



**Annual Report**  
**for EL9/2011 Monarch Flats**  
**for the Period 14 August 2013 to 13 August 2014**

**Date: August 2014**

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## ABSTRACT

This report describes the exploration activities completed within EL9/2011 during the period 14 August 2013 to 13 August 2014. This is the third annual report for the third year of grant of the Tenement.

The Tenement is located north-west and south-west of the town of Gladstone.

There has been a long history of prospecting since the mid 1870s, and mining for alluvial tin was carried out between 1874 and 1982.

The Tenement covers several major past producer alluvial tin mines, including Pioneer, Endurance, Monarch, New Dorset Dredge, and Scotia, and many smaller alluvial deposits. Past placer production is about 20,000t cassiterite, including:

- Pioneer - 10,814t
- Endurance- 6,240t
- Scotia - 1,270t
- New Dorset Dredge - 762t
- Monarch - 479t

The company's main focus is exploration for tin, in alluvial deposits and in bedrock.

Work done by Tin Dragon during the period consisted of

1. Evaluating the MRT database of past stream sediment geochemical exploration
2. Compilation and evaluation of previous company exploration for the following areas:-
  - New Dorset Dredge Area
  - Ringarooma Flats Area.
3. Evaluation of the potential for extensions of the Monarch deposit.
4. Re-appraisal of the Scotia Deposit.

**KEYWORDS**

NE Tasmania  
 Geology  
 Mineralisation  
 Alluvial  
 Paleochannel  
 Leads  
 Primary Deposits  
 Granite  
 Mathinna Group  
 Tin  
 Exploration Targets

**SUMMARY OF ACTIVITIES for EL9/2011 Monarch Flats  
 for the Period 14 August 2013 to 13 August 2014**

- Evaluating the MRT database of past stream sediment geochemical exploration
- Compilation and evaluation of previous company exploration for the following areas:-
  - New Dorset Dredge Area
  - Ringarooma Flats Area.
- Evaluation of the potential for extensions of the Monarch deposit.
- Re-appraisal of the Scotia Deposit.

**CO-ORDINATES**

All lat/long co-ordinates in this report refer to the GDA94 Datum, unless stated otherwise.  
 All AMG co-ordinates in this report refer to the GDA94 - Zone55, unless stated otherwise.

**FILE SUMMARY LIST**

<b>File name</b>	<b>Format</b>	<b>Contents</b>
EL9-2011_2014_report.pdf	Pdf	Annual Report

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## 1.0 INTRODUCTION

This report describes the exploration activities completed within EL9/2011 (The 'Tenement') during the period 14 August 2013 to 13 August 2014. This is the third annual report for the third year of grant of the Tenement.

For Tin Dragon's convenience the project is named "Pioneer", rather than the MRT designator of Monarch Flats.

The Tenement is located north-west and south-west of the town of Gladstone, Fig.1.

Table 1 - Tenement Details

Tenement	Holder	Date Applied	Date Granted	Size
EL9/2011 Monarch Flats	Tin Dragon Pty Ltd 100%	28 February 2011	13 August 2011 (Categories 1 and 5)	103km <sup>2</sup>

Excluded from the grant of the tenement are two small mining leases granted only for Category 3 Construction Minerals, (not for Category 1 Minerals and Category 5 Minerals such as tin and sapphires):-

8M/1993 10 ha, Dorset Council

10M/2008 86 ha, Sanbar Pty Ltd.

Crown Land covers most past mines and resources and prospective areas, and Private Land the remainder. There are no restrictive Reserves.

The project lies within the Tasmania NE (SK55-21) 1:250,000 map sheet, and the 1:25,000 map sheets of Tomahawk, Musselroe, Monarch, Gladstone, Pioneer and Lanka.

Access is via sealed roads, formed local roads and other rough tracks.

The Tenement covers several major past producer alluvial tin mines, including Pioneer, Endurance, Monarch, New Dorset Dredge, and Scotia, and many smaller alluvial deposits.

The company's main focus is exploration for tin, in alluvial deposits and in bedrock.

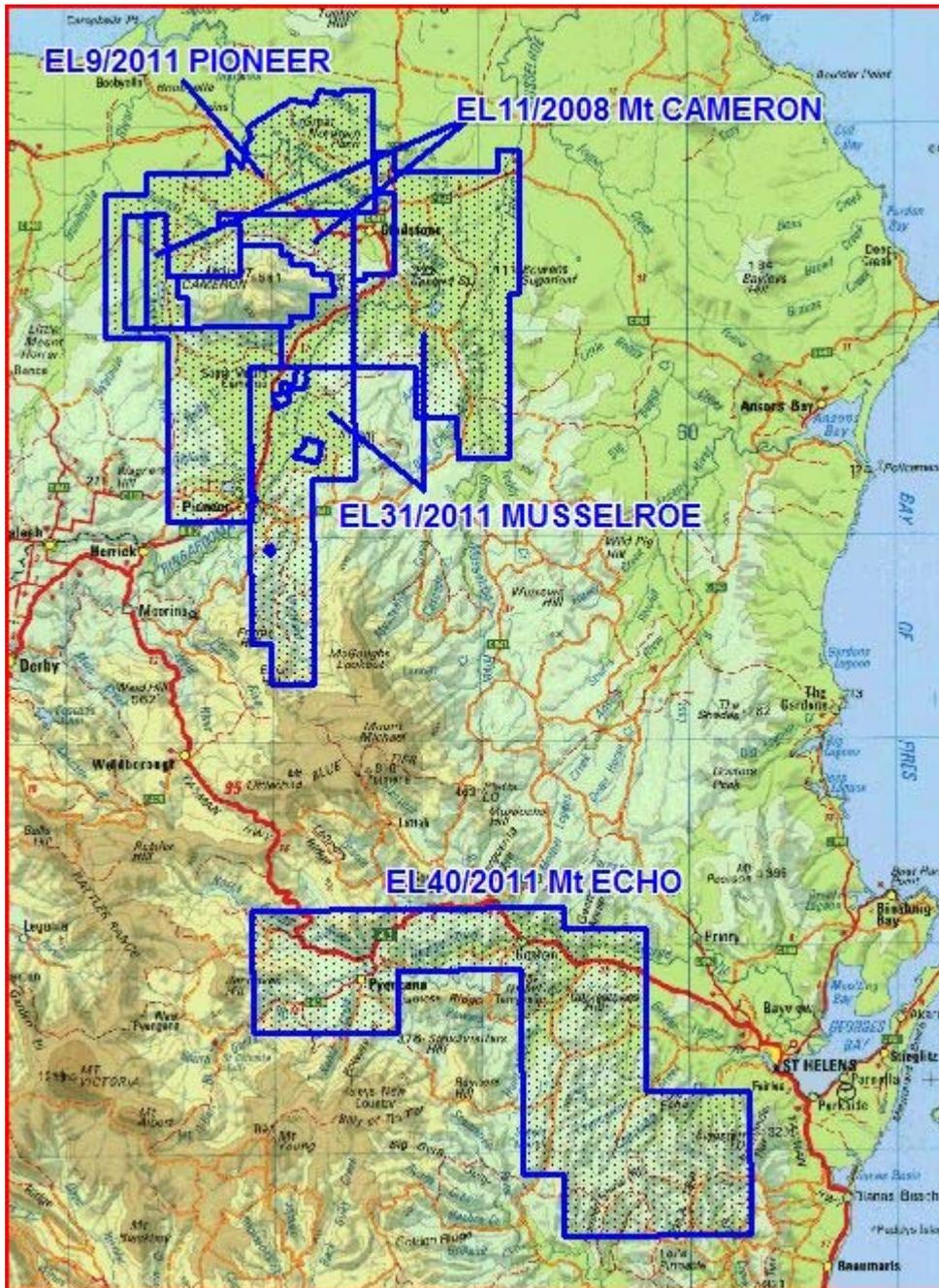


Fig. 1 Tin Dragon Tenement Locations

## 2.0 GEOLOGICAL SETTING and MINERALISATION

The area is characterized by relatively poor outcrop. Much of the basement rocks are covered with various types of unconsolidated sediments, most of which are tin bearing.

Nearly all known metallic deposits in the Tenement are alluvial tin (with accessory gold, monazite, sapphires) hosted in paleochannels (leads), Fig 2. Some tin deposits in basement rocks occur around Gladstone, but this area is outside the Tenement. Given the widespread alluvial occurrences, the lack of known tin mineralisation in basement is striking.

Past placer production is about 20,000t cassiterite, including from these main deposits:

- Pioneer - 10,814t
- Endurance- 6,240t
- Scotia - 1,270t
- New Dorset Dredge - 762t
- Monarch - 479t

In the region the original sources of the tin were phases of the Devonian tin-bearing granites of the Blue Tier Batholith, where tin occurs as cassiterite in quartz and greisen vein systems in the roof zone of the granites near the contact with overlying Silurian Mathinna Beds.

A generalised history of development of the region's alluvial deposits is as follows:-

During Middle Eocene time (ca 46Ma) volcanic activity commenced along the Blue Tier with the extrusion of the Older Basaltic lava flows. It is likely that these were emplaced along stream valleys incised into the pre-Eocene granitic land surface, and so buried the older alluvial cassiterite deposits.

From the Mid Eocene to Late Oligocene (ca 46 to 24Ma) uplift and a humid tropical climate resulted in rapid erosion of the basalts, and renewed liberation of cassiterite from granites and reworking and upgrading of the earlier pre Middle Eocene alluvial deposits. The Middle Miocene (ca 14Ma) saw a second period of basaltic volcanism with extensive lava flows down many of the larger valleys in the Derby area.

Post Middle Miocene to Recent alluvial deposits were then formed along the alluvial flats of the major rivers.

In areas closer to the present coast there were marine incursions which have reworked the earlier alluvials.

In summary there has been a complex history of placer formation involving reworking and reconcentration of cassiterite.

