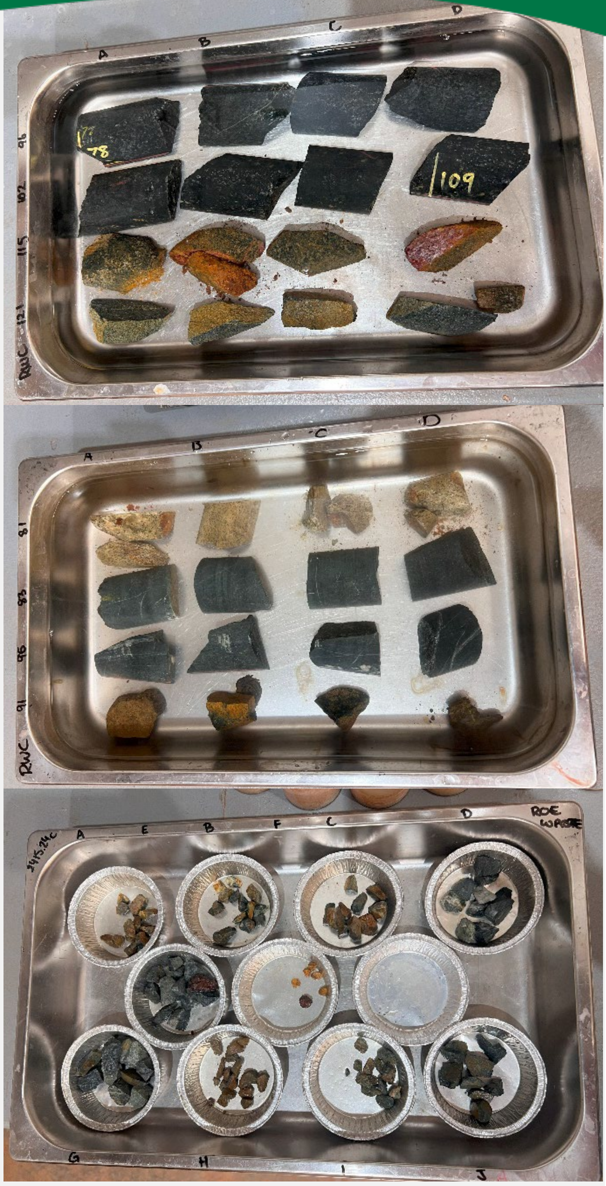
# LAKE ROE PROJECT – KOPAI CRESCENT AND BOMBARA WASTE CHARACTERISATION

Ramelius Resources Ltd

April 2025



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## Review History

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| Rev 0 (Draft) | M. Ferreira, C. Lison | E. Howard, P. Rokich | 20/03/2025 |
| Rev 1 | C. Lison | E. Howard | 15/04/2025 |
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# 1. INTRODUCTION

## 1.1 Overview

Landloch Pty Ltd (Landloch) has been engaged by Ramelius Resources Limited (Ramelius) to conduct a waste material characterisation study related to the mining activities of the Lake Roe Gold Project (the Project). This project involves the development of high-grade gold deposits, specifically the Kopai Crescent and Bombora deposits, which are part of a continuous mineralisation within an approximately 9 km long greenfields gold district. Gold extraction at Kopai Crescent is proposed to occur through open-pit mining, while Bombora will be mined using both open-pit and underground methods. The results of this study are expected to inform the submission of the Mining Proposal (MP) and Mine Closure Plan (MCP) for the Project.

## 1.2 Regulatory context

This study is anticipated to inform development of the MCP in accordance with the Department of Energy, Mines, Industry Regulation and Safety's (DEMIRS) MCP guidance document (DMIRS 2023a) that supports the MCP statutory guidelines (DMIRS 2023b). The MCP guidance document states that:

> *"Comprehensive characterisation of materials (including soils and mine waste) is critical to effective closure planning and successful progressive rehabilitation. This process should start during the exploration phase and continue throughout the life of the mine. Characterisation of materials allows for separation and selective placement of materials considered beneficial to rehabilitation and segregation of materials that may inhibit rehabilitation or cause detrimental effects".*

DEMIRS provides additional information relating to characterisation of wastes in the Draft Guidance for Materials Characterisation Baseline Data Requirements for Mining Proposals (DMP 2016). Broadly, characterisation of wastes should be undertaken to evaluate their physical stability and plant growth potential, and to identify risks associated with materials that are dispersive, asbestiform, radioactive, and that may produce acidic, metalliferous, or saline drainage.

## 1.3 Scope of work

The scope of this waste characterisation assessment included:

- Review of existing geological information;
- Submission of samples for assessment of geochemical and physical characteristics, presence of Normally Occurring Radioactive Materials (NORMs), absence/presence of fibrous mineral, durability of rocky wastes, and erosion potential;
- Collation of all laboratory data and interpretation of the results using industry-accepted classification schemes; and
- Definition of the suitability of waste materials for rehabilitation, including strategies for their management.

# 2. ENVIRONMENTAL SETTING

## 2.1 Project location and setting

The Lake Roe Gold Project is located approximately 100 km east of Kalgoorlie in the Eastern Goldfields region, within the Shire of Kalgoorlie in Western Australia (WA). The Project is situated on the south-western edge of Lake Roe, a large, naturally saline playa. The Project is within tenement M28/388, covering an area of approximately 3,753 hectares (ha) (Figure 1).

The Kopai Crescent and Bombora deposits each consist of three open pits. At Bombora, the pit areas are known as BOM 1800, BOM 1100, and BOM 0700. At Kopai Crescent, the pit areas are known as KC 5750 Pit, KC 4900 Pit, and KC 4700 Pit (Figure 1).

At Bombara, a decline and associated underground mining is anticipated to developed at BOM 1800 (referred to as Kidney Lake (KL) underground) and BOM 0700 (referred to as Tura underground). The anticipated depth of the underground is ~555 m and ~180 m below ground level for KL and Tura, respectively. The underground mining will commence on completion of open pit mining.

## 2.2 Topography and surface water hydrology

The Project is situated along the south-western margin of Lake Roe, which forms part of the Roe Palaeodrainage system. This system originates west of Kalgoorlie, with drainage flowing eastward toward Lake Yindarlgooda and Lake Roe. The salt lake playas along this drainage system contain clay, silt, and sand, interbedded with evaporite minerals such as gypsum and halite. Although the playas are naturally saline, they are bordered by numerous smaller peripheral claypans that often contain non-saline water. Although typically dry, the region experiences infrequent flood events, usually triggered by intense winter rains or cyclonic activity (Campagna 2007; Kern 1996a; Stantec 2022).

Contaminants potentially mobilised within surface runoff from the Project's waste materials, if present, could be transported to nearby water systems and the broader landscape. Runoff from constructed waste landforms containing materials that generate soluble contaminants may adversely affect downstream water quality. To mitigate this risk, the presence and mobility of contaminants in leachates generated from the waste were assessed.

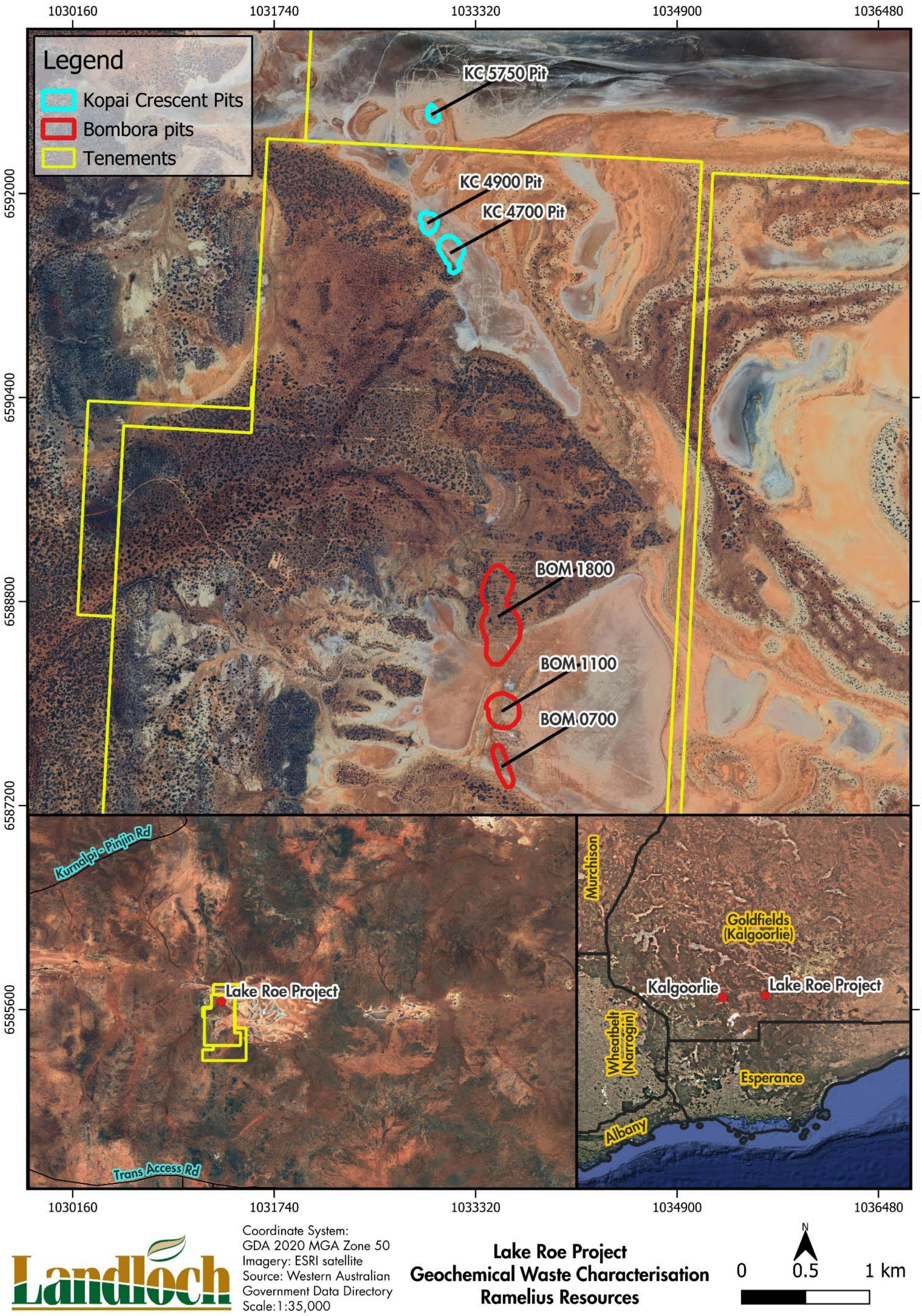


**Figure 1:** Location of the Project and deposits relevant to this study.

## 2.3 Climate

The climate of the Project is characterised as *"Desert Hot (persistently dry)"* under the modified Köppen classification system. This climate is characterised by hot summers and cool winters. Average monthly rainfall is greatest in February (31.7 mm) and lowest in September (13.4 mm) (BOM 2025a) (Table 1). January has the warmest mean maximum daily temperature (33.7° C); the mean minimum daily temperature for the same month is 18.4° C. In contrast, July is the coolest month, with a mean daily maximum temperature of 16.9° C and a mean daily minimum temperature of 5.1° C. Mean monthly pan evaporation (BoM 2006) exceeds mean monthly rainfall for all months throughout the year (Table 1).

Given that mean annual pan evaporation exceeds mean annual rainfall, water availability is likely limited and landform surfaces are likely to be dry for much of the time. As a result, infiltration of water and the associated movement of dissolved salts and/or metals (if present) is likely to be less than would occur in higher rainfall environments.

**Table 1:** Mean monthly rainfall and pan evaporation and mean daily temperature for Kalgoorlie-Boulder Airport.

| Month | Mean Monthly Rainfall* (mm) | Mean Monthly Pan Evaporation^ (mm) | Mean Daily Max. Temperature* (°C) | Mean Daily Min. Temperature* (°C) |
|---|---|---|---|---|
| January | 26.4 | 387.8 | 33.7 | 18.4 |
| February | 31.7 | 304.0 | 32.2 | 18.0 |
| March | 25.6 | 267.0 | 29.5 | 16.2 |
| April | 20.1 | 174.9 | 25.3 | 12.7 |
| May | 24.1 | 111.6 | 20.8 | 8.7 |
| June | 27.7 | 80.9 | 17.6 | 6.3 |
| July | 24.0 | 90.4 | 16.9 | 5.1 |
| August | 21.3 | 121.6 | 18.8 | 5.8 |
| September | 13.4 | 182.4 | 22.4 | 8.2 |
| October | 15.5 | 261.9 | 26.0 | 11.3 |
| November | 19.6 | 311.3 | 29.1 | 14.2 |
| December | 15.8 | 368.5 | 32.1 | 16.7 |
| | **265.3**<br>(MEAN ANNUAL) | **2 656.9**<br>(MEAN ANNUAL) | **25.4**<br>(MEAN DAILY) | **11.8**<br>(MEAN DAILY) |

* Rainfall and temperature data was sourced from the Kalgoorlie-Boulder Airport weather station (BOM station 12038) for the period of 1939-2024 (BoM 2025a).

^ Pan evaporation data was sourced from gridded data supplied by the Bureau of Meteorology (BoM 2006).

## 2.4 Project geology and associated wastes

### *2.4.1 Regional geology*

The Project is situated within the Eastern Goldfields geological province of the Yilgarn Craton which forms a large section of the Western Shield geotectonic unit (Pilgrim 1979; Stantec 2022). The terrain at Lake Roe is characterised by gently undulating plains interrupted in the west by low hills and ridges of Archaean greenstones and in the east by a host of Proterozoic basaltic granulite. The underlying strata are eroded and covered with Tertiary sand and gravel soils, scattered exposures of bedrock, and plains of calcareous earths (Cowan 2001; Kern 1996b; Stantec 2022).

### *2.4.2 Project geology*

The Bombora resource lies on the eastern limb of the Bombora Antiform, within differentiated mafic volcanic and intrusive rocks (primarily basalt and dolerite), flanked by mafic sediments to the east and west (Figure 2). An unnamed syenite pluton extends beneath the deposit and beyond Lake Roe.

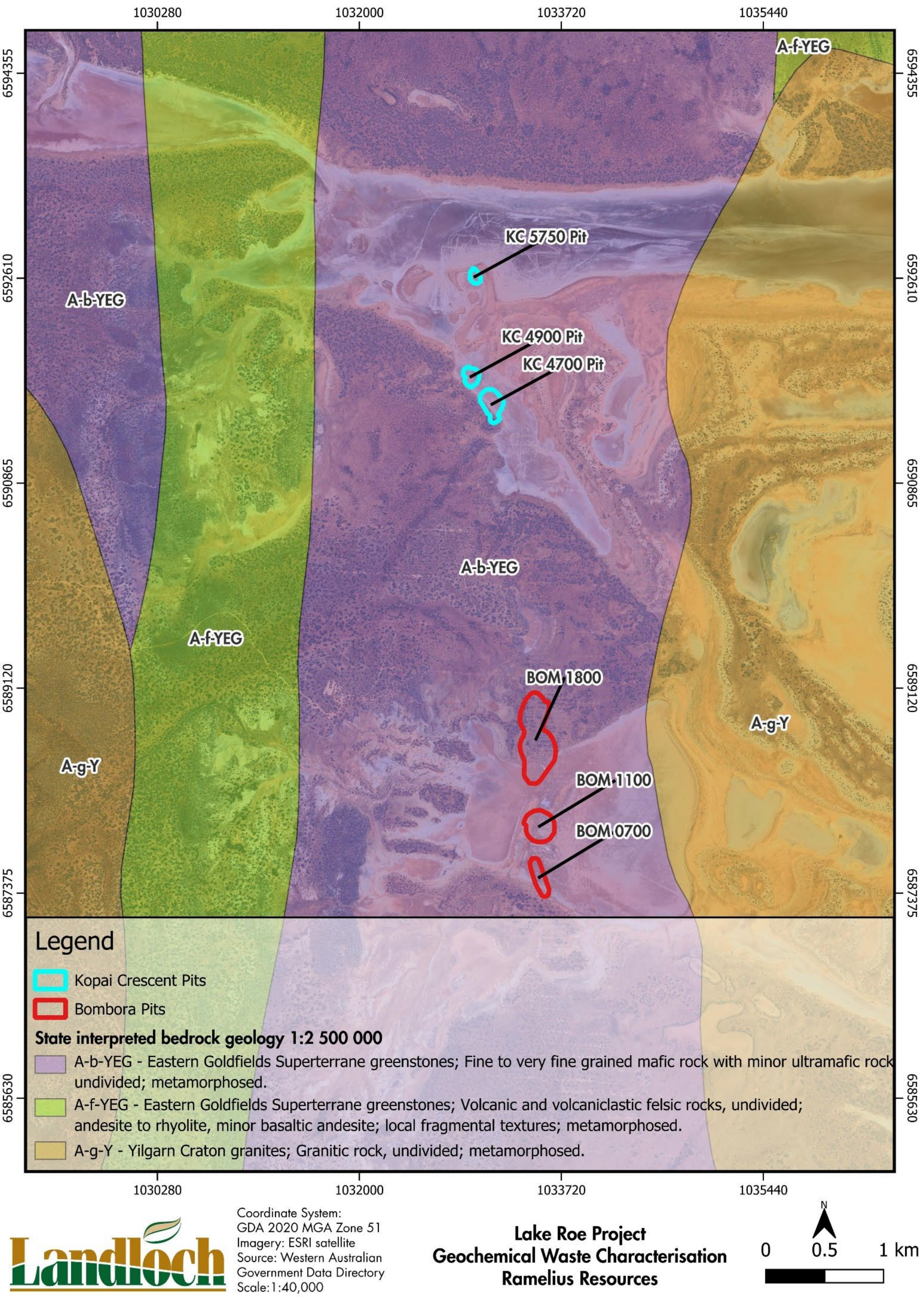
The deposit is hosted within a domed, fractionated dolerite with lamprophyre intrusions, extensive lineaments, and crosscutting de-magnetisation features, indicating potential alteration zones. Mineralisation is associated with iron sulphides, accompanied by quartz, biotite, albite, and carbonate alteration in unweathered zones.

The gold-bearing system consists of a quartz-sulphide vein stockwork at the quartz-dolerite and dolerite contact, overlain by highly weathered saprolite and less weathered saprock. Mineralisation is shallow, occurring from as little as 5 m deep, and extends across multiple lodes within a 150 m wide zone over a 3.7 km strike (Watson 2019; Ramelius 2025; Stantec 2022). Table 2 provides a detailed description of lithology at the Bombara deposit.

Mineralisation at Kopai Crescent is similar to Bombara in that it is hosted by iron-rich mafic host rocks (basalt and dolerite) and is associated with quartz veining and silica-albite-biotite-carbonate-sulphide alteration (Breaker Resources 2020).

**Table 2:** Detailed description of host lithologies at Bombora deposit (Source: Ramelius, pers. comm. G. Lister, September 2024)

| Lithology | | Description |
|---|---|---|
| Western Package | Footwall | Interbedded meta sediments (fine grained and finely beded, usually silicified) and high Mg basalt (foliated to massive) |
| Bombora Sill | Mafic quartz dolerite | Most prospective unit of the Bombora Sill; granophyric |
| | Mafic dolerite | Medium grained dolerite, lacking granophyric textures |
| Eastern Package | Hanging wall | Foliated andesitic basalts and metasediments (incl. siltstones, shales, cherts and mafic volcaniclastics) |
| Lamprophyre | | Late -stage intrusions characterised by coarse biotite, amphibole and carbonate |
| Cover | | Transported cover |


1030280
1032000
1033720
1035440
6594355
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6589120
6587375
6585630
A-f-YEG
A-b-YEG
KC 5750 Pit
KC 4900 Pit
KC 4700 Pit
A-b-YEG
A-f-YEG
BOM 1800
A-g-Y
A-g-Y
BOM 1100
BOM 0700
Legend
Kopai Crescent Pits
Bombora Pits
State interpreted bedrock geology 1:2 500 000
A-b-YEG - Eastern Goldfields Superterrane greenstones; Fine to very fine grained mafic rock with minor ultramafic rock undivided; metamorphosed.
A-f-YEG - Eastern Goldfields Superterrane greenstones; Volcanic and volcaniclastic felsic rocks, undivided; andesite to rhyolite, minor basaltic andesite; local fragmental textures; metamorphosed.
A-g-Y - Yilgarn Craton granites; Granitic rock, undivided; metamorphosed.
Coordinate System:
GDA 2020 MGA Zone 51
Imagery: ESRI satellite
Source: Western Australian Government Data Directory
Scale: 1:40,000
Lake Roe Project
Geochemical Waste Characterisation
Ramelius Resources
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0.5
1 km

## 2.5 Expected mass of waste and ore

Approximately 24 Mt of waste material is proposed to be generated over the life of mine for the Project. A breakdown of waste materials across deposits, lithology, and weathering is provided in Table 3.

Kopai Crescent is expected to generate 2.9 Mt of waste. A large proportion of waste is expected to be dolerite (86%), with smaller proportions of basalt (14%) The majority of material is likely to be transitional (moderately weathered) (~98%) (Ramelius 2024a).

Bombora is expected to generate 21.4 Mt of waste. The dominant waste is expected to be quartz dolerite (68%) with smaller proportions of footwall (13%), dolerite (10%), and transported cover (8%). Less than 1% of lamprophyre is expected to be intersected. The majority of material brought to the surface is expected to be transitional (41%) and fresh waste (47%) (Ramelius 2024b).

**Table 3**: Anticipated life of mine waste mass for Kopai Crescent and Bombara (Source: Ramelius).

| Deposit | Lithology | Lithology Code | Overall Proportion (%) | Weathering | Mass (t) | Proportion (%) |
|---|---|---|---|---|---|---|
| Kopai Crescent | Basalt | MB | 14 | Oxide | 27,104 | 0.9 |
| | | | | Transitional | 380,457 | 13 |
| | | | | Fresh | 0 | 0 |
| | Dolerite | MD | 86 | Oxide | 33,750 | 1 |
| | | | | Transitional | 2,476,247 | 85 |
| | | | | Fresh | 4,350 | <1 |
| | | | | **SUB-TOTAL** | **2,921,908** | **100** |
| Bombora | Lampro-phyre | ALP | 1 | Oxide | 119 | 0.0 |
| | | | | Transition | 23,495 | 0.1 |
| | | | | Fresh | 127,013 | 0.6 |
| | Dolerite | MD | 10 | Oxide | 332,499 | 1.6 |
| | | | | Transition | 1,713,380 | 8.0 |
| | | | | Fresh | 102,814 | 0.5 |
| | Quartz dolerite | MDQ | 68 | Oxide | 522,674 | 2.4 |
| | | | | Transition | 5,969,667 | 27.9 |
| | | | | Fresh | 8,147,228 | 38.1 |
| | Footwall | MR_FW | 13 | Oxide | 59,279 | 0.3 |
| | | | | Transition | 1,024,051 | 4.8 |
| | | | | Fresh | 1,738,377 | 8.1 |
| | Transported cover | TRANSP | 8 | Oxide | 1,574,304 | 7.4 |
| | | | | Transition | 69,738 | 0.3 |
| | | | | **SUB-TOTAL** | **21,404,638** | **100** |
| | | | | **TOTAL** | **24,326,546** | |

### 2.6 Previous test work

Preliminary waste characterisation at Bombora was conducted by Stantec on behalf of Breaker Resources (Stantec 2022). Sixty (60) drill core samples were analysed to evaluate waste materials expected from open-pit mining. The findings indicated that the waste materials were predominantly non-acid forming (NAF) with a low risk of metalliferous drainage. Salinity levels ranged from slightly saline to extremely saline. Most wastes were inferred to be physically stable, although a small subset of samples showed partial clay dispersion.

The assessment did not evaluate the suitability of waste rock for rehabilitation purposes, such as their use as growth media or rock armour. Additionally, no testing was conducted for the presence of asbestiform/fibrous minerals or Naturally Occurring Radioactive Material (NORM). To date, no waste characterisation studies have been conducted for materials at Kopai Crescent.

## 3. METHODOLOGY

### 3.1 Sample selection

Ramelius provided Landloch with 73 diamond core samples selected from 14 diamond drill (DD) holes at Kopai Crescent and 60 pulp samples selected from 16 rotary drill (RC) holes at Bombara (Figure 3).

The samples were selected to represent the waste lithologies in terms of their volumes, spatial distribution, and weathering state across each of the open pits and underground. Table 4 provides an overview of the sample numbers split by lithology and weathering. No transported cover samples were available for analysis as this waste lithology was not intersected frequently during the drilling. Further detail on selected samples, including targeted depth intervals and associated cross sections, are provided in Appendix A.

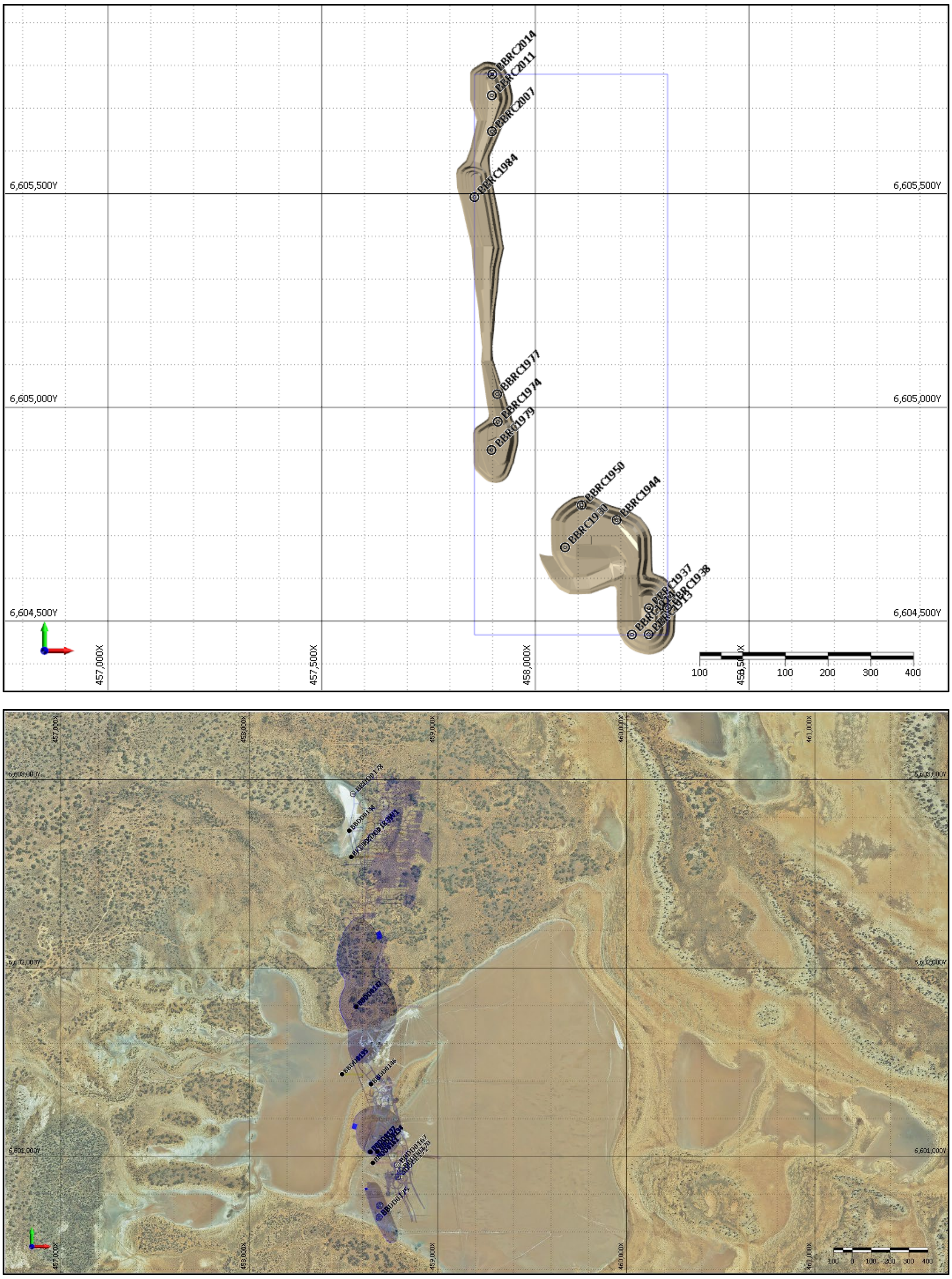

**Figure 3:** Collar locations of drill holes selected for characterisation at Kopai Crescent (top) and Bombara (bottom) (Source: Ramelius).

**Table 4:** Sample numbers selected for this study split by lithology and weathering

| Deposit | Lithology Codes | Weathering | Proportion (%) | Sample Number | Proportion (%) |
|---|---|---|---|---|---|
| Kopai Crescent | MB | Oxide | 0.9 | 0 | 0 |
| | | Transitional | 13 | 15 | 21 |
| | | Fresh | 0 | 3 | 4 |
| | MD | Oxide | 1 | 3 | 4 |
| | | Transitional | 85 | 49 | 67 |
| | | Fresh | <1 | 3 | 4 |
| | | | **SUB-TOTAL** | **73** | **100** |
| Bombora | ALP | Oxide | 0.0 | 0 | 0 |
| | | Transition | 0.1 | 0 | 0 |
| | | Fresh | 0.6 | 3 | 5 |
| | MD | Oxide | 1.6 | 0 | 0 |
| | | Transition | 8.0 | 7 | 12 |
| | | Fresh | 0.5 | 3 | 5 |
| | MDQ | Oxide | 2.4 | 0 | 0 |
| | | Transition | 27.9 | 19 | 32 |
| | | Fresh | 38.1 | 19 | 32 |
| | MR_FW | Oxide | 0.3 | 0 | 0 |
| | | Transition | 4.8 | 4 | 7 |
| | | Fresh | 8.1 | 5 | 8 |
| | TRANSP | Oxide | 7.4 | 0 | 0 |
| | | Transition | 0.3 | 0 | 0 |
| | | | **SUB-TOTAL** | **60** | **100** |

## 3.2 Test work program

All 133 waste samples provided for characterisation were initially screened for:

- Soil $pH_w$ (1:5 solid:deionised water solution);
- Electrical Conductivity ($EC_{1:5}$);
- Total S (LECO), sulphide S, and sulphate S; and
- Naturally Occurring Radioactive Materials (NORMs).

Samples considered to be at higher risk of generating acid based on the screening total S values were further assessed for acid-base accounting (ABA) parameters and other indicators of acid generation potential, including:

- Total C;
- Net Acid Generation (NAG)[1];
- $NAG_{4.5}$[2];

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[1] Sulphur released by reaction with strong hydrogen peroxide at pH 4.5 and pH 7.0.

[2] Free acid (i.e. $H_2SO_4$) in the NAG liquor at pH 4.5.

- Final NAG pH[3];
- pH (ox);
- Maximum Potential Acidity (MPA)[4];
- Acid Producing Potential (APP);
- Acid Neutralising Capacity (ANC); and
- Net Acid Production Potential (NAPP)[5].

A subset of 33 samples were subjected to 4-acid digest followed by ICP-MS and assessed for total metal concentrations in the solids[6]. Leachate testing was carried out for the same samples using a 1:20 solids:water solution and the concentrations of 21 elements within the leachate were assessed to consider drainage water quality[7].

A subset of 25 samples were tested for rock durability indices including rock water absorption and rock particle density (11 DD core, and 14 RC rock chips).

A subset of 33samples were assessed for chemical indicators of structural stability:

- Exchangeable cations and dispersion risk, including:
    - Exchangeable cations ($Ca^{2+}$, $Mg^{2+}$, $Na^{+}$, $K^{+}$, $Al^{3+}$)
    - Effective Cation Exchange Capacity (ECEC)[8];
    - Exchangeable Na Percentage (ESP)[9];
    - Exchangeable Mg Percentage (EMP)[10];
    - Electrochemical Stability Index (ESI)[11]; and
    - Ca:Mg ratio[12];

A subset of 13 samples were also assessed for presence of asbestiform materials via optical microscopy.

## 3.3 Description of characterisation parameters

### *3.3.1 pH$_w$*

The pH of water extracts can be used as an indication of whether a sample is acidic or alkaline (pH) on short-term contact with water.

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[3] pH of the sample after oxidisation with hydrogen peroxide.
[4] Calculated as total S multiplied by 30.6.
[5] Calculated as the difference between APP and ANC.
[6] **Elements assessed via 4-acid digest include:** Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Ge, Hf, Hg, In, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Re, S, Sb, Sc, Se, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, and Zr.
[7] **Leachate elements assessed include:** Al, As, B, Ba, Be, Ca, Cd, Cr, Co, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Se, $SO_4^{2-}$, V, Zn, and water leachable Hg.
[8] Calculated as the sum of exchangeable cations.
[9] Calculated as the ratio of Ex. Na to ECEC expressed as a percentage.
[10] Calculated as the ratio of Ex. Mg to ECEC expressed as a percentage.
[11] Calculated as the ratio of EC1:5 to ESP.
[12] Calculated as the ratio of exchangeable Ca to exchangeable Mg.

A general classification of pH values when measured in a 1:5 solids:deionised water solution ($pH_w$) is given in Table 5 (Hazelton and Murphy 2016). This classification allows for a range of pH values to be grouped but does not define whether a certain classification is suitable or not for vegetation growth. This is because vegetation in different areas is adapted to different pH values.

Responses in plant growth to varying pH is complex and determination of guidelines for pH suitability relevant for a wide range of materials is impractical. A rational approach when considering the potential impact of waste pH on rehabilitation success is to compare them with naturally occurring soil pH values and the vegetation that is endemic in soil having these pH values. Materials that have similar pH can be considered suitable for plant growth, at least with respect to pH.

Baseline soil assessments at Lake Roe recorded $pH_w$ values for surface soils (0–0.15 m) ranging from 7.9 to 8.8 (median 8.4), classifying the soils as slightly to moderately alkaline (Stantec 2019). Therefore, for the purpose of comparison, pH values falling within ±1 pH unit of 8 to 9 were considered suitable for plant growth. This range is also consistent with pH classifications for moderately alkaline soils.

Wastes with $pH_w$ values outside this range may still support vegetation, but for the purposes of this report, they are classified as unsuitable unless additional work is completed to demonstrate their suitability or amendments are applied to adjust their pH.

**Table 5:** General material $pH_w$ classification (Hazelton and Murphy 2016).

| Material $pH_w$ (pH units) | Classification |
|---|---|
| <4.0 | Very strongly acidic |
| 4.0–5.5 | Strongly acidic |
| 5.5–6.0 | Moderately acidic |
| 6.0–7.0 | Slightly acidic |
| 7.0–8.0 | Slightly alkaline |
| 8.0–9.0 | Moderately alkaline |
| 9.0–10.0 | Strongly alkaline |
| >10.0 | Very strongly alkaline |

### *3.3.2 Salinity ($EC_{1:5}$)*

Salinity is often measured using the electrical conductivity of a solution containing 1 part solids to 5 parts deionised water ($EC_{1:5}$). Most published salinity suitability ranking systems assume agricultural vegetation, and application of these ranking systems have little relevance for plant species used in rangeland rehabilitation.

