astron)
6. WIM 150 (Australian Zircon), Avonbank (WIM Resources)
7. Eneabba mining district (Iluka and Tronox)
8. Tutanup South mine (now closed, Iluka)
9. Boonanarring and Atlas (Image)
10. Keysbrooks (MZI Resources)
11. Coburn (Gunson)
12. Thunderbird (Sheffield)
13. Fingerboards (Kalbar)

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