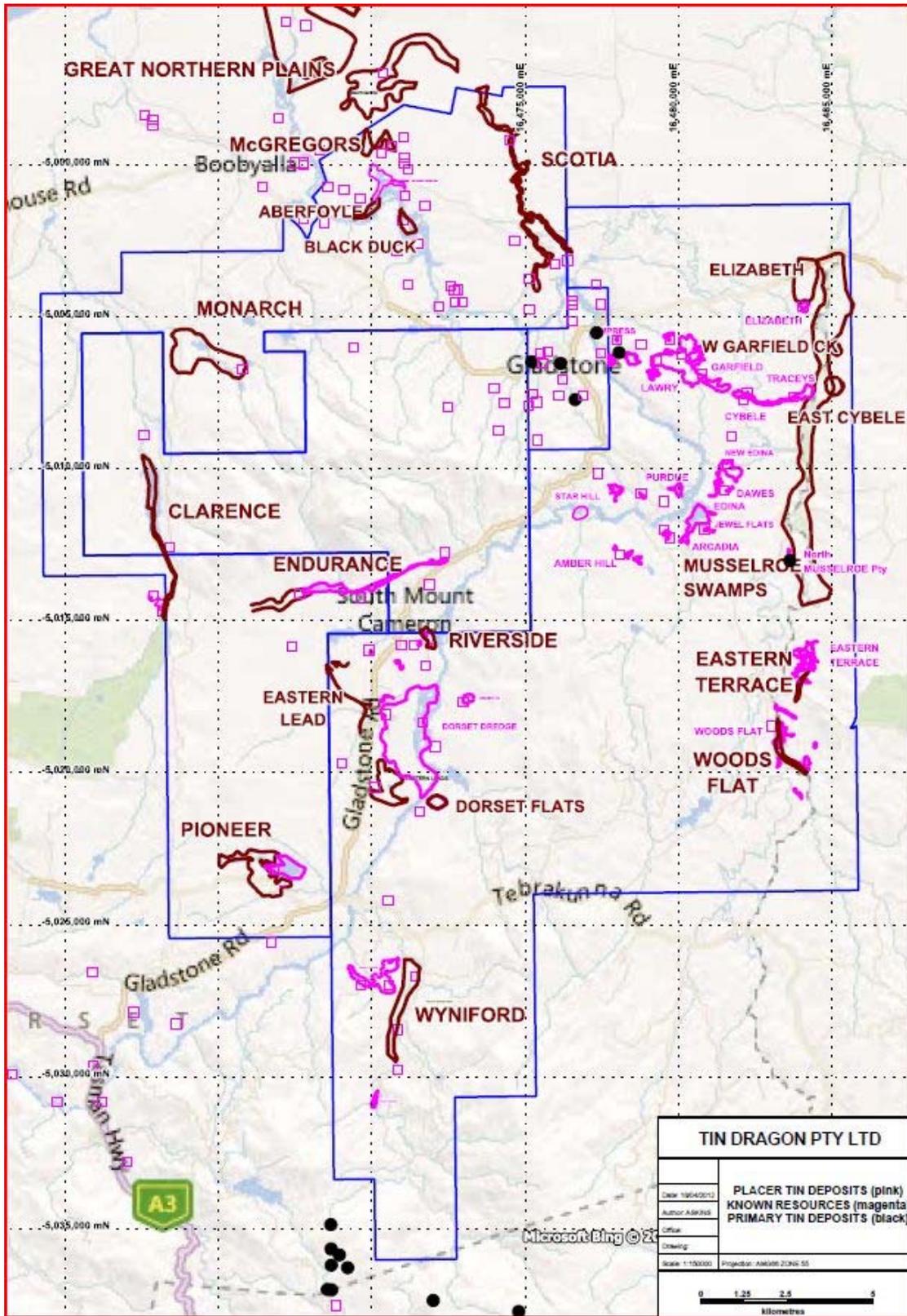


Fig. 2

The area is dominated by the topographically prominent Mt Cameron, consisting of one distinctive major phase of a Devonian granite suite. The phase is easily distinguished from those surrounding it because it has a prominent airborne thorium (and U and K) response, Fig 3.

Mt Cameron stands prominently in an otherwise flat landscape. Geomorphologically this attests to a neotectonic origin; it is interpreted to be a pop-up horst structure resulting from regional compression. The neotectonics will be no older than Eocene, and the main movement is likely to much younger, namely Miocene or younger, because otherwise erosion would have levelled the hill closer to the prevailing plain level. The bounding faults are not directly mapped though must occur near the change of slopes. These faults will be close to or on the contacts of the thorium rich granite phase. More discussion on the neotectonics of Mt Cameron can be found in Section 8.0.

The central massif area contains no known mineralisation. It is possible that prior to uplift the carapace was mineralised with tin bearing greisen sheets and vein systems, but these have been entirely eroded and thus have contributed the tin (cassiterite) to the peripheral alluvial tin deposits such as Monarch, Endurance and Clarence.

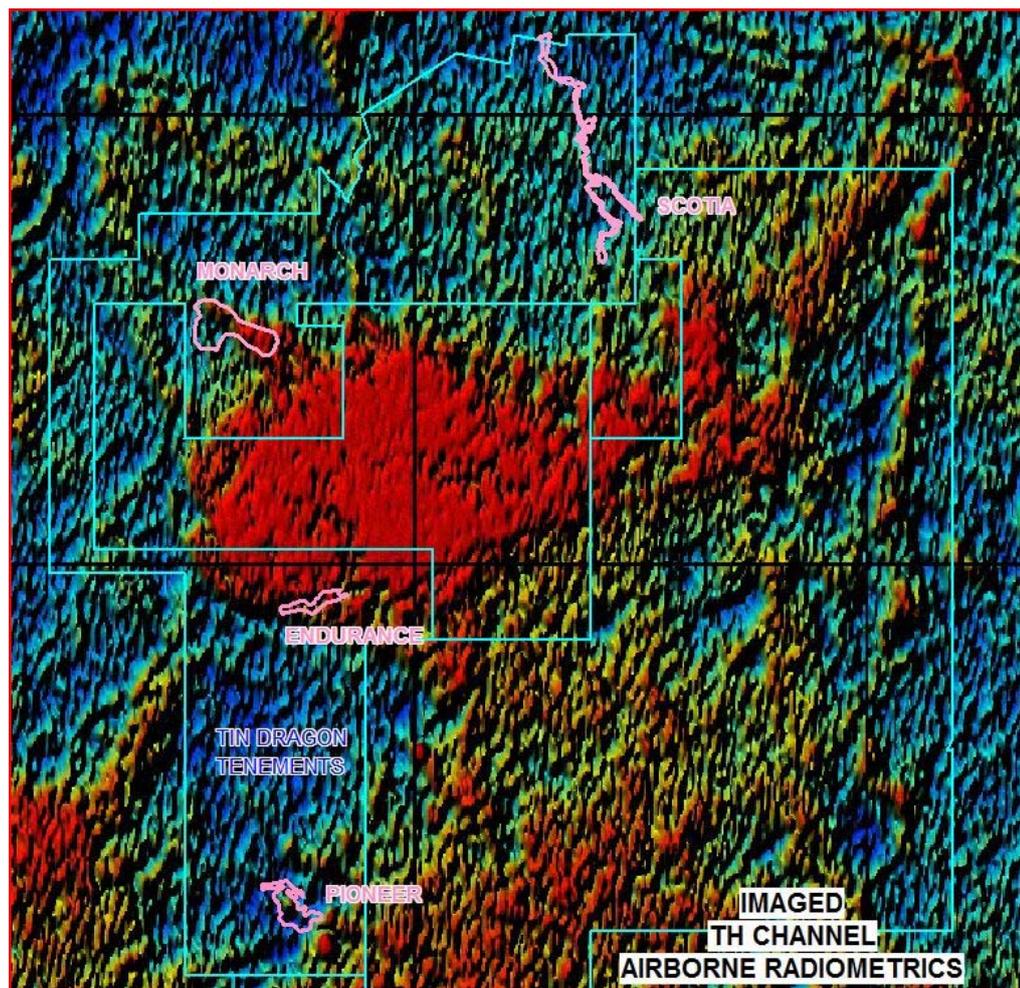


Fig 3. Intense Thorium anomaly corresponding to the Mt Cameron granite body.

### **3.0 REVIEW OF PREVIOUS WORK**

A generalised history of mining in the area was presented in Tin Dragon's first annual report and is not repeated here.

There has been very extensive and intensive exploration for alluvial tin in the Tenement, and no attempt is made to summarise that here.

Instead, work done by various companies and the Tasmanian Department of Mines has been covered within chapters covering the main mineralised areas in this report and in the second annual report.

Work reported in Tin Dragon's second annual report (to August 2013) covered a review of previous exploration and mining of, and a field visit to, the Scotia, Monarch and Pioneer Deposits.

#### **4.0 EXPLORATION COMPLETED DURING THE REPORT PERIOD**

Work done by Tin Dragon during the period consisted of

1. Evaluating the MRT database of past stream sediment geochemical exploration
2. Compilation and evaluation of previous company exploration for the following areas:-
  - a. New Dorset Dredge Area
  - b. Ringarooma Flats Area.
3. Evaluation of the potential for extensions of the Monarch deposit.
4. Re-appraisal of the Scotia Deposit.

### 5.0 STREAM SEDIMENT GEOCHEMISTRY

Stream sediment geochemical data from past explorers was reviewed. All data was obtained from the MRT database and processed.

Although some samples have been taken and analysed for elements such as copper lead and zinc, the number of samples which have been analysed for tin and for tungsten is very low, and data is virtually absent in most of the Tenement, as shown on Fig 4.

Thus stream sediment geochemistry cannot be used in the Tenement for exploration targeting. Clearly geochemical surveys in some areas would be very useful, though of course away from known alluvial deposits and known stream contamination.

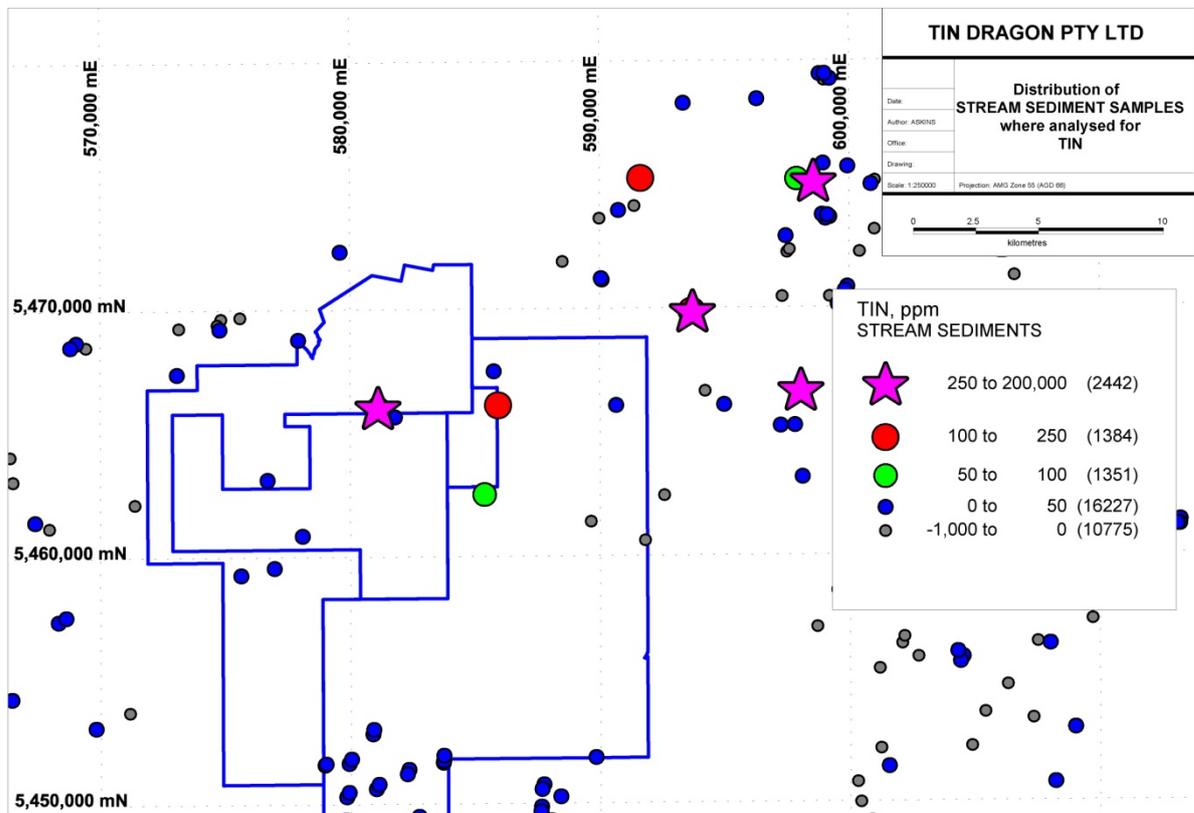


Fig. 4 Previous Stream Sediment Sampling for Tin

## 6.0 NEW DORSET DREDGE

**History** [part source: Dickens, MRT note, undated]

When operations ceased in alluvial terraces adjacent to the Ringarooma River at the Dorset Dredge area, (north of Pioneer and south of Mt Cameron- outside this Tenement), the dredge was shifted many kilometres to the north along the river to this site, here named the New Dorset Dredge area.

The Storeys Creek Tin Mining Company commenced dredging operations in this area in April 1964 and ceased in March 1971.

Early in 1977 Amdex purchased the dredge and mining leases from the Aberfoyle group (incorporating The Storeys Creek Tin Mining Company), for \$40,000. Salvage of equipment unbalanced the dredge leading to its complete capsizing in 1989.