The Western Australian Department of Primary Industries and Regional Development (DPIRD) provides a summary of published salinity tolerance values for a range of common species used in revegetation of disturbed rangelands in Western Australia (DAFWA 2004). These tolerance values are given as EC values measured not using the 1:5 soil:water solution method, but the alternative saturation extract method ($EC_e$). Conversion between $EC_{1:5}$ and $EC_e$ is dependent on soil texture. Hazelton and Murphy (2016) suggest that for sandy and sandy loam soils $EC_e$ should be divided by ~20 to estimate $EC_{1:5}$.

Using these conversion factors, salt sensitive species such as *Eucalyptus* have salt tolerance values ($EC_{1:5}$) ranging from 0.5–2.0 dS/m. Salinity trials performed near Kalgoorlie indicated that $EC_{1:5}$ in excess of 4 dS/m is likely to cause significant adverse impacts on germination and establishment of salt tolerant species (Jennings *et al.* 1993). Therefore, salinity values greater than 4 dS/m was used to indicate materials that are sufficiently saline to potentially impact vegetation growth.

These values correlate with the range of $EC_{1:5}$ values recorded for surface soils at Lake Roe (0.01–4.56 dS/m) (Stantec 2019). Stantec (2019) noted saline soils at Lake Roe to support growth of local salt tolerant species such as samphire.

### *3.3.3 Acid-base accounting (ABA)*

Measurements of total S were used to determine the presence of potentially acid producing materials. A screening cut-off value for total S of ≥0.3% was used to provide a preliminary characterisation of samples with the potential for acid generation (Price 1997). Samples with total S <0.3% were classed as NAF irrespective of further ABA test work results. The classification scheme by which potentially acid forming (PAF) and NAF materials were identified is provided in Table 6. The classification system is based on the *Guidelines on Preventing Acid and Metalliferous Drainage* (DFAT 2016) and the *ARD Test Handbook* (AMIRA International 2002). The latter is advocated for by the *Global Acid Rock Drainage Guidelines* (INAP 2009).

**Table 6:** Acid generation risk classification scheme used for this study.

| Classification* | Total S (%) | NAPP ($kgH_2SO_4$/tonne) | Final NAG pH | $NAG_{4.5}$ ($kgH_2SO_4$/tonne) | ANC/MPA |
|---|---|---|---|---|---|
| NAF | ≤0.3 | - | - | - | - |
| | >0.3 | <0 | ≥4.5 | <5 | >2 |
| NAF-HS | >1.0 | <0 | ≥4.5 | <5 | >2 |
| PAF | >0.3 | ≥0 | <4.5 | >5 | <2 |
| PAF LC | >0.3 | ≥0 | <4.5 | <5 | <2 |
| Uncertain | >0.3 | ≥0 | >4.5 | - | <2 |
| | >0.3 | <0 | ≤4.5 | - | <2 |

*NAF: non-acid forming; NAF-HS: non-acid forming, high sulphur; PAF: potentially acid forming; PAF-LC: potentially acid forming, low capacity.

### *3.3.4 Elemental enrichment (solids)*

The screening of solids for metals and metalloids serves the purpose of detecting any elements that might raise environmental concerns in terms of revegetation and the quality of surface water and groundwater. The results obtained can serve as a basis for further investigation if necessary. To determine if any environmentally sensitive elements are significantly enriched, the concentrations of metals and metalloids in each sample were compared with the median concentration of that element within a reference material, in this case the median crustal abundance values provided by AusIMM (2011). The degree of enrichment was assessed using the Geochemical Abundance Index (GAI) equation:

$$GAI = log_2\left[\left(\frac{C}{1.5 * S}\right)\right]$$

in which C represents the concentration of the element in the sample and S denotes the median concentration of that element in the reference material (INAP 2009). GAI values are rounded to their integer value (from 0 to 6). A GAI of 0 indicates that the element is present at a concentration similar to or lower than the median abundance, while a GAI of 6 suggests an enrichment of approximately 100 times or more above the median abundance. As a general guideline, a GAI of 3 or higher is considered significant, indicating the need for further examination of such enrichment (INAP 2009).

The results were also compared to the background concentrations provided by the National Environmental Protection Council (NEPC) for Health Investigation Level (HIL C) and Ecological Investigation Level (open public spaces) ranges applicable to soils (NEPC 2011a, 2011b). HILs and EILs serve as indicators for the requirement of a more detailed risk assessment and do not imply the presence of significant health or ecological risks. If the guidelines do not specify criteria, Landloch cannot comment on the appropriateness of the measured values, but the data are included for completeness.

### *3.3.5 Elemental enrichment (leachate)*

Drainage (produced by leaching materials) that contains elevated concentrations of soluble metals or metalloids can have adverse impacts on downstream surface water and/or groundwater. Metals at high concentrations can be toxic to biota. Additionally, dissolution of salts from saline materials may result in local or regional dispersion of salts through leaching, or accumulation of salt in soil pore water which can inhibit plant growth. Short-term static leach tests provide a means of screening for the potential of a material to become a mine waste contaminant source. The tests provide insight into aspects such as an element's solubility, mobility, bioavailability, and toxicity. The deionised water extraction undertaken for this study (1:20 solid:water) seeks to provide an indication of the mobile fraction under field conditions (an unbuffered water source, i.e. rainfall).

Evaluation of leachate data for each element was undertaken as follows:

- Comparison of the measured element concentration within the leachate with:
    - Freshwater and livestock (beef cattle) drinking water guideline limits (ANZECC 2000), or where freshwater and livestock limits did not exist;
    - Australian drinking water guideline limits (NHMRC and NRMMC 2011).
- Identification of element(s) with measurable but not elevated concentrations (i.e. significantly above the detection limit but below the guideline limits);
- Identification of element(s) with elevated concentrations (i.e. above one or more guideline limit); and
- Consideration of probable physical characteristics that may control solubility in certain pH ranges.

### *3.3.6 Structural stability*

A materials' structural stability was assessed by considering the interrelated properties of exchangeable cations, salinity, and particle size distribution. These were considered from three different perspectives. The order in which they are discussed should not be taken to indicate the relative importance of the different perspectives. Other perspectives, such as instability due to an abundance of fine sands, silts, and clays in the samples, were not considered due to the disturbed nature of the sample provided; the particle size distributions of the samples are unlikely to be representative of the particle sizes resulting from mining.

The proportion of exchangeable sodium (Na) held on the material's cation exchange complex in relation to other exchangeable cations is important. This is referred to as the Exchangeable Sodium Percent (ESP). McKenzie *et al.* (2004) considers the measurement of ESP as suitable for assessing the potential for clay dispersion when a material's Effective Cation Exchange Capacity (ECEC) is ≥3meq/100g and exchangeable Na ≥0.3meq/100g. Further, the risk of clay dispersion is relevant only in materials with loam or clay textures (clay fraction ≥10%); sand-dominated materials are not prone to structural instability via clay dispersion. When these conditions are met, ESP ≥6% is considered to indicate a material at prone to structural instability.

Dispersion potential for a material is also influenced by interactions between clay content, ESP, and $EC_{1:5}$. The Electrochemical Stability Index (ESI) is a way of considering these relationships for loam and clay textured materials (clay fraction ≥10%). ESI is the ratio of $EC_{1:5}$ expressed in dS/m to ESP expressed as a percent. A tentative critical ESI value is 0.05 (McKenzie 1998), with ESI <0.05 indicating a material that is prone to structural instability when the materials have sufficient clay.

Magnesic materials can also be prone to structural instability. Fenton and Conyers (2002) indicated that Mg by itself has little effect on spontaneous clay dispersion. However, it can enhance the effect of exchangeable Na in causing clay dispersion. This is assessed using a combination of the Exchangeable Magnesium Percent (EMP), Ca:Mg ratio, and ESP. When EMP ≥30%, dispersion is more likely to occur when the Ca:Mg ratio is <1 and when either ESP ≥4%,or ESP+(EMP÷10) is ≥6% ,assuming clay content is also ≥10%.

Relevant to all three of these perspectives, a material can have a fine fraction that is prone to structural instability, but if the proportion of fines is small, the material as a whole may be structurally stable. Typically, a binary mixture containing a >30–40% fine fraction and <60–70% coarse fraction could be considered a fines-dominated material that contains some coarse-grained particles; a binary mixture containing a <30–40% fine fraction and >60–70% coarse fraction could be considered a coarse-dominated material that contains some fine-grained particles. For this report, a fines cut-off of ≥40% was adopted, with a material that contains a ≥40% fine fraction being at risk of structural instability if it meets one or more of the criteria described above. Measurement of the fine/coarse fraction was not possible due to the nature of the samples provided. Therefore, for the purposes of this report, it was assumed that the fine fraction for all samples was >40%.

To capture interactions between physical and chemical properties and their effect on structural stability, the samples were assessed against these three criteria. If any of these criteria are met, that material was classified as being prone to structural instability. The assessment assumes that all materials had a clay content ≥10% and fine fraction ≥40%. This is because the particle size distributions of the samples are unlikely to be representative of the particle sizes resulting from mining. This provides a conservative assessment of structural stability, particularly for materials that are less weathered (i.e. fresh). The criteria are detailed in Table 7.

**Table 7:** Structural stability criteria, assuming clay content ≥10% and fine fraction ≥40%.

| ESP-based criteria: | EMP-based criteria: |
|---|---|
| • ECEC ≥3meq/100g, and<br>• Ex. Na ≥0.3meq/100g, and<br>• ESP ≥6%. | • ECEC ≥3meq/100g, and<br>• EMP ≥30%, Ca:Mg <1, & ESP ≥4%, or<br>• EMP ≥30%, Ca:Mg <1, & (ESP + (EMP ÷ 10) ≥6% |
| **ESI-based criteria:** | |
| • ESI <0.05. | |

### *3.3.7 Rock durability*

Understanding the susceptibility of the rock fraction of a waste to breakdown is important when considering them as a potential armour against erosion in rehabilitation plans. Where rock particles are observed to breakdown, this can result in an increase in the proportion of fines over time, which would either increase erosion potential in the long term or sustain elevated erosion rates for longer periods (i.e. surface armouring by rainfall that can lead to reductions in erosion would be impeded). The breakdown of rock particles can also occur during landform re-shaping using heavy machinery, whereby rock particles of a certain size become smaller as machinery traverses over them, push them, and rip into them. Where rocks are shown to be durable, they could be considered for use as a rock armour to reduce erosion potential of rehabilitation landform batters if required.

In this study the durability of rock particles is classed as 'excellent', 'good', 'marginal', or 'poor' based on their lithology, weathering grade, particle density, and water absorption values (Table 8). This rating system is based on CIRIA *et al.* (2007) criteria for determining the quality and durability of armour-stone from a quarry source.

The degree to which a rocky waste can successfully mitigate risks associated with erosion is related not only to rock durability, but also to the size and abundance of rock, the geometry of the landforms being considered, and the climate in which the landform is situated. Therefore, the rock durability results provide a useful indication of potential rock armour materials, but more comprehensive particle size distribution and erodibility testing, and landform design modelling is still required to determine the limits of its use as a rock armour material.

**Table 8:** Rock durability rating system (adapted from CIRIA *et al.* (2007)).

| Criteria | Excellent | Good | Marginal | Poor |
|---|---|---|---|---|
| Lithology | Unfoliated igneous and metamorphic rocks, quartzites and high silica cemented sandstones, compact crystalline limestones | Crystalline dolomites, crystalline limestone and moderately well cemented sandstones | Argillaceous limestones, poorly cemented sandstones, dolomite reef rock with void cavities | Shaly limestones, reef breccia, shale, siltstone, slate, schist, chalk, gypsiferous carbonates |
| Weathering grade | Fresh, unweathered | Faintly weathered (staining on major surfaces) | Slightly weathered (staining persists through a greater part of rock mass) | Moderately weathered (less than half the rock mass is decomposed) |
| Particle density (g/cm$^3$) | >2.7 | 2.5-2.7 | 2.3-2.5 | <2.3 |
| Water absorption (%) | <0.5 | 0.5-2.0 | 2.0-6.0 | >6.0 |

### *3.3.8 Naturally occurring radioactive material*

All mining wastes contain radionuclides of natural origin. For most activities involving minerals and raw materials, the levels of exposure to these radionuclides are not significantly greater than normal background levels and are not of concern for radiation protection. However, some materials may give off radiant energy at levels higher than background levels. Human activity around these types of materials can increase the risk of radiological exposure. Material giving rise to these enhanced exposures is known as naturally occurring radioactive material (NORM).

The WA Radiological Council (2019) and the DMP (2010) require that the dose limit and surface concentration for betta, gamma, and low toxicity alpha emitters falls below 10µSv/hr and 0.40Bq/cm$^2$, respectively. Dose limits and surface concentrations in samples are assessed against these criteria.

### *3.3.9 Asbestiform minerals*

"Asbestos" is a commercial term referring to six types of naturally occurring silicate mineral fibres that can be separated into two broad mineral categories: amphibole and serpentine. These minerals are hydrated silicates with varying metal compositions and are known as asbestiform minerals. Figure 4 shows asbestos mineral categories that are considered to be harmful to human health based on the Department of Energy, Mines, Industry Regulation and Safety's (DEMIRS) guidance document *Management of fibrous minerals in Western Australian mining operations* (DMP 2015).

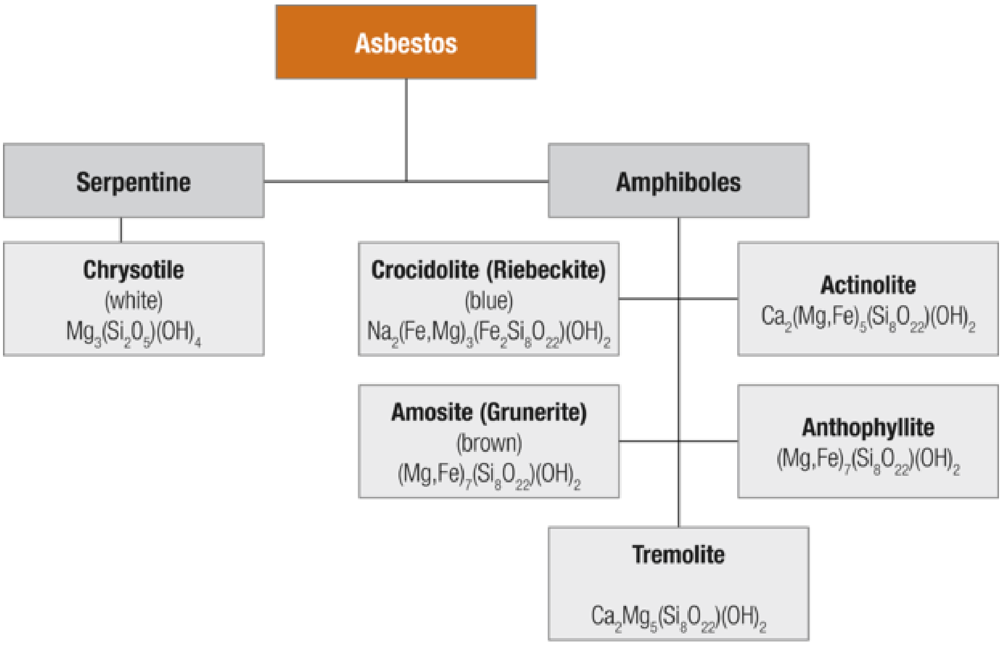

**Figure 4:** Asbestos mineral categories that are considered to be harmful to human health (DMP 2015).

Amphibole and serpentine minerals are major components of mafic and ultramafic rocks found in Western Australia's greenstone belts, which contain the State's major gold and base metal deposits. Amphibole minerals may also be encountered in the banded iron formations of the Hamersley Basin (DMP 2015). Exposure to asbestiform minerals can have adverse impacts on human health, when fibres are of a size that can be airborne and respirable.

Assessment of samples for presence/absence of mineral fibres is undertaken in accordance with the polarised light microscopy and dispersion staining method established in AS:4964-2004 *Method for the qualitative identification of asbestos in bulk samples*.

Samples returning mineral fibres are further analysed for fibre characteristics using scanning electron microscopy (SEM) with elemental analysis by energy dispersive spectroscopy (EDS) following AS: 4964-2004 (modified for SEM). Under AS 4964-2004 asbestos is defined as:

- Many particles with aspect ratios (i.e. length to width ratios) ranging from 20:1 to 100:1 or higher for particles >5 micrometres (µm) in length. Bundles of fibres may have lower aspect ratios;
- Sets of fibre bundles generally less than 0.5 µm, but always less than 1.0 µm in width, unless in thick bundles;
- In addition to the mandatory fibrillar crystal growth, one or more, and preferably three of the following aspects:
    - Parallel fibres occurring in bundles;
    - Fibre bundles displaying splayed ends;
    - Matted masses of individual fibres;
    - Fibres showing characteristic curvature.

- Respirable asbestos fibres are defined as:
    - Asbestos fibres less than 3 μm in width, and greater than 5 μm in length, and with a length to width ratio greater than 3 to 1.

The detection limit for asbestiform minerals using the AS 4964-2004 method is influenced by sample condition, composition, and fibre type. Typically, this method can detect asbestos at concentrations ranging from 1 in 1,000 (0.1 wt%) to 1 in 10,000 (0.01 wt%) by weight, which is equivalent to 1 to 0.1 g/kg. For the purposes of this assessment, a Limit of Reporting (LoR) of 0.01 wt% has been applied in alignment with AS 4964.

Concentrations greater than 0.01 wt% are considered potentially hazardous to human health based on limits set by the Globally Harmonised System (GHS) of classification and labelling of chemicals and soil screening levels set by the Department of Health (DoH 2009).

# 4. TEST WORK RESULTS

This section provides a summary of the completed test work. Detailed laboratory results can be found in Appendix B. To simplify data presentation, the results have been grouped according to deposit and lithology classification.

## 4.1 $pH_w$

The majority (65%) of the Kopai Crescent samples analysed recorded pH values within the range considered suitable for vegetation establishment and plant growth (Figure 5). The pH values ranged from 6.2–10.0, with a median of 7.9, classifying them as slightly acidic to strongly alkaline.

A number of dolerite samples from Kopia Crescent had lower $pH_w$ than measured for surface soils at the Project. However, the median $pH_w$ of the dolerite ($pH_w$ 8.2) remained within the range considered suitable for vegetation establishment. The $pH_w$ of all but 2 basalt samples are classed as suitable, and the median $pH_w$ (8.2) was within the acceptable range. Subsequently, all waste materials from Kopai Crescent are considered suitable for use as growth media based on pH.

All of the samples from Bombara recorded pH levels within (or very close to) the range considered suitable for vegetation establishment ($pH_w$ 7–10) (Figure 6). Waste materials from Bombara recorded $pH_w$ values ranging from 7.4 to 10.1, with a median of 9.6. All waste material from this deposit is considered suitable for use in rehabilitation as growth media based on pH.

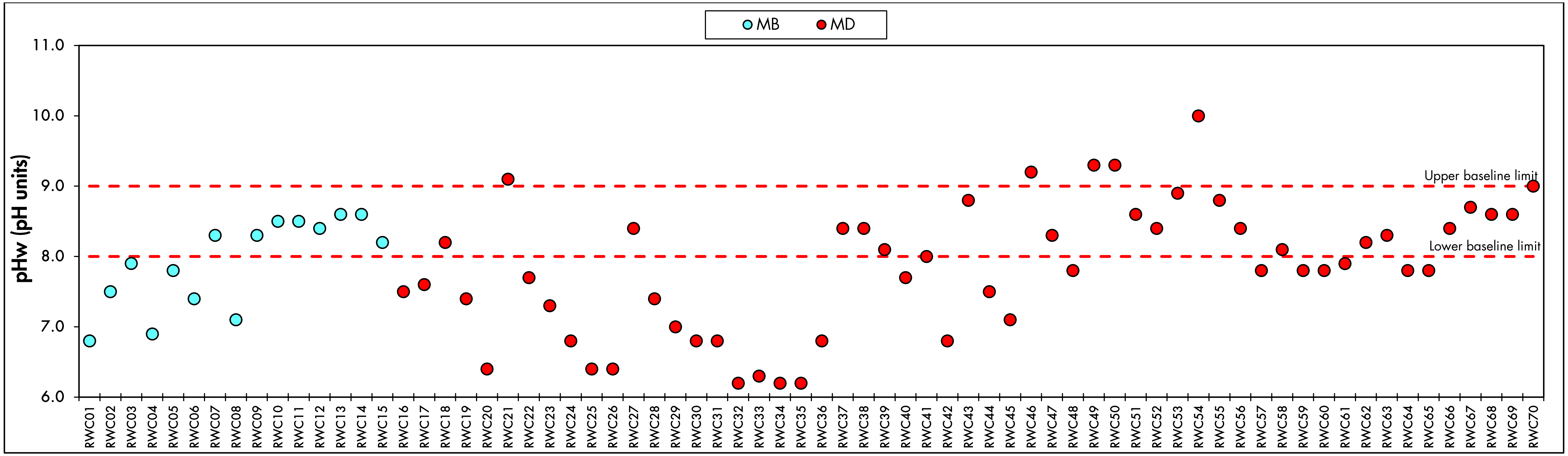

**Figure 5:** pH$_w$ recorded for 70 Kopai Crescent samples. Data points are compared to limits stipulated in section 3.3.1. MB=Basalt, MD=Dolerite.

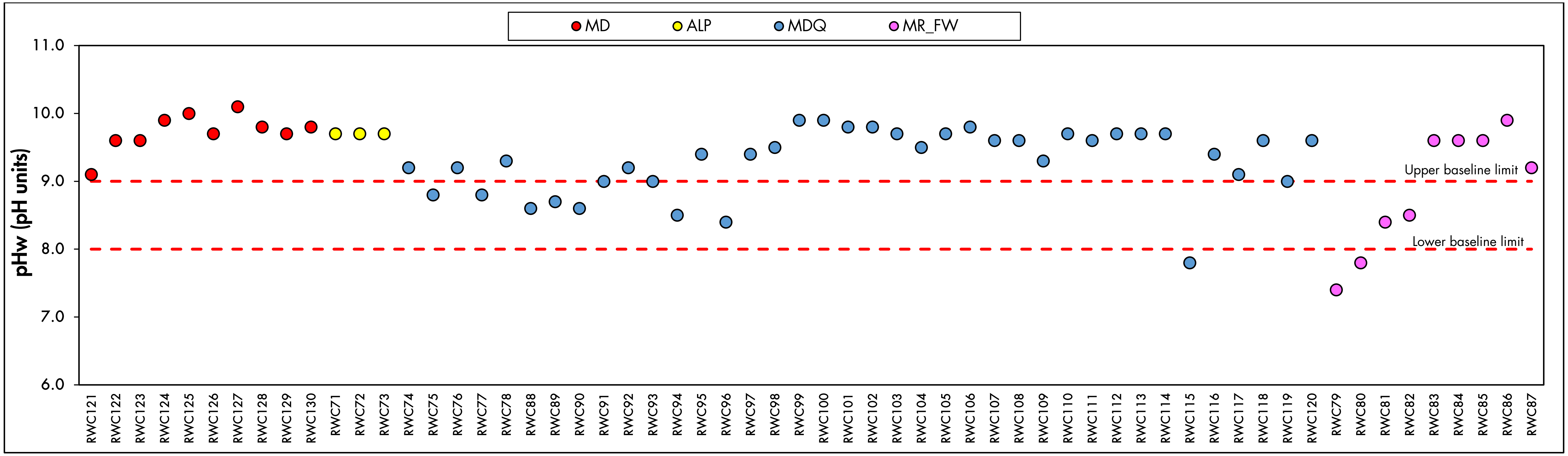

**Figure 6:** pH$_w$ recorded for 60 Bombora samples. Data points are compared to limits stipulated in section 3.3.1. ALP= Lamprophyre, MD=Dolerite, MDQ= Quartz dolerite, MR_FW=Footwall.

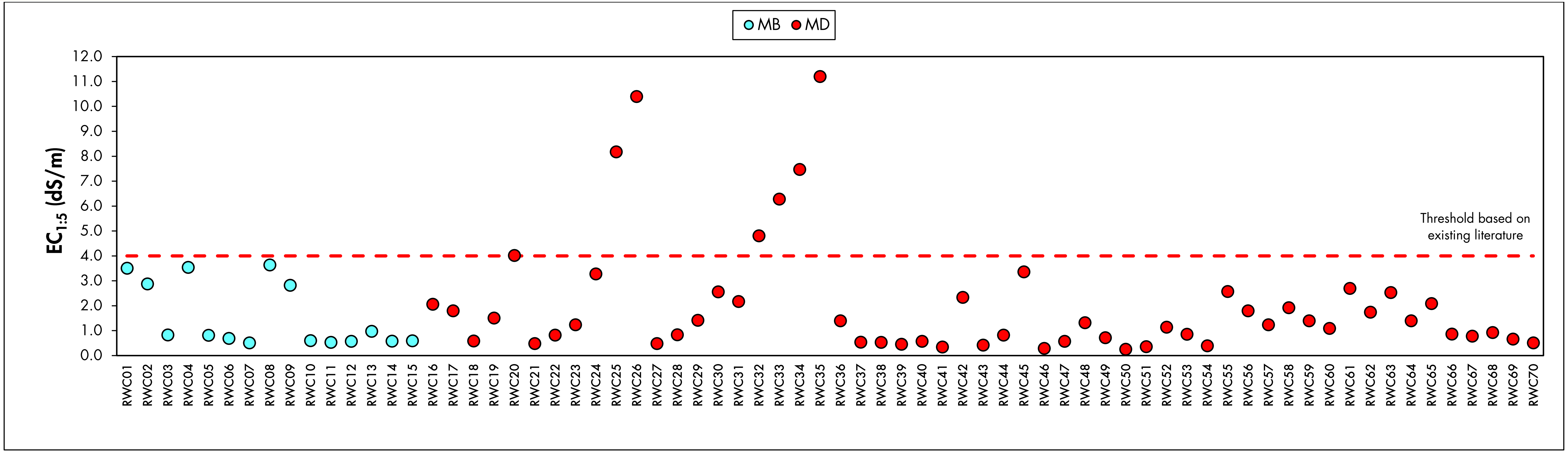

**Figure 7:** EC$_{1:5}$ recorded for 70 Kopai Crescent samples. Data points are compared to limits stipulated in section 3.3.2. MB=Basalt, MD=Dolerite.

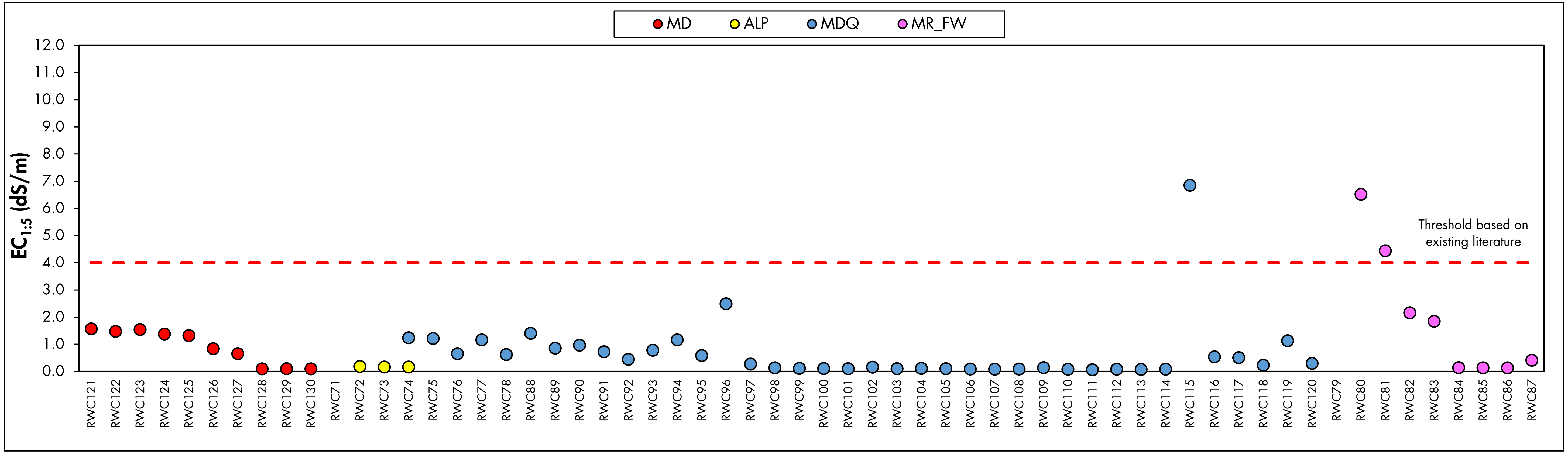

**Figure 8:** EC$_{1:5}$ recorded for 60 Bombora samples. Data points are compared to limits stipulated in section 3.3.2. ALP= Lamprophyre, MD=Dolerite, MDQ= Quartz dolerite, MR_FW=Footwall.

## 4.2 Salinity ($EC_{1:5}$)

The majority of samples (91%) from both Kopai Crescent and Bombara exhibited $EC_{1:5}$ values within the acceptable limits (Figure 7). Samples from Kopai Crescent exhibited higher salinity values compared to Bombora with recorded $EC_{1:5}$ values ranging from 0.26–11.2 dS/m (median 1.12 dS/m). Samples from Bombara had $EC_{1:5}$ values ranging from 0.07–6.9 dS/m (median 0.36 dS/m) (Figure 8).

A small proportion (9%) of samples recorded $EC_{1:5}$ levels >4 dS/m. These samples originated from oxidised and transitional dolertie at Kopai Crescent. Stockpiling and handling of this material with other waste materials of lower salinity is likely to dilute salinity concentrations. When considered as a whole, waste from both Kopai Crescent and Bombara deposits are considered suitable for use in rehabilitation based on their salinity.

## 4.3 Acid-base accounting (ABA)

Of the 133 samples tested, 125 (94%) recorded total S values <0.3%. Further assessment of sulphur speciation showed that the majority of S present in these samples was in the form of sulphate ($SO_4^{2-}$), a non-acid generating form of sulphur. These samples were classified as NAF.

Five (5) samples returned a total S value >0.3%. Two (2) of the 5 samples originated from Kopai Crescent and were logged as fresh dolerite (MD) and three of the samples originated from Bombora and were logged as fresh quartz dolerite (MDQ). Further assessment of acid-base accounting parameters for these samples showed that 4 of the 5 samples could be classified as NAF based on:

- Final NAG pH >4;
- NAG4.5<5kg $H_2SO_4$/tonne; and
- NAPP <0kg $H_2SO_4$/tonne.

One fresh quartz dolerite sample from the Bombora deposit, was classified as PAF based on the acid neutralising capacity (ANC 57.8 kg $H_2SO_4$/t) being insufficient to neutralise the maximum potential acidity (MPA 60.28 kg $H_2SO_4$/t) (Figure 9). This is further evidenced by a NAG pH of 3 and positive NAPP of 1.6 kg $H_2SO_4$/t (Figure 10). This sample resides at a depth interval of 182.5–184 m and represents quartz dolerite occurring at the maximum planned depth of the Tura underground. All quartz dolerite samples originating from depths <182.5 m for Tura underground and open pits returned a NAF classification.

Total S values, sulphur speciation, acid-base accounting parameters and assigned acid generation risk classification for all samples is provided in Appendix B.

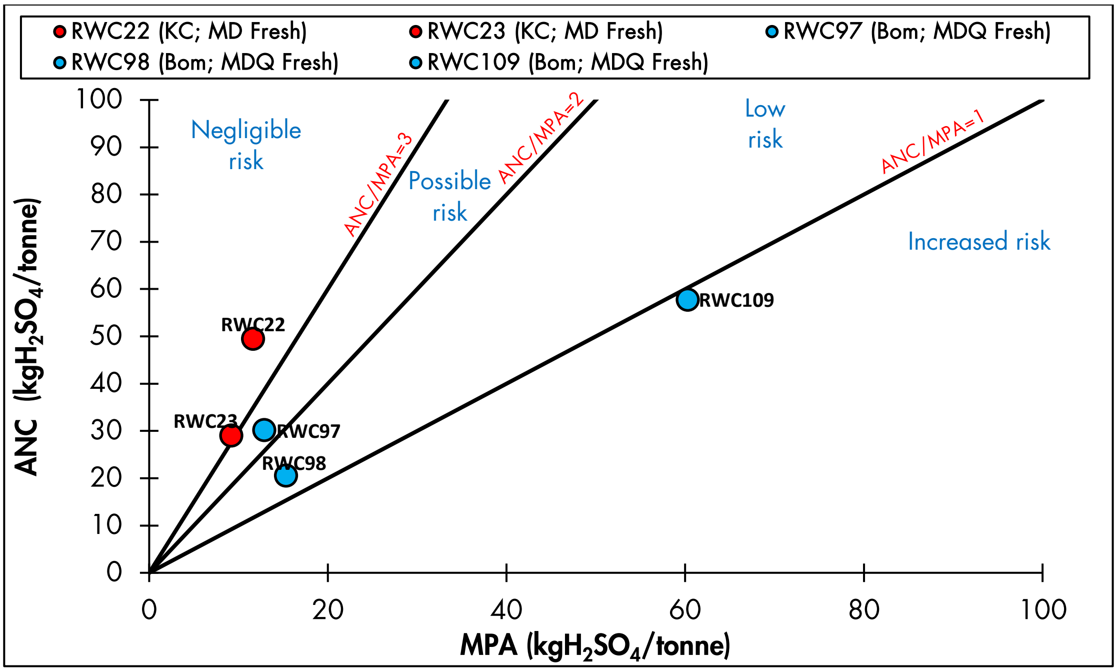

**Figure 9:** Acid neutralising capacity (ANC) compared to Maximum potential acidity (MPA). MD=Dolerite, MDQ= Quartz dolerite. Bom = Bomabara, KC = Kopai Crescent.