The main resources which were dredged, as visible in Google satellite imagery, were south of MacGregor Flats, Fig 6. Records state that the Black Duck area was worked but there is little evidence of dredging such as scarring of the terrain visible on satellite imagery.

The dredge was then moved 3.5km up river to the Doone area where the dredge is presently located half submerged in a pond on the north-eastern side of the Ringarooma River.



Fig. 5 Submerged Dorset Dredge

Before mining the reserves of the New Dorset area were estimated [63\_0354] [80\_1497] to be 12.6Mm<sup>3</sup> averaging 124g cassiterite/m<sup>3</sup> over an area of 97ha. Details of these reserves, sufficient for 12 years, are tabulated below:-

Location	Area,ha	Volume, m <sup>3</sup>	Grade, cassiterite,g/m <sup>3</sup>
Aberfoyle	13.4	1,529,000	147
McGregor	50.4	6,880,000	127
Black Duck 1	22.1	3,058,000	95
Black Duck 2	11.6	1,146,000	148
TOTAL	97.5	12,613,000	124

This equates to 1560t of cassiterite yet the actual production from the New Dorset was 762t of tin concentrate assaying 75% Sn, [80\_1497]. Also recovered were 24.8kg gold, for a gold recovered grade of 3mg/m<sup>3</sup>.

Records of production details in MRT open file records are scant. On MRT archived plan 6294A New Dorset production statistics for 1965 are given. 1.07Mm<sup>3</sup> were treated to yield 117.7t cassiterite and 3.0kg gold, which means a recovered grade of 110g/m<sup>3</sup> cassiterite and 3mg/m<sup>3</sup> gold.

The stated reasons for dredge closure were low grades at a time of low tin prices and the unavailability of a dredgeable path to get to higher grade resources at Fosters Marshes [95-3703].

### **Remaining Known Resources**

It seems that the remaining known resources are the unmined areas, being all of the Aberfoyle and Black Duck 1 & 2 deposits, as tabulated above.

### **Potential for new alluvial resources**

The resources worked by the dredge were apparently Quaternary age river terrace deposits formed in former channels of the Ringarooma River.

There are remaining unmined resources here, as stated above. However there is confusion about the extent or overlap of resources and their names:

(a) the McGregor resource worked by the dredge does not seem to be the McGregor deposits shown on MRT maps nor in VDM assessments.

(b) the Aberfoyle resource may or may not include resources assessed by VDM and earlier explorers.

To sort out these differences would need careful historical research. The tenure held by various parties when their resources were assessed may be crucial in this respect.

It is likely a careful assessment of such historical records will outline partially tested resources and will define considerable areas of untested prospective ground.

Environmentally more acceptable areas would need to be away from and unconnected to the current active Ringarooma River.

Fuller aspects of other deposits and resources in this general area are in the next chapter of this report, 7.0 RINGAROOMA FLATS AREA.

**17. RINGAROOMA FLATS AREA, west of Scotia**

**Introduction**

This area is part of the so called Great Northern Plain area, much of which is now in a Ramsar heritage site where access for exploration and mining is prohibited. Areas so affected and so not within the Tin Dragon Tenement are the historical Echo, Delta, Dry Creek, Dry Gut, Dobson's and Dugard's workings and significant unmined resources in Fosters Marshes and Braithwaite's.

Deposits within the Tenement are detailed below, and shown on Fig. 6.

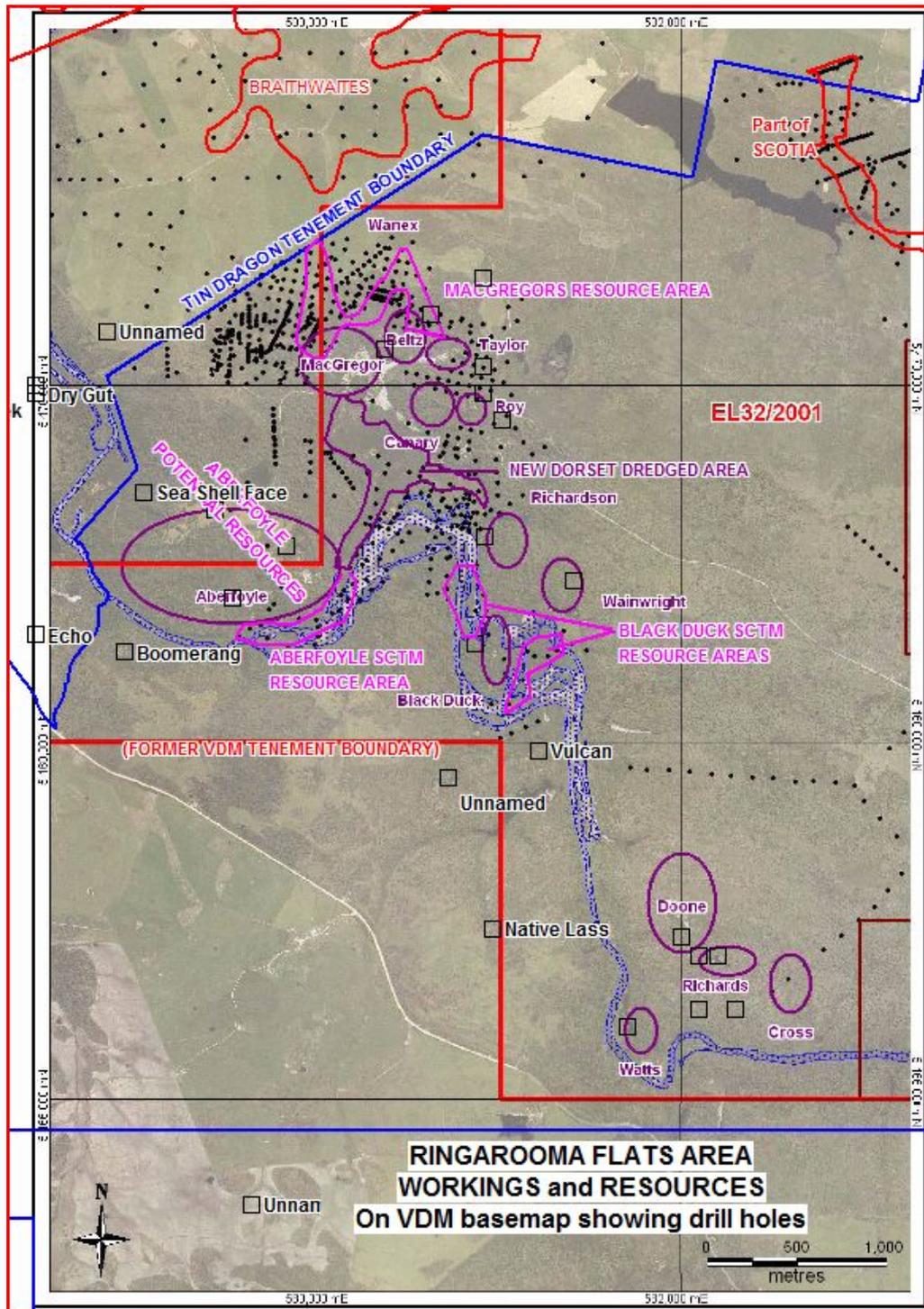


Fig.6

### **History of Mining and Exploration** [Largely derived from Kinnane 2005, 05\_5172]

Tin was discovered in the Great Northern Plain area in the 1870s. Numerous small workings were developed in the south-eastern part of the area, the largest producers being located on the northern bank of the Ringarooma River before the turn of the 20<sup>th</sup> century.

Several types of deposit were worked, including deep leads, estuarine wash beds and alluvial terraces; the principal workings included (from SE to NW) Vulcan, Doone, Black Duck, Richardson, Roy, Canary, Taylor, Beltz, MacGregor (McGregor), Aberfoyle, Echo, Delta and Dugard.

The majority of the workings were sluicing operations using water from a branch of the Mount Cameron water race, but water supply was a perennial problem. They were shallow operations, generally less than 15m deep, and total production probably has not exceeded 5000 tonnes of concentrates. Past mining and production records are poor or non-existent.

The northern part of the plain in the Foster's Marshes area was not available for mining, due to the attitude of a landowner, until the passing of a newer Mining Act in 1929. This area was also remote from the Mount Cameron water race.

#### **Aberfoyle Workings:**

Alluvial tin was first worked in the Aberfoyle area in the early 1880s. For a number of those early years the main workings were controlled by the Aberfoyle Company and peripheral workings such as the Boomerang and Sea-Shell were operated by You Hen and other Chinese miners. Van Dieman Mines located several Chinese dwelling and camp areas along the south western edge of the Aberfoyle workings.

In 1906 the New Aberfoyle Company commenced operations and was succeeded in 1909 by the Aberroe Tin Mining Co. NL. The latter group did not register its operations until 1912. Mining continued until around 1916 at which time many of the working faces were connected resulting in three main worked cuts; the Eastern, the Main and the Western or Curnow's workings. There are no production records for the early production years up to 1906. From 1906 to 1916 the New Aberfoyle and Aberroe companies produced some 129.3 tons of concentrate with peak production of 22 tons occurring in 1910.

Development of these deposits was limited by water supply and operating hydraulic head. Water races were developed from the Boobyalla River and across the Ringarooma River by an inverted siphon system and from the Mt Cameron Water Race.

It is doubtful if any further development occurred at Aberfoyle after 1916 probably due to a large fall in tin prices after 1918.

#### **McGregor's Workings:**

Mining probably commenced around the same time as at Aberfoyle. Few records seem to exist however the earliest Departmental work appears to have been in 1902 with the drilling of four holes, Government Line 6, in the floor of the McGregor open cut.

In addition to this program, in 1917 the Department (Roach's Drilling) put down a further 127 drill holes to the south and the west of the workings.

Nye (1932) reported that Mallinson worked ground close to those holes and is reported to have recovered some 37 tons of tin from the ground he worked. Nye reports that this equates to a return of 1.5lb/cubic yard. The McGregor workings appear to have been developed by means of a series of tails races along the eastern edge of the deposit. Mallinson and several others in their part of the deposit worked the area utilising a power plant (probably steam driven) to operate nozzles and an elevator.

#### **Beltz Workings:**

This large worked area immediately north east of McGregor's was first developed by H. Beltz in about 1911 as MLs 7037/M, 7038/M and 7092/M. Beltz operated for a number of years and the workings were taken over by Ogilvie and Packett who continued until the water supply was cut off in 1922.

In 1917 the Department (Roach) drilled 39 holes in the vicinity of these workings and at the time of the Nye inspection in 1932 some of those holes had been worked away. The mine appears to have been developed using water from the No. 1 Government Dam using a long pipe column.

#### **Workings between Beltz & Canary:**

Nye listed three small workings just to the south east of Beltz workings. The main working was developed by Taylor in about 1913 and the other two appeared to be small workings developed on either side of a short creek by Chinese diggers. The latter workings probably pre-dated Taylor. The current workings described as "Taylor's" are now far larger than those mapped by Nye and appear to have encompassed and expanded the old Chinese workings. The ground was worked using water from the No. 1 Government Dam.

Canary Workings: These consist of three mine faces of which the largest is the Roy face. They appear to have been developed early in the local mine development process because Nye (1932) stated that the workings were abandoned and Twelvetrees (1901) stated that the workings were "unremunerative".

#### **Richardson's Workings:**

These were situated within lease 9997/M and were probably developed around 1905 to 1906. The mine was worked using water from the Black Duck Dam which derived its water from the Mt Cameron Water Race. Four small workings are located just north of Richardson's along the edge of the high bank of the Great Northern Plain. In 1917 the Department (Roach) put down a line of five drill holes east of the southernmost of those workings. Results were disappointing and the workings were not extended to the east.

**Wainwright's Workings:**

These workings were apparently developed within lease 9998/M around 1906 and take the form of a long narrow open cut apparently following a section of tin bearing valley infill.

**Black Duck Workings:**

These workings, developed to about 6m deep are located on an alluvial terrace immediately east of the Ringarooma River. The workings were abandoned by 1899 and workings were not resumed after that date. The ground was bored by the Department (Roach) in 1917 however the plan and results appear to have been lost.

**Doone, Richards & Murray's, Watt's and Cross workings:**

The Doone mine appears to have been developed before 1885 and was actively working during the period 1893 to 1898, and there are no records of production. The Richard's and Murray's mine was developed later, around 1917 and work continued on that deposit for several years until the closure of the water race in 1922. There is no reference to the Cross workings which appear to be an easterly extension of the main Doone Lead. Five small workings exist south of the Doone Lead and include Watt's Workings situated immediately adjacent to the Ringarooma River. These workings were apparently developed in a recent terrace of the river and commenced around 1916.

**Regionally**

The main workings appear to have been abandoned around 1922 when the water race was closed. After 1922 most work in the region was drill based and included:

- 1935 - Austral Malay drilled on the Great Northern Plains just north of Aberfoyle;
- 1937 - Delta Tin drilled on Boobyalla Plains north of Aberfoyle
- 1955-56 - Dorset Tin Dredging investigated the area and drilled north and east of Aberfoyle looking for a dredge path onto the Great Northern Plains;
- 1958 - Rio Tinto Exploration drilled in the region but generally west and east of Aberfoyle
- 1960-68 Storeys Creek Tin Mining conducted various drill programs around Aberfoyle, McGregors and Black Duck areas. This project area they termed "New Dorset".
- 1966 - Utah development conducted regional auger drilling in the general area and it is believed conducted some backhoe pitting near Aberfoyle;
- 1967 - The Mines Department drilled a line of holes just north of Aberfoyle from the Delta Workings eastward to the Scoloch Lead;
- 1971 – Portland Holdings carried out pitting and auger drilling in the immediate vicinity of the old alluvial workings:
  - Sea-Shell Workings - 7 Channeled pits; 1 Auger hole; and 2 Percussion drill holes.
  - Curnow's Workings- 2 Channeled pits; and 1 Percussion drill hole.
  - Aberfoyle Hill- 3 Pit samples; and 3 Percussion drill holes.

Portland Holdings reported some excellent grades however their testing was not sufficient to define further resources or the directions in which the alluvial leads were trending.

- 1972-3 – The Dorset Tin Division of Wanex Mining Pty Ltd (West Australian Nickel Exploration Co) completed an intense program of percussion drilling in the area surrounding the Higgs, MacGregor, Beltz, Taylor and Canary workings. The holes were mostly drilled on a 88 x 88m (4 chain) grid. A resource at MacGregors was defined (see below). It was also established that a channel of the order of 200m wide extended northwestwards towards the Fosters Marshes/Braithwaites area. None of the holes, whose maximum depth was 30m, penetrated to basement.
- 1978 - Preussag Australia conducted work in the region including several lines of drill holes one of which was located just north of the Aberfoyle workings.
- 1981 - Hellyer conducted a comprehensive drilling program across the area
- 2001 - Mineral Holdings conducted bulk testing at Aberfoyle and at Taylor's, see below.
- 2001-8 – Van Dieman Mines commenced a data review and digitised drill holes from past reports. They intended to locate holes on the ground so as to enable new resource calculations to be made but this was not done before they went into liquidation.

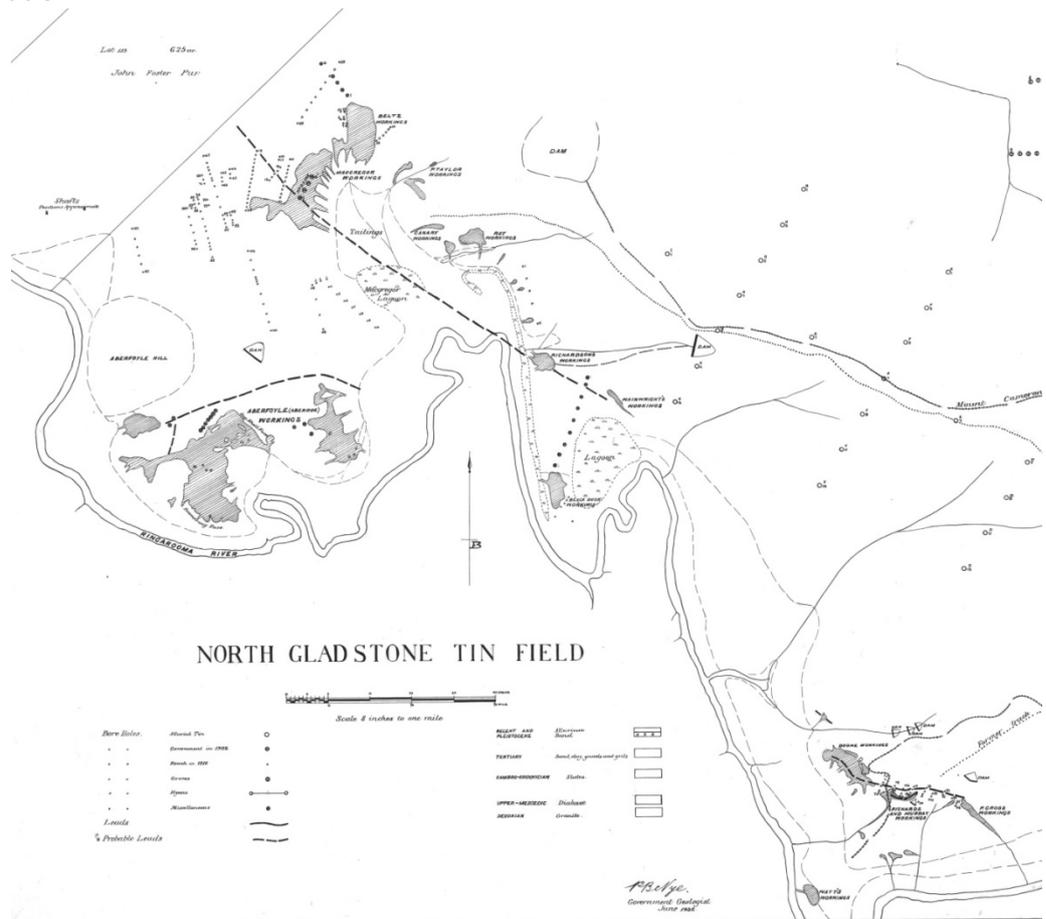


Fig 7. Mapping by Nye 1932

### **Remaining Alluvial Resources**

This area lies at the edge of a Tertiary marine embayment, which appears to have suffered a number of regressive and transgressive phases, and has further been complicated by Quaternary local reworking by various phases of the Ringarooma River system. Both terrestrial and marine sediments are represented in the Tertiary profile at Aberfoyle and the area may host a near shore deltaic type environment with terrestrial sediments; grits, pebble and cobble beds representing terrestrial channel fill deposits and thick sands containing shelly fossils the near shore marine environment.

The areas have had a long mining history and much drilling and sampling data exists but the necessary time to fully reappraise all the data, digitise it, and verify past results with new sampling and drilling was not completed by VDM.

Thus all resources quoted below are from early literature and their veracity has not been established.

#### **McGregor's**

The Dorset dredge worked a resource called McGregors but it is south of the resource outlined by Santos/Hellyer Mining in report 83-1966.

They defined a resource whose outline is shown on Fig 6; the resource outline appears to be constrained by the tenement boundary at the time and thus a resource is likely to be larger and extend further south.

"Proven in situ reserves" were estimated to be 3.82Mm<sup>3</sup> grading cassiterite 106g/m<sup>3</sup> and included a "probable recoverable" high grade zone of 1.51Mm<sup>3</sup> grading cassiterite 139g/m<sup>3</sup> within the lower grade reserve.

#### **Aberfoyle**

Production records from the mines here are not continuous but during 1906-1916 129.3 tons of tin concentrates were produced.

To test the value of the residual wash, a limited bulk-testing program of 4 pits was carried out at Aberfoyle workings using an excavator and mobile jig plant. Basal alluvial wash of reasonable grade was accessed; cassiterite grades were in the range 100-130g/m<sup>3</sup>, and sapphire up to 3.3 g/m<sup>3</sup>.

Nye [1932 - UR1932A\_017\_44] produced a plan compilation of historic workings for the larger alluvial mines and showing the sporadic exploration drilling covering the area, Fig 7. Nye postulated that there were deep leads or depositional channels in or near the old mines.

Duncan [03\_4856], has estimated possible resources of 1.3Mm<sup>3</sup> contained in the interpreted Aberfoyle Lead or palaeochannel running from the Aberfoyle workings to the Delta resource block.

### Aberfoyle SCTM

The Dorset Dredge apparently did not mine resources they outlined close to the Ringarooma River, depicted as the Aberfoyle SCTM Resource Area on Fig 6. These are;

Location	Area,ha	Volume, m <sup>3</sup>	Grade, cassiterite,g/m <sup>3</sup>
Aberfoyle	13.4	1,529,000	147

### Black Duck

Along the Ringarooma River the Dorset Dredge apparently did not mine these outlined resources;

Location	Area,ha	Volume, m <sup>3</sup>	Grade, cassiterite,g/m <sup>3</sup>
Black Duck 1	22.1	3,058,000	95
Black Duck 2	11.6	1,146,000	148

### Potential Basement Resources

There is no production from basement mineralisation recorded in this area, nor are there any old basement workings recorded.

At Dry Gut, and Taylors Workings, fine grained tin is the norm, and there are local concentrations of coarse angular cassiterite often occurring as particles locked on quartz. A very local source is indicated [10\_6111].

The area is close to the contact of Mathinna Beds and granite, as shown on the 1:25000 geology plan extract below, Fig 8, [see also Storeys Ck Tin Mining mapping in 63\_0354], suggesting that the areas of granite could have been unroofed in recent geological time; this apical zone could be a proximal source of most of the alluvial tin in the area.

The area thus represents a prime target for basement mineralisation, hosted in both granite and Mathinna Beds. The style of mineralisation, as elsewhere in the district, could be as sheeted greisen/quartz veins and mineralised joints, and have been ignored or been unrecognized by prospectors.



## **8.0 MONARCH – The Enigmatic Deposit**

### **The Enigma**

The Monarch Deposit sits north of Mt Cameron, isolated from other major paleochannel deposits. Why is it alone? Is it unique, or do similar deposits occur, but as yet are undiscovered?

### **Previous Review**

The history of production and exploration, and the geology of the deposit were presented in the previous annual report.

### **Key Factors and Problems**

The position of the Monarch deposit at the northern foot of the Mt Cameron granite massif suggests that Monarch's alluvium and contained cassiterite has a nearby provenance within that massif. A favoured source would be greisen or sheeted vein systems at the original and now eroded carapace of the granite. Because of the pattern of drainages in the massif the source areas can be only a few hundred metres away at most.

If this explanation is correct why are there not more similar deposits on the flank of Mt Cameron towards the east? The source granite suite is geologically identical (as mapped by MRT) and the U- Th-K airborne radiometric signatures are identical, and there are many streams and gullies to erode and deliver alluvium.

The explanation suffers from some considerable problems:

- The cassiterite in the Monarch deposit is fine grained and some is within composite quartz grains. Because there is little or no coarse grained cassiterite, as is known in the other major deposits in the region, there is a strong case to argue that there was a distal rather than proximal source.
- Sapphire is known at Monarch yet there are no known basalt sources nearby. Monarch is not a basalt covered lead, as occurs for example around Derby.
- The gravels of the deposit comprise very well rounded quartz and quartzite pebbles. Whilst there are adjacent metamorphosed Mathinna beds from which to derive the quartzite, the exceptional roundness of the pebbles demands transport from a distance much greater than a proximal few hundred metres.