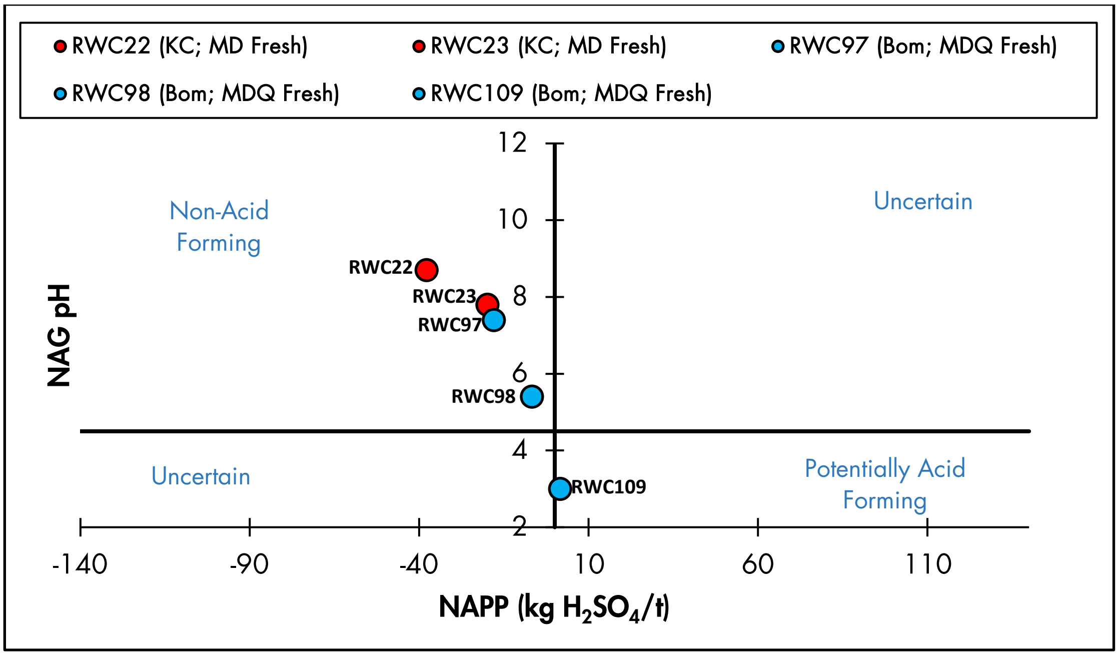

**Figure 10:** NAG pH compared to NAPP. MD=Dolerite, MDQ=Quartz dolerite. Bom= Bomabara, KC=Kopai Crescent.

## 4.4 Elemental enrichment (solids)

Elemental concentrations of 33 samples were analysed as part of the study. At least one sample from each lithology was included in the assessment. Elemental concentrations of all samples can be found in Appendix B. Elements typically shown to be enriched in the samples include:

- Iron (Fe) with a median GAI of 6;
- Selenium (Se) with a median GAI of 4; and
- Tellurium (Te) with a median GAI of 3.

Neither Fe or Te are known to be toxic to natural biota. It is noted that, although Se had a median GAI value of 4, the detection limit of the laboratory assessment (1 ppm) exceeds the median crustal abundance (0.05 ppm).

Comparison of elemental concentrations in samples to NEPC Health Investigation Level (HIL C) thresholds showed that one footwall sample (MR_FW Fresh) from Bombora exceeded the HIL threshold for chromium (Cr) with a value of 489 mg/kg.

Comparison of elemental concentrations in samples to NEPC Ecological Investigation Level (EIL) thresholds for open public spaces showed that:

- 1 sample of Bombara footwall (MR-FW) exceeded the EIL value for Cr;
- 6 samples exceeded the EIL value for copper (Cu), including;
    - 5 Kopai Crescent dolerite (MD); and
    - 1 Bombara quartz dolerite (MDQ).
- 24 samples exceeded the EIL value for nickel (Ni) notably including all lithologies across both deposits except quartz dolerite (MDQ);
- 15 samples exceeded the EIL value for zinc (Zn) including:
    - 7 Kopai Crescent samples (2 basalt (MB); and
    - 5 dolerite (MD)); and
    - 8 Bombora samples (quartz dolerite (MDQ)).

The remainder of elements with EIL or HIL values fell within the recommended threshold (i.e. As, Bi, Cd, Co, Mn, Ni, Pb).

## 4.5 Elemental enrichment (leachate)

Results of elemental testing of the leachate are provided in Appendix B. For all deposits, leaching of the samples with an unbuffered water source (i.e. rainfall) generated:

- Kopai Crescent:
    - Measurable but not elevated concentrations of chromium, manganese, nickel, selenium, and zinc;
    - Elevated concentrations of aluminium and chloride; and
    - Salinity levels between 0.09–3.54 dS/m (median 0.58 dS/m).
- Bombora:
    - Measurable but not elevated concentrations of chromium, nickel, selenium, and zinc; and
    - Elevated concentrations of aluminium; and
    - Salinity levels between 0.05–0.61 dS/m (median 0.09dS/m).

The mafic volcanic and intrusive rocks at Lake Roe, particularly basalt and dolerite, are natural sources of trace metals such as chromium, manganese, and nickel. These elements are commonly hosted within iron sulphides and mafic minerals, which undergo oxidation and leaching in the weathering profile.

The concentration of aluminium in the majority of samples across various lithologies exceeded the guideline trigger values. Elevated aluminium levels are likely attributed to secondary aluminium-bearing clays (e.g., kaolinite, gibbsite) formed through the weathering of feldspars and micas, particularly within the fractionated dolerite and syenite units. The enrichment and mobilisation of aluminium are driven by intense weathering and further enhanced by structural controls such as shearing, jointing, and folding, which increase rock permeability and promote fluid-driven alteration. Additionally, demagnetisation features observed in the dolerite host rock indicate zones of hydrothermal alteration, where magnetic minerals (e.g. magnetite) have been replaced by non-magnetic minerals like hematite, sulphides, and clays. These alteration processes further contribute to aluminium enrichment by facilitating mineral breakdown and secondary clay formation.

The potential for elevated levels of aluminium in leachate to pose a risk to the environment was considered further with respect to probable pH ranges and bioavailability. The higher aluminium concentrations may be attributed to the formation of soluble $Al(OH)_{4-}$ (negatively charged complex at neutral and slightly alkaline conditions) due to the pH of the leachate solution, which has a median pH of 9.0. The potential for adverse effects on the receiving environment due to elevated aluminium levels primarily exists when the pH is below 5. In such conditions, aluminium is more likely to be present as trivalent $Al^{3+}$, which is known to be highly toxic to organisms (Bojórquez-Quintal *et al.* 2017). However, in environments where the $pH_w$ ranges from ~5.5 up to moderately alkaline conditions ($pH_w$ 8.5), soluble aluminium concentrations are expected to remain low. In these conditions, aluminium is predominantly in the non-soluble forms of $Al(OH)_3$ and $Al(OH)_{4-}$, and it does not pose a significant toxicity issue.

The salinity of leachate is consistent with the salinity generated on short-term contact with water (Section 3.3.2) and provides further evidence to suggest the salinity of the waste materials is likely to remain below 4 dS/m. The Project's location within a low-lying terrain, influenced by an enhanced weathering profile over syenite, has led to the accumulation of gypseous loams, saline loams, and lake clays (CSIRO and BRS 1991). These deposits, formed in a semi-arid environment with limited drainage, may contribute to the elevated salinity levels observed in the leachate. The proximity of Project to the salt lakes also plays a role in chloride enrichment, as evaporative processes concentrate dissolved salts in the soil and shallow groundwater. Due to the presence of *in situ* saline soils, it is expected that vegetation in the vicinity has some degree of salt tolerance.

The impact of saline drainage on groundwater quality will depend on existing groundwater salinity. Given the close proximity of the deposit to Lake Roe, it is likely that groundwater in the area is already saline. Additional studies are necessary to assess whether the salinity levels of drainage from waste materials are comparable to that of local groundwater.

## 4.6 Structural stability

Thirty-two (32) samples (97%) assessed were found to be prone to structural instability, triggering the ESP and ESI criterions. These samples exhibited elevated ESP, high exchangeable sodium (Ex. Na) concentrations, increased effective cation exchange capacity (ECEC), and/or low ESI values (Table 9). This assessment of structural stability is conservative as it assumes that all materials have a clay content ≥10% and fine fraction ≥40%. A small proportion of waste material will be oxidised (12%). This waste type is likely to be dominated by fine grained particles and clay minerals and so will be at greatest risk of structural instability.

The remainder of materials mined from Kopai Crescent and Bombara will be transitional (moderately weathered) and fresh. If the post-mined matrix of transitional and fresh materials is predominantly coarse-grained, these materials may retain structural stability. Based on the mining sequence fresh waste rock is expected to be extracted last. The fresh rock may be used on the outer surface of the waste rock landform to encapsulate materials that are at greater risk of structural instability (i.e. oxides) pending it carries an abundance of coarse fraction (>60%).

The susceptibility of the transitional and fresh materials to structural instability was further considered based on their geology. Basalt is likely to consist of more than 40% dense, silica-rich minerals (e.g., quartz), which offer increased resistance to weathering and are expected to break down into coarser sandy material. The dolerite primarily comprises feldspar (~40–70%) and pyroxene minerals. Feldspars weather into kaolinite and gibbsite, while pyroxenes degrade into 1:1 and 2:1 clays, contributing to material breakdown. The transitional dolerite may have greater dominance of fine-grained particles and clay minerals. That being said, the increased quartz content in quartz dolerite at Bombara is likely to improve resistance to weathering, with the degree of resistance directly dependent on the proportion of quartz within the material. Based on the above, transitional and fresh materials are likely to retain their structural stability, however further physical testing of extracted material during mining operations is recommended to determine the proportion of coarse versus fine fractions, assess clay content, and re-evaluate their structural stability.

## 4.7 Rock durability

The durability of the majority of samples is highly variable, ranging from marginal to poor. This is expected given their variability in weathering and alteration. The lamprophyre, oxidised dolerite and transitional basalt waste materials are shown to have poor to marginal durability and are considered unsuitable for use as rock armour.

The fresh quartz dolerite and transitional and fresh dolerite at both Kopai Crescent and Bombara exhibit good durability and may be considered as potential rock armour materials, if these materials also carry an abundance coarse fraction (>60%).

**Table 9:** Assessment of structural stability of fine fraction in wastes.

| Sample ID | Material | Oxidation | ECEC | Ex. Na | Ca:Mg | ESP | EMP | ESI | Assessment Criteria | | | Prone to Structural Instability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ESP | EMP | ESI | |
| | | | meq/100g | meq/100g | - | % | % | - | - | - | - | - |
| **Kopai Crescent** | | | | | | | | | | | | |
| RWC01 | Basalt (MB) | Transitional | 13.4 | 9.5 | 0.6 | 70.5 | 16.8 | 0.063 | ✓ | ✗ | ✗ | ✓ |
| RWC05 | Basalt (MB) | Transitional | 13.5 | 9.9 | 0.2 | 73.2 | 20.9 | 0.056 | ✓ | ✗ | ✗ | ✓ |
| RWC09 | Basalt (MB) | Transitional | 18.6 | 14.3 | 0.2 | 77.1 | 18.0 | 0.049 | ✓ | ✗ | ✓ | ✓ |
| RWC13 | Basalt (MB) | Transitional | 12.4 | 9.4 | 0.2 | 75.9 | 17.9 | 0.025 | ✓ | ✗ | ✓ | ✓ |
| RWC17 | Dolerite (MD) | Transitional | 7.3 | 5.5 | 0.2 | 74.8 | 19.4 | 0.032 | ✓ | ✗ | ✓ | ✓ |
| RWC22 | Dolerite (MD) | Fresh | 3.4 | 1.2 | 3.1 | 34.6 | 15.2 | 0.029 | ✓ | ✗ | ✓ | ✓ |
| RWC26 | Dolerite (MD) | Oxide | 18.3 | 11.6 | 0.2 | 63.2 | 29.0 | 0.212 | ✓ | ✗ | ✗ | ✓ |
| RWC30 | Dolerite (MD) | Transitional | 2.3 | 1.0 | 1.2 | 42.5 | 25.4 | 0.076 | ✗ | ✗ | ✗ | ✗ |
| RWC34 | Dolerite (MD) | Transitional | 4.1 | 0.9 | 2.6 | 23.0 | 20.5 | 0.404 | ✓ | ✗ | ✗ | ✓ |
| RWC38 | Dolerite (MD) | Transitional | 18.8 | 14.6 | 0.2 | 77.9 | 17.7 | 0.026 | ✓ | ✗ | ✓ | ✓ |
| RWC42 | Dolerite (MD) | Transitional | 6.2 | 3.8 | 0.5 | 60.1 | 25.1 | 0.055 | ✓ | ✗ | ✗ | ✓ |
| RWC46 | Dolerite (MD) | Transitional | 1.4 | 0.7 | 1.4 | 50.4 | 17.7 | 0.008 | ✗ | ✗ | ✓ | ✓ |
| RWC50 | Dolerite (MD) | Transitional | 1.6 | 0.7 | 1.3 | 42.0 | 23.7 | 0.008 | ✗ | ✗ | ✓ | ✓ |
| RWC54 | Dolerite (MD) | Transitional | 3.1 | 1.7 | 0.7 | 53.8 | 25.6 | 0.010 | ✓ | ✗ | ✓ | ✓ |
| RWC58 | Dolerite (MD) | Transitional | 6.6 | 4.5 | 0.3 | 68.7 | 22.7 | 0.039 | ✓ | ✗ | ✓ | ✓ |
| RWC62 | Dolerite (MD) | Transitional | 7.8 | 5.8 | 0.3 | 74.5 | 18.9 | 0.035 | ✓ | ✗ | ✓ | ✓ |
| RWC66 | Dolerite (MD) | Transitional | 10.2 | 7.5 | 0.3 | 74.2 | 19.3 | 0.032 | ✓ | ✗ | ✓ | ✓ |
| RWC70 | Dolerite (MD) | Transitional | 7.8 | 5.9 | 0.3 | 75.5 | 16.9 | 0.020 | ✓ | ✗ | ✓ | ✓ |
| **Bombora** | | | | | | | | | | | | |
| RWC73 | Lamprophyre (ALP) | Fresh | 1.7 | 0.4 | 3.3 | 21.7 | 11.2 | 0.014 | ✗ | ✗ | ✓ | ✓ |
| RWC77 | Quartz dolerite (MDQ | Transitional | 9.1 | 7.0 | 0.4 | 76.9 | 15 | 0.015 | ✓ | ✗ | ✓ | ✓ |
| RWC81 | Interbedded meta sediments and high Mg basalt (MR_FW) | Transitional | 19.5 | 17.1 | 0.2 | 87.5 | 9.44 | 0.029 | ✓ | ✗ | ✓ | ✓ |
| RWC85 | MR_FW Fresh | Fresh | 1.4 | 0.6 | 1.9 | 38.1 | 16.20 | 0.006 | ✗ | ✗ | ✓ | ✓ |
| RWC89 | Quartz dolerite (MDQ) | Transitional | 3.3 | 2.2 | 0.7 | 65.9 | 18.00 | 0.014 | ✓ | ✗ | ✓ | ✓ |
| RWC93 | Quartz dolerite (MDQ) | Transitional | 4.5 | 3.3 | 0.7 | 72.7 | 14.1 | 0.013 | ✓ | ✗ | ✓ | ✓ |

| Sample ID | Material | Oxidation | ECEC | Ex. Na | Ca:Mg | ESP | EMP | ESI | Assessment Criteria | | | Prone to Structural Instability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ESP | EMP | ESI | |
| | | | meq/100g | meq/100g | - | % | % | - | - | - | - | - |
| RWC97 | Quartz dolerite (MDQ) | Fresh | 1.9 | 0.8 | 4.4 | 42.8 | 6.31 | 0.007 | ✖ | ✖ | ✓ | ✓ |
| RWC101 | Quartz dolerite (MDQ) | Fresh | 1.1 | 0.5 | 4.6 | 42.0 | 7.59 | 0.004 | ✖ | ✖ | ✓ | ✓ |
| RWC105 | Quartz dolerite (MDQ) | Fresh | 0.9 | 0.3 | 14.0 | 33.6 | 10.40 | 0.005 | ✖ | ✖ | ✓ | ✓ |
| RWC109 | Quartz dolerite (MDQ) | Fresh | 0.9 | 0.2 | 14.7 | 27.6 | 9.68 | 0.007 | ✖ | ✖ | ✓ | ✓ |
| RWC113 | Quartz dolerite (MDQ) | Fresh | 1.0 | 0.3 | 4.4 | 32.1 | 8.74 | 0.005 | ✖ | ✖ | ✓ | ✓ |
| RWC117 | Quartz dolerite (MDQ) | Transitional | 2.5 | 1.6 | 11.0 | 65.8 | 13.90 | 0.007 | ✖ | ✖ | ✓ | ✓ |
| RWC121 | Dolerite (MD) | Transitional | 4.8 | 3.3 | 0.7 | 67.7 | 18.20 | 0.025 | ✓ | ✖ | ✓ | ✓ |
| RWC125 | Dolerite (MD) | Transitional | 4.8 | 3.3 | 0.9 | 69.1 | 15.10 | 0.016 | ✓ | ✖ | ✓ | ✓ |
| RWC129 | Dolerite (MD) | Fresh | 0.9 | 0.3 | 1.2 | 36.4 | 23.00 | 0.004 | ✖ | ✖ | ✓ | ✓ |

**Table 10**: Durability classification for wastes.

| Deposit | Material | Weathering | Average rock density (g/cm³) | Average water absorption (%) | Durability rating |
|---|---|---|---|---|---|
| Kopai Crescent | Basalt (MB) | Transitional | 3.41 | 4.99 | Marginal |
| | Basalt (MB) | Transitional | 3.62 | 6.91 | Marginal |
| | Dolerite (MD) | Transitional | 1.77 | 4.33 | Poor |
| | Dolerite (MD) | Fresh | 2.66 | 2.51 | Marginal |
| | Dolerite (MD) | Fresh | 3.18 | 2.93 | Marginal |
| | Dolerite (MD) | Oxide | 1.90 | 13.16 | Poor |
| | Dolerite (MD) | Oxide | Disintegrated on wetting after 24 hrs. | | Poor |
| | Dolerite (MD) | Transitional | 3.43 | 1.97 | Good |
| | Dolerite (MD) | Transitional | 2.63 | 17.87 | Poor |
| | Dolerite (MD) | Transitional | 2.59 | 7.72 | Poor |
| | Dolerite (MD) | Transitional | 3.40 | 1.32 | Good |
| Bombara | Lamprophyre (ALP) | Fresh | 2.48 | 0.10 | Good |
| | Lamprophyre (ALP) | Fresh | 2.55 | 0.11 | Good |
| | Footwall (MR_FW) | Transitional | 2.80 | 3.23 | Marginal |
| | Quartz dolerite (MDQ) | Fresh | Disintegrated on wetting after 24 hrs. | | Poor |
| | Quartz dolerite (MDQ) | Fresh | 2.02 | 6.51 | Poor |
| | Quartz dolerite (MDQ) | Fresh | 3.15 | 0.25 | Good |
| | Quartz dolerite (MDQ) | Fresh | 2.78 | 0.22 | Good |
| | Quartz dolerite (MDQ) | Fresh | 3.07 | 0.18 | Good |
| | Quartz dolerite (MDQ) | Fresh | 3.39 | 0.10 | Good |
| | Quartz dolerite (MDQ) | Fresh | 4.61 | 8.92 | Poor |
| | Dolerite (MD) | Fresh | 1.40 | 1.52 | Poor |
| | Dolerite (MD) | Fresh | 3.08 | 1.25 | Good |
| | Dolerite (MD) | Fresh | 2.90 | 0.14 | Good |
| | Dolerite (MD) | Fresh | 3.03 | 0.13 | Good |

## 4.8 Naturally occurring radioactive material

All samples provided by Ramelius to Landloch were tested for NORMs. None of the samples had values for either alpha/beta or gamma that exceeded the specified limit. Therefore, none of the samples give rise to enhanced exposures of radioactivity (Table 11).

**Table 11:** Results of NORM assessment

| Measurement | Surface activity (Bq/cm²) | Dose rate (μSv/hr) |
|---|---|---|
| Sample average | 0.0098 | 0.0008 |
| Specified limit | 0.40 | 10 |

## 4.9 Asbestiform minerals

A subset of thirteen (13) samples was assessed for the presence of asbestiform minerals using optical microscopy, in accordance with AS 4964-2004—the standard qualitative method for bulk material analysis employing polarised light microscopy (PLM) and dispersion staining. Of these 13 samples, 7 (54%) returned indications of unknown mineral fibres. These samples were logged as basalt and dolerite from the Kopai Crescent area, as well as footwall and dolerite from the Bombora deposit.

Although these 7 samples were not associated with any known asbestos seams, they may contain trace amounts of asbestiform minerals, particularly where alteration or mineral enrichment has occurred.

In line with standard industry procedure and as permitted under the modified application of AS 4964-2004, the samples were subjected to further analysis using scanning electron microscopy (SEM) coupled with energy dispersive spectroscopy (EDS) to determine the mineralogical composition and morphological characteristics of the fibres.

The samples were first assessed to determine if asbestos fibres were visible to the naked eye or under low powered microscope. All 7 samples returned a "no fibrous mineral" visually apparent in first inspection. Subsamples were then taken and analysed using SEM to 2,000x magnification.

SEM/EDS analysis confirmed that all 7 samples contained asbestos mineral fibres at concentrations below the limit of reporting (LoR) of 0.01 wt%.

At Kopai Crescent, the asbestos-type and mineral fibres were identified as:

- Hornblende (82.1%);
- Chlorite group (10.7%); and
- Actinolite (7.1%).

At Bombora, the asbestos-type and mineral fibres were identified as:

- Chlorite (47.6%);
- Hornblende (28.6%);
- Halite (14.3%);
- Albite (4.8%); and
- Iron oxide (4.8%).

Hornblende and Actinolite are the only asbestos-type minerals identified under SEM that fall under the Amphibole classification in the DEMIRS guidelines (Section 3.3.9).Although the identified fibres meet the broader morphological and compositional definitions of asbestos, none exceeded 0.01 wt%, and therefore pose no risk to human health under current occupational exposure standards.

A summary of the characteristics of the samples containing asbestos mineral fibres is provided in Table 12.

**Table 12:** Characteristics of samples returning asbestos mineral fibre,

| Deposit | Sample ID | Lithology | Weathering | Wt % of Asbestos in Sample | Depth From (m) | Depth To (m) | No. of Asbestos Fibres Observed | Assigned Dominant Minerology | Mineral Type 2 (subordinate ) | Mineral Type 3 (subordinate) |
|---|---|---|---|---|---|---|---|---|---|---|
| Kopai Crescent | RWC11 | Basalt | Transitional | <0.01 | 10 | 11 | <3 | Hornblende | | |
| | RWC21 | Dolerite | Fresh | <0.01 | 30 | 31 | <3 | Hornblende | | |
| | RWC32 | Dolerite | Transitional | <0.01 | 15 | 16 | <5 | Hornblende | Chlorite | Actinolite |
| | RWC56 | Dolerite | Transitional | <0.01 | 5 | 6 | <5 | Hornblende | Chlorite | Actinolite |
| Bombara | RWC79 | Footwall | Transitional | <0.01 | 6 | 8 | <5 | Chlorite | Halite | |
| | RWC123 | Dolerite | Transitional | <0.01 | 14 | 16 | <5 | Hornblende | Chlorite | Albite |
| | RWC128 | Dolerite | Fresh | <0.01 | 592 | 594 | <5 | Chlorite | Chlorite | Fe oxide |

## 5. KEY FINDINGS AND RECOMMENDATIONS

Overall, the results of test work regime suggests that waste materials from Kopai Crescent and Bombara present low risk of generating acid and metalliferous drainage. Wastes from these deposits are not expected to give rise to enhanced exposure of NORMs. These findings are consistent with the results of previous characterisation test work undertaken for Bombara.

PAF quartz dolerite waste material was encountered at the Bombora deposit between 182.5–184 m, approaching the maximum planned Tura underground depth. All quartz dolerite samples from depths shallower than this returned a NAF classification. This suggests that PAF may be encountered at Tura underground at depths beyond 182 m. If mining is planned to extend beyond 180 m, further sampling should be conducted of materials below this depth to help delineate locations of sulphide mineralisation and estimate the volumes of PAF that may be intersected (at the time of this study, the number of drill holes within Tura underground extending >200m below ground level was limited). If the anticipated volume of PAF is less than 1% of the total waste volume, co-mingling PAF with NAF may be a viable management strategy. For volumes exceeding 1% of the total waste volume, PAF may need to be managed via encapsulation within a designated PAF cell.

Seven (7) samples analysed were found to contain asbestos mineral fibres. These 7 samples originated from a number of lithologies (basalt, dolerite, and footwall) across different locations within the deposit. The samples were not part of a known asbestos seam. There is potential for waste material to contain traces of asbestos where it occurs in zones where alteration or mineral enrichment has occurred. Although some of the identified fibres meet the broader morphological and compositional definitions of asbestos, none exceeded 0.01 wt%, and therefore pose no risk to human health under current occupational exposure standards.

Waste materials from both Kopai Crescent and Bombara are considered suitable for use as growth media based on pH and salinity. Drainage from these materials is likely to generate salinity <4 dS/m. It is expected that vegetation in the vicinity of the project has some degree of salt tolerance however due to the presence of saline soils. Salt tolerant plants have also been observed to grow on these soils. It is recommended that salt tolerant species be included in the rehabilitation seed mix to account for the presence of these plant species *in situ* soils and promote vegetation establishment. The effect of saline drainage on the receiving environment will be dependent on the existing salinity of groundwater.

The post-mining matrix of the majority of waste material placed at surface is likely to be predominantly coarse-grained based on the weathering state (transitional and fresh). These materials are likely to remain stable when used in rehabilitation. Further physical testing of the waste materials is recommended once they become available in mining, to re-assess their physical characteristics and susceptibility to structural instability. There is potential for the fresh quartz dolerite and transitional and fresh dolerite at both deposits to be used in rehabilitation as rock armour, provided they retain a predominantly coarse-grained composition post-mining (>60%). The inclusion of rock armour on the outer surface of landforms may help to improve their resistance to erosion.

A small proportion of waste placed in waste rock landforms will be oxidised (<10%) and likely to be prone to structural instability. This waste type is likely to be dominated by fine grained particles and clay minerals and should not be placed at the surface of the landform (i.e. encapsulated).

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# APPENDIX A: SAMPLE DETAILS AND DEPOSIT CROSS SECTIONS

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**Table A-1:** Sample details for Kopai Crescent.

| Drill Hole ID | Sample ID | Lithology Code | Lithology | Oxidation | Depth From (m) | Depth To (m) | Location |
|---|---|---|---|---|---|---|---|
| BBRC1913 | RWC01 | MB | Basalt | Transitional | 10 | 11 | KC 4700 |
| BBRC1913 | RWC02 | MB | Basalt | Transitional | 11 | 12 | KC 4700 |
| BBRC1913 | RWC03 | MB | Basalt | Transitional | 12 | 13 | KC 4700 |
| BBRC1913 | RWC04 | MB | Basalt | Transitional | 13 | 14 | KC 4700 |
| BBRC1913 | RWC05 | MB | Basalt | Transitional | 14 | 15 | KC 4700 |
| BBRC1913 | RWC06 | MB | Basalt | Transitional | 15 | 16 | KC 4700 |
| BBRC1913 | RWC07 | MB | Basalt | Transitional | 16 | 17 | KC 4700 |
| BBRC1913 | RWC08 | MB | Basalt | Transitional | 17 | 18 | KC 4700 |
| BBRC1913 | RWC09 | MB | Basalt | Transitional | 18 | 19 | KC 4700 |
| BBRC1913 | RWC10 | MB | Basalt | Transitional | 19 | 20 | KC 4700 |
| BBRC1914 | RWC11 | MB | Basalt | Transitional | 10 | 11 | KC 4700 |
| BBRC1914 | RWC12 | MB | Basalt | Transitional | 11 | 12 | KC 4700 |
| BBRC1914 | RWC13 | MB | Basalt | Transitional | 12 | 13 | KC 4700 |
| BBRC1914 | RWC14 | MB | Basalt | Transitional | 13 | 14 | KC 4700 |
| BBRC1914 | RWC15 | MB | Basalt | Transitional | 14 | 15 | KC 4700 |
| BBRC1930 | RWC16 | MD | Dolerite | Transitional | 10 | 11 | KC 4700 |
| BBRC1930 | RWC17 | MD | Dolerite | Transitional | 11 | 12 | KC 4700 |
| BBRC1930 | RWC18 | MD | Dolerite | Transitional | 12 | 13 | KC 4700 |
| BBRC1930 | RWC19 | MD | Dolerite | Transitional | 13 | 14 | KC 4700 |
| BBRC1930 | RWC20 | MD | Dolerite | Transitional | 14 | 15 | KC 4700 |
| BBRC1937 | RWC21 | MD | Dolerite | Fresh | 30 | 31 | KC 4700 |
| BBRC1937 | RWC22 | MD | Dolerite | Fresh | 31 | 32 | KC 4700 |
| BBRC1937 | RWC23 | MD | Dolerite | Fresh | 32 | 33 | KC 4700 |
| BBRC1938 | RWC24 | MD | Dolerite | Oxide | 7 | 8 | KC 4700 |
| BBRC1938 | RWC25 | MD | Dolerite | Oxide | 8 | 9 | KC 4700 |
| BBRC1938 | RWC26 | MD | Dolerite | Oxide | 9 | 10 | KC 4700 |
| BBRC1944 | RWC27 | MD | Dolerite | Transitional | 10 | 11 | KC 4700 |
| BBRC1944 | RWC28 | MD | Dolerite | Transitional | 11 | 12 | KC 4700 |
| BBRC1944 | RWC29 | MD | Dolerite | Transitional | 12 | 13 | KC 4700 |
| BBRC1944 | RWC30 | MD | Dolerite | Transitional | 13 | 14 | KC 4700 |
| BBRC1944 | RWC31 | MD | Dolerite | Transitional | 14 | 15 | KC 4700 |
| BBRC1950 | RWC32 | MD | Dolerite | Transitional | 15 | 16 | KC 4700 |
| BBRC1950 | RWC33 | MD | Dolerite | Transitional | 16 | 17 | KC 4700 |
| BBRC1950 | RWC34 | MD | Dolerite | Transitional | 17 | 18 | KC 4700 |
| BBRC1950 | RWC35 | MD | Dolerite | Transitional | 18 | 19 | KC 4700 |
| BBRC1950 | RWC36 | MD | Dolerite | Transitional | 19 | 20 | KC 4700 |
| BBRC1974 | RWC37 | MD | Dolerite | Transitional | 5 | 6 | KC 4700 |
| BBRC1974 | RWC38 | MD | Dolerite | Transitional | 6 | 7 | KC 4700 |
| BBRC1974 | RWC39 | MD | Dolerite | Transitional | 7 | 8 | KC 4700 |
| BBRC1974 | RWC40 | MD | Dolerite | Transitional | 8 | 9 | KC 4700 |
| BBRC1974 | RWC41 | MD | Dolerite | Transitional | 9 | 10 | KC 4700 |
| BBRC1977 | RWC42 | MD | Dolerite | Transitional | 10 | 11 | KC 4700 |
| BBRC1977 | RWC43 | MD | Dolerite | Transitional | 11 | 12 | KC 4700 |

| Drill Hole ID | Sample ID | Lithology Code | Lithology | Oxidation | Depth From (m) | Depth To (m) | Location |
|---|---|---|---|---|---|---|---|
| BBRC1977 | RWC44 | MD | Dolerite | Transitional | 12 | 13 | KC 4700 |
| BBRC1977 | RWC45 | MD | Dolerite | Transitional | 13 | 14 | KC 4700 |
| BBRC1977 | RWC46 | MD | Dolerite | Transitional | 14 | 15 | KC 4700 |
| BBRC1979 | RWC47 | MD | Dolerite | Transitional | 9 | 10 | KC 4900 |
| BBRC1979 | RWC48 | MD | Dolerite | Transitional | 10 | 11 | KC 4900 |
| BBRC1979 | RWC49 | MD | Dolerite | Transitional | 11 | 12 | KC 4900 |
| BBRC1979 | RWC50 | MD | Dolerite | Transitional | 12 | 13 | KC 4900 |
| BBRC1984 | RWC51 | MD | Dolerite | Transitional | 5 | 6 | KC 4900 |
| BBRC1984 | RWC52 | MD | Dolerite | Transitional | 6 | 7 | KC 4900 |
| BBRC1984 | RWC53 | MD | Dolerite | Transitional | 7 | 8 | KC 4900 |
| BBRC1984 | RWC54 | MD | Dolerite | Transitional | 8 | 9 | KC 4900 |
| BBRC1984 | RWC55 | MD | Dolerite | Transitional | 9 | 10 | KC 4900 |
| BBRC2007 | RWC56 | MD | Dolerite | Transitional | 5 | 6 | KC 5750 |
| BBRC2007 | RWC57 | MD | Dolerite | Transitional | 6 | 7 | KC 5750 |
| BBRC2007 | RWC58 | MD | Dolerite | Transitional | 7 | 8 | KC 5750 |
| BBRC2007 | RWC59 | MD | Dolerite | Transitional | 8 | 9 | KC 5750 |
| BBRC2007 | RWC60 | MD | Dolerite | Transitional | 9 | 10 | KC 5750 |
| BBRC2011 | RWC61 | MD | Dolerite | Transitional | 15 | 16 | KC 5750 |
| BBRC2011 | RWC62 | MD | Dolerite | Transitional | 16 | 17 | KC 5750 |
| BBRC2011 | RWC63 | MD | Dolerite | Transitional | 17 | 18 | KC 5750 |
| BBRC2011 | RWC64 | MD | Dolerite | Transitional | 18 | 19 | KC 5750 |
| BBRC2011 | RWC65 | MD | Dolerite | Transitional | 19 | 20 | KC 5750 |
| BBRC2014 | RWC66 | MD | Dolerite | Transitional | 8 | 9 | KC 5750 |
| BBRC2014 | RWC67 | MD | Dolerite | Transitional | 9 | 10 | KC 5750 |
| BBRC2014 | RWC68 | MD | Dolerite | Transitional | 10 | 11 | KC 5750 |
| BBRC2014 | RWC69 | MD | Dolerite | Transitional | 11 | 12 | KC 5750 |
| BBRC2014 | RWC70 | MD | Dolerite | Transitional | 12 | 13 | KC 5750 |