### **The Neotectonic History and the consequences for paleochannel development**

I have postulated that the entire Mt Cameron massif is a horst, raised up in the Tertiary above its surrounding plains, (Section 2). The plains occupy an old land surface, eroded flat, and Mt Cameron is a rugged juvenile topography.

The Ringarooma River has cut its way into bedrock between South Mt Cameron and Gladstone, Fig. 9, rather than meandering through a flat plain as elsewhere. This is evidence that the terrain is still rising there and erosion along the river is keeping pace with the uplift.

The tectonic implications of a Mt Cameron horst on the geological development of the paleochannel tin deposits in the region is doubtless profound, but have received no attention in the literature.

Paleochannels, many of Eocene to Miocene age, and predating or coeval with the progressive raising of Mt Cameron, will have changed direction, been eroded and reworked possibly several times.

The bounding faults for the Mt Cameron horst are interpreted from a change in slope, from topographic features visible on satellite imagery such as SPOT, and the sharp boundaries in high tenor K-U-Th domains on airborne radiometric data, Figs 9 and 10.

The effects on the Monarch deposit are

- The known lenses of mineralisation, which trend south east and are abruptly cut off by these interpreted faults, Fig 11.
- An associated NE trending fault can be interpreted to control the deepest part of the Monarch body in the west. The deep basement here and an apparent cliff on its east side seem to control the extent of a Tertiary marine incursion and the consequent marine reworking of that part of the deposit.
- The several lenses of the deposit could have had their origin in several phases of uplift and partial reworking by the local creeks and gullies.

### **Evidence to the east, and a hypothesis**

Outside the licence, 6.3km east in EL11/2008, in the roots of fallen trees, rounded pebbles of quartzite were discovered in an area mapped apparently mistakenly by MRT as granite, (I assume because the soils have the appearance of being derived from granite). An unrecognised alluvial paleochannel may exist.

I postulate that it runs westward along the northern flank of Mt Cameron in an analogous position to that of the Endurance system to the south of Mt Cameron.

It is postulated to run through to Monarch, and so explains the distal characteristics of the Monarch alluvial body.

The position of the proposed paleochannel is shown on Figs 9 and 10.

This is a very large paleochannel with a potentially large economic impact.

It may have been an ancient iteration of the Ringarooma River, which has been displaced by tectonism north to its current position. The Ringarooma River system is known to carry sapphires, so this would explain the presence of sapphires at Monarch.

Locally where it is cut by existing modern gullies there are known small workings for alluvial tin and topaz. On Th (and U, and K) imagery, Fig.10, local high tenor areas in gullies and creeks give clues to the presence of the interpreted paleochannel. It may not now be

continuous because of erosion and tectonism, and so may be absent locally, for example at the east end of Monarch.

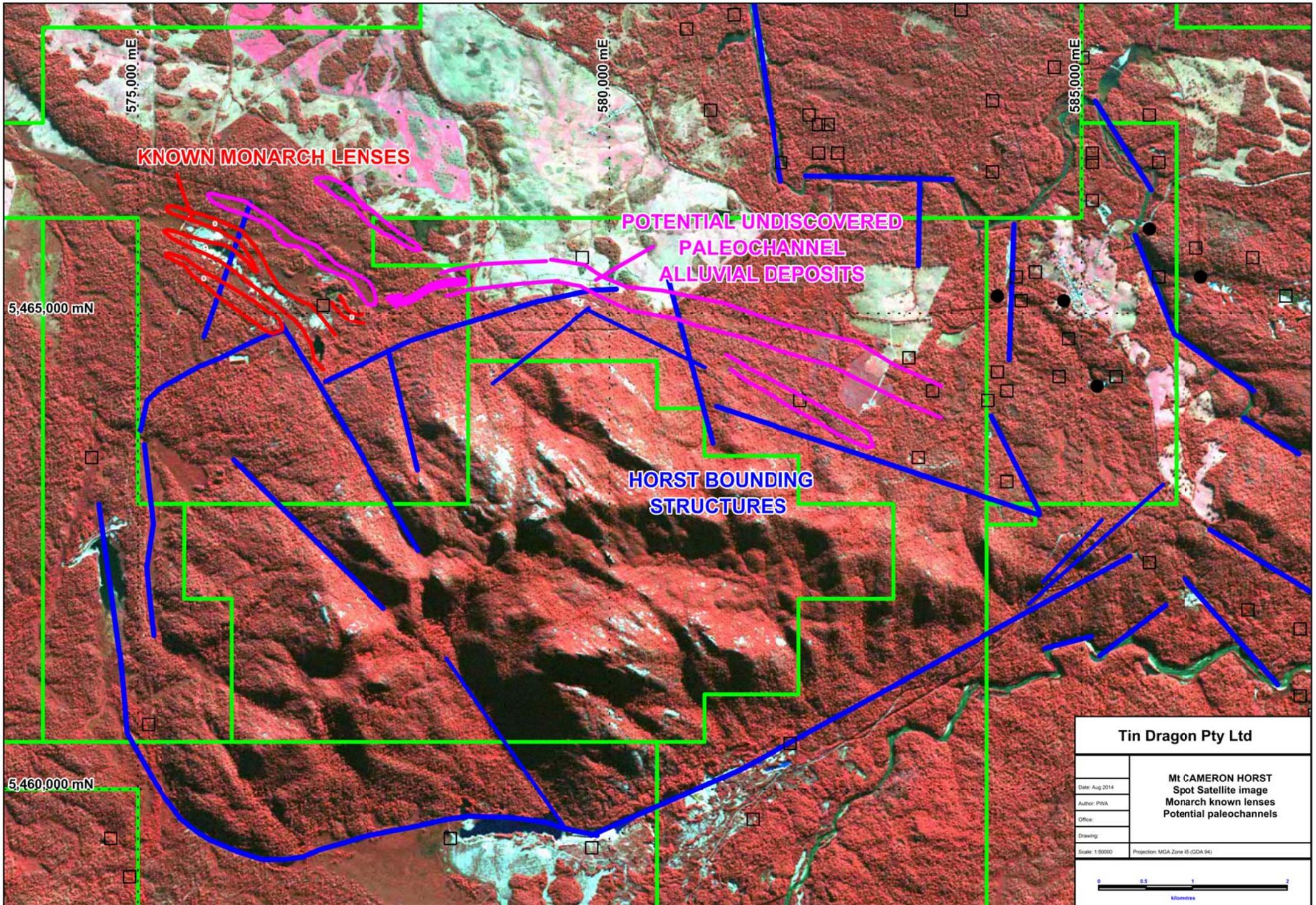
### **Potential for new resources**

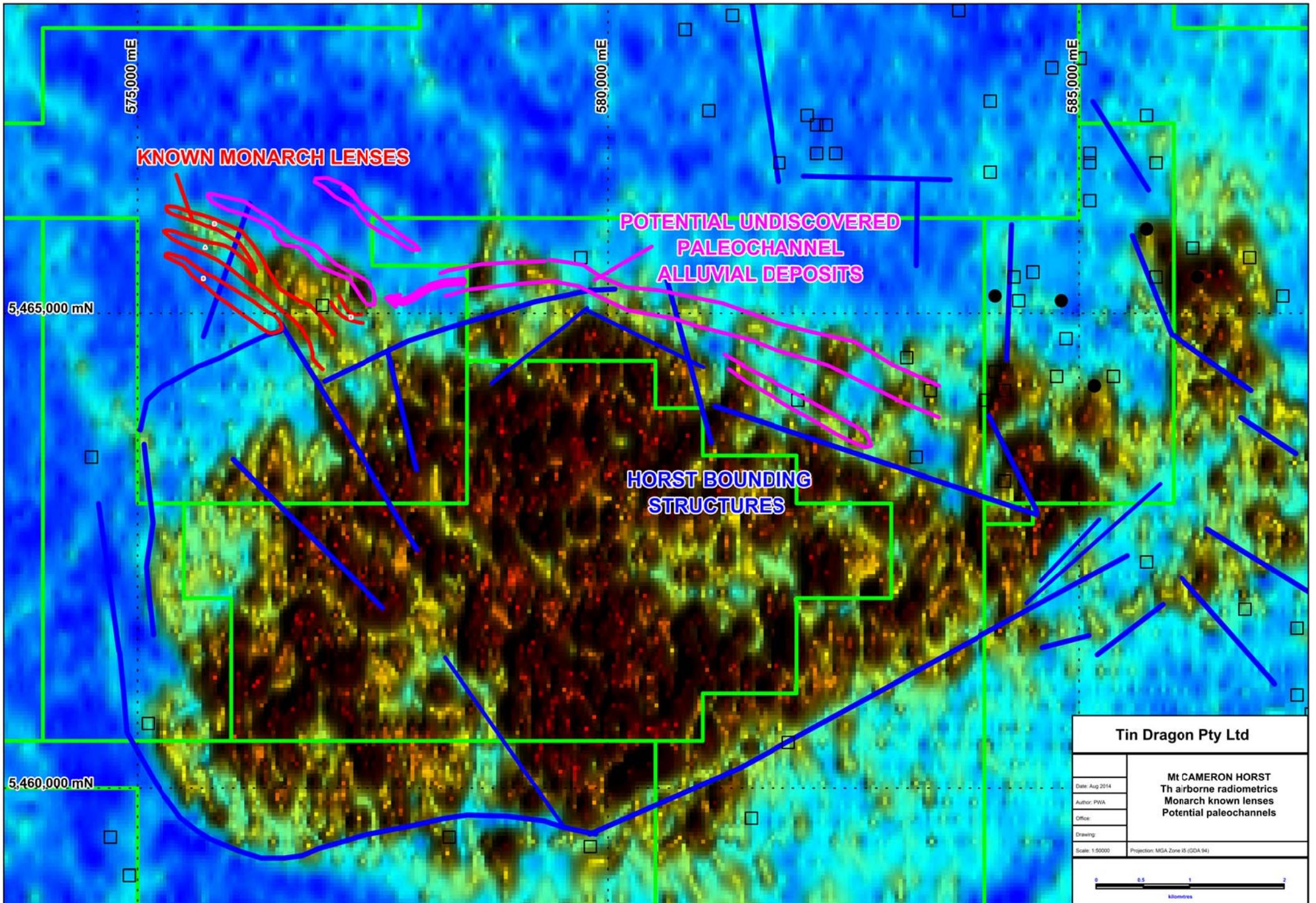
As discussed above there is a potential for large extensions of Monarch to the east in the dissected paleochannel. Possibly the best potential is eastwards outside the licence, in Tin Dragon's Mt Cameron Exploration Licence EL11/2008.

There are potential new northern lenses at Monarch corresponding to swampy areas, parallel to the known lenses, readily visible on SPOT imagery, Fig. 9. These areas are undrilled or poorly drilled in past campaigns, Fig. 11.

### **Future exploration program**

The next phase of exploration should include geological mapping and sampling to seek further evidence of the existence of this large paleochannel, before planning an appropriate evaluation phase.