**Table A-2:** Sample details for Bombora.

| Drill Hole ID | Sample ID | Lithology Code | Lithology | Oxidation | Depth From (m) | Depth To (m) | Location |
|---|---|---|---|---|---|---|---|
| BBDD0135 | RWC71 | ALP | Lamprophyre | Fresh | 160.85 | 162.21 | BOM1800 |
| BBDD0146 | RWC72 | ALP | Lamprophyre | Fresh | 105.42 | 107.01 | Tura UG |
| BBDD0178 | RWC73 | ALP | Lamprophyre | Fresh | 426 | 428 | KL UG |
| BBDD0134 | RWC74 | MDQ | Q. dolerite | Trans | 5 | 7.1 | BOM1100 |
| BBDD0134 | RWC75 | MDQ | Q. dolerite | Transitional | 8 | 10 | BOM1100 |
| BBDD0134 | RWC76 | MDQ | Q. dolerite | Transitional | 10 | 12 | BOM1100 |
| BBDD0134 | RWC77 | MDQ | Q. dolerite | Transitional | 12 | 14 | BOM1100 |
| BBDD0134 | RWC78 | MDQ | Q. dolerite | Transitional | 14 | 16 | BOM1100 |
| BBDD0135 | RWC79 | MR_FW | Footwall | Transitional | 6 | 8 | BOM1800 |
| BBDD0135 | RWC80 | MR_FW | Footwall | Transitional | 8 | 10 | BOM1800 |
| BBDD0135 | RWC81 | MR_FW | Footwall | Transitional | 10 | 12 | BOM1800 |
| BBDD0135 | RWC82 | MR_FW | Footwall | Transitional | 12 | 14 | BOM1800 |
| BBDD0135 | RWC83 | MR_FW | Footwall | Fresh | 147 | 149 | BOM1800 |
| BBDD0135 | RWC84 | MR_FW | Footwall | Fresh | 149 | 151 | BOM1800 |
| BBDD0135 | RWC85 | MR_FW | Footwall | Fresh | 151 | 153 | BOM1800 |
| BBDD0135 | RWC86 | MR_FW | Footwall | Fresh | 153 | 155 | BOM1800 |
| BBDD0135 | RWC87 | MR_FW | Footwall | Fresh | 155 | 157 | BOM1800 |
| BBDD0137 | RWC88 | MDQ | Q. dolerite | Transitional | 5 | 7 | BOM1100 |
| BBDD0137 | RWC89 | MDQ | Q. dolerite | Transitional | 7 | 9 | BOM1100 |
| BBDD0137 | RWC90 | MDQ | Q. dolerite | Transitional | 9 | 11 | BOM1100 |
| BBDD0137 | RWC91 | MDQ | Q. dolerite | Transitional | 11 | 13 | BOM1100 |
| BBDD0137 | RWC92 | MDQ | Q. dolerite | Transitional | 13 | 15 | BOM1100 |
| BBDD0137 | RWC93 | MDQ | Q. dolerite | Transitional | 15 | 17 | BOM1100 |
| BBDD0147 | RWC94 | MDQ | Q. dolerite | Transitional | 6.9 | 9 | BOM1800 |
| BBDD0147 | RWC95 | MDQ | Q. dolerite | Transitional | 11 | 13 | BOM1800 |
| BBDD0147 | RWC96 | MDQ | Q. dolerite | Fresh | 78 | 80 | BOM1800 |
| BBDD0147 | RWC97 | MDQ | Q. dolerite | Fresh | 89.37 | 90.71 | BOM1800 |
| BBDD0147 | RWC98 | MDQ | Q. dolerite | Fresh | 90.71 | 92 | BOM1800 |
| BBDD0147 | RWC99 | MDQ | Q. dolerite | Fresh | 102 | 104 | BOM1800 |
| BBDD0147 | RWC100 | MDQ | Q. dolerite | Fresh | 104 | 106 | BOM1800 |
| BBDD0147 | RWC101 | MDQ | Q. dolerite | Fresh | 106 | 108.09 | BOM1800 |
| BBDD0147 | RWC102 | MDQ | Q. dolerite | Fresh | 108.72 | 110 | BOM1800 |
| BBDD0147 | RWC103 | MDQ | Q. dolerite | Fresh | 110 | 112 | BOM1800 |
| BBDD0147 | RWC104 | MDQ | Q. dolerite | Fresh | 112 | 114 | BOM1800 |
| BBDD0161 | RWC105 | MDQ | Q. dolerite | Fresh | 175 | 177 | Tura UG |
| BBDD0161 | RWC106 | MDQ | Q. dolerite | Fresh | 177 | 179 | Tura UG |
| BBDD0161 | RWC107 | MDQ | Q. dolerite | Fresh | 179 | 181 | Tura UG |
| BBDD0161 | RWC108 | MDQ | Q. dolerite | Fresh | 181 | 182.5 | Tura UG |
| BBDD0161 | RWC109 | MDQ | Q. dolerite | Fresh | 182.5 | 184 | Tura UG |
| BBDD0154W1 | RWC110 | MDQ | Q. dolerite | Fresh | 544.04 | 545.72 | KL UG |
| BBDD0154W1 | RWC111 | MDQ | Q. dolerite | Fresh | 545.72 | 547 | KL UG |
| BBDD0183W1 | RWC112 | MDQ | Q. dolerite | Fresh | 550 | 552 | KL UG |
| BBDD0183W1 | RWC113 | MDQ | Q. dolerite | Fresh | 552 | 554 | KL UG |
| BBDD0183W1 | RWC114 | MDQ | Q. dolerite | Fresh | 554 | 556 | KL UG |

| Drill Hole ID | Sample ID | Lithology Code | Lithology | Oxidation | Depth From (m) | Depth To (m) | Location |
|---|---|---|---|---|---|---|---|
| BBDD0175 | RWC115 | MDQ | Q. dolerite | Transitional | 5 | 7 | BOM 0700, above Tura UG |
| BBDD0175 | RWC116 | MDQ | Q. dolerite | Transitional | 7 | 9 | BOM 0700, above Tura UG |
| BBDD0175 | RWC117 | MDQ | Q. dolerite | Transitional | 9 | 11 | BOM 0700, above Tura UG |
| BBDD0173 | RWC118 | MDQ | Q. dolerite | Transitional | 5 | 7 | BOM 0700, above Tura UG |
| BBDD0173 | RWC119 | MDQ | Q. dolerite | Transitional | 7 | 9 | BOM 0700, above Tura UG |
| BBDD0173 | RWC120 | MDQ | Q. dolerite | Transitional | 9 | 11 | BOM 0700, above Tura UG |
| BBDD0171 | RWC121 | MD | Dolerite | Transitional | 10 | 12 | Tura UG |
| BBDD0171 | RWC122 | MD | Dolerite | Transitional | 12 | 14 | Tura UG |
| BBDD0171 | RWC123 | MD | Dolerite | Transitional | 14 | 16 | Tura UG |
| BBDD0170 | RWC124 | MD | Dolerite | Transitional | 18 | 20 | Tura UG |
| BBDD0170 | RWC125 | MD | Dolerite | Transitional | 20 | 22 | Tura UG |
| BBDD0167 | RWC126 | MD | Dolerite | Transitional | 16 | 18 | Tura UG |
| BBDD0167 | RWC127 | MD | Dolerite | Transitional | 18 | 19.85 | Tura UG |
| BBDD0148 | RWC128 | MD | Dolerite | Fresh | 592 | 594 | KL UG |
| BBDD0148 | RWC129 | MD | Dolerite | Fresh | 594 | 596 | KL UG |
| BBDD0148 | RWC130 | MD | Dolerite | Fresh | 596 | 598 | KL UG |

## Kopai Crescent

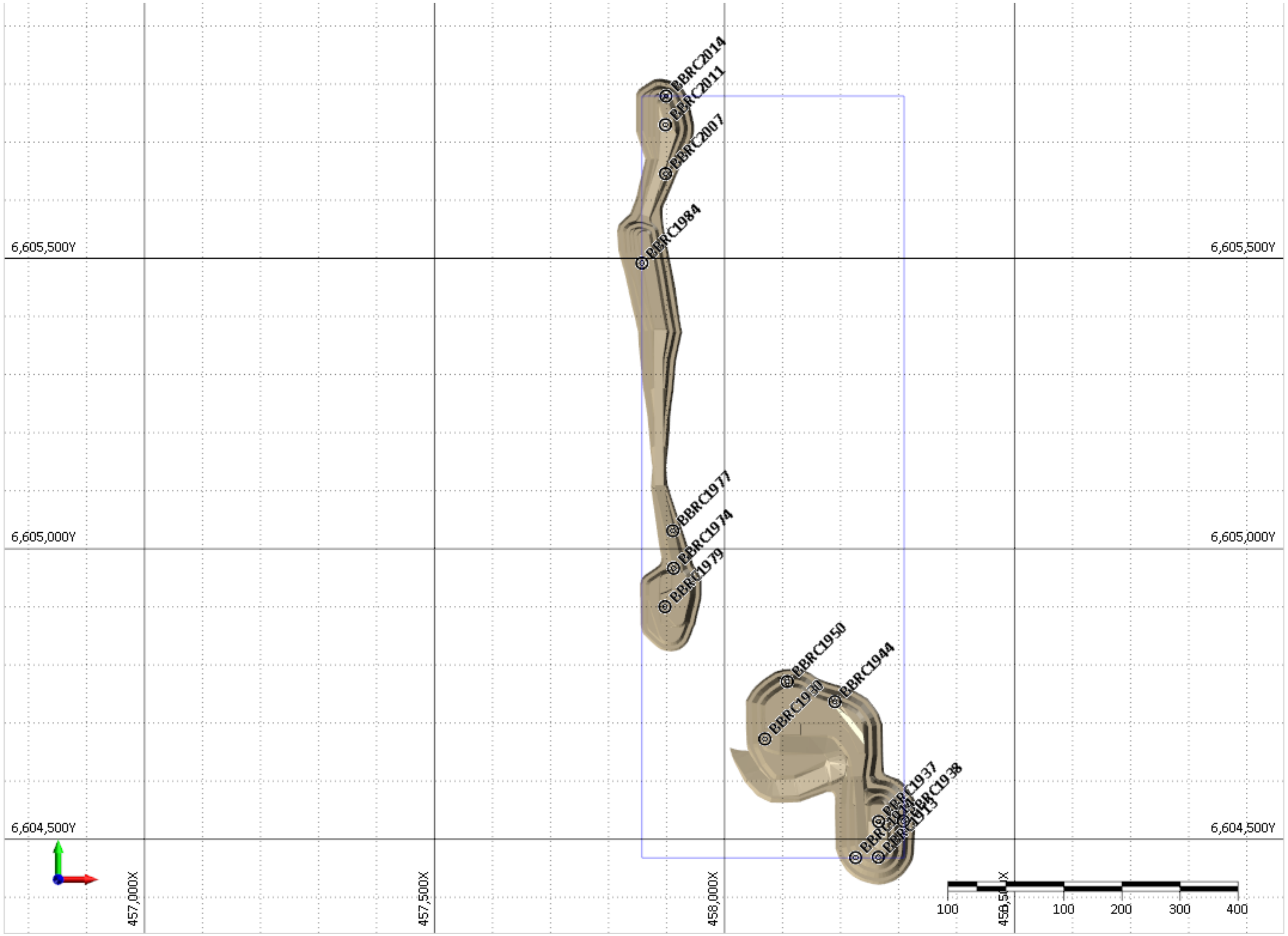

**Figure A-1:** Locality plan view showing selected drill holes and pit shell used for this study (Source: Ramelius).

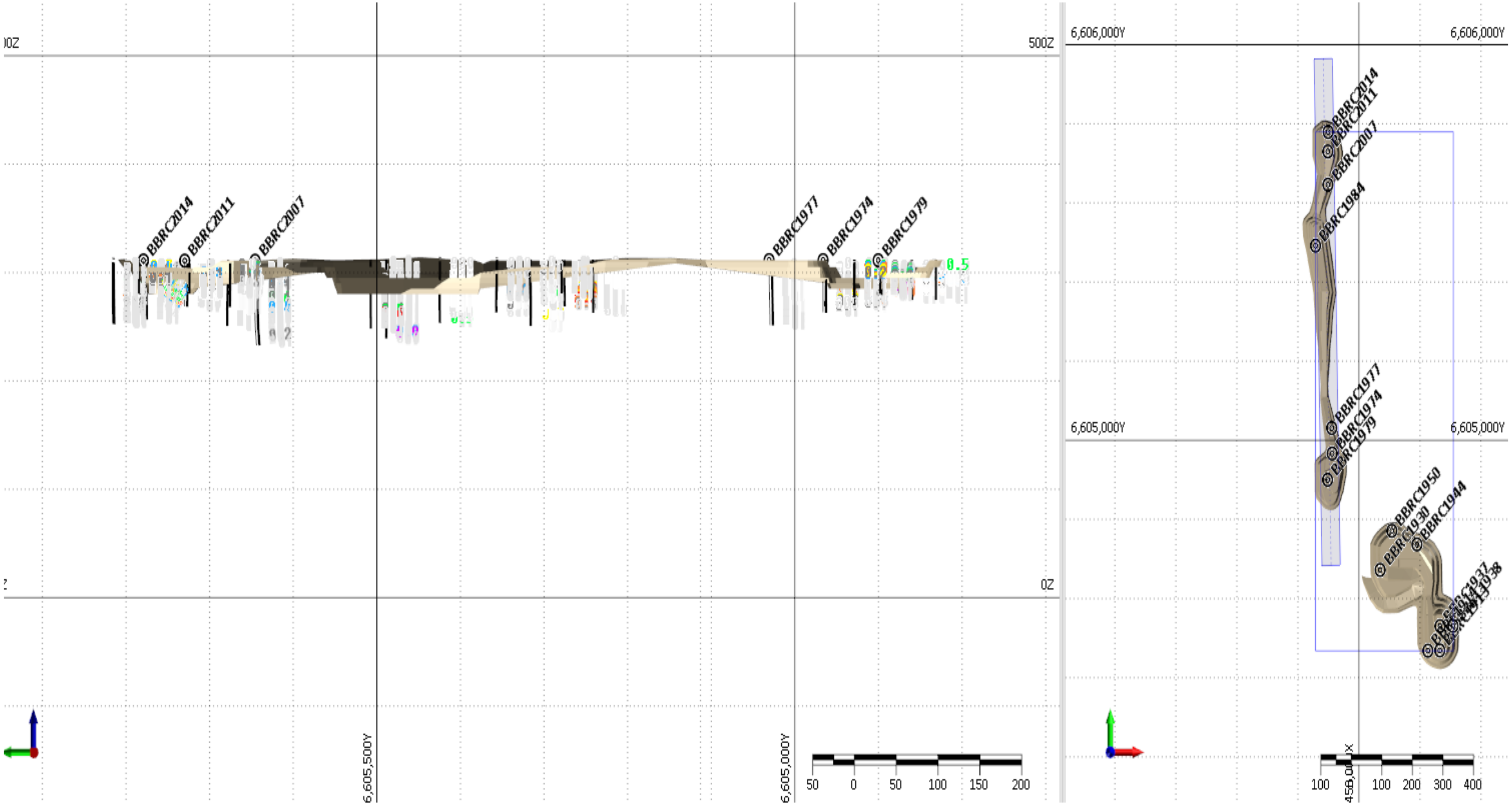

**Figure A-2:** Long section of the middle and northern pits (Source: Ramelius).

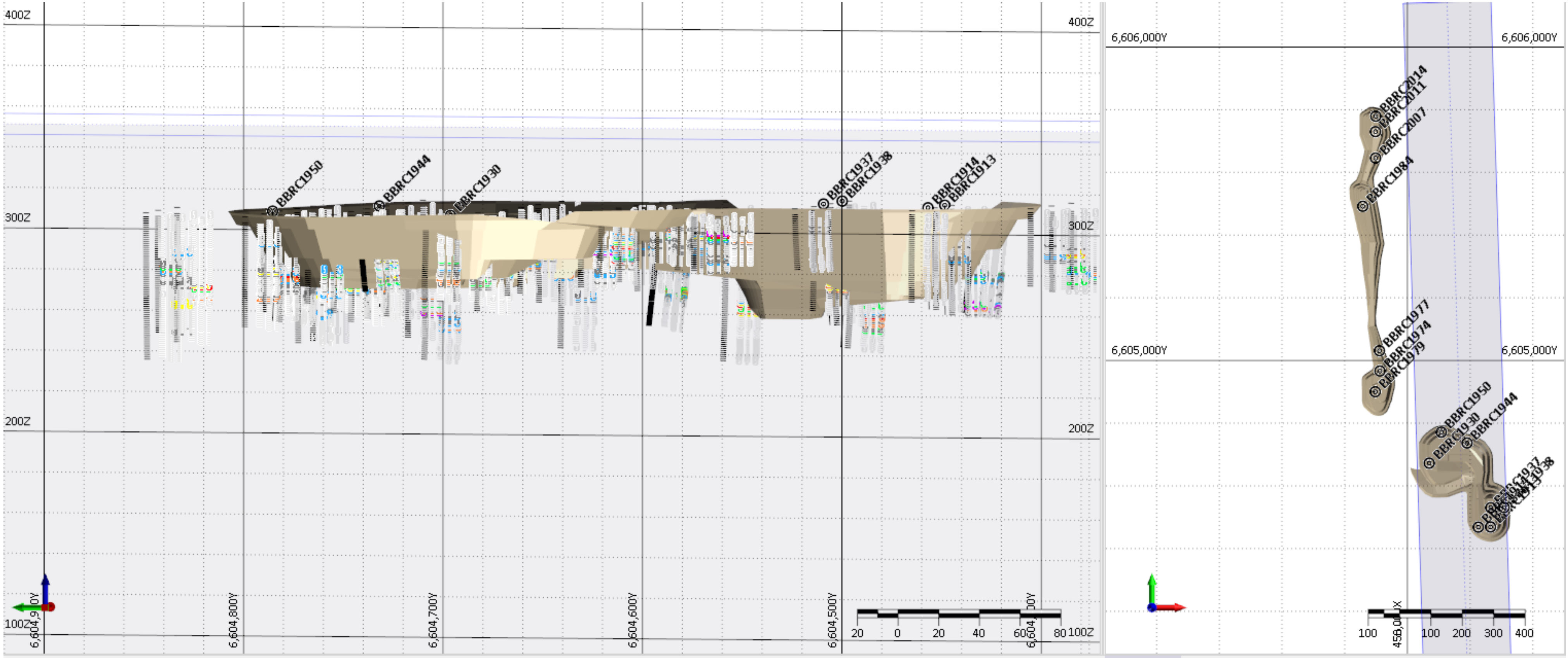

**Figure A-3:** Long section of southern pit (Source: Ramelius).

The following cross-sections depict the drill string coloured by lithology code, with light green representing basalt and dark green indicating dolerite. The information displayed to the right of the drill string indicates the assay grade of gold (Au) in ppm, while the depth in meters is shown on the left side.

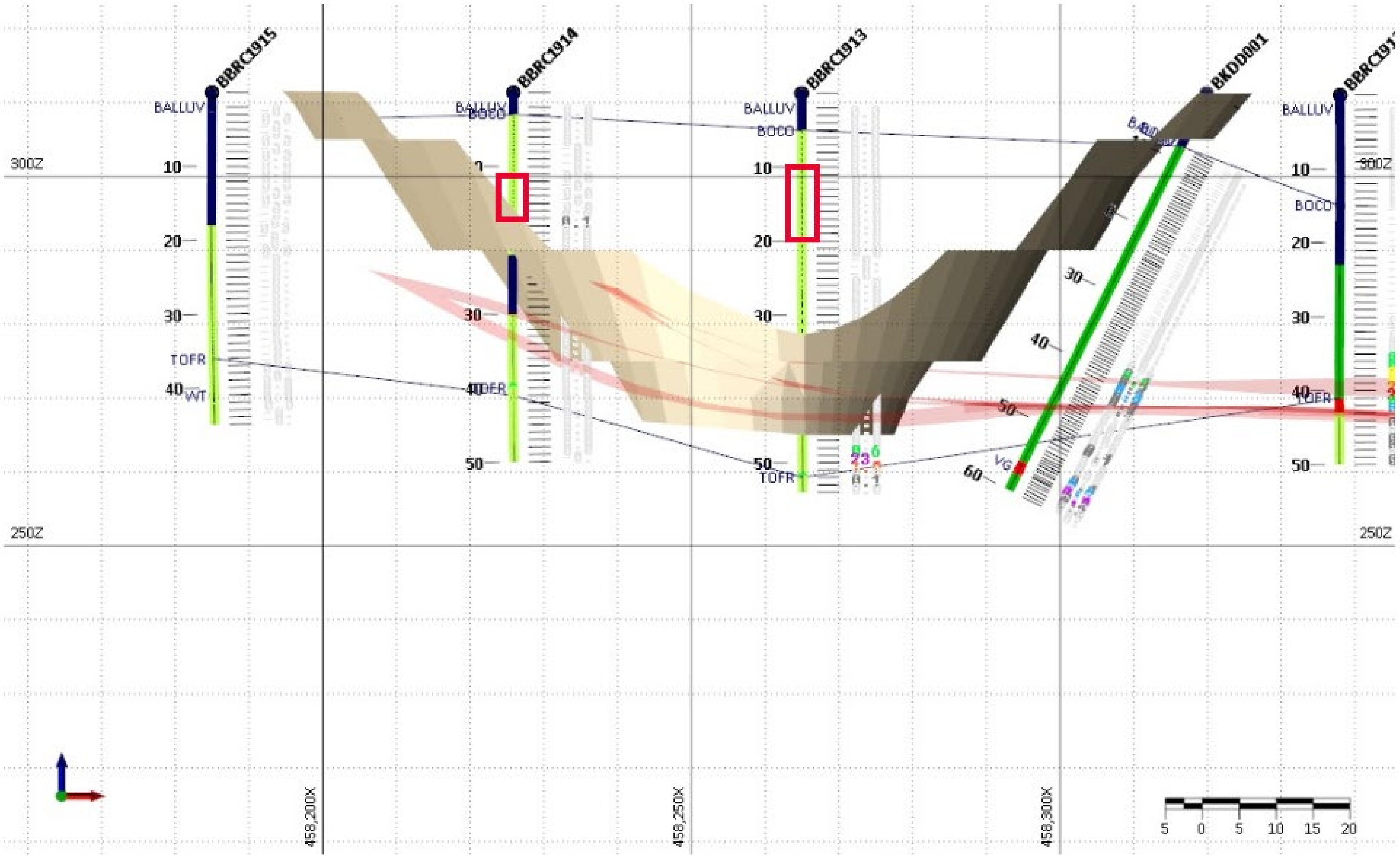

**Figure A-4:** 6604470N BBRC1913 samples 10-20m and BBRC1914 10-15m in transitional basalt (Source: Ramelius).

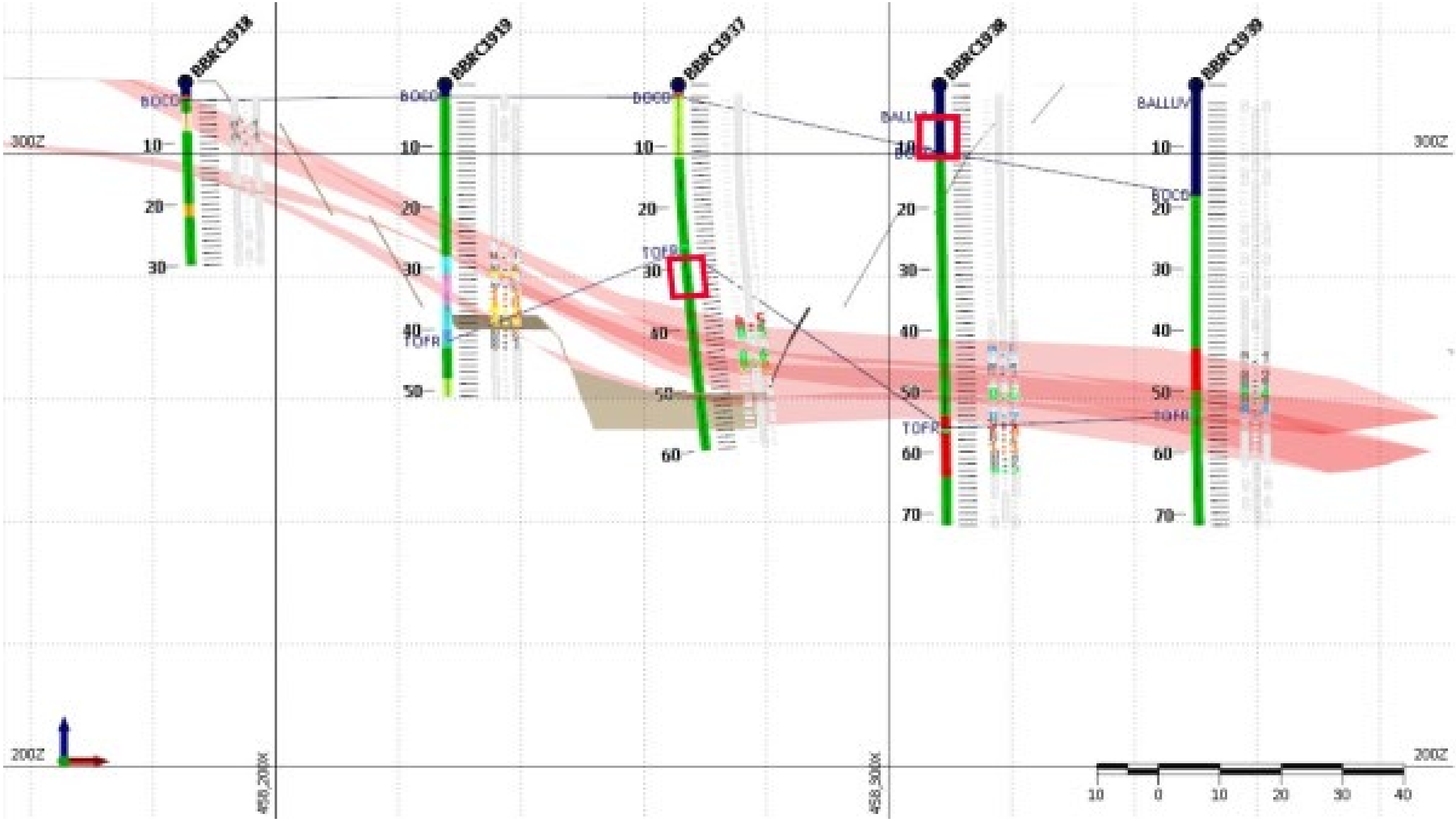

**Figure A-5:** 6604530N BBRC1937 28-33m fresh dolerite and BBRC1938 5-10m oxide dolerite (Source: Ramelius).

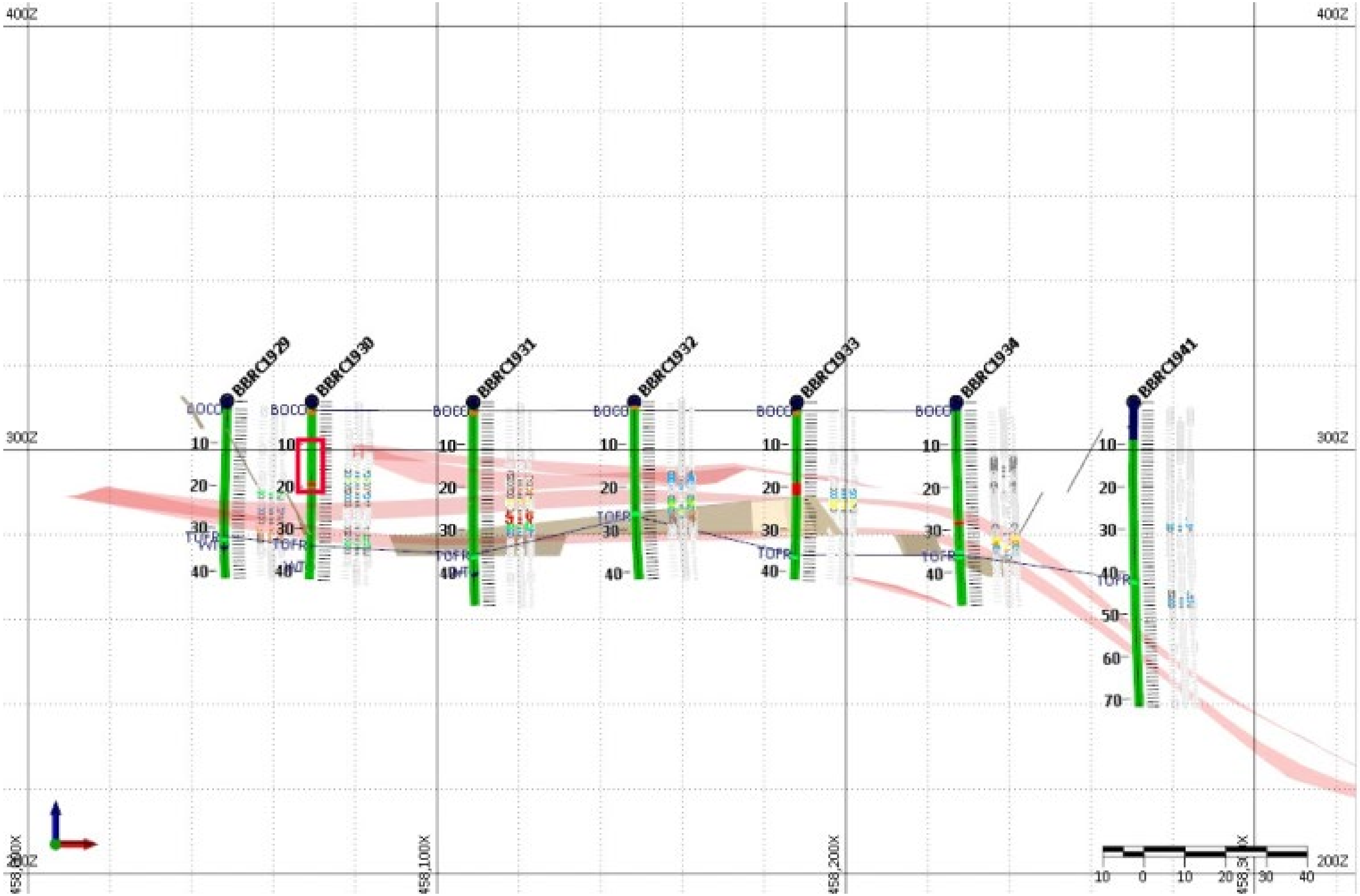

**Figure A-6:** 6604670N BBRC1930 10-15m transitional dolerite (Source: Ramelius).

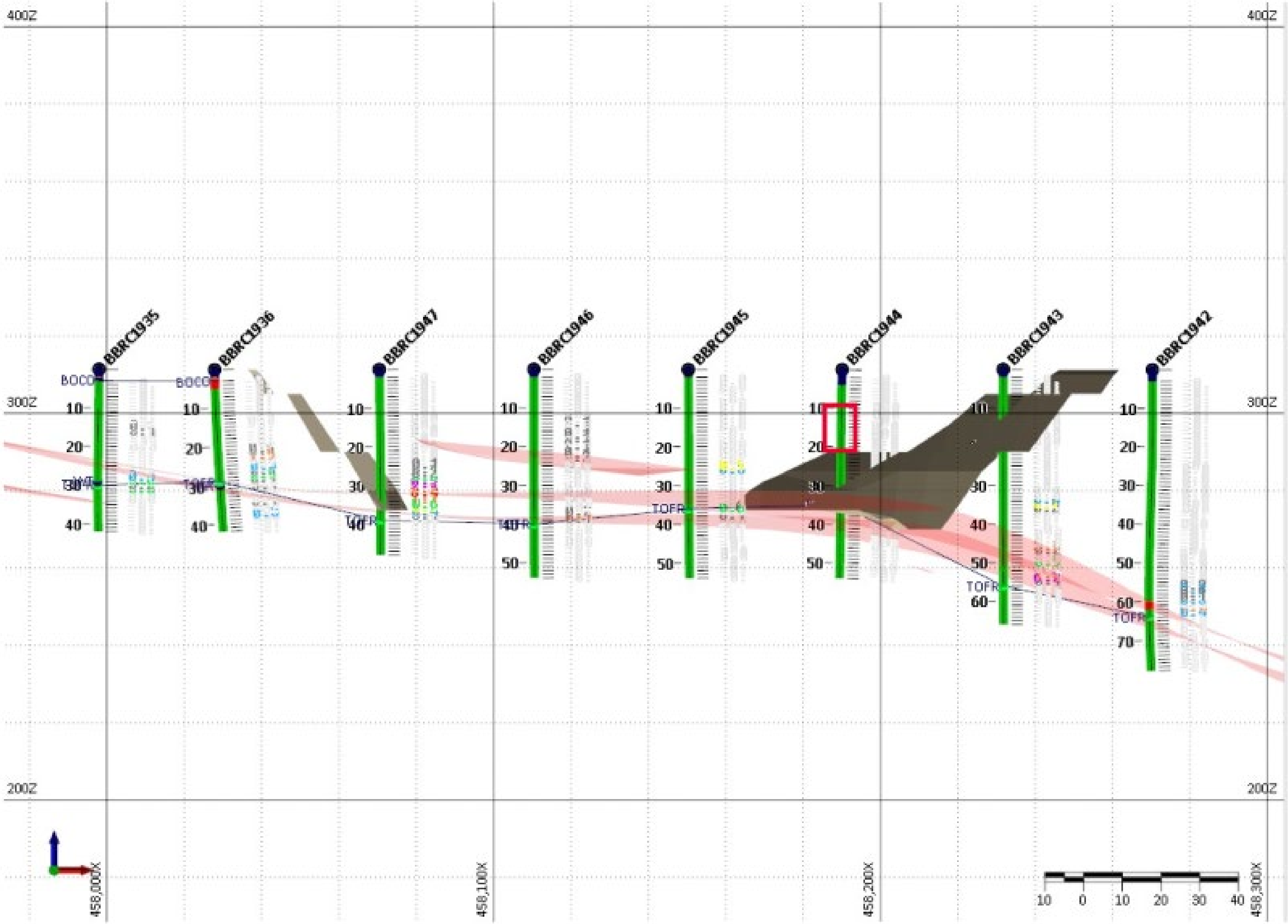

**Figure A-7:** 6604740N BBRC1944 10 to 15m transitional dolerite (Source: Ramelius).

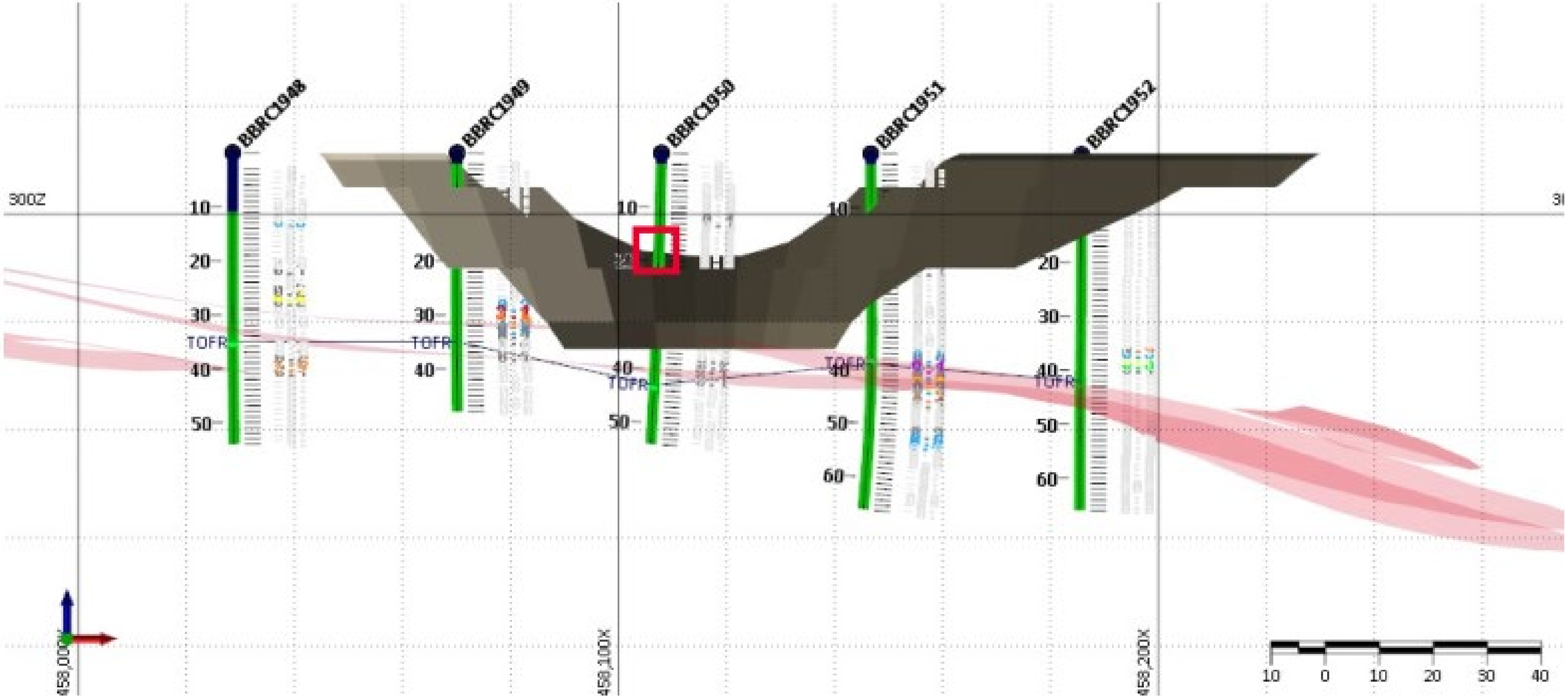

**Figure A-8:** 6604770N BBRC1950 15-20m transitional dolerite (Source: Ramelius).

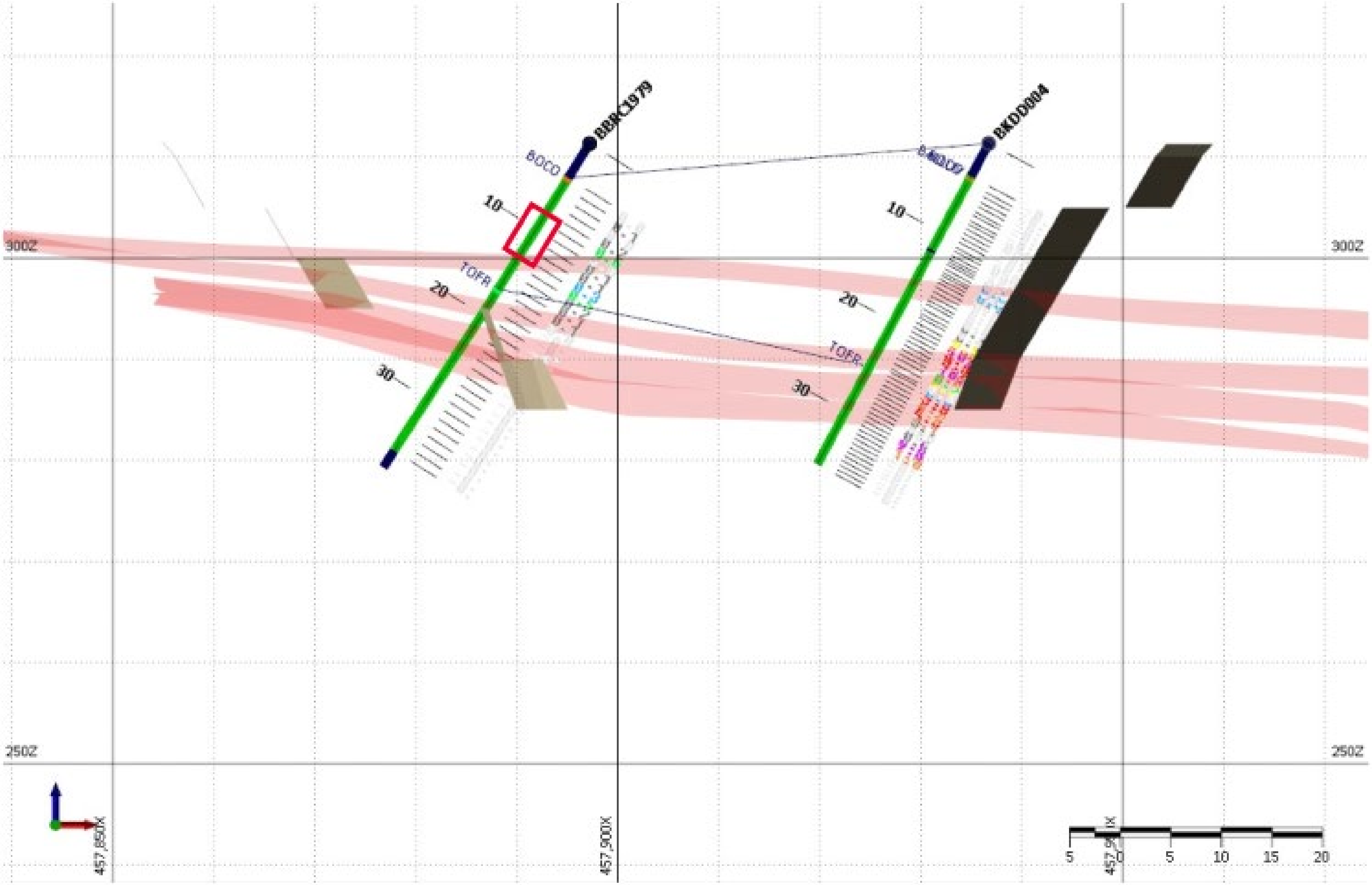

**Figure A-9:** 6604900N BBRC1979 9-13m transitional dolerite (Source: Ramelius).

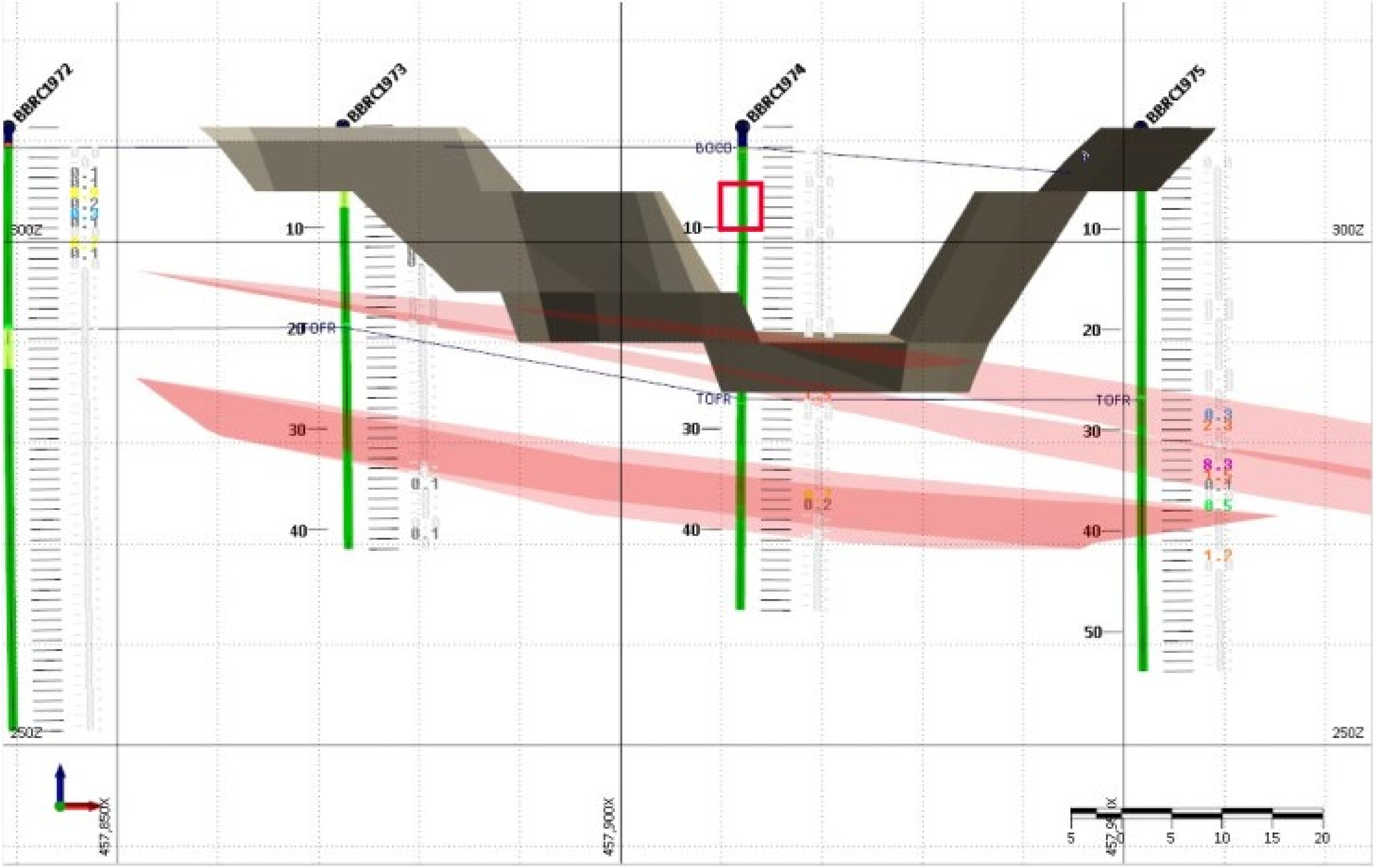

**Figure A-10:** 6604970 BBRC1974 5 to 10m transitional dolerite (Source: Ramelius).

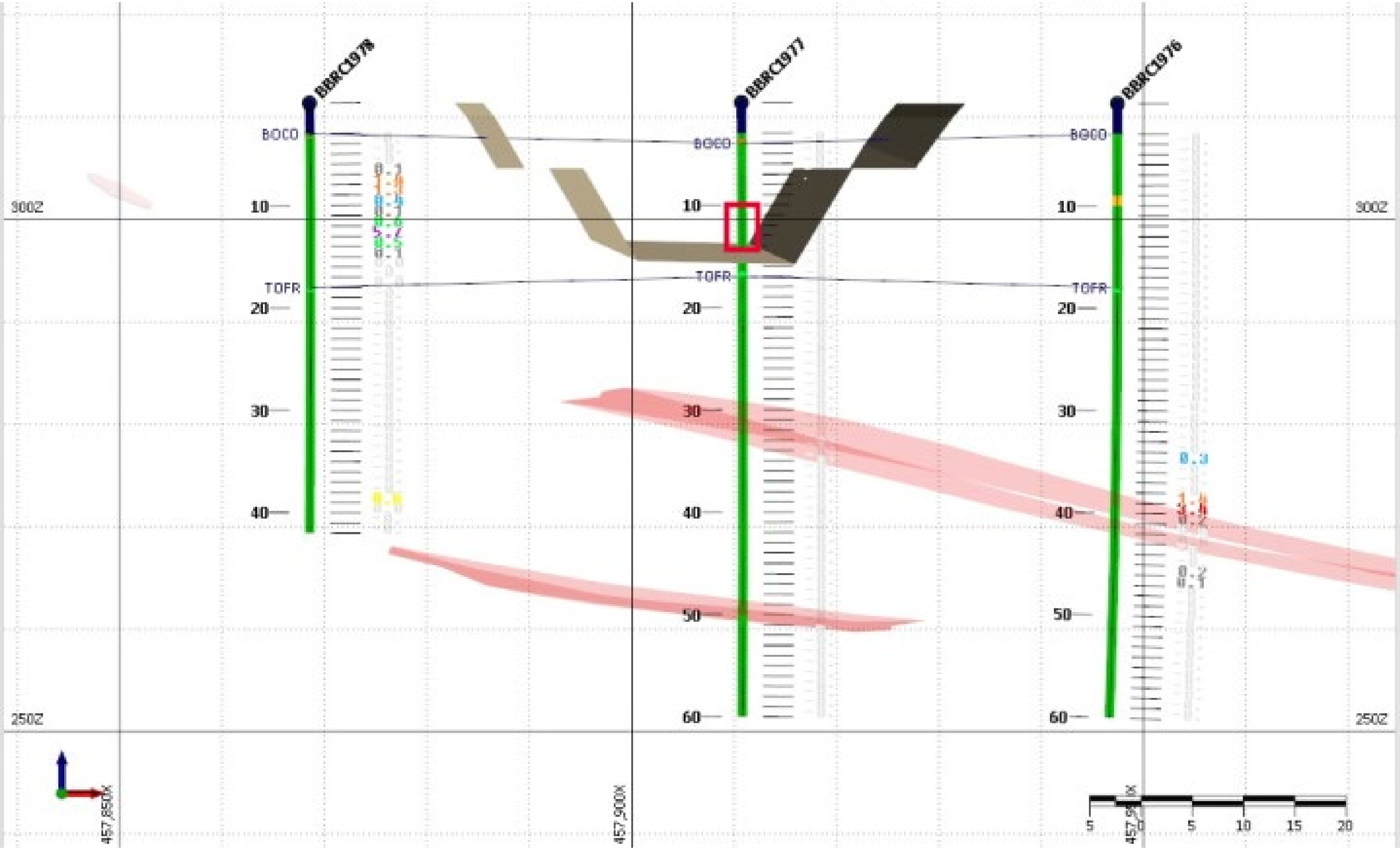

**Figure A-11:** 6605030N BBRC1977 10 to 15m transitional dolerite (Source: Ramelius).

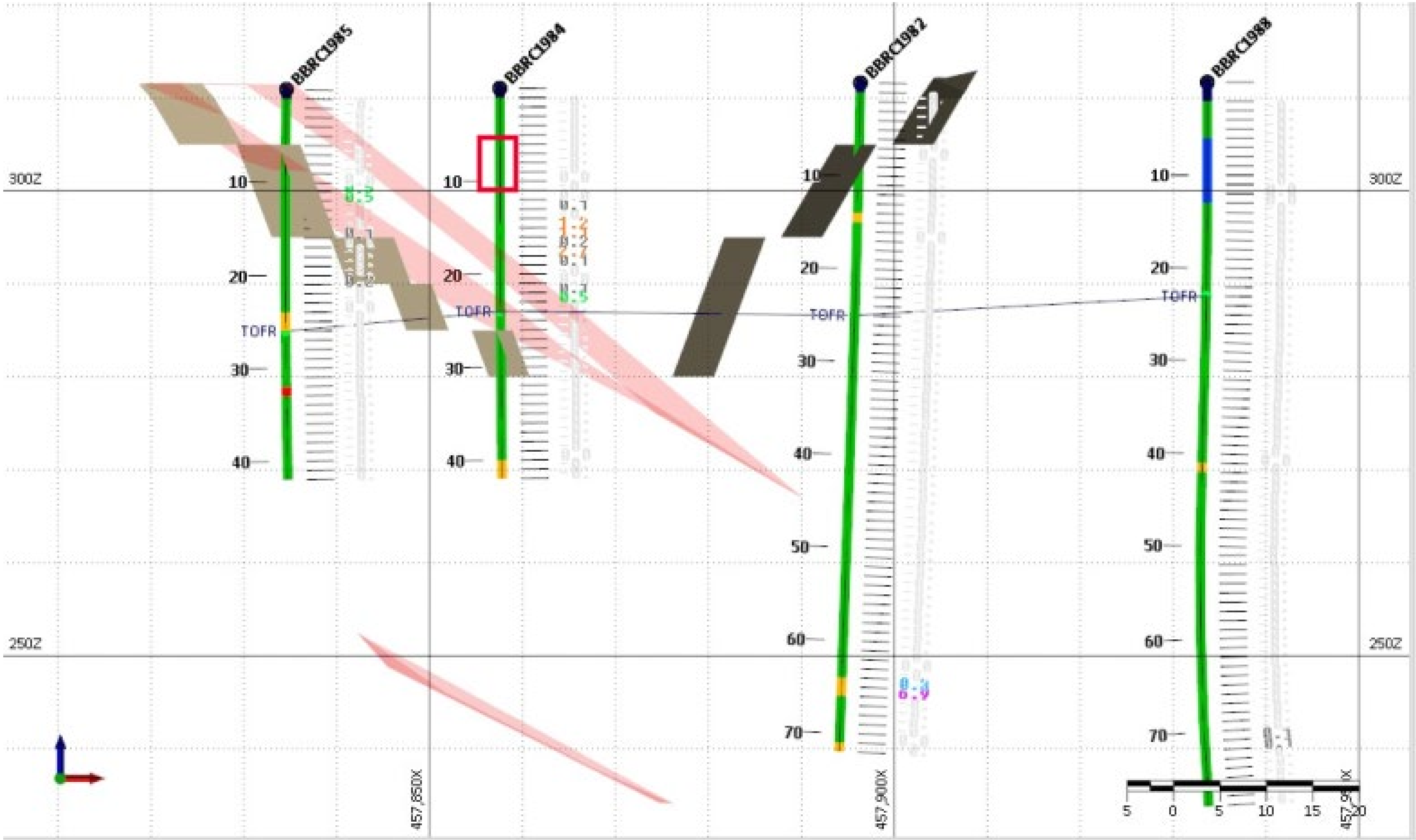

**Figure A-12:** 6605490N BBRC1984 5-10m transitional dolerite (Source: Ramelius).

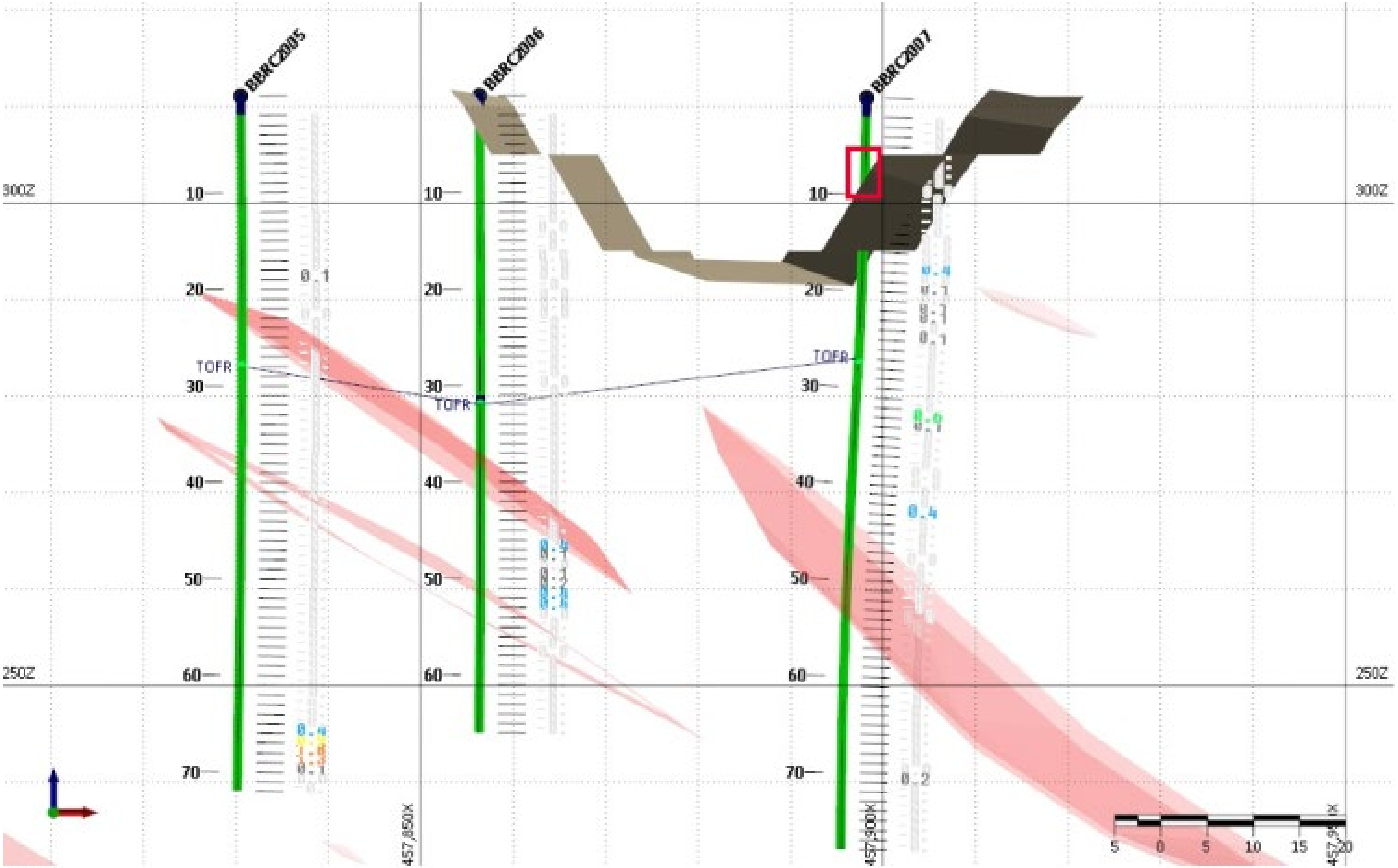

Figure A-13: 6605640N BBRC2007 5-10m transitional dolerite (Source: Ramelius).

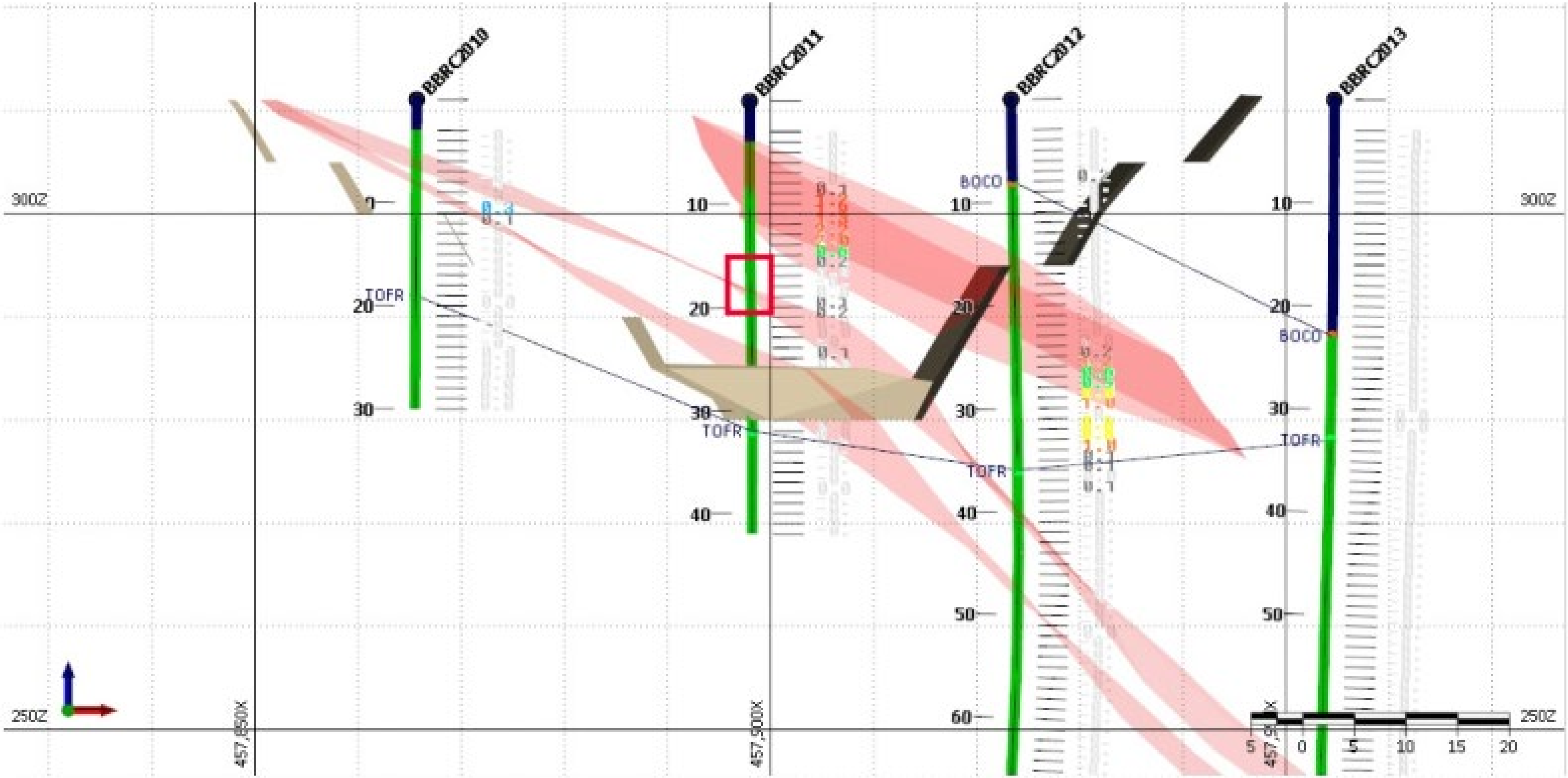

**Figure A-14:** 6605730N BBRC2011 15-20m transitional dolerite (Source: Ramelius).

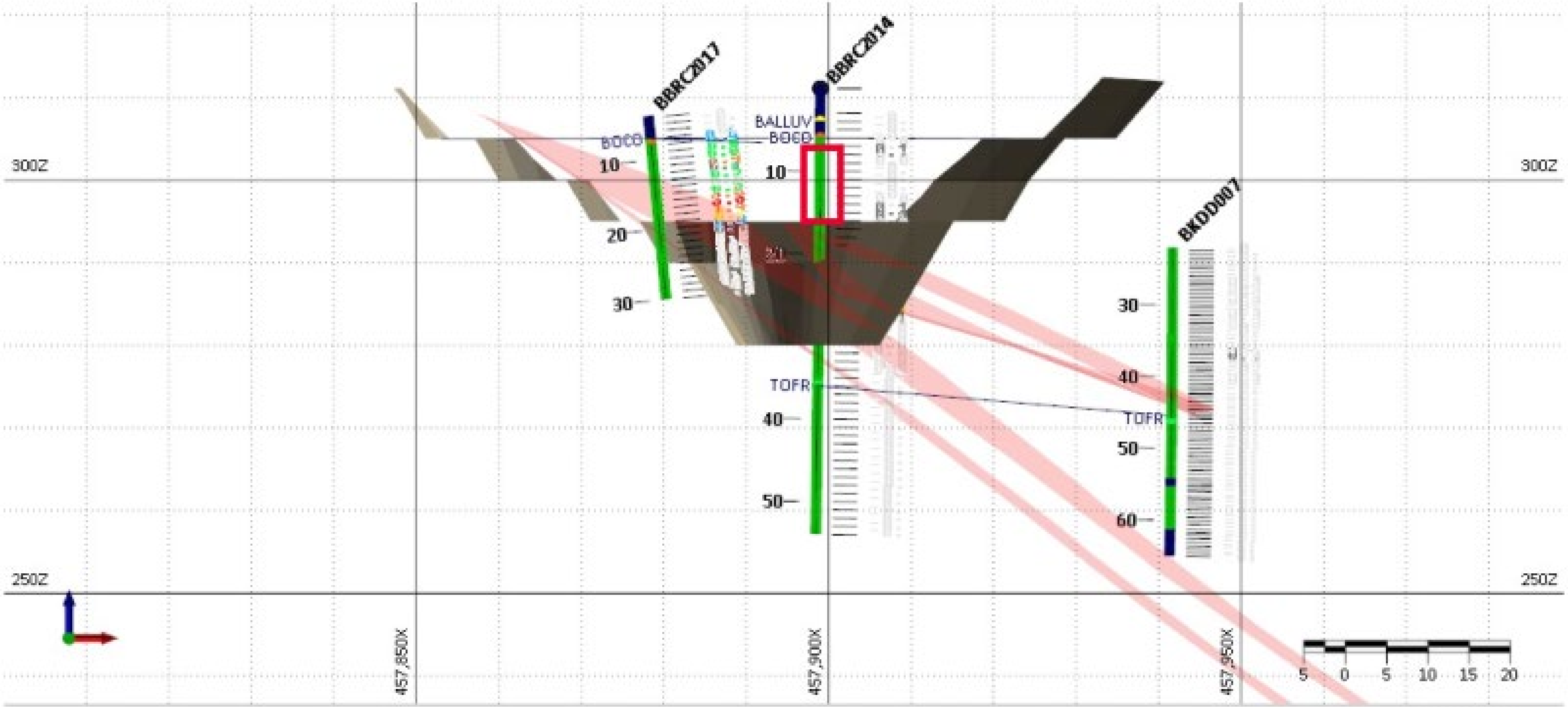

**Figure A-15:** 6605780 BBRC2014 8-13m transitional dolerite (Source: Ramelius).

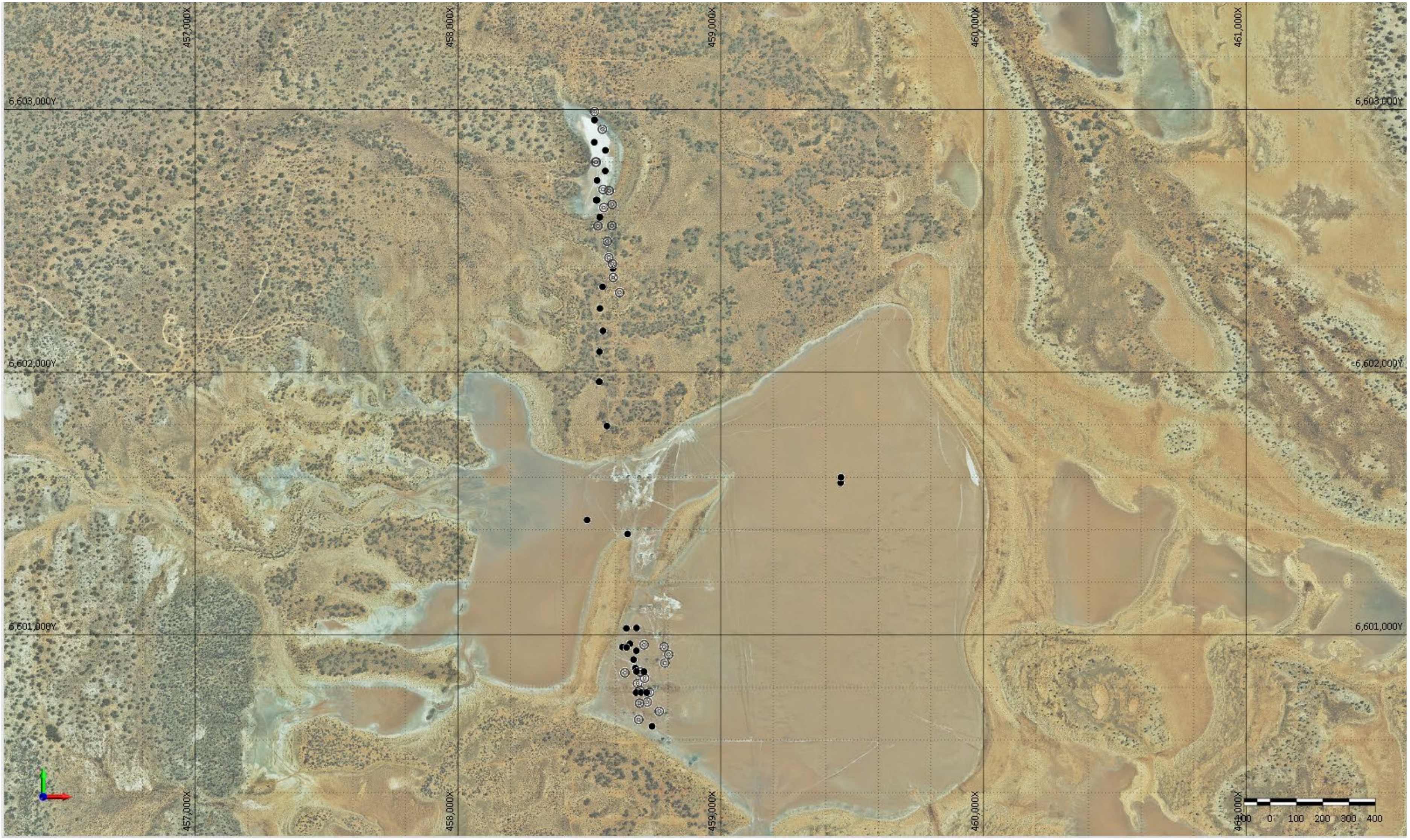

**Figure A-16:** Map showing all available drill holes <3 years old, for waste characterisation (Source: Ramelius).

**Figure A-17:** Showing location of selected drill holes for the waste characterisation study. Hollow points indicate 2021-2022 drilling campaign (Breaker Resources) and solid points indicate 2023-2024 Ramelius resources drilling campaign) (Source: Ramelius).