**KNOWN MONARCH LENSES**

**POTENTIAL UNDISCOVERED  
PALEOCHANNEL  
ALLUVIAL DEPOSITS**

**HORST BOUNDING  
STRUCTURES**

**Tin Dragon Pty Ltd**

Date: Aug 2014  
Author: PWA  
Office:  
Drawing:

**Mt CAMERON HORST  
Th airborne radiometrics  
Monarch known lenses  
Potential paleochannels**

Scale: 1:50000

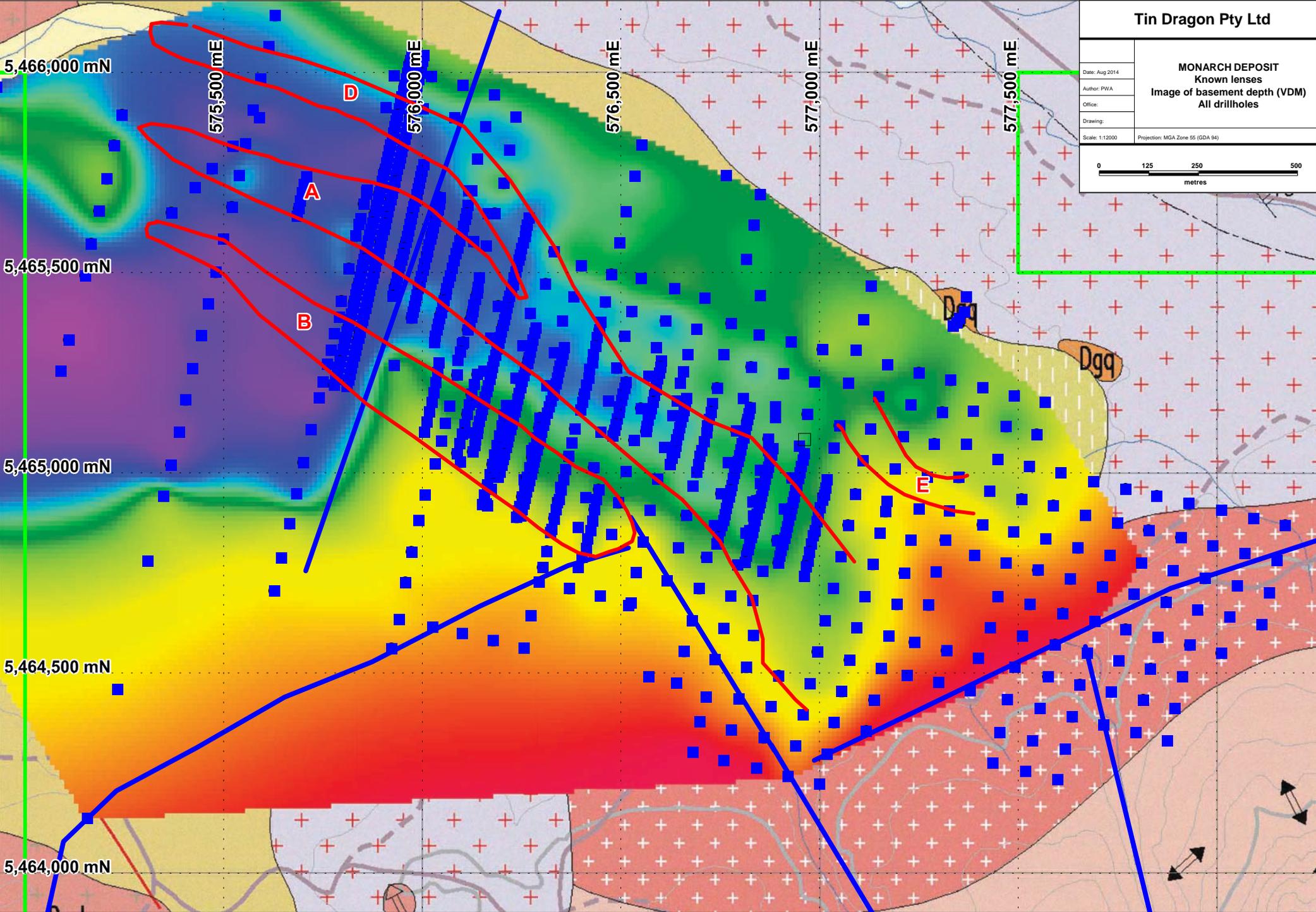
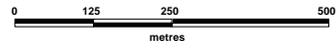
Projection: MGA Zone 55 (GDA 94)



**MONARCH DEPOSIT**  
Known lenses  
Image of basement depth (VDM)  
All drillholes

Date: Aug 2014  
Author: PWA  
Office:  
Drawing:

Scale: 1:12000 Projection: MGA Zone 55 (GDA 94)



## 9.0 SCOTIA

### Introduction

Work undertaken during the year included:

- Review of the historical drill pattern, past opinions on the drill surveys, and resources estimates
- Inspection of drill sections and drill logs
- Interpretation of forward looking potential based upon depth to basement isopachs and drill results
- Review of the Van Diemen trial pit , geologist attempted reconciliations with the 2008-2010 drilling , and recovery and sizing results of a small trial bulk sample .

### Geology

In summary the Scotia alluvial cassiterite system occurs in unconsolidated Tertiary (Eocene) aged sediments overlying a basement of slaty sediments belonging to the Mathinna Beds and dolerites (e.g. drillholes SRC3, AS20 to 22).

Within the alluvial profile a hardpan cement occurs sporadically in the upper soil zone, followed by occasional clayey and/or peat beds overlying a medium to coarse grained sandy, gravelly to conglomeratic basal wash.

Estuarine facies sediments have been recognized in the profile indicating a paleo tidal influence on the alluvial stream system.

Cassiterite occurs in the basal 10-15 metres of “wash” on basement for over 6.5 kilometres of strike length, on the current Exploration Licence, trending to the NNW. To the north of the VDM work area there is a suggestion that the alluvial system widens and may be accompanied by apparently richer heavy mineral concentrations as the channels “spill onto the Great Northern Plains (an estuarine environment) and then into Ringarooma Bay (with abundant heavy mineral deposits). The immensity of the cassiterite resources (from Scotia to the bay) and mineral characteristics have been interpreted by some workers (e.g. Paul Askins, Dr Yim and Professor Ian Plimer) to interpret tin source areas/primary hardrock in that region rather than from the Blue Tier Batholith.

The currently known alluvial system is sinuous in geometry and up to 30 to 80 metres wide.

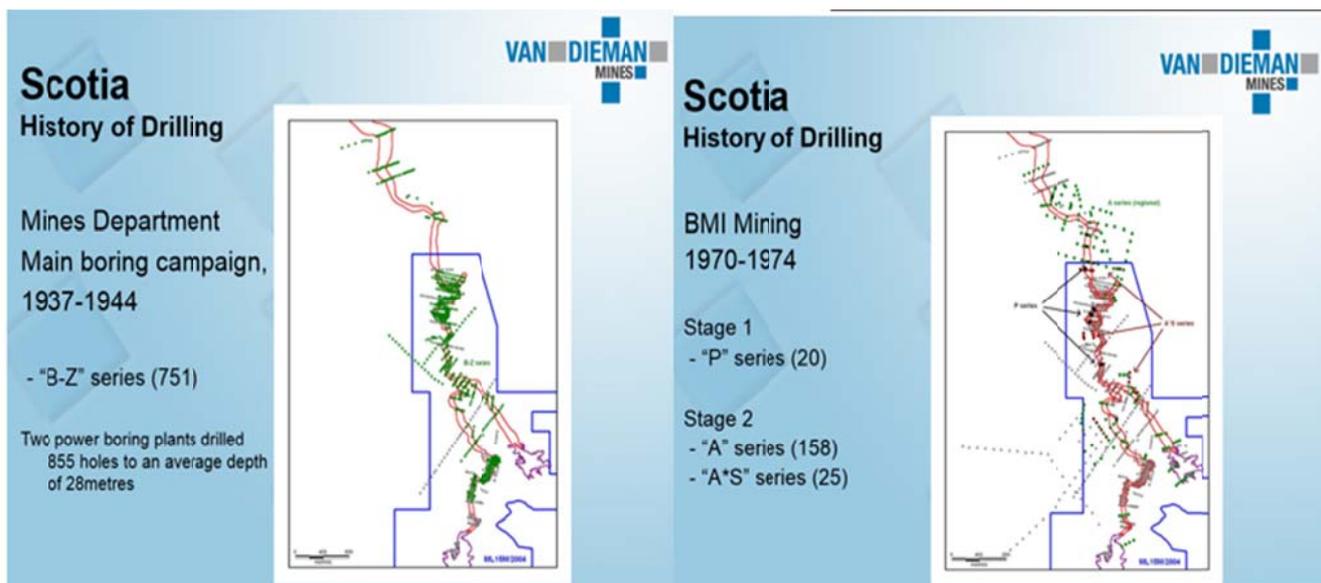
### Resources and Drilling

In terms of cassiterite resources there have been a substantial number of exploration drill bores sunk in the period 1901-1983 (over 1,372 holes in the 4.5 km length of the larger alluvial system) to generate a range of resource estimates. The table below summarizes some of these estimates, culminating in the Van Dieman calculation in 2008;

**Scotia - Summary of Published Resource Estimates**

Company	Author	Year	MRT ID	Volume ore cubic metres	Ave BI grade gSnO2/bcm	Contained SnO2 tonnes
1 Mines Department	F. Blake	1955	UR55/61-66		n/a	952
2 Storeys Creek	J. K. Couper	1966	66-0440	1,201,680	1216	1,439
3 BMI	J. Standard	1971	71-0783	1,107,400	n/a	n/a
4 Kibuka	C. Gibson	1976	76-1188	1,346,459	1222	1,540
5 Amdex		1980	80-1497			1,645
6 Niugini Resources	N. Kinnane	2003				7,052
7 AMDAD	R. de Jongg	2004				1,195
8 Mincom	T. McManus	2006		1,220,930	1552	1,895
9 Niugini Resources	N. Kinnane	2007		5,320,000	1300	6,916
10 Van Dieman Mines	G. McIntyre	2008		3,500,000	1300	4,230

Each group that conducted drilling campaigns had a somewhat dissimilar or poorly documented methodology with varying opinions of the work that preceded them. By and large the Kibuka and Storey Creek resource calculations are historically stated as being comparable (*summary plot of selected campaigns illustrated below*).



In terms of reliance of drill results, for example, the BMI geologists accepted the Mines Department work (Standing 1971-73) after completing an infill test drill programme in Nth Block 3-Block 4 area – the Lochaber Resource area (*see below*). The 1976 campaigns and modern work by Van Diemen generated over 76 drill cross sections from which resources were calculated.



**Scotia**  
 History of Drilling

**BMI Mining**  
 1970-1974

First stage involved drilling of four test lines across known tin-bearing channel within zones of intense Mines Department drilling.

The aim was to check accuracy of Mines Department drilling.