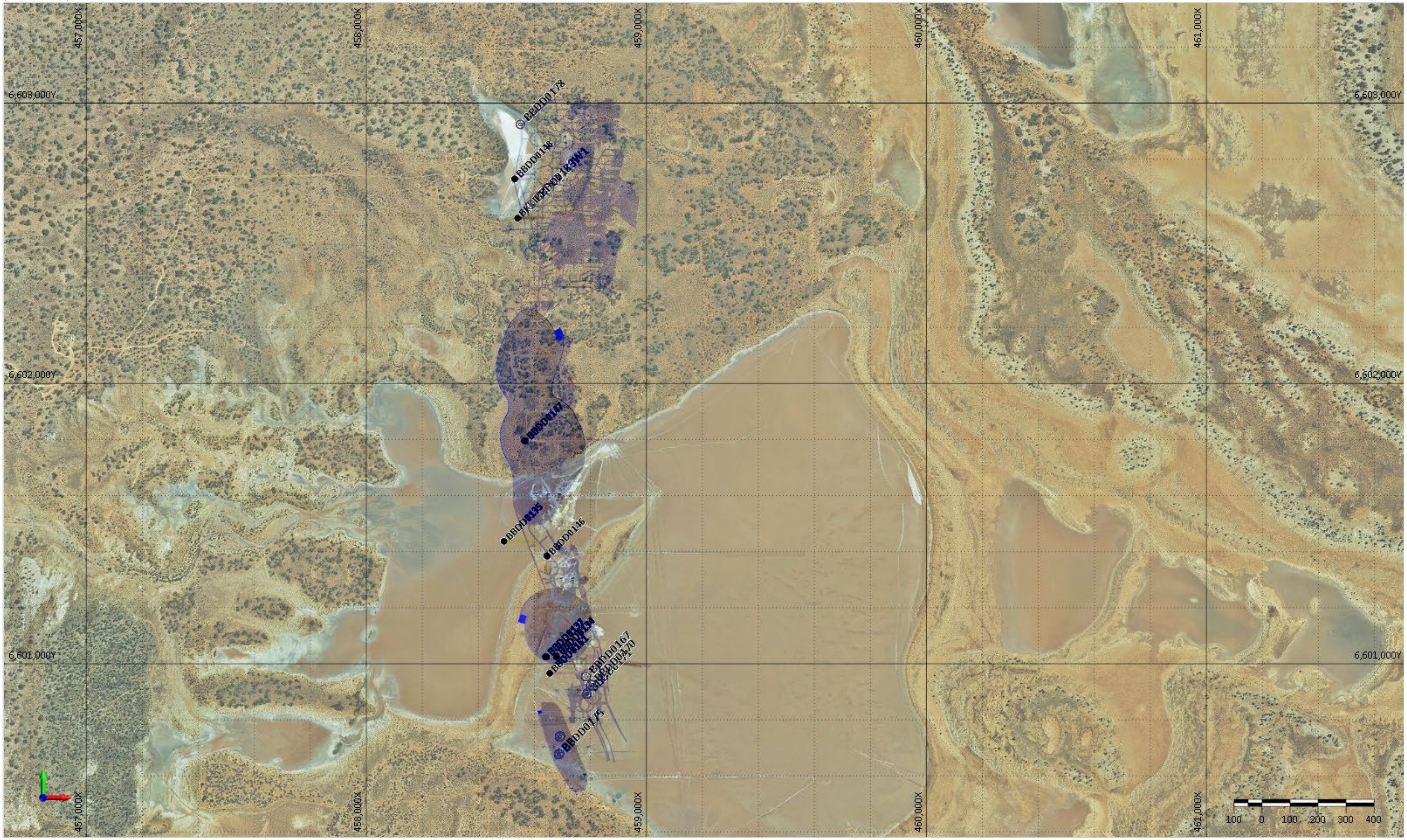

**Figure A-18:** Showing collar locations with planned open pit and underground development (Source: Ramelius)

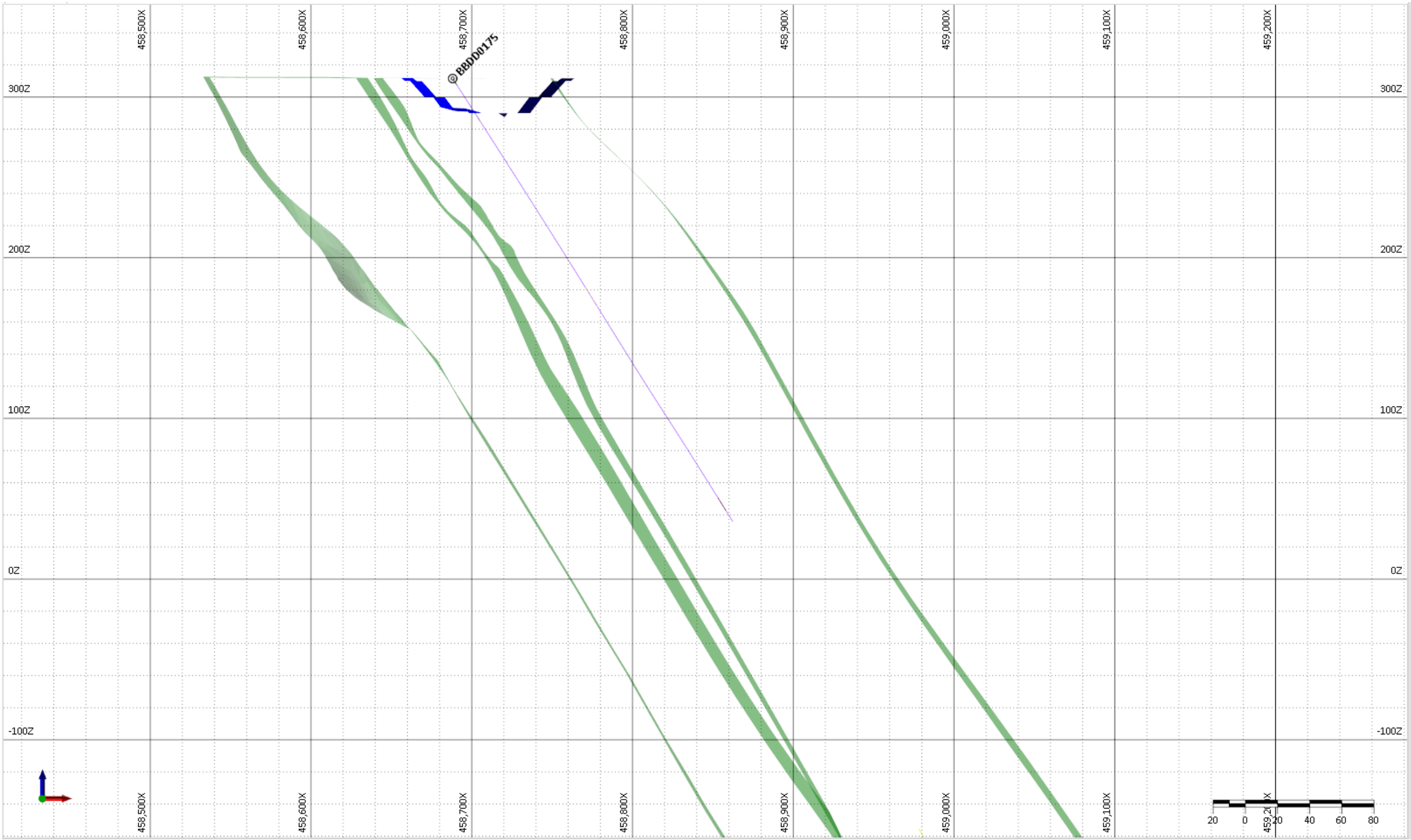

**Figure A-19:** BBDD0175 6600666 Northing, sampled from 5-11 in transitional weathered MDQ, within BOM0700 (Source: Ramelius).

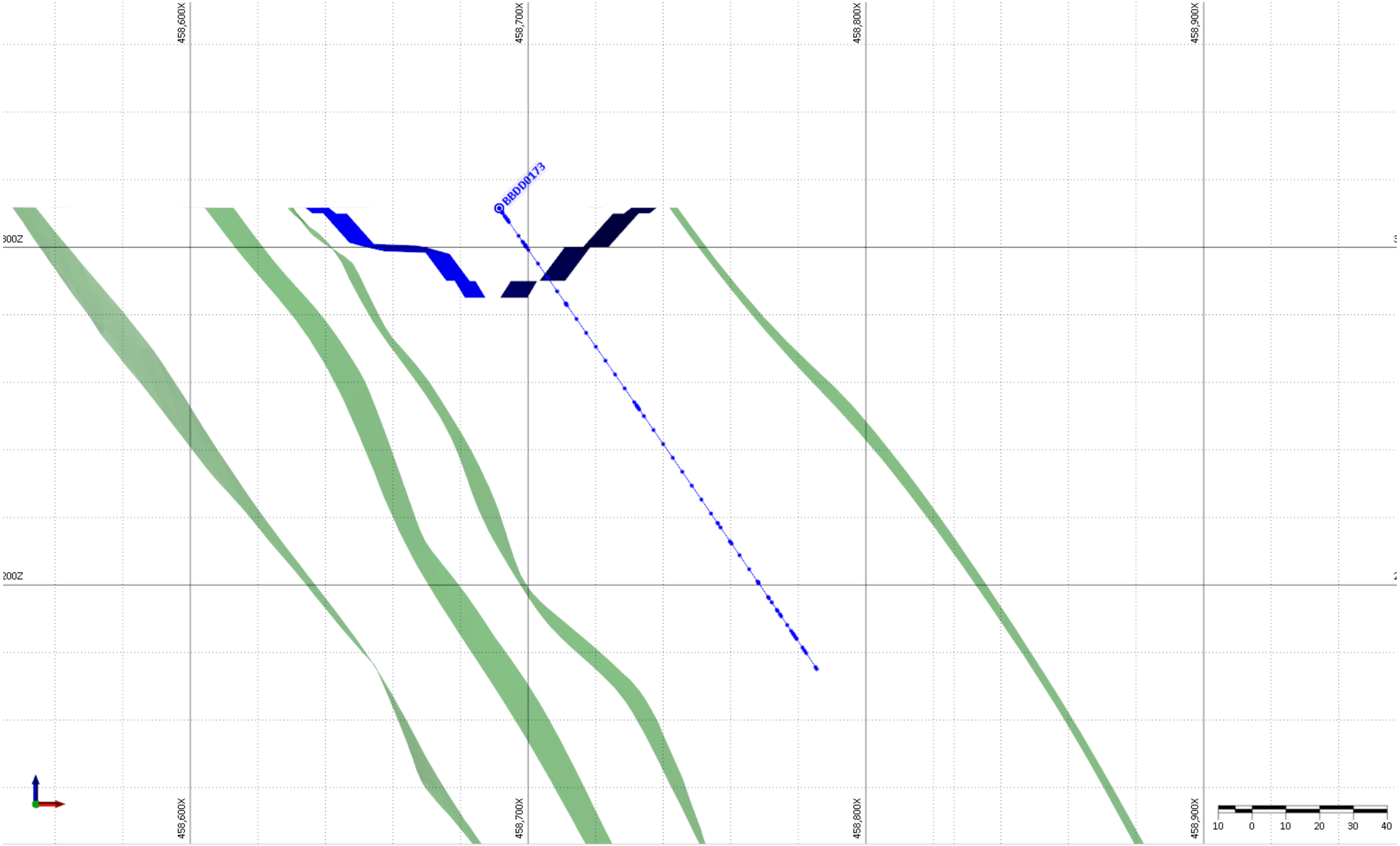

**Figure A-20:** BBDD0173 6600740 Northing sampled from 5-11m in transitional MDQ within BOM 0700 (Source: Ramelius).

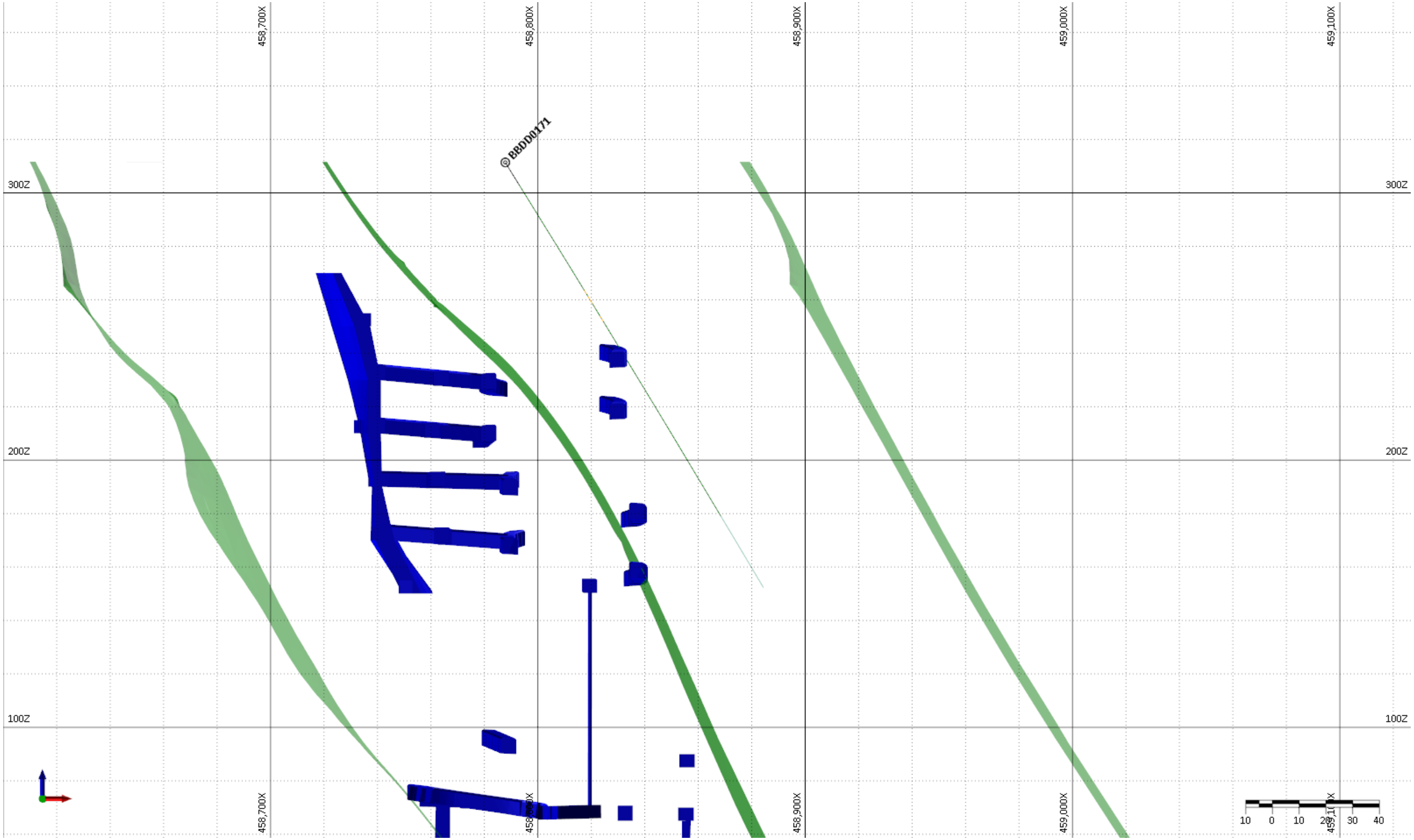

**Figure A-21:** BBDD0171 6600892 Northing sampled from 10-16m in transitional MD (Source: Ramelius).

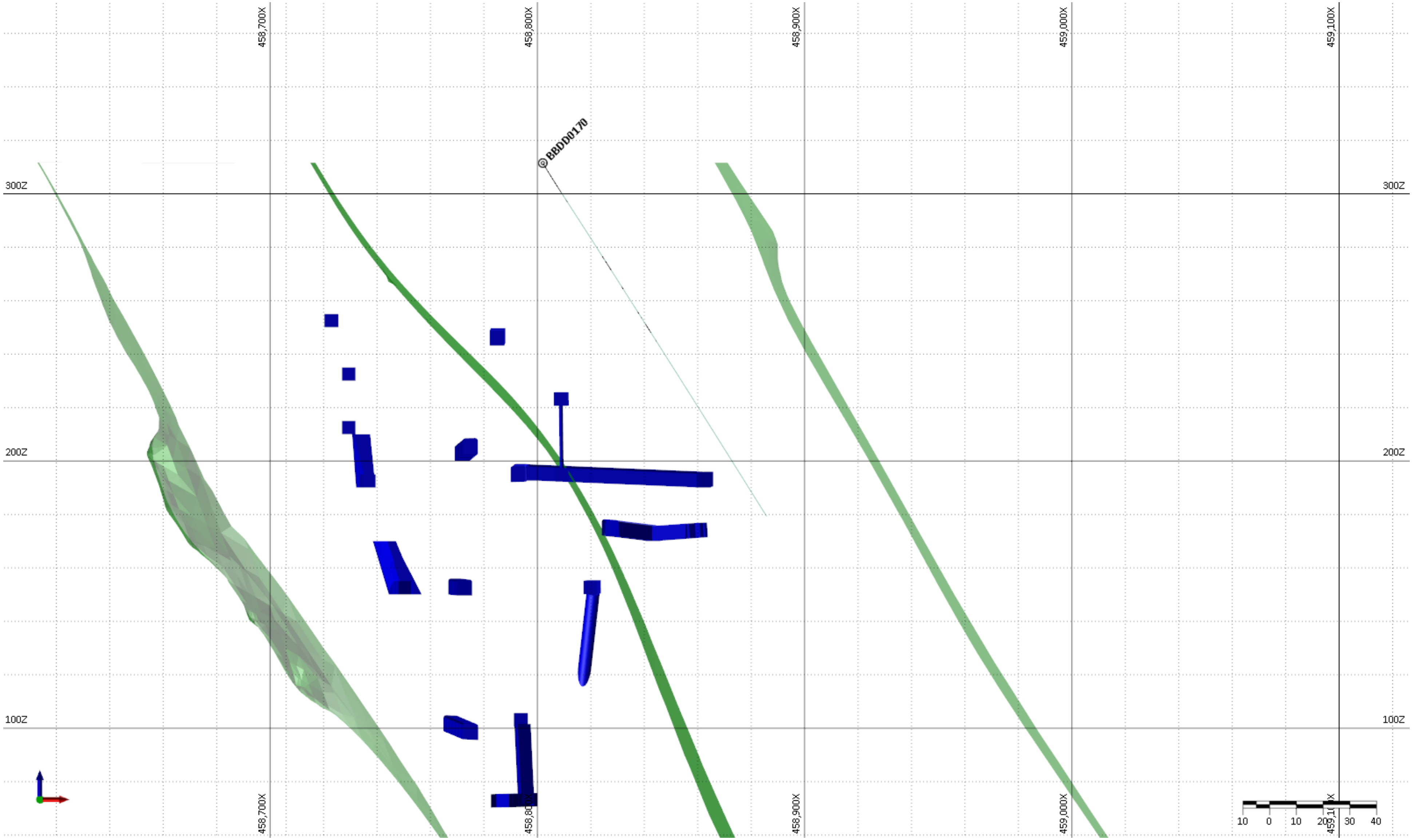

**Figure A-22:** BBDD0170 6600925 northing sampled from 18-22m in transitional MD close to Tura underground (Source: Ramelius).

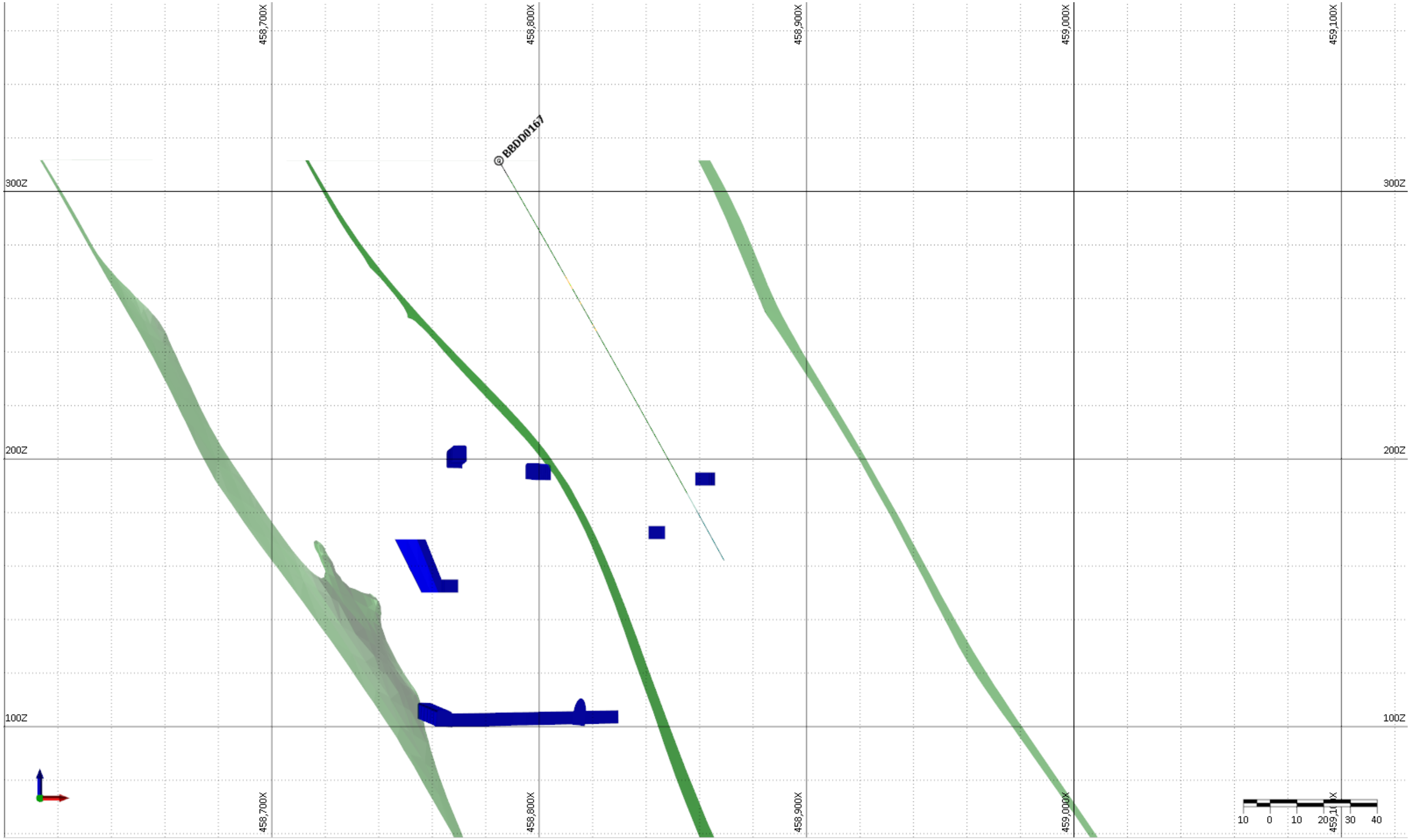

**Figure A-22:** BBDD0167 6600954 Northing sampled from 16-19.85 in transitional MD located above Tura underground (Source: Ramelius).

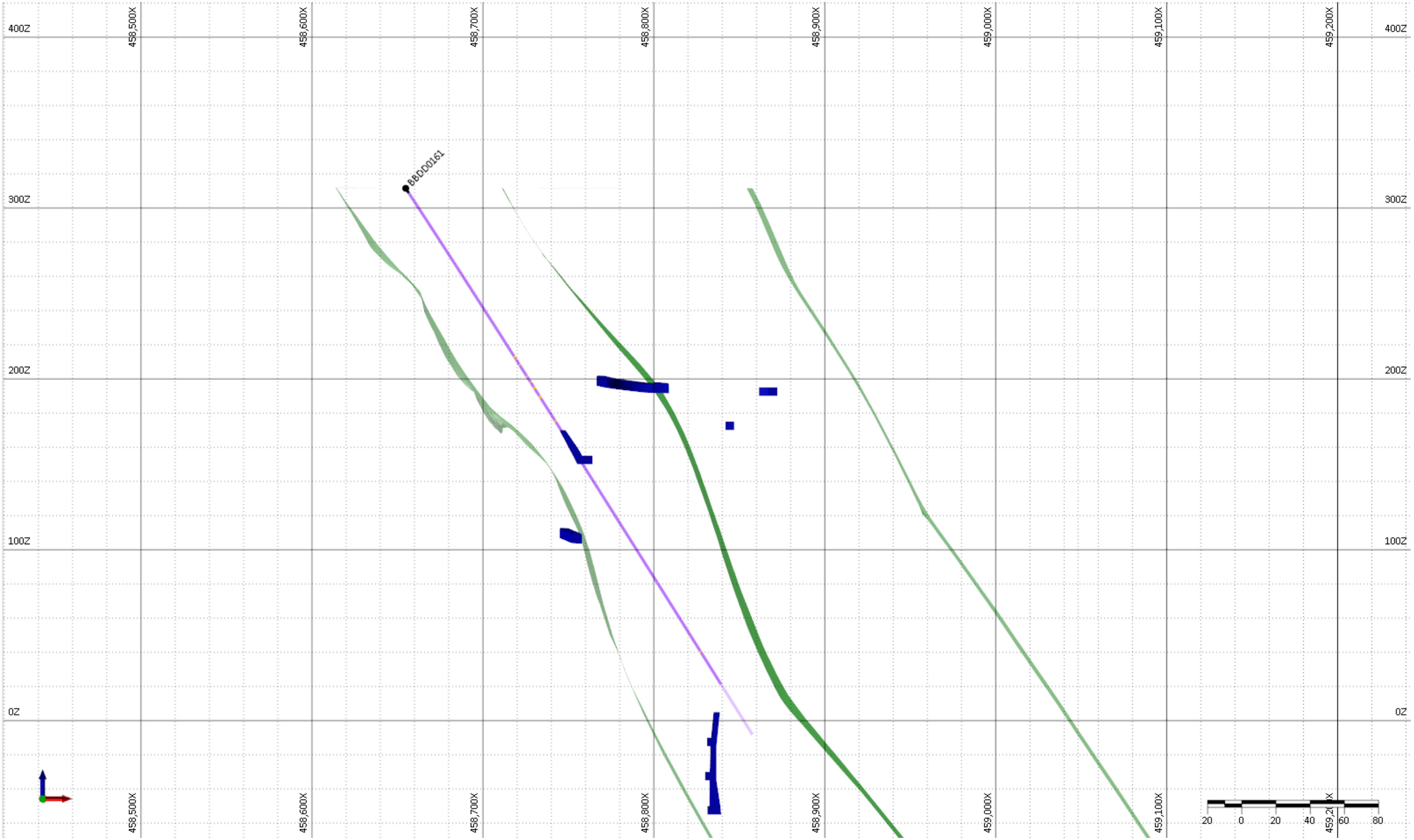

**Figure A-23:** BBDD0161 6600966 northing sampled from 174-184m in Fresh MDQ, within Tura underground (Source: Ramelius).

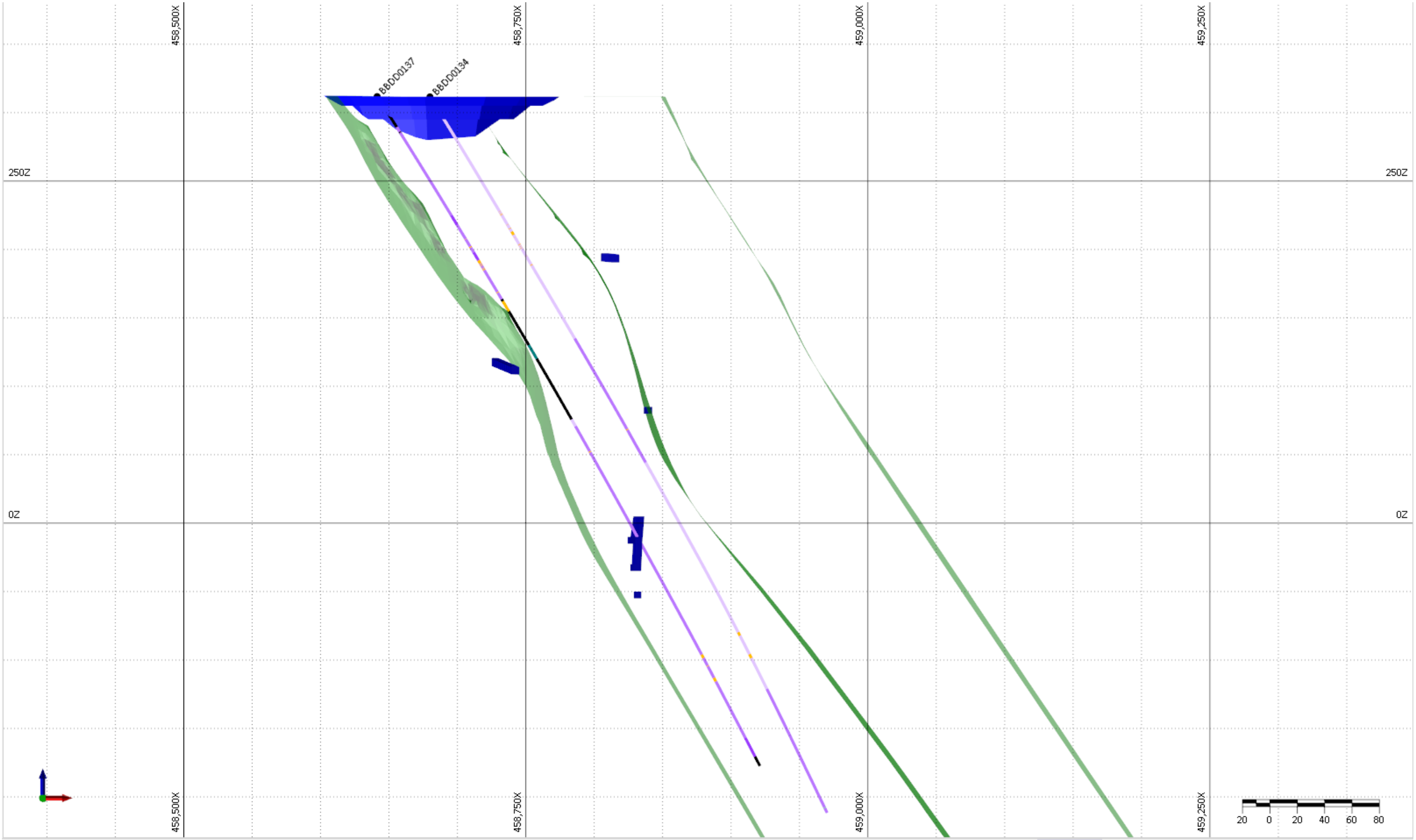

**Figure A-24:** BBDD0137 and BBDD0134 6601026 Northing BBDD0137 sampled between 5-17m transitional MDQ and BBDD0134 sampled between 5-16m transitional MDQ, within BOM1100 (Source: Ramelius).

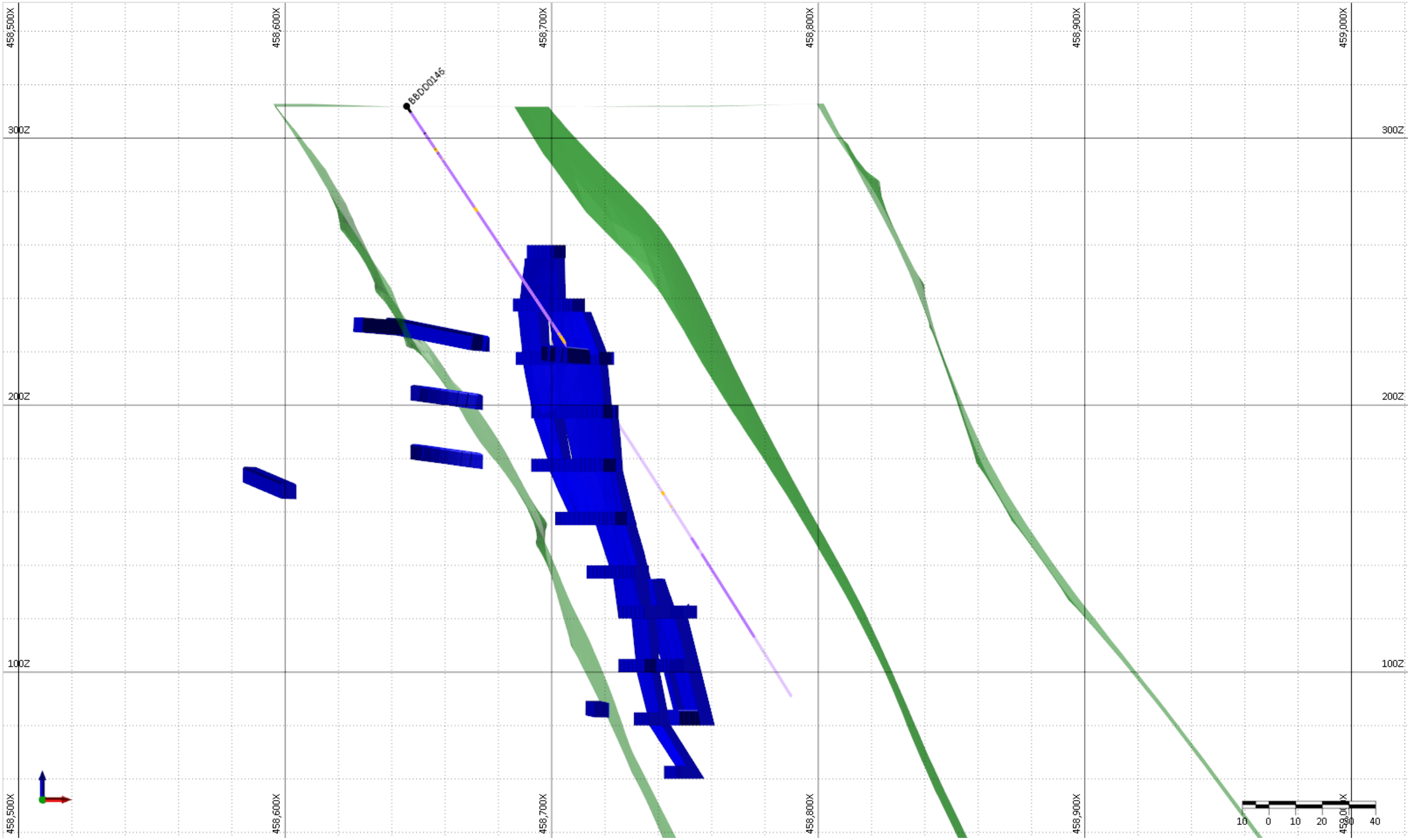

**Figure A-25:** BBDD0146 6601383 Northing sampled from 105.42-107.01m Fresh Lamprophyre Tura underground (Source: Ramelius).

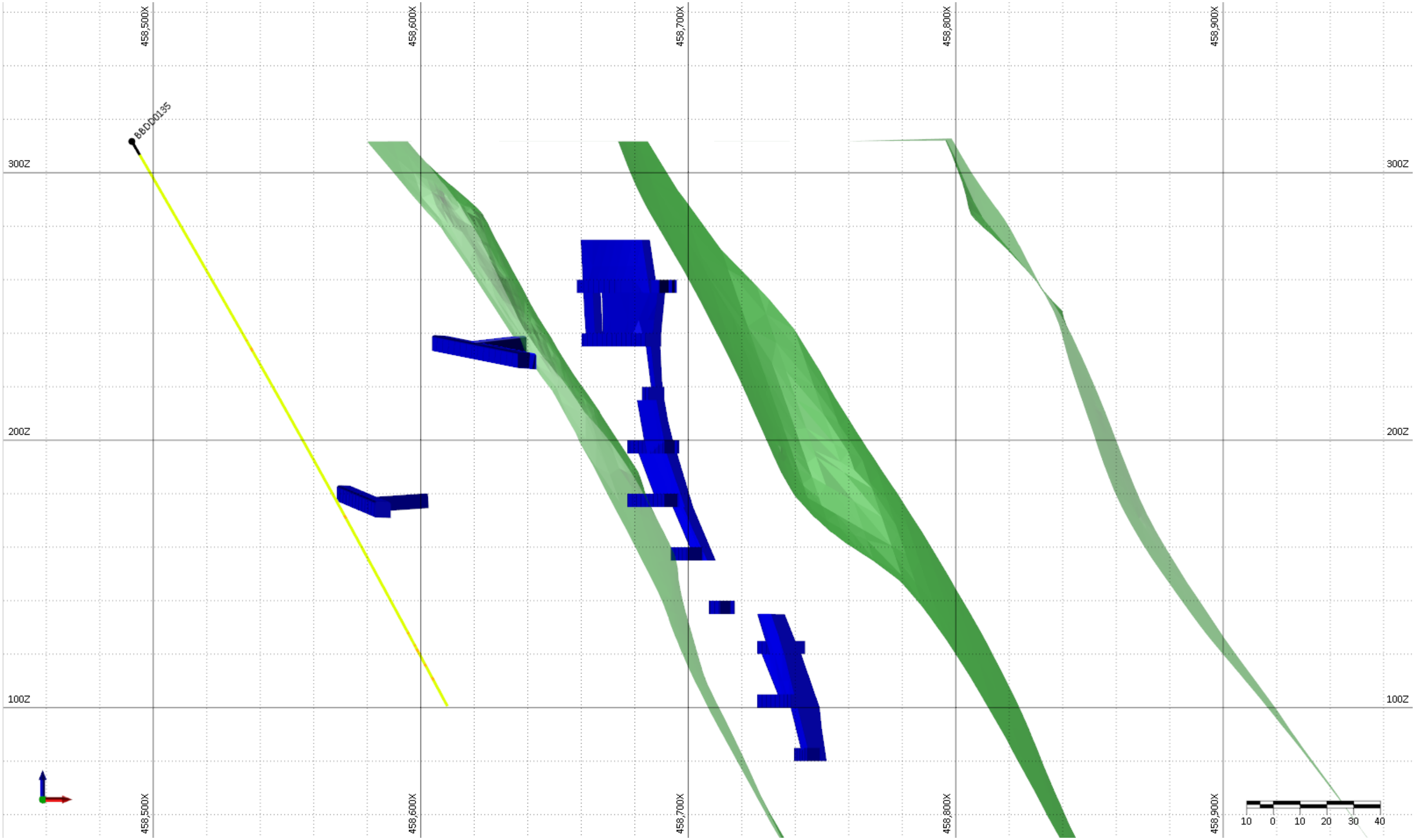

**Figure A-26:** BBDD0135 6601437 Northing sampled from 6-14m transitional MR_FW and 147-157m fresh MR_FW. This is the only hole that intercepted MR_FW. Close to Tura underground (Source: Ramelius).