BMI reported drilling to be reliable and able to be used for reserve calculations

**VAN DIEMAN MINES**

**Examples of the drilling density in the Scotia Central Zone**

North BLOCK 3 (left) and  
 South BLOCK 3 (above)

★ Van Diemen "Starter Pit"

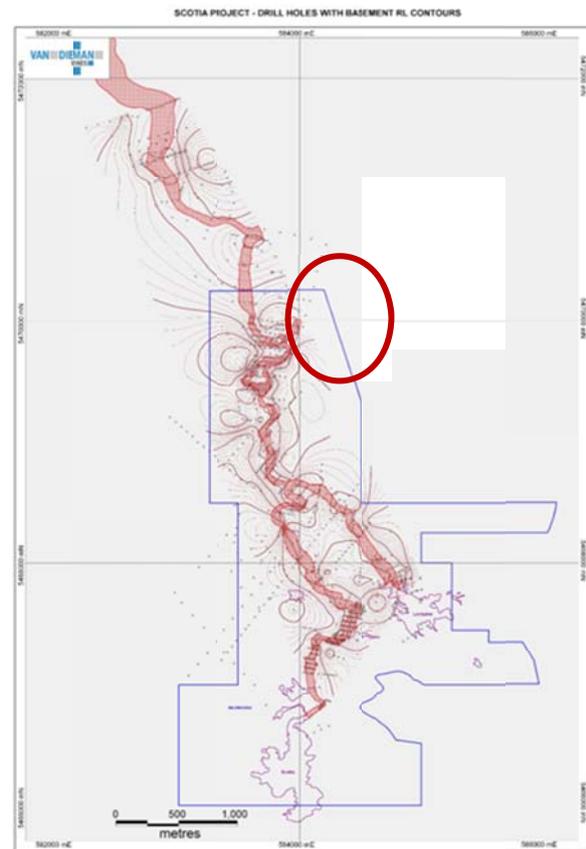
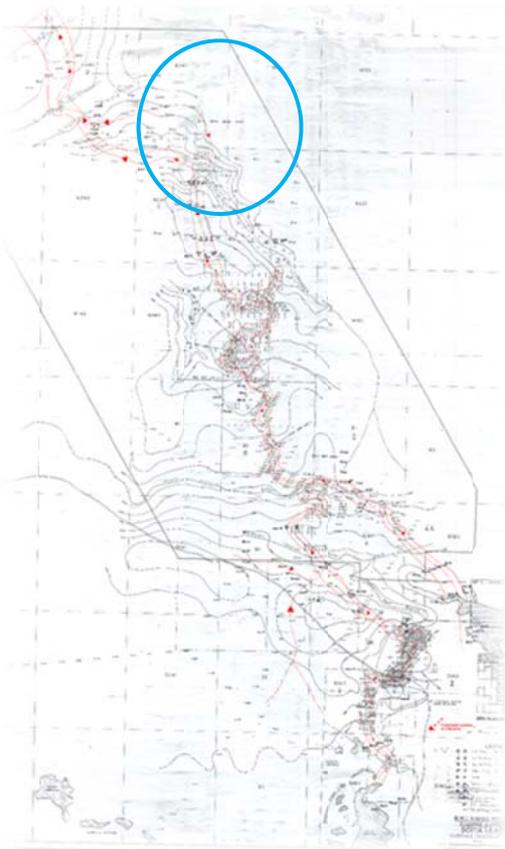
The breakdown of prospective resources by Block is reported by Kinnane in 2007 (see below). Of note is the possible resource of 3,860 tonnes of cassiterite at Block 7-the Scoloch Area, which corresponds with an apparent uplift in basement and a widening of the alluvial channel complex further to the north (table below).

### INFERRED MINERAL RESOURCE

#### SCOTIA RESOURCE CALCULATOR

##### SUMMARY TOTAL INTERSECTIONS - SURFACE TO BASEMENT - PROSPECTIVITY

RESOURCE DATA BASED	NUMBER HOLES	AVERAGE DEPTH m	AVERAGE GRADE g/m <sup>3</sup> SnO <sub>2</sub>	AREA m <sup>2</sup>	VOLUME m <sup>3</sup>	CONTAINED SnO <sub>2</sub> Tonnes
<b>PROSPECTIVITY</b>						
SCOLOCH	12	36.78	350.00	300,000	11,034,000	3,862
LOCHABER	7	37.03	350.00	100,000	3,703,000	1,296
MALLINSONS	NIL	35.00	350.00	30,000	1,050,000	367.5
NEWHAVEN FEEDER	NIL	28.00	350.00	40,000	1,120,000	392
DOONE FEEDER	NIL	30.00	350.00	100,000	3,000,000	1,050
STINKING CREEK FEEDER	NIL	36.00	325.00	40,000	1,440,000	468
<b>TOTALS</b>					<b>21,347,000</b>	<b>7,435</b>



SRC and AS drill series of AngloAustrian in 1981—based upon a significant widening of the alluvial system Block 7 – the **Scoloch Prospective Resource** area of approximately 3,600 tonnes of cassiterite—see diagram below for additional potential. ○

From the year 2003 Mineral Holdings and Van Diemen Mines (largely managed by Nuigini Resources and associates) compared the results of assay equivalent in wash zones versus full hole "assays" at a prevailing tin price of between US\$5,350 and \$15,000.

For example the full assay from surface to basement in the Lochaber, Scorloch, and Scotia Feeder Zones produce Indicated Resources of 14,990,983 bcm grading 289.9 gm/cu meter for 4,346 tonnes of cassiterite.

To date the majority of these prospective resources remain unchanged.

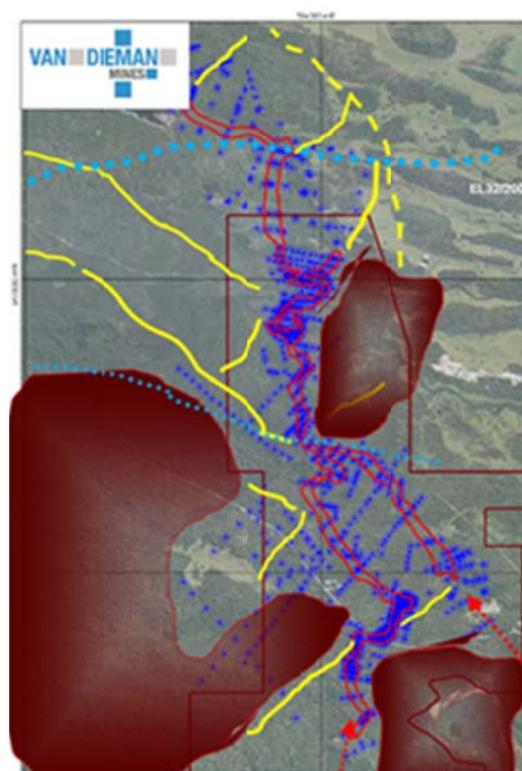
Some of the caveats attached to the merging of the entire drill data set include;

- Some of the Mines Department drill logs are missing, only visual tin recoveries warranted assay equivalent calculations, accusations of unsupervised drilling,
- While accepting past drilling to be reliable Gibson (1976) calculated his resources taking into account possible dredge pathways and pit batter angles (which vary between authors).
- The 1979 work of L. McDonald recommended utilizing an industry accepted "Radford Factor" to account for a 20% dilution of tin concentrate drill samples due to the ubiquitous inflow of wallrock slurry into each sample. This would effectively increase recovered grades by 20%.
- The use of length of hole assay equivalents verses wash only "assays".

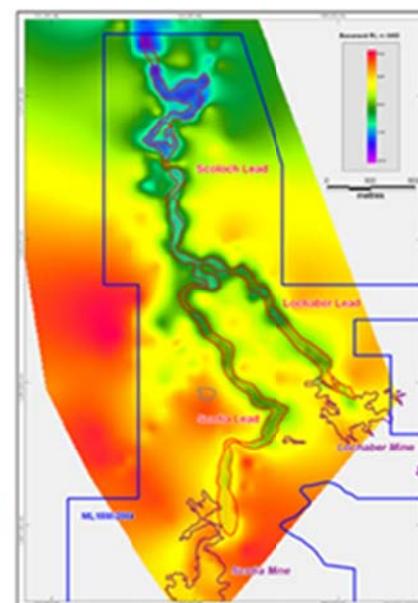
### **Further Prospectivity**

Review of the historical drill sections, basement isopachs and MRT radiometrics the potential for further cassiterite bearing channels is interpreted to lie in three groups;

- Interpreted feeder channels or streams (from north to south on the diagram below - in yellow) that might have contributed to the endowment of the Scotia system are NE Scoloch, NW and SE Block 4, Doone and Newhaven. The latter three have a significant impact on the course of both the Scotia and Lochaber channels (as evidenced by isopachs and drilling data) and may well generate improved heavy mineral entrapment.
- At least two, NE trending, basement corridors at Newhaven-Lochaber, Doone -Block 4, and between Block 4 and 7 *and*
- Poorly explored major channels SW of Block 4-8 and around a possible basement high NE of Block 7.



Broad interpretation of feeder and paleo stream pathways from previous studies, drilling based depth to basement isopachs (right) and relative basement highs



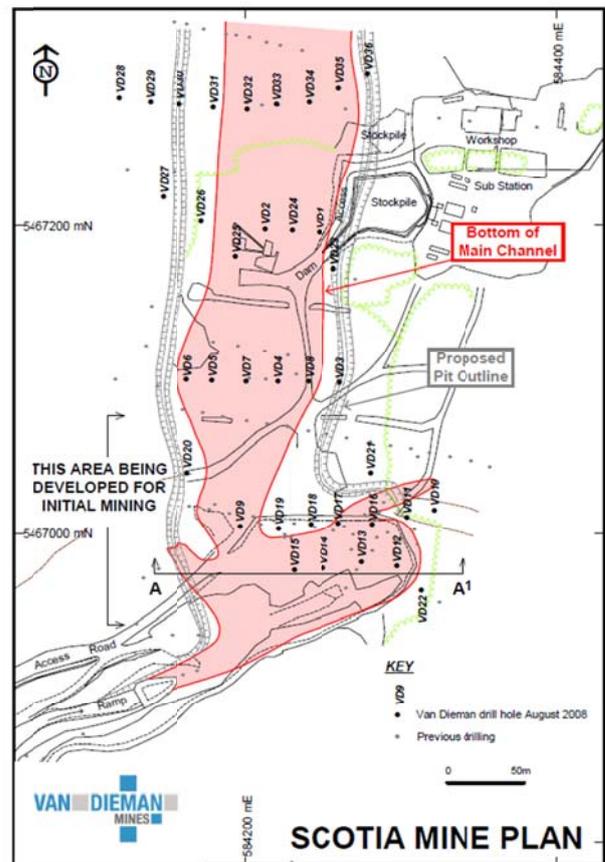
**Hardrock potential** exists under and in the headwaters of the Lochaber workings indicated by the lack of a radiometric pathway to the south, the NE –trending basement alignment in workings and significant veining in basement (quartz-feldspar-biotite metasandstone/siltstone and hornfels; AS4-5,8 and SRC1-5-6) and coarse angular wash in holes such as AS20.

**Trial Open Pit Overburden Stripping, Dewatering, Processing** (MRT records, Internal Memoranda VDM) **and Infill Check Drilling in the Starter Pit Area**