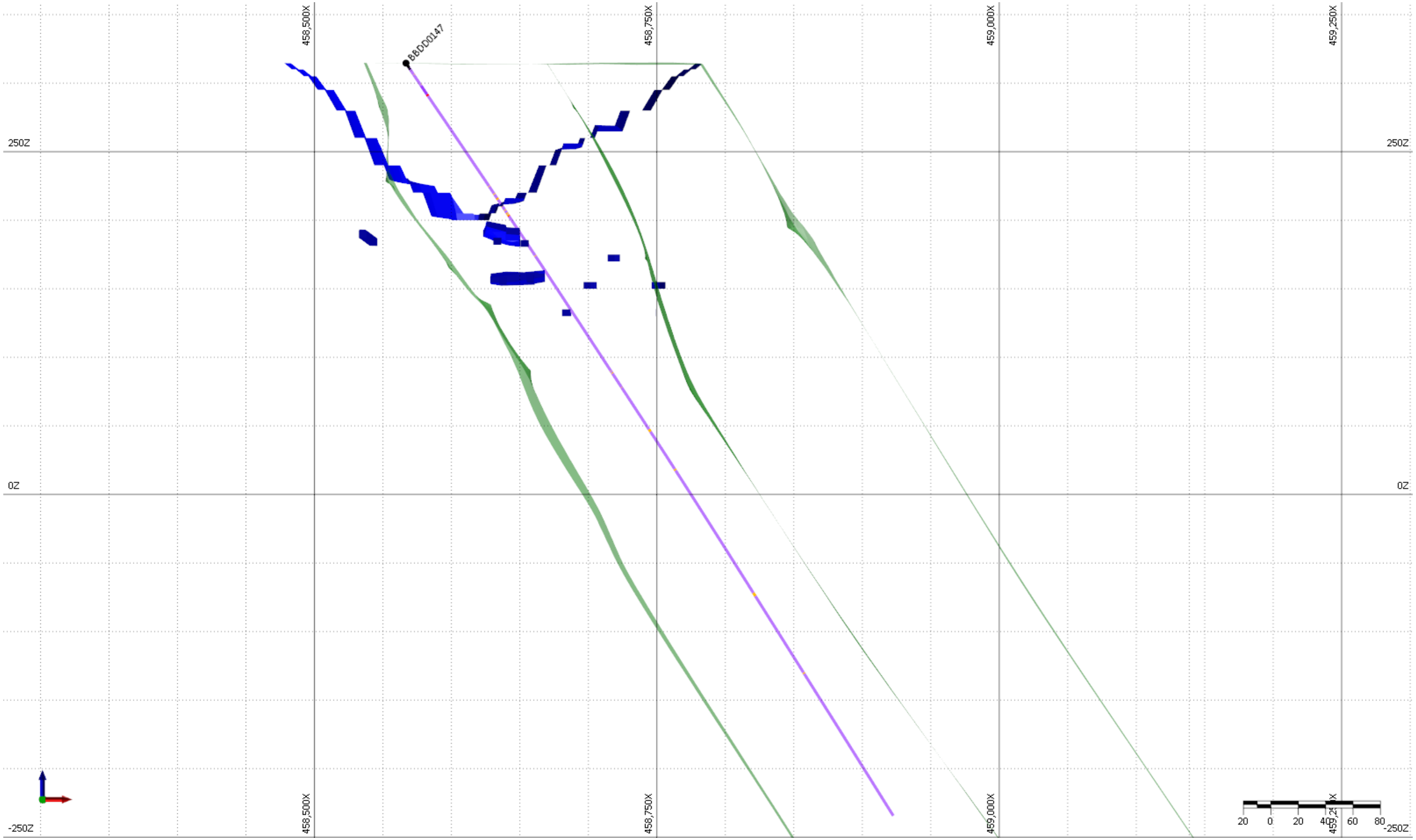

**Figure A-27:** BBDD0147 6601794 Northing MDQ sampled from 6.9-13m (Transitional), 78-92m (Fresh), 102-114m (Fresh) within BOM1800 pit shell (Source: Ramelius).

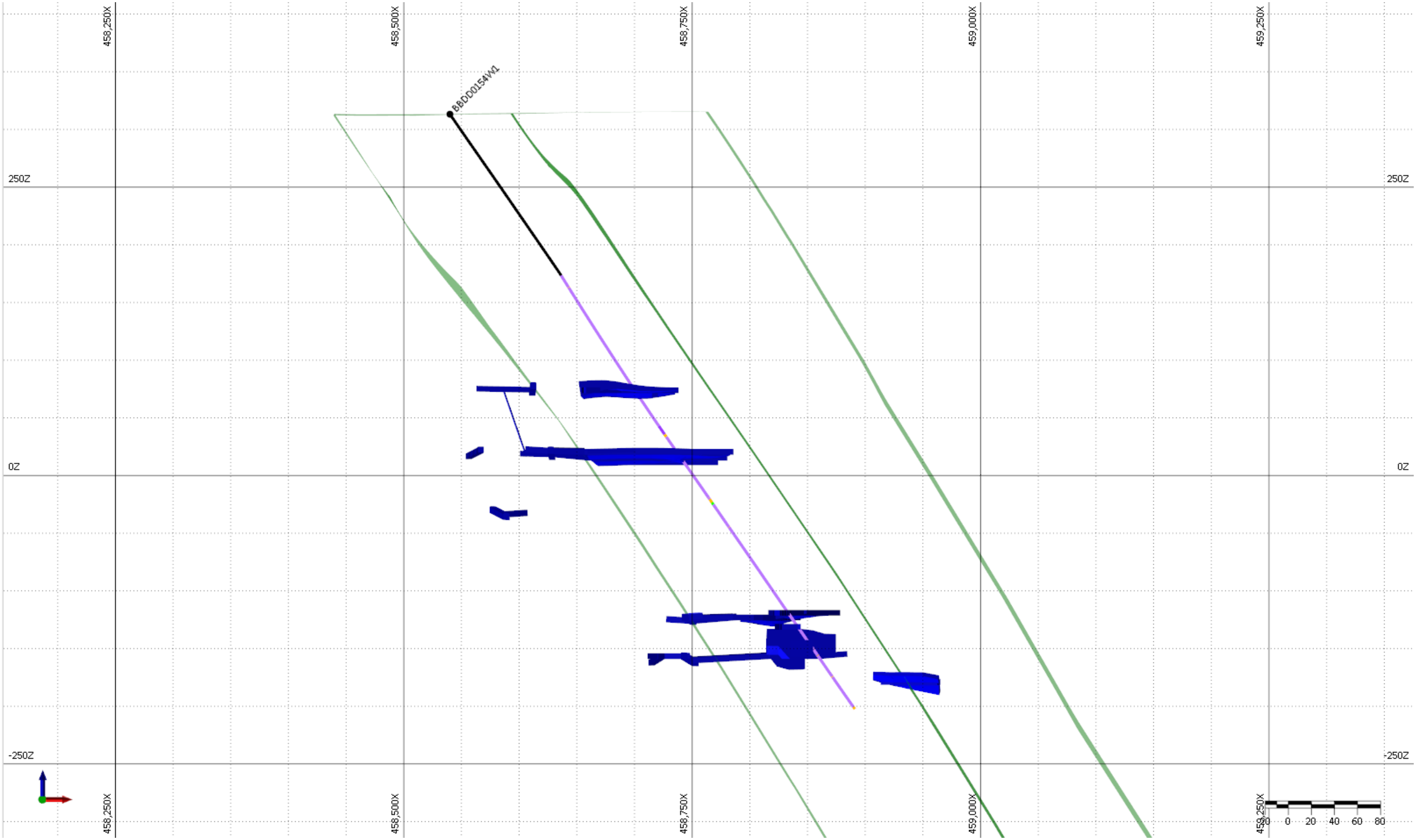

**Figure A-28:** BBDD0154W1 6602589 northing sampled from 544.04 – 547m fresh MDQ, within or proximal to KL underground (Source: Ramelius).

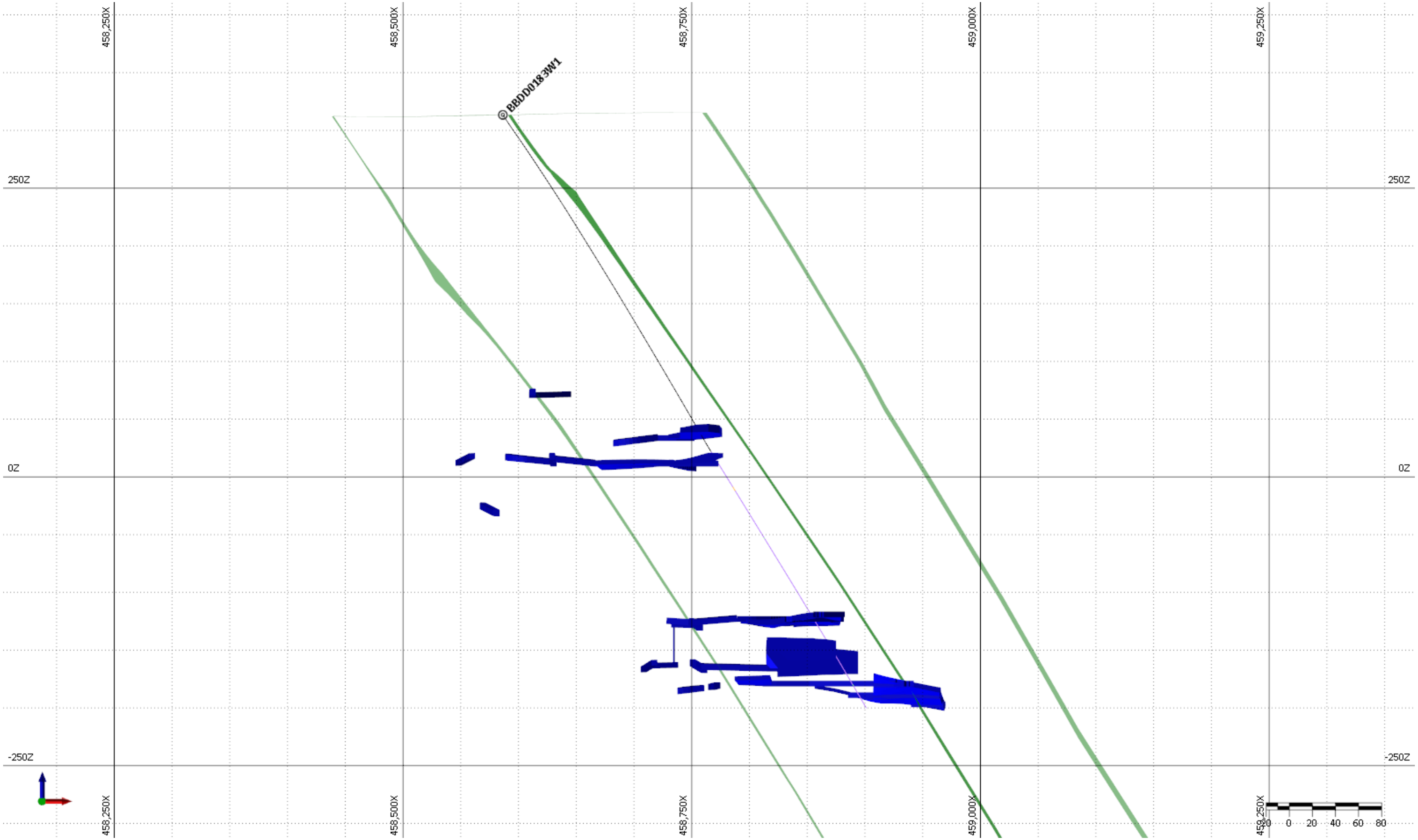

Figure A-29: BBDD0183W1 6602637 Northing, sampled from 550-556m fresh MDQ KL underground (Source: Ramelius).

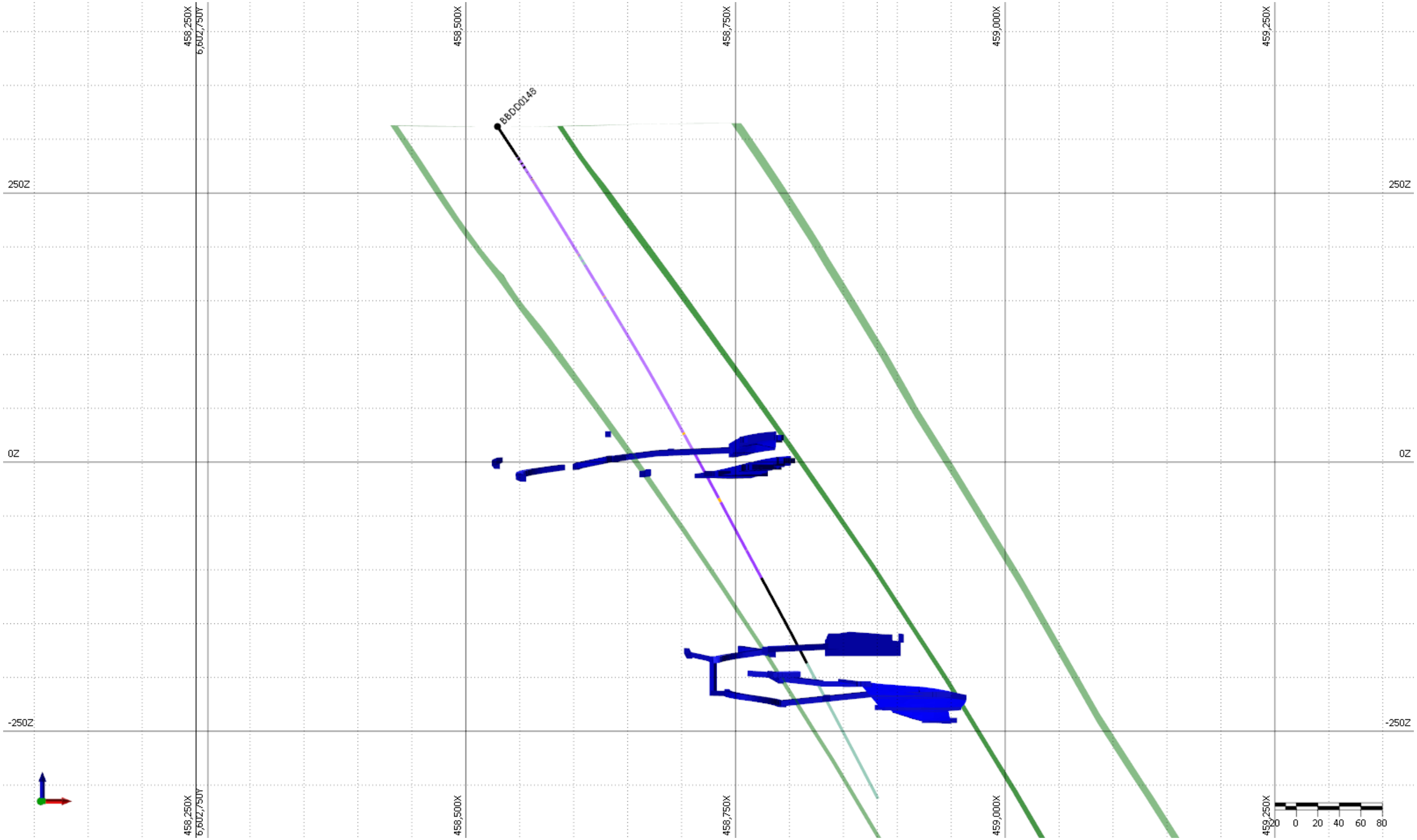

**Figure A-30:** BBDD0148 6602729 Northing, sampled from 592-598m fresh MD, KL underground (Source: Ramelius).

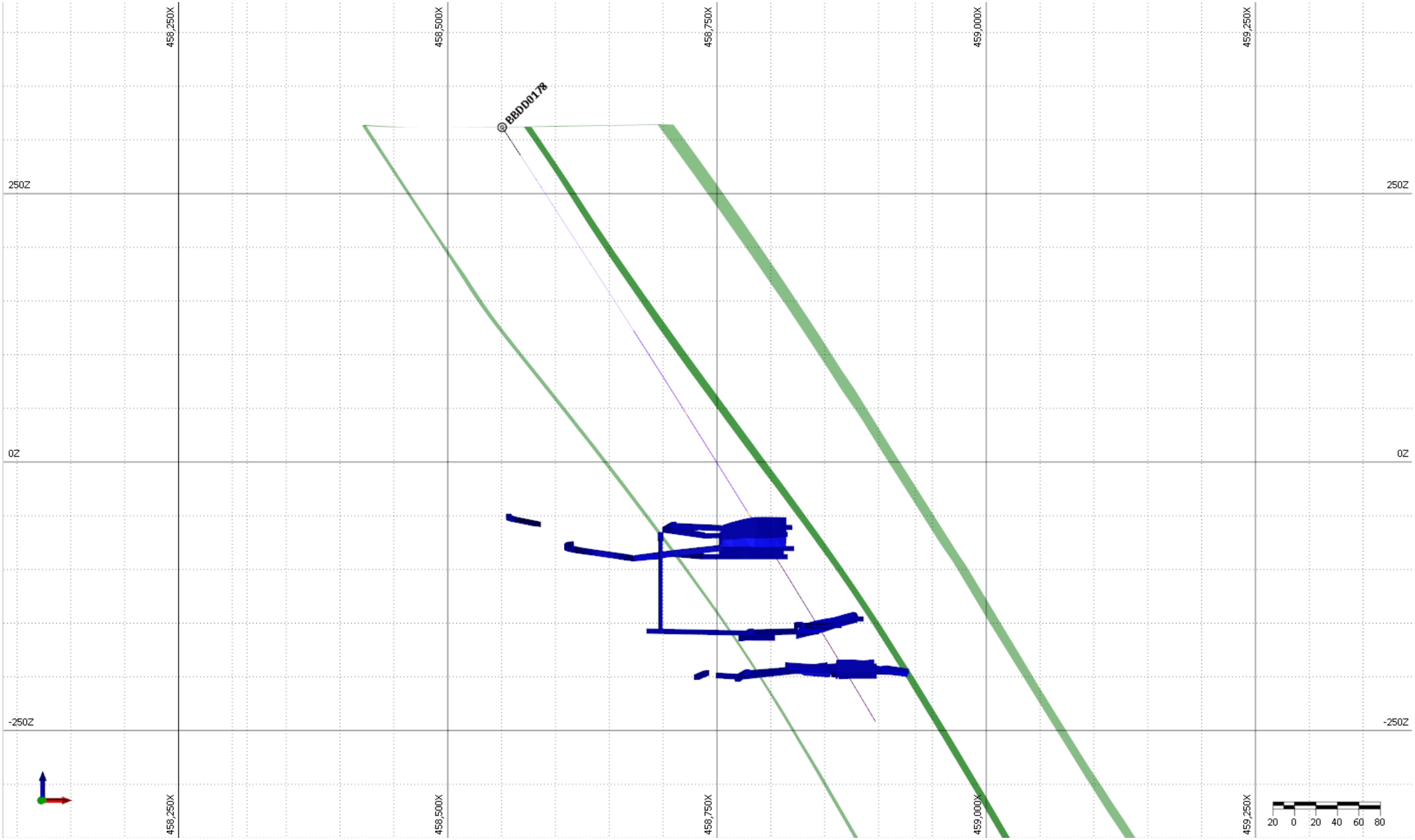

**Figure A-31:** BBDD0178 6602924 Northing, sampled from 426-428m fresh ALP Lamprophyre, KL underground (Source: Ramelius).

# APPENDIX B: LABORATORY RESULTS

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**Table B-1:** Baseline laboratory results for Kopai Crescent samples

| Analysis | | Unit | RWC01 | RWC05 | RWC09 | RWC13 | RWC17 | RWC22 | RWC26 | RWC30 | RWC34 | RWC38 | RWC42 | RWC46 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | RRK000188 | RRK000193 | RRK000197 | RRK000248 | RRK000831 | RRK001178 | RRK001218 | RRK001693 | RRK002029 | RRK003208 | RRK003383 | RRK003387 |
| | | | 10m-11m | 14m-15m | 18m-19m | 12m-13m | 11m-12m | 31m-32m | 9m-10m | 13m-14m | 17m-18m | 6m-7m | 10m-11m | 14m-15m |
| | | | MB Trans | MB Trans | MB Trans | MB Trans | MD Trans | MD Fresh | MD Oxide | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans |
| | | | 241968-1 | 241968-2 | 241968-3 | 241968-4 | 241968-5 | 241968-6 | 241968-7 | 241968-8 | 241968-9 | 241968-10 | 241968-11 | 241968-12 |
| $pH_w$ | | pH units | 6.61 | 7.10 | 7.59 | 8.52 | 7.90 | 8.67 | 6.54 | 8.45 | 6.61 | 8.61 | 6.61 | 7.10 |
| Electrical Conductivity ($EC_{1:5}$) | | dS/m | 4.41 | 4.13 | 3.76 | 1.88 | 2.43 | 1.01 | 13.40 | 3.23 | 9.30 | 2.00 | 4.41 | 4.13 |
| Chloride | | mg/kg | 6306 | 5608 | 4992 | 2275 | 3326 | 643 | 26539 | 3824 | 16586 | 2484 | 6306 | 5608 |
| Exchange-able cations | Cation Extraction Method | Rayment & Lyons | 15A2 | 15A2 | 15C1 | 15C1 | 15C1 | 15C1 | 15A2 | 15C1 | 15A2 | 15C1 | 15A2 | 15A2 |
| | Effective Cation Exchange Capacity | meq/100g | 13.40 | 13.50 | 18.60 | 12.40 | 7.30 | 3.40 | 18.30 | 2.30 | 4.10 | 18.80 | 13.40 | 13.50 |
| | Ex Sodium Percent | % | 70.52 | 73.16 | 77.09 | 75.92 | 74.80 | 34.62 | 63.23 | 42.53 | 23.03 | 77.91 | 70.52 | 73.16 |
| | Ex Magnesium Percent | % | 16.79 | 20.90 | 17.98 | 17.88 | 19.37 | 15.16 | 28.96 | 25.40 | 20.53 | 17.67 | 16.79 | 20.90 |
| | Exchangeable Calcium | meq/100g | 1.44 | 0.48 | 0.63 | 0.54 | 0.30 | 1.63 | 1.19 | 0.69 | 2.13 | 0.57 | 1.44 | 0.48 |
| | Exchangeable Magnesium | meq/100g | 2.26 | 2.83 | 3.34 | 2.22 | 1.42 | 0.52 | 5.29 | 0.58 | 0.83 | 3.32 | 2.26 | 2.83 |
| | Exchangeable Potassium | meq/100g | 0.25 | 0.29 | 0.26 | 0.21 | 0.11 | 0.06 | 0.22 | 0.03 | 0.14 | 0.24 | 0.25 | 0.29 |
| | Exchangeable Sodium | meq/100g | 9.48 | 9.89 | 14.33 | 9.41 | 5.47 | 1.18 | 11.55 | 0.97 | 0.93 | 14.62 | 9.48 | 9.89 |
| | Exchangeable Aluminium | meq/100g | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | Calcium/Magnesium Ratio | - | 0.64 | 0.17 | 0.19 | 0.24 | 0.21 | 3.13 | 0.22 | 1.19 | 2.57 | 0.17 | 0.64 | 0.17 |

| Analysis | | Unit | RWC42 | RWC46 | RWC50 | RWC54 | RWC58 | RWC62 | RWC66 | RWC70 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | RRK003383 | RRK003387 | RRK003491 | RRK003742 | RRK005131 | RRK005411 | RRK005625 | RRK005629 |
| | | | 10m-11m | 14m-15m | 12m-13m | 8m-9m | 7m-8m | 16m-17m | 8m-9m | 12m-13m |
| | | | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans |
| | | | 241968-11 | 241968-12 | 241968-13 | 241968-14 | 241968-15 | 241968-16 | 241968-17 | 241968-18 |
| $pH_w$ | | pH units | 8.06 | 9.06 | 9.01 | 9.67 | 8.29 | 8.44 | 8.47 | 8.78 |
| Electrical Conductivity ($EC_{1:5}$) | | dS/m | 3.32 | 0.38 | 0.33 | 0.54 | 2.71 | 2.58 | 2.35 | 1.51 |
| Chloride | | mg/kg | 3824 | 325 | 198 | 414 | 3001 | 2667 | 3592 | 1658 |
| Exchange-able cations | Cation Extraction Method | Rayment & Lyons | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 |
| | Effective Cation Exchange Capacity | meq/100g | 6.20 | 1.40 | 1.60 | 3.10 | 6.60 | 7.80 | 10.20 | 7.80 |
| | Ex Sodium Percent | % | 60.05 | 50.44 | 41.99 | 53.77 | 68.67 | 74.53 | 74.15 | 75.52 |
| | Ex Magnesium Percent | % | 25.07 | 17.68 | 23.69 | 25.62 | 22.71 | 18.89 | 19.34 | 16.93 |
| | Exchangeable Calcium | meq/100g | 0.81 | 0.36 | 0.51 | 0.56 | 0.50 | 0.40 | 0.55 | 0.45 |
| | Exchangeable Magnesium | meq/100g | 1.57 | 0.25 | 0.39 | 0.79 | 1.50 | 1.47 | 1.97 | 1.33 |
| | Exchangeable Potassium | meq/100g | 0.10 | 0.07 | 0.03 | 0.05 | 0.05 | 0.09 | 0.09 | 0.12 |
| | Exchangeable Sodium | meq/100g | 3.75 | 0.71 | 0.68 | 1.65 | 4.53 | 5.79 | 7.54 | 5.91 |
| | Exchangeable Aluminium | meq/100g | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | Calcium/Magnesium Ratio | - | 0.52 | 1.44 | 1.31 | 0.71 | 0.33 | 0.27 | 0.28 | 0.34 |

**Table B-2:** Baseline laboratory results for Bombara samples

| | Analysis | Unit | RWC73 | RWC77 | RWC81 | RWC85 | RWC89 | RWC93 | RWC97 | RWC101 | RWC105 | RWC109 | RWC113 | RWC117 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | BBDD0134 | BBDD0134 | BBDD0135 | BBDD0135 | BBDD0137 | BBDD0137 | BBDD0147 | BBDD0147 | BBDD0161 | BBDD0161 | BBDD0183W1 | BBDD0175 |
| | | | 426m-428m | 12m-14m | 10m-12m | 151m-153m | 7m-9m | 15m-17m | 89.37m-90.71m | 106m-108.09m | 175m-177m | 182.5m-184m | 552m-554m | 9m-11m |
| | | | ALP Fresh | MDQ Trans | MR_FW Trans | MR_FW Fresh | MDQ Trans | MDQ Trans | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Trans |
| | | | 242109-1 | 242109-2 | 242109-3 | 242109-4 | 242109-5 | 242109-6 | 242109-7 | 242109-8 | 242109-9 | 242109-10 | 242109-11 | 242109-12 |
| | $\mathrm{pH_w}$ | pH units | 9.41 | 8.51 | 8.52 | 9.10 | 8.76 | 8.61 | 8.95 | 9.27 | 9.18 | 8.75 | 9.01 | 9.00 |
| | Electrical Conductivity ($EC_{1:5}$) | dS/m | 0.31 | 1.19 | 2.54 | 0.24 | 0.90 | 0.91 | 0.31 | 0.18 | 0.16 | 0.18 | 0.17 | 0.48 |
| | Chloride | mg/kg | 154 | 1370 | 3300 | 114 | 1080 | 1035 | 109 | 102 | 63 | 137 | 85 | 480 |
| Exchange-able cations | Cation Extraction Method | Rayment & Lyons | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 | 15C1 |
| | Effective Cation Exchange Capacity | meq/100g | 1.66 | 9.08 | 19.50 | 1.44 | 3.26 | 4.51 | 1.85 | 1.10 | 0.89 | 0.86 | 0.95 | 2.50 |
| | Ex Sodium Percent | % | 21.70 | 76.90 | 87.50 | 38.10 | 65.90 | 72.70 | 42.80 | 42.00 | 33.60 | 27.60 | 32.10 | 65.80 |
| | Ex Magnesium Percent | % | 11.20 | 15.00 | 9.44 | 16.20 | 18.00 | 14.10 | 6.31 | 7.59 | 10.40 | 9.68 | 8.74 | 13.90 |
| | Exchangeable Calcium | meq/100g | 0.63 | 0.52 | 0.32 | 0.44 | 0.41 | 0.47 | 0.53 | 0.37 | 0.42 | 0.44 | 0.40 | 0.44 |
| | Exchangeable Magnesium | meq/100g | 0.19 | 1.37 | 1.84 | 0.23 | 0.59 | 0.64 | 0.12 | 0.08 | 0.09 | 0.08 | 0.08 | 0.35 |
| | Exchangeable Potassium | meq/100g | 0.46 | 0.19 | 0.25 | 0.18 | 0.09 | 0.10 | 0.37 | 0.16 | 0.03 | 0.03 | 0.09 | 0.04 |
| | Exchangeable Sodium | meq/100g | 0.36 | 6.99 | 17.10 | 0.55 | 2.15 | 3.28 | 0.79 | 0.46 | 0.30 | 0.24 | 0.31 | 1.64 |
| | Exchangeable Aluminium | meq/100g | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.04 | 0.03 | 0.05 | 0.07 | 0.07 | 0.02 |
| | Calcium/Magnesium Ratio | - | 3.32 | 0.38 | 0.17 | 1.91 | 0.69 | 0.73 | 4.42 | 4.63 | 14.00 | 14.67 | 4.44 | 11.00 |

| | Analysis | Unit | RWC121 | RWC125 | RWC129 |
|---|---|---|---|---|---|
| | | | BBDD0171 | BBDD0170 | BBDD0148 |
| | | | 10m-12m | 20m-22m | 594m-596m |
| | | | MD Trans | MD Trans | MD Fresh |
| | | | 242109-13 | 242109-14 | 242109-15 |
| | $\mathrm{pH_w}$ | pH units | 9.00 | 9.54 | 9.03 |
| | Electrical Conductivity ($EC_{1:5}$) | dS/m | 1.66 | 1.14 | 0.14 |
| | Chloride | mg/kg | 1830 | 1140 | 53 |
| Exchange-able cations | Cation Extraction Method | Rayment & Lyons | 15C1 | 15C1 | 15C1 |
| | Effective Cation Exchange Capacity | meq/100g | 4.84 | 4.82 | 0.91 |
| | Ex Sodium Percent | % | 67.70 | 69.10 | 36.40 |
| | Ex Magnesium Percent | % | 18.20 | 15.10 | 23.00 |
| | Exchangeable Calcium | meq/100g | 0.59 | 0.66 | 0.25 |
| | Exchangeable Magnesium | meq/100g | 0.88 | 0.73 | 0.21 |
| | Exchangeable Potassium | meq/100g | 0.07 | 0.09 | 0.09 |
| | Exchangeable Sodium | meq/100g | 3.28 | 3.33 | 0.33 |
| | Exchangeable Aluminium | meq/100g | 0.02 | 0.02 | 0.03 |
| | Calcium/Magnesium Ratio | - | 0.67 | 0.90 | 1.19 |

**Table B-3:** Total metals concentrations in solid component of a subset 33 samples, with EIL exceedances in yellow and HIL exceedances in red (both EIL and HIL values exceeded text is highlighted in red).