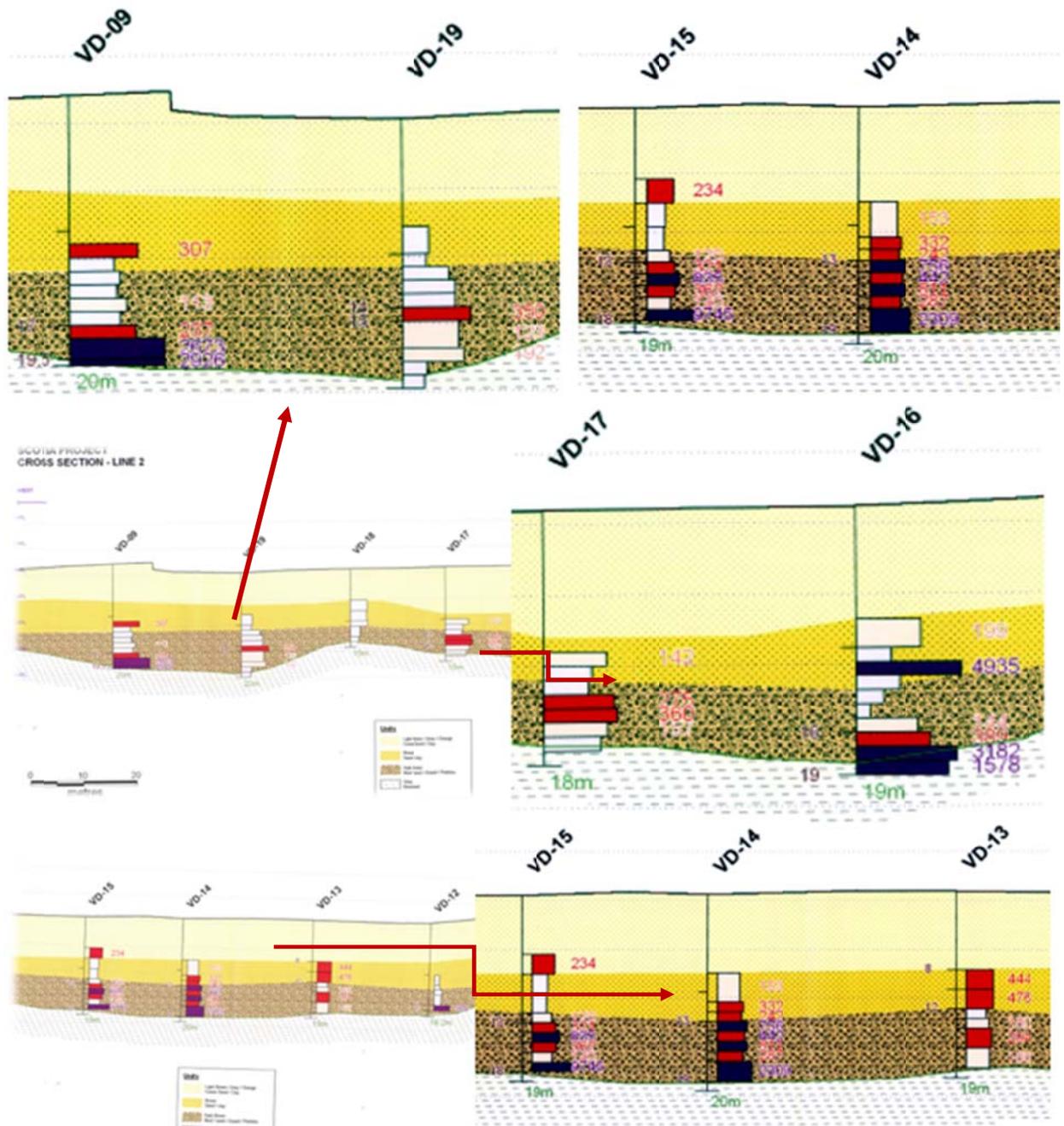
During 2008-2009 geologists for VDM (McIntyre, L. Newnham and Dr M Etheridge) conducted a 38 drill hole programme in and around the trial overburden stripping pit (holes in the table below).

Scotia - 2008 Drilling XYZ

HoleID	Easting	Northing	Elevation
VD-01	584247.2	5467195.6	48.5
VD-02	584212.6	5467197.7	47.9
VD-03	584260.6	5467098.2	48.1
VD-04	584220.6	5467098.9	46.2
VD-05	584178.7	5467099.4	45.0
VD-06	584162.5	5467099.8	44.3
VD-07	584200.3	5467098.5	45.8
VD-08	584240.2	5467098.7	47.1
VD-09	584196.6	5467004.7	47.1
VD-10	584321.3	5467015.1	50.3
VD-11	584303.9	5467010.4	49.5
VD-12	584297.6	5466978.5	45.9
VD-13	584274.7	5466981.5	45.9
VD-14	584249.9	5466977.5	45.6
VD-15	584231.1	5466976.3	45.5
VD-16	584281.8	5467005.6	46.2
VD-17	584259.9	5467006.2	46.0
VD-18	584241.7	5467006.1	45.8
VD-19	584221.1	5467003.6	45.2
VD-20	584163.0	5467039.8	47.0
VD-21	584280.7	5467039.2	49.7
VD-22	584313.0	5466963.3	49.5
VD-23	584257.0	5467171.6	49.3
VD-24	584229.7	5467197.0	48.3
VD-25	584193.6	5467179.8	47.6
VD-26	584171.9	5467202.9	46.7
VD-27	584146.3	5467218.5	49.0
VD-28	584118.3	5467283.2	50.9
VD-29	584138.1	5467280.4	50.4
VD-30	584157.9	5467279.4	49.7
VD-31	584179.4	5467276.9	49.2
VD-32	584201.0	5467276.3	48.7
VD-33	584219.8	5467278.9	48.2
VD-34	584240.7	5467280.6	48.3
VD-35	584260.2	5467289.0	48.8
VD-36	584278.6	5467298.1	49.2







A formal report of the outcome of the programme has not been sighted during our research but the key outcomes of the work include:

- The historical drilling indicated wash grades of between 130 and 4,600gm/bcm
- There cannot be a direct comparison of recovered tin versus drill predicted as the excavation of the trial area did not proceed through the lower 6 meters of mineralized wash due to water saturated sediments
- There is no indication as to the rationale of the siting of the starter pit, especially prior to grade control drilling
- The VDM pit perimeter drilling, on average, was below expectations. However, the size of samples-recovery and methodology of 'assay' allocation is not defined

Comments made on the early drill results noted that;

- On the eastern margin of the interpreted channel returned 1 meter of wash was grading 958gm/bcm
- Holes 13 and 14 confirmed a wash thickness of 6 meters with grades of 1152gm/bcm- 20-30% thicker than the original resource estimate
- Overlying the 13-14 wash section was an unexpected 8 meter thick section assaying 206-460gm/bcm.
- Many historical sections along the Scotia system revealed elevated tin bearing wash zones
- VDM were encouraged by this as it suggested the possibility of a waste to ore ratio of 1 rather than 3.

VDM commented that there was a consensus that a basal wash interval of 1,300gm/bcm was confirmed and proceeded to recalculate the larger resource figure. In the 7 BLOCKS considered the global tin resource was downgraded to 4,200 tonnes of cassiterite versus the original 6,916 tonnes.

VDM (Lindsay Newnham and Ron Goodman, 2009) went on to consider the best (1000gm ore) and worst (400-500gm ore) case economic scenarios for the stripped zone to 40m RL (between 5,466,976 and 5,467,006 North). This equated to 116,500 bcm of material grading 524gm/t ore for 61 tonnes of cassiterite.

Based upon a waste and milling cost of \$6/bcm, 500gm/t assay, and a cassiterite equivalent price of \$11,000/t the value at mine gate was deemed to be \$12,000/t – concluding that:

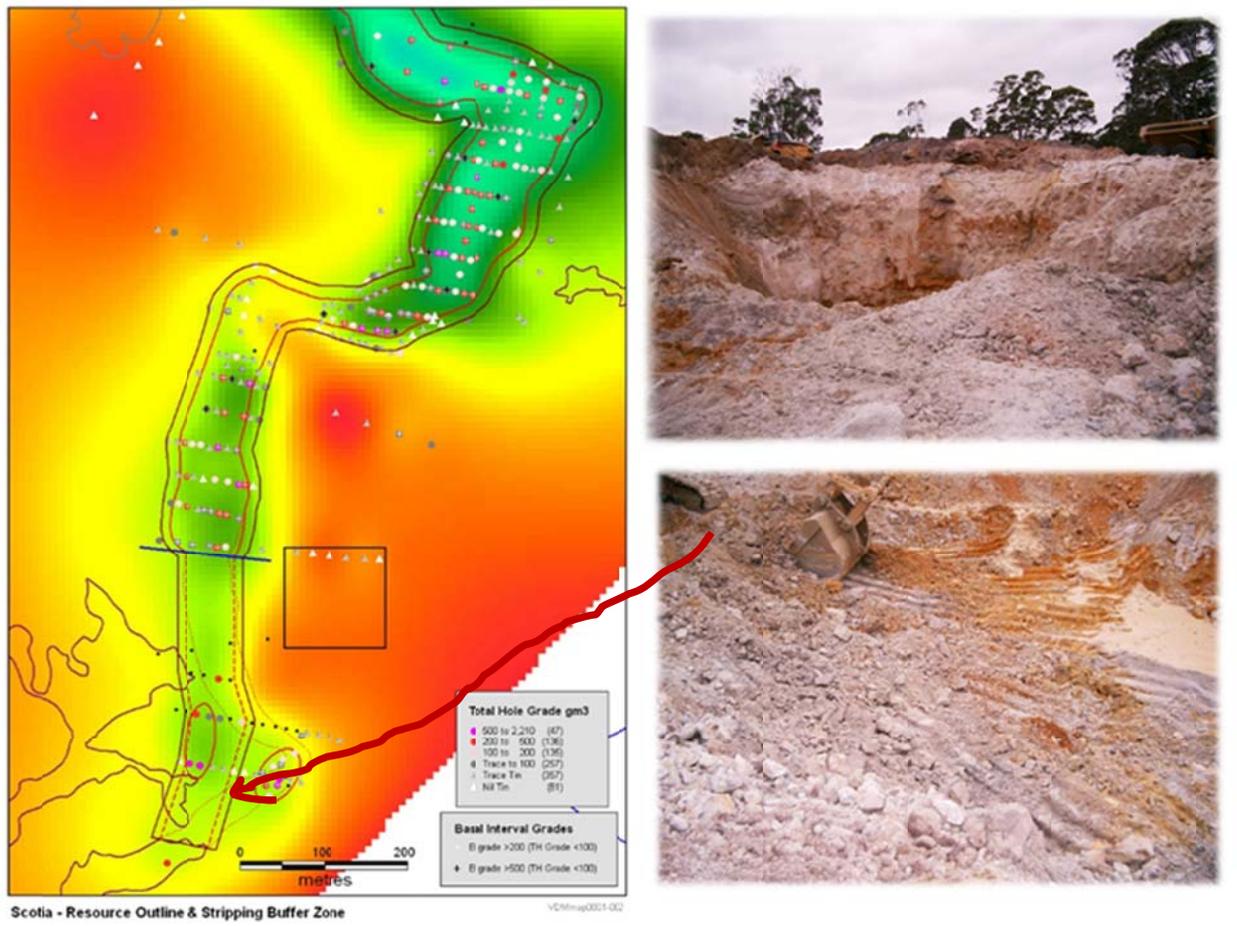
- The operation to be viable required an increase in tin price, a cheaper mining method, and or an increase in grade to the north of starter block 1.

### **Processing of a Small Bulk Sample by Excavator and Mobile Jig**

Review of the notes pertaining to a small bulk sample extracted and processed by VDM in the period 2009-2010 (memoranda by Peter Campbell and Geologist Ken Morrison) was undertaken.

The sample was collected from a 20 meter diameter excavation at the south western end of the abandoned trial de-watering pit by a CAT Excavator.

Site presented below.



At this location the overburden and wash were each 8 meters thick. Due to the wet nature of the wash only the top 4 meters was recovered- 100 tonnes. It is described as clay free and moderately well sorted gravel. VDM commented that the material would be ideal for a slurry- pumping operation. The sample was processed through a transportable jig and the other heavy minerals (monazite, illmenite, marcasite) and cassiterite (reddish – brown in color-*SEE plates below*) were removed by floatation and shaker table in a laboratory at Burnie. It is reported that the head grade was 5,000gm/bcm with 100% of the cassiterite in the concentrate being between 50 and 400 micron in size.

Further investigation is required to:

- Recover further data
- Determine the quantity of by-product
- The reconciliation against the top 4 meters of wash in drilling
- And the cost of conducting further bulk sampling – recovering the entire wash section



### **Further recommended work**

Ongoing work should comprise

1. Detailed analysis of the prospectivity beyond the stated Resources
2. Further GIS interrogation of the Large Scotia Resource
3. Further interrogation of the 2008-2010 drill results north of the VDM trial de-watering pit
4. Investigation of the basement geology in the headwaters of Lochaber for hardrock potential within contact aureoles and granite.

## 10.0 GENERAL CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

There are substantial known alluvial tin resources and substantial potential for new resources to be discovered, for example at Monarch and Scotia as discussed above.

The potential for basement deposits has yet to be thoroughly reviewed and is recommended to be done in the next period.

## 11.0 EXPENDITURE

Expenditures have been reported via MRT Quarterly Returns.

## 12.0 REFERENCES

[A full reference list has not been attempted. Below are some references used. Open file reports are referred to in the text by the MRT designators , such as 95\_1354, and are not repeated here].

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