| Element | Unit | Detection Limit | RWC01 | RWC05 | RWC09 | RWC13 | RWC17 | RWC22 | RWC26 | RWC30 | RWC34 | RWC38 | RWC42 | RWC46 | RWC50 | RWC54 | EIL | HIL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kopai Crescent | | | | | | | | | | | | | | | |
| | | | MB Trans | MB Trans | MB Trans | MB Trans | MD Trans | MD Fresh | MD Oxide | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | | |
| | | | 10m-11m | 14m-15m | 18m-19m | 12m-13m | 11m-12m | 31m--32m | 9m-10m | 13m-14m | 17m-18m | 6m-7m | 10m-11m | 14m-15m | 12m-13m | 8m-9m | | |
| Ag | ppm | 0.01 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.07 | 0.03 | 0.02 | 0.04 | 0.03 | 0.08 | 0.08 | 0.06 | <0.01 | NA | NA |
| Al | ppm | 100 | 78500 | 76810 | 77900 | 77000 | 87900 | 75600 | 115500 | 91600 | 85000 | 73900 | 74900 | 72100 | 73400 | 71700 | NA | NA |
| As | ppm | 0.2 | 1.7 | 1.6 | 2.8 | 2.9 | 1.7 | 2.1 | 1.9 | 3.1 | 1.7 | 3.1 | 2.6 | 2.3 | 0.9 | 1.2 | **40** | **300** |
| Ba | ppm | 10 | 260 | 170 | 180 | 130 | 160 | 100 | 20 | 60 | 280 | 50 | 50 | 40 | 10 | 50 | NA | NA |
| Be | ppm | 0.05 | 0.53 | 0.62 | 0.53 | 0.31 | 0.6 | 0.42 | 0.92 | 0.5 | 0.45 | 0.38 | 0.33 | 0.32 | 0.35 | 0.37 | NA | NA |
| Bi | ppm | 0.01 | 0.07 | 0.13 | 0.06 | 0.05 | 0.04 | 0.02 | 0.05 | 0.02 | 0.02 | 0.02 | 0.05 | 0.02 | 0.03 | 0.04 | NA | **100** |
| B | ppm | 50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | NA | NA |
| Ca | ppm | 100 | 25900 | 32900 | 35800 | 53100 | 37000 | 65100 | 700 | 58200 | 45100 | 45800 | 36700 | 67300 | 62200 | 47900 | NA | NA |
| Cd | ppm | 0.02 | 0.06 | 0.06 | 0.09 | 0.08 | 0.05 | 0.23 | 0.08 | 0.03 | 0.06 | 0.07 | 0.05 | 0.11 | 0.09 | 0.1 | NA | **90** |
| Ce | ppm | 0.01 | 28.40 | 29.80 | 19.55 | 8.04 | 26.40 | 12.70 | 21.40 | 24.00 | 16.90 | 10.20 | 11.15 | 9.50 | 9.37 | 9.20 | NA | NA |
| Co | ppm | 0.1 | 30.0 | 30.7 | 48.3 | 50.4 | 30.2 | 53.5 | 38.9 | 42.4 | 41.2 | 45.3 | 52.9 | 50.6 | 45.3 | 49.4 | NA | **300** |
| Cr | ppm | 1 | 76 | 83 | 105 | 151 | 130 | 116 | 149 | 141 | 124 | 110 | 107 | 98 | 103 | 97 | **400** | **240** |
| Cs | ppm | 0.05 | 1.28 | 1.48 | 1.40 | 1.30 | 0.79 | 0.61 | 2.15 | 0.38 | 2.13 | 0.59 | 0.86 | 0.19 | 0.19 | 0.32 | NA | NA |
| Cu | ppm | 0.2 | 51.6 | 68.0 | 119.0 | 113.5 | 40.5 | 133.0 | 65.8 | 28.5 | 37.0 | 142.0 | 186.0 | 101.5 | 24.2 | 91.0 | **130** | **20,000** |
| Fe | ppm | 100 | 56300 | 68000 | 95600 | 96700 | 60700 | 64200 | 51100 | 64700 | 71900 | 106000 | 106000 | 99700 | 99900 | 101000 | NA | NA |
| Ga | ppm | 0.05 | 16.7 | 17.6 | 20.0 | 17.4 | 18.8 | 21.1 | 21.7 | 18.8 | 16.1 | 20.1 | 19.5 | 18.7 | 19.4 | 18.4 | NA | NA |
| Ge | ppm | 0.05 | 0.16 | 0.18 | 0.20 | 0.21 | 0.18 | 0.16 | 0.21 | 0.15 | 0.20 | 0.23 | 0.31 | 0.25 | 0.23 | 0.30 | NA | NA |
| Hf | ppm | 0.1 | 2.90 | 2.90 | 2.00 | 1.20 | 2.80 | 1.70 | 3.40 | 2.40 | 2.40 | 1.60 | 1.60 | 1.60 | 1.60 | 1.70 | NA | NA |
| Hg | ppm | 0.01 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.006 | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 | NA | NA |
| In | ppm | 0.005 | 0.049 | 0.057 | 0.085 | 0.073 | 0.065 | 0.093 | 0.08 | 0.066 | 0.062 | 0.088 | 0.093 | 0.087 | 0.088 | 0.093 | NA | NA |
| K | ppm | 100 | 7000 | 6300 | 7000 | 6100 | 4700 | 3300 | 1200 | 1100 | 6800 | 3900 | 1400 | 2100 | 1600 | 1400 | NA | NA |
| La | ppm | 0.5 | 14.2 | 14.9 | 8.6 | 2.6 | 9.2 | 4.4 | 5.8 | 9.5 | 5.9 | 3.5 | 3.3 | 3.2 | 3.4 | 3.4 | NA | NA |
| Li | ppm | 0.2 | 11.6 | 9.5 | 11.7 | 13.3 | 9.1 | 12.5 | 14.3 | 11.0 | 17.6 | 7.7 | 14.6 | 7.8 | 11.5 | 10.5 | NA | NA |
| Mg | ppm | 0.01 | 17200 | 14200 | 22400 | 38100 | 15000 | 22400 | 4200 | 21200 | 40700 | 21100 | 36900 | 35200 | 37000 | 37400 | NA | **NA** |
| Mn | ppm | 5 | 529 | 510 | 1015 | 1385 | 927 | 1500 | 522 | 1370 | 1175 | 1105 | 1340 | 1635 | 1610 | 1365 | NA | **9,000** |
| Mo | ppm | 0.05 | 1.41 | 1.90 | 2.29 | 0.53 | 2.20 | 1.38 | 1.14 | 3.24 | 0.92 | 1.66 | 0.80 | 1.32 | 0.45 | 0.26 | NA | NA |
| Na | ppm | 100 | 31200 | 21800 | 20900 | 17800 | 31900 | 20700 | 15100 | 23500 | 34800 | 16500 | 15900 | 15400 | 10200 | 23900 | NA | NA |
| Nb | ppm | 0.1 | 4.7 | 4.9 | 4.0 | 2.5 | 5.5 | 3.6 | 6.6 | 4.9 | 4.1 | 3.2 | 3.2 | 3.1 | 3.3 | 3.1 | NA | NA |
| Ni | ppm | 0.2 | 125.5 | 88 | 100 | 84.1 | 97.3 | 89.7 | 163.5 | 124 | 107.5 | 69.1 | 70.8 | 56.5 | 48.2 | 57.7 | **30** | **800** |
| P | ppm | 10 | 540 | 520 | 510 | 330 | 830 | 470 | 500 | 670 | 580 | 510 | 470 | 430 | 450 | 450 | NA | NA |
| Pb | ppm | 0.5 | 5.7 | 7.2 | 5.1 | 1.9 | 2.8 | 1.6 | 3.6 | 1.5 | 1.5 | 1.5 | 1.6 | 0.8 | 1.2 | 1.4 | **1100** | **600** |
| Rb | ppm | 0.1 | 28.8 | 33.2 | 33.9 | 29.4 | 10.3 | 13.2 | 8.3 | 3.1 | 17.7 | 10.2 | 7.2 | 6.4 | 4.6 | 3.8 | NA | NA |
| Re | ppm | 0.002 | 0.002 | <0.002 | 0.002 | <0.002 | <0.002 | 0.003 | <0.002 | <0.002 | <0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | NA | NA |
| S | ppm | 100 | 300 | 300 | 300 | 100 | 200 | 4500 | 1100 | 300 | 500 | 200 | 200 | 700 | 300 | <100 | NA | NA |
| Sb | ppm | 0.05 | 0.13 | 0.21 | 0.25 | 0.23 | 0.28 | 0.18 | 0.14 | 0.16 | 2.83 | 0.35 | 0.23 | 0.26 | 0.28 | 0.15 | NA | NA |
| Sc | ppm | 0.1 | 19.7 | 19.1 | 39.2 | 48.2 | 31.8 | 43.8 | 41.8 | 35.0 | 28.5 | 52.2 | 50.6 | 48.3 | 52.3 | 50.4 | NA | NA |
| Se | ppm | 1 | 1 | <1 | 1 | 1 | 1 | 2 | <1 | 1 | 1 | 1 | 1 | 1 | 1 | <1 | NA | NA |
| Sn | ppm | 0.2 | 1 | 1.3 | 1 | 0.7 | 2.1 | 0.9 | 1 | 1.3 | 0.8 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | NA | NA |
| Sr | ppm | 0.2 | 151.5 | 110.5 | 167.5 | 150.5 | 155.0 | 153.0 | 10.8 | 130.5 | 318.0 | 129.0 | 107.0 | 135.5 | 94.8 | 141.5 | NA | NA |
| Ta | ppm | 0.05 | 0.33 | 0.35 | 0.26 | 0.15 | 0.36 | 0.22 | 0.42 | 0.32 | 0.27 | 0.19 | 0.20 | 0.19 | 0.19 | 0.19 | NA | NA |
| Te | ppm | 0.05 | 0.07 | 0.12 | 0.1 | 0.08 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | NA | NA |
| Th | ppm | 0.01 | 2.95 | 3.12 | 1.19 | 0.2 | 1.65 | 0.26 | 2.23 | 1.47 | 1.23 | 0.24 | 0.25 | 0.23 | 0.21 | 0.2 | NA | NA |
| Ti | ppm | 0.005 | 4160 | 4280 | 7010 | 6120 | 7430 | 8360 | 7500 | 7430 | 6440 | 7960 | 8130 | 7690 | 8340 | 8060 | NA | NA |
| Tl | ppm | 0.02 | 0.42 | 0.44 | 0.35 | 0.25 | 0.10 | 0.21 | 0.05 | 0.04 | 0.27 | 0.07 | 0.04 | 0.13 | 0.03 | 0.03 | NA | NA |
| U | ppm | 0.1 | 0.90 | 0.80 | 0.50 | 0.10 | 0.90 | 0.10 | 1.60 | 0.40 | 0.30 | 0.30 | 0.40 | 0.10 | 0.10 | 0.30 | NA | NA |
| V | ppm | 1 | 133 | 139 | 298 | 294 | 211 | 348 | 243 | 211 | 195 | 371 | 354 | 345 | 373 | 358 | NA | NA |
| W | ppm | 0.1 | 0.8 | 1.4 | 0.8 | 0.8 | 0.8 | 3.4 | 0.4 | 3.7 | 0.9 | 1.1 | 1.7 | 1.5 | 0.7 | 0.3 | NA | NA |
| Y | ppm | 0.1 | 15.8 | 19.4 | 30.8 | 27.2 | 23.0 | 31.8 | 12.2 | 24.0 | 21.4 | 33.4 | 28.1 | 30.7 | 33.2 | 32.1 | NA | NA |
| Zn | ppm | 2 | 114 | 154 | 200 | 108 | 75 | 122 | 137 | 58 | 69 | 121 | 122 | 110 | 113 | 112 | **130** | **30,000** |
| Zr | ppm | 0.5 | 110.5 | 112.0 | 69.4 | 38.2 | 105.5 | 76.0 | 123.0 | 86.1 | 90.7 | 44.2 | 55.0 | 56.0 | 48.7 | 78.8 | NA | NA |

**Table B-3 (cont'd):** Total metals concentrations in solid component of a subset 33 samples, with EIL exceedances in yellow and HIL exceedances in red (both EIL and HIL values exceeded text is highlighted in red).

| Element | Unit | Detection Limit | RWC58 | RWC62 | RWC66 | RWC70 | RWC73 | RWC77 | RWC81 | RWC85 | RWC89 | RWC93 | RWC97 | RWC101 | RWC105 | RWC109 | EIL | HIL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kopai Crescent | | | | Bombora | | | | | | | | | | | |
| | | | MD Trans | MD Trans | MD Trans | MD Trans | ALP Fresh | MDQ Trans | MR_FW Trans | MR_FW Fresh | MDQ Trans | MDQ Trans | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Fresh | | |
| | | | 7m-8m | 16m-17m | 8m-9m | 12m-13m | 426m-428m | 12m-14m | 10m-12m | 151m-153m | 7m-9m | 15m-17m | 89.37m-90.71m | 106m-108.09m | 175m-177m | 182.5m-184m | | |
| Ag | ppm | 0.01 | 0.02 | 0.18 | 0.03 | <0.01 | 0.08 | 0.05 | 0.1 | 0.01 | 0.05 | 0.03 | 0.06 | 0.03 | 0.02 | 0.13 | NA | NA |
| Al | ppm | 100 | 75400 | 76700 | 75400 | 73800 | 76400 | 62400 | 78600 | 72400 | 59800 | 61100 | 56300 | 58400 | 58400 | 55200 | NA | NA |
| As | ppm | 0.2 | 1.6 | 1.2 | 9.2 | 3.5 | 0.7 | 1.1 | 0.5 | 0.4 | 1.1 | 1.2 | 1.1 | 2.7 | 0.6 | 1.4 | **40** | **300** |
| Ba | ppm | 10 | 60 | 70 | 30 | 40 | 740 | 20 | 20 | 210 | 40 | 40 | 30 | 40 | 40 | 40 | NA | NA |
| Be | ppm | 0.05 | 0.35 | 0.28 | 0.63 | 0.55 | 1.25 | 0.33 | 0.81 | 0.36 | 0.67 | 0.71 | 0.82 | 0.91 | 0.68 | 0.85 | NA | NA |
| Bi | ppm | 0.01 | 0.02 | 0.04 | 0.04 | 0.06 | 0.03 | 0.01 | 0.01 | 0.01 | 0.02 | 0.04 | 0.04 | 0.01 | 0.02 | 0.08 | NA | **100** |
| B | ppm | 50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | NA | NA |
| Ca | ppm | 100 | 27900 | 5300 | 61300 | 58500 | 40700 | 47800 | 4000 | 63000 | 42100 | 42000 | 42500 | 46100 | 51500 | 51800 | NA | NA |
| Cd | ppm | 0.02 | 0.08 | 0.02 | 0.09 | 0.12 | 0.1 | 0.1 | 0.03 | 0.02 | 0.12 | 0.11 | 0.35 | 0.12 | 0.12 | 0.06 | NA | **90** |
| Ce | ppm | 0.01 | 13.05 | 7.62 | 21.50 | 10.65 | 91.40 | 8.19 | 16.45 | 16.40 | 13.85 | 14.60 | 24.70 | 27.90 | 19.55 | 18.10 | NA | NA |
| Co | ppm | 0.1 | 70.6 | 104.0 | 67.5 | 55.8 | 23.3 | 68.8 | 58.8 | 58.0 | 45.6 | 38.0 | 37.0 | 24.1 | 38.1 | 49.5 | NA | **300** |
| Cr | ppm | 1 | 115 | 103 | 108 | 100 | 106 | 5 | 378 | 489 | 3 | 6 | 8 | 4 | 4 | 3 | **400** | **240** |
| Cs | ppm | 0.05 | 0.74 | 4.08 | 0.25 | 0.29 | 3.98 | 0.30 | 0.17 | 1.25 | 0.19 | 0.19 | 2.13 | 0.70 | 0.22 | 0.74 | NA | NA |
| Cu | ppm | 0.2 | 147.0 | 245.0 | 61.4 | 115.5 | 37.0 | 78.1 | 2.9 | 3.7 | 30.5 | 32.1 | 70.6 | 6.7 | 24.8 | 587 | **130** | **20,000** |
| Fe | ppm | 100 | 104500 | 104500 | 84400 | 99000 | 36000 | 136000 | 76900 | 74400 | 139000 | 137000 | 153000 | 123000 | 130500 | 137500 | NA | NA |
| Ga | ppm | 0.05 | 19.8 | 18.7 | 19.8 | 17.9 | 19.6 | 20.6 | 12.9 | 13.8 | 24.3 | 24.3 | 25.1 | 24.1 | 23.1 | 21.8 | NA | NA |
| Ge | ppm | 0.05 | 0.28 | 0.26 | 0.19 | 0.27 | 0.20 | 0.27 | 0.19 | 0.26 | 0.26 | 0.28 | 0.31 | 0.25 | 0.27 | 0.26 | NA | NA |
| Hf | ppm | 0.1 | 1.70 | 1.30 | 1.80 | 1.80 | 3.40 | 0.90 | 2.20 | 1.90 | 2.1 | 2.4 | 2.4 | 3.1 | 2.1 | 2.1 | NA | NA |
| Hg | ppm | 0.01 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.009 | NA | NA |
| In | ppm | 0.005 | 0.1 | 0.083 | 0.111 | 0.089 | 0.033 | 0.098 | 0.058 | 0.053 | 0.149 | 0.141 | 0.253 | 0.18 | 0.141 | 0.142 | NA | NA |
| K | ppm | 100 | 1100 | 2500 | 1600 | 1900 | 18300 | 3000 | 600 | 5600 | 3700 | 3100 | 2800 | 2500 | 2100 | 2000 | NA | NA |
| La | ppm | 0.5 | 5.4 | 2.8 | 7.5 | 3.6 | 42.3 | 3 | 10.1 | 7.4 | 4.3 | 4.3 | 8.5 | 9.7 | 6.6 | 5.8 | NA | NA |
| Li | ppm | 0.2 | 14.7 | 22.7 | 6.0 | 7.3 | 31.0 | 10.0 | 26.5 | 16.4 | 7.8 | 8.1 | 13.4 | 7.1 | 8.4 | 14.7 | NA | NA |
| Mg | ppm | 0.01 | 36300 | 42400 | 33300 | 36000 | 24600 | 26800 | 39000 | 56300 | 12000 | 11700 | 11600 | 7000 | 12200 | 13800 | NA | **NA** |
| Mn | ppm | 5 | 1520 | 1185 | 1535 | 1750 | 553 | 1715 | 786 | 1470 | 2280 | 1965 | 2460 | 2060 | 2130 | 1855 | NA | **9,000** |
| Mo | ppm | 0.05 | 1.30 | 0.43 | 0.78 | 0.37 | 0.21 | 0.34 | 0.26 | 0.41 | 0.68 | 0.42 | 1.54 | 0.82 | 1.06 | 0.71 | NA | NA |
| Na | ppm | 100 | 18000 | 23200 | 23100 | 23200 | 35200 | 16900 | 28300 | 16400 | 20500 | 20600 | 11800 | 19700 | 18400 | 16300 | NA | NA |
| Nb | ppm | 0.1 | 3.3 | 2.8 | 3.5 | 3.1 | 5.0 | 3.0 | 3.4 | 3.1 | 6.4 | 6.6 | 7.2 | 9.7 | 6.6 | 6.0 | NA | NA |
| Ni | ppm | 0.2 | 87.2 | 109.5 | 85 | 73.8 | 106 | 16.6 | 357 | 393 | 3.3 | 9.7 | 3.6 | 1 | 0.9 | 0.4 | **30** | **800** |
| P | ppm | 10 | 490 | 440 | 520 | 460 | 1550 | 380 | 620 | 470 | 920 | 930 | 1410 | 1100 | 850 | 890 | NA | NA |
| Pb | ppm | 0.5 | 2.6 | 1.5 | 1.5 | 1.3 | 10.4 | 0.9 | 0.7 | 0.7 | 0.9 | 0.9 | 0.9 | 1.5 | 0.7 | 1.3 | **1100** | **600** |
| Rb | ppm | 0.1 | 4.9 | 14.3 | 5.0 | 4.5 | 60.9 | 5.5 | 0.9 | 19.2 | 8 | 5 | 5.8 | 4.3 | 3.6 | 4.9 | NA | NA |
| Re | ppm | 0.002 | 0.002 | <0.002 | <0.002 | <0.002 | 0.002 | 0.003 | <0.002 | 0.002 | 0.002 | <0.002 | 0.002 | 0.002 | 0.002 | 0.002 | NA | NA |
| S | ppm | 100 | 300 | 300 | 100 | 100 | 1900 | 100 | 100 | 100 | 100 | 100 | 4300 | 200 | 1600 | 20800 | NA | NA |
| Sb | ppm | 0.05 | 0.36 | 0.14 | 0.41 | 0.31 | 0.13 | 0.12 | 0.06 | 0.08 | 0.1 | 0.08 | 0.1 | 0.1 | 0.1 | 0.3 | NA | NA |
| Sc | ppm | 0.1 | 51.8 | 48.4 | 56.5 | 53.4 | 10.4 | 59.0 | 29.2 | 26.7 | 47.5 | 47.6 | 34.6 | 39.9 | 44.4 | 40.4 | NA | NA |
| Se | ppm | 1 | 1 | <1 | 1 | 1 | <1 | 1 | <1 | <1 | 1 | 1 | <1 | 1 | 1 | 4 | NA | NA |
| Sn | ppm | 0.2 | 1.1 | 0.7 | 0.8 | 0.9 | 0.9 | 0.8 | 1.5 | 2 | 1.1 | 1.2 | 2.4 | 1.5 | 1 | 1.8 | NA | NA |
| Sr | ppm | 0.2 | 109.0 | 55.2 | 239.0 | 230.0 | 748.0 | 75.9 | 61.8 | 161.0 | 91.0 | 97.5 | 28.0 | 119.0 | 97.8 | 85.5 | NA | NA |
| Ta | ppm | 0.05 | 0.20 | 0.17 | 0.21 | 0.19 | 0.27 | 0.19 | 0.23 | 0.20 | 0.37 | 0.39 | 0.43 | 0.56 | 0.39 | 0.35 | NA | NA |
| Te | ppm | 0.05 | 0.06 | 0.12 | <0.05 | 0.05 | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 | <0.05 | <0.05 | 0.35 | NA | NA |
| Th | ppm | 0.01 | 0.22 | 0.18 | 0.29 | 0.2 | 5.64 | 0.18 | 1.04 | 0.95 | 0.41 | 0.44 | 0.45 | 0.57 | 0.4 | 0.34 | NA | NA |
| Ti | ppm | 0.005 | 8380 | 7770 | 8810 | 8310 | 3790 | 11950 | 6070 | 5320 | 12350 | 11950 | 6230 | 7970 | 11150 | 10150 | NA | NA |
| Tl | ppm | 0.02 | 0.02 | 0.06 | 0.05 | 0.02 | 0.29 | 0.03 | 0.03 | 0.13 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | 0.10 | NA | NA |
| U | ppm | 0.1 | 1.30 | 0.40 | 0.30 | 0.20 | 1.40 | 0.20 | 0.40 | 0.30 | 0.10 | 0.10 | 0.10 | 0.20 | 0.10 | 0.10 | NA | NA |
| V | ppm | 1 | 370 | 350 | 392 | 371 | 88 | 601 | 208 | 173 | 144 | 128 | 4 | 5 | 92 | 86 | NA | NA |
| W | ppm | 0.1 | 0.5 | 1.4 | 0.4 | 0.5 | 3.1 | 0.6 | 0.3 | 0.5 | 0.5 | 0.6 | 0.4 | 0.4 | 0.4 | 11.4 | NA | NA |
| Y | ppm | 0.1 | 35.5 | 23.7 | 59.3 | 41.5 | 12.1 | 31.1 | 36.8 | 16.6 | 55.7 | 57.5 | 69.1 | 79.7 | 56.6 | 52.6 | NA | NA |
| Zn | ppm | 2 | 224 | 144 | 145 | 141 | 73 | 137 | 93 | 54 | 164 | 150 | 381 | 154 | 159 | 111 | **130** | **30,000** |
| Zr | ppm | 0.5 | 44.3 | 46.6 | 87.7 | 59.8 | 138.5 | 25.2 | 80.3 | 68.8 | 68.5 | 79.6 | 83.8 | 113.5 | 75.3 | 78.9 | NA | NA |

**Table B-3 (cont'd):** Total metals concentrations in solid component of a subset 33 samples, with EIL exceedances in yellow and HIL exceedances in red (both EIL and HIL values exceeded text is highlighted in red).

| Element | Unit | Detection Limit | RWC113 | RWC118 | RWC121 | RWC126 | RWC129 | EIL | HIL |
|---|---|---|---|---|---|---|---|---|---|
| | | | Bombora | | | | | | |
| | | | MDQ Fresh | MDQ Trans | MD Trans | MD Trans | MD Fresh | | |
| | | | 552m-554m | 5m-7m | 10m-12m | 16m-18m | 594m-596m | | |
| | | | EP2417121_029 | EP2417121_030 | EP2417121_031 | EP2417121_032 | EP2417121_033 | | |
| Ag | ppm | 0.01 | 0.11 | 0.04 | 0.18 | 0.07 | 0.04 | NA | NA |
| Al | ppm | 100 | 59400 | 62700 | 83500 | 78400 | 80000 | NA | NA |
| As | ppm | 0.2 | 0.4 | 1.2 | 1.5 | 1.1 | <0.2 | **40** | **300** |
| Ba | ppm | 10 | 50 | 30 | 30 | 20 | 120 | NA | NA |
| Be | ppm | 0.05 | 0.91 | 0.52 | 0.27 | 0.25 | 0.6 | NA | NA |
| Bi | ppm | 0.01 | 0.04 | 0.01 | 0.01 | 0.02 | <0.01 | NA | **100** |
| B | ppm | 50 | <50 | <50 | <50 | <50 | <50 | NA | NA |
| Ca | ppm | 100 | 45400 | 52500 | 65600 | 66500 | 42400 | NA | NA |
| Cd | ppm | 0.02 | 0.14 | 0.1 | 0.07 | 0.07 | 0.08 | NA | **90** |
| Ce | ppm | 0.01 | 28.70 | 8.61 | 6.57 | 6.54 | 28.40 | NA | NA |
| Co | ppm | 0.1 | 23.2 | 60.6 | 50.4 | 51.5 | 42.8 | NA | **300** |
| Cr | ppm | 1 | 3 | 2 | 74 | 139 | 170 | **400** | **240** |
| Cs | ppm | 0.05 | 0.54 | 0.23 | 0.64 | 0.65 | 1.89 | NA | NA |
| Cu | ppm | 0.2 | 26.5 | 39.3 | 49.1 | 96.6 | 56.8 | **130** | **20,000** |
| Fe | ppm | 100 | 119000 | 136500 | 84600 | 91000 | 74100 | NA | NA |
| Ga | ppm | 0.05 | 24.8 | 21.7 | 18.9 | 18.0 | 18.6 | NA | NA |
| Ge | ppm | 0.05 | 0.22 | 0.22 | 0.18 | 0.21 | 0.20 | NA | NA |
| Hf | ppm | 0.1 | 2.6 | 1.4 | 0.9 | 0.8 | 2.6 | NA | NA |
| Hg | ppm | 0.01 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | NA | NA |
| In | ppm | 0.005 | 0.181 | 0.112 | 0.073 | 0.071 | 0.062 | NA | NA |
| K | ppm | 100 | 2300 | 2200 | 1700 | 1700 | 5100 | NA | NA |
| La | ppm | 0.5 | 10.6 | 2.8 | 3.1 | 2.6 | 13.2 | NA | NA |
| Li | ppm | 0.2 | 10.5 | 6.0 | 6.6 | 5.8 | 20.5 | NA | NA |
| Mg | ppm | 0.01 | 7700 | 23500 | 31600 | 36800 | 45700 | NA | **NA** |
| Mn | ppm | 5 | 1935 | 1950 | 1215 | 1440 | 1185 | NA | **9,000** |
| Mo | ppm | 0.05 | 1.53 | 0.26 | 0.27 | 0.26 | 0.62 | NA | NA |
| Na | ppm | 100 | 18500 | 24900 | 20200 | 16800 | 28700 | NA | NA |
| Nb | ppm | 0.1 | 8.5 | 3.8 | 2.3 | 2.2 | 5.6 | NA | NA |
| Ni | ppm | 0.2 | 0.2 | 7.9 | 56.2 | 69.2 | 137.5 | **30** | **800** |
| P | ppm | 10 | 1110 | 500 | 300 | 280 | 800 | NA | NA |
| Pb | ppm | 0.5 | 1.3 | 0.6 | 0.8 | 0.7 | 2.7 | **1100** | **600** |
| Rb | ppm | 0.1 | 5 | 6.3 | 3.3 | 5.6 | 23.2 | NA | NA |
| Re | ppm | 0.002 | 0.003 | 0.002 | <0.002 | 0.002 | <0.002 | NA | NA |
| S | ppm | 100 | 1700 | <100 | 200 | 100 | 100 | NA | NA |
| Sb | ppm | 0.05 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | NA | NA |
| Sc | ppm | 0.1 | 39.8 | 58.8 | 46.2 | 51 | 24.3 | NA | NA |
| Se | ppm | 1 | 1 | 1 | 1 | 1 | <1 | NA | NA |
| Sn | ppm | 0.2 | 1.7 | 0.8 | 0.6 | 0.5 | 1.1 | NA | NA |
| Sr | ppm | 0.2 | 112.5 | 91.8 | 116.0 | 106.0 | 144.5 | NA | NA |
| Ta | ppm | 0.05 | 0.50 | 0.22 | 0.13 | 0.13 | 0.35 | NA | NA |
| Te | ppm | 0.05 | 0.17 | <0.05 | <0.05 | <0.05 | <0.05 | NA | NA |
| Th | ppm | 0.01 | 0.55 | 0.23 | 0.17 | 0.13 | 1.34 | NA | NA |
| Ti | ppm | 0.005 | 8520 | 12600 | 6220 | 5870 | 5700 | NA | NA |
| Tl | ppm | 0.02 | 0.03 | 0.04 | 0.04 | 0.04 | 0.12 | NA | NA |
| U | ppm | 0.1 | 0.10 | 0.30 | 0.20 | 0.20 | 0.40 | NA | NA |
| V | ppm | 1 | 4 | 403 | 292 | 287 | 162 | NA | NA |
| W | ppm | 0.1 | 1.1 | 0.4 | 0.9 | 0.5 | 0.2 | NA | NA |
| Y | ppm | 0.1 | 76.6 | 38.4 | 29.2 | 25.7 | 21.9 | NA | NA |
| Zn | ppm | 2 | 157 | 151 | 81 | 84 | 67 | **130** | **30,000** |
| Zr | ppm | 0.5 | 97.3 | 41.8 | 28.0 | 22.0 | 97.6 | NA | NA |

**Table B-4:** GAI values for subset of 33 samples with GAI values >3 in yellow.

| Element | Unit | Median Crustal Abundance | RWC01 | RWC05 | RWC09 | RWC13 | RWC17 | RWC22 | RWC26 | RWC30 | RWC34 | RWC38 | RWC42 | RWC46 | RWC50 | RWC54 | RWC58 | RWC62 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kopai Crescent | | | | | | | | | | | | | | | |
| | | | MB Trans | MB Trans | MB Trans | MB Trans | MD Trans | MD Fresh | MD Oxide | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans |
| | | | 10m-11m | 14m-15m | 18m-19m | 12m-13m | 11m-12m | 31m--32m | 9m-10m | 13m-14m | 17m-18m | 6m-7m | 10m-11m | 14m-15m | 12m-13m | 8m-9m | 7m-8m | 16m-17m |
| Ag | ppm | 0.07 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Al | ppm | 82,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| As | ppm | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ba | ppm | 500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Be | ppm | 2.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bi | ppm | 0.048 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cd | ppm | 0.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ce | ppm | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Co | ppm | 20 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Cr | ppm | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cs | ppm | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cu | ppm | 50 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 2 |
| Fe | ppm | 950 | 5 | 6 | 6 | 6 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Ga | ppm | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ge | ppm | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hf | ppm | 5.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hg | ppm | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| In | ppm | 0.049 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| La | ppm | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Li | ppm | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mn | ppm | 950 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mo | ppm | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nb | ppm | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ni | ppm | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pb | ppm | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rb | ppm | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Re | ppm | 0.0004 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Sb | ppm | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sc | ppm | 16 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Se | ppm | 0.05 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Sn | ppm | 2.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sr | ppm | 370 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ta | ppm | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Te | ppm | 0.005 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| Th | ppm | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ti | ppm | 5600 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tl | ppm | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| U | ppm | 2.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| V | ppm | 160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | ppm | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Y | ppm | 30 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Zn | ppm | 75 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Zr | ppm | 190 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table B-4 (cont'd):** GAI values for subset of 33 samples with GAI values >3 in yellow.

| Element | Unit | Median Crustal Abundance | RWC66 | RWC70 | RWC73 | RWC77 | RWC81 | RWC85 | RWC89 | RWC93 | RWC97 | RWC101 | RWC105 | RWC109 | RWC113 | RWC118 | RWC121 | RWC126 | RWC129 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kopai Crescent | | Bombora | | | | | | | | | | | | | | |
| | | | MD Trans | MD Trans | ALP Fresh | MDQ Trans | MR_FW Trans | MR_FW Fresh | MDQ Trans | MDQ Trans | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Trans | MD Trans | MD Trans | MD Fresh |
| | | | 8m-9m | 12m-13m | 426m-428m | 12m-14m | 10m-12m | 151m-153m | 7m-9m | 15m-17m | 89.37m-90.71m | 106m-108.09m | 175m-177m | 182.5m-184m | 552m-554m | 5m-7m | 10m-12m | 16m-18m | 594m-596m |
| Ag | ppm | 0.07 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Al | ppm | 82,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| As | ppm | 1.5 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ba | ppm | 500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Be | ppm | 2.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bi | ppm | 0.048 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cd | ppm | 0.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Ce | ppm | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Co | ppm | 20 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| Cr | ppm | 100 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cs | ppm | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cu | ppm | 50 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Fe | ppm | 950 | 6 | 6 | 5 | 7 | 6 | 6 | 7 | 7 | 7 | 6 | 7 | 7 | 6 | 7 | 6 | 6 | 6 |
| Ga | ppm | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ge | ppm | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hf | ppm | 5.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hg | ppm | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| In | ppm | 0.049 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| La | ppm | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Li | ppm | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mn | ppm | 950 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mo | ppm | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nb | ppm | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ni | ppm | 80 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pb | ppm | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rb | ppm | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Re | ppm | 0.0004 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Sb | ppm | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sc | ppm | 16 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Se | ppm | 0.05 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 6 | 4 | 4 | 4 | 4 | 4 |
| Sn | ppm | 2.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sr | ppm | 370 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ta | ppm | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Te | ppm | 0.005 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 6 | 5 | 3 | 3 | 3 | 3 |
| Th | ppm | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ti | ppm | 5600 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Tl | ppm | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| U | ppm | 2.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| V | ppm | 160 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| W | ppm | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Y | ppm | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Zn | ppm | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Zr | ppm | 190 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table B-5**: Elemental concentrations in leachate for subset of 24 samples, with measurable but not elevated concentrations in yellow and elevated concentrations in red.

| Element | Unit | Detection limit | RWC01 | RWC05 | RWC09 | RWC13 | RWC17 | RWC22 | RWC26 | RWC30 | RWC34 | RWC38 | RWC42 | RWC46 | RWC50 | RWC54 | RWC58 | RWC62 | Guideline | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kopai Crescent | | | | | | | | | | | | | | | | Freshwater* (ANZECC 2000) | Livestock Drinking (ANZECC 2000) | Human Drinking (NHMRC 2011) |
| | | | MB Trans | MB Trans | MB Trans | MB Trans | MD Trans | MD Fresh | MD Oxide | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | MD Trans | | | |
| | | | 10m-11m | 14m-15m | 18m-19m | 12m-13m | 11m-12m | 31m--32m | 9m-10m | 13m-14m | 17m-18m | 6m-7m | 10m-11m | 14m-15m | 12m-13m | 8m-9m | 7m-8m | 16m-17m | | | |
| Aluminium | mg/L | 0.1 | 46.3 | 51.5 | 65.7 | 55.7 | 37.6 | 4.01 | 0.53 | 2.11 | 1.23 | 83.9 | 15.9 | 8.09 | 8.2 | 10.8 | 24.9 | 24.5 | 0.05 | 5 | 0.2 |
| Arsenic | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.013 | 0.5 | 0.01 |
| Barium | mg/L | 0.1 | 0.1 | 0.1 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NA | NA | 2 |
| Beryllium | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | NA | NA | 0.06 |
| Boron | mg/L | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.37 | 5 | 4 |
| Cadmium | mg/L | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.0002 | 0.01 | 0.002 |
| Chloride | mg/L | 1 | 336 | 307 | 263 | 100 | 128 | 32 | 1080 | 235 | 800 | 103 | 208 | 17 | 11 | 22 | 164 | 164 | NA | NA | 250 |
| Calcium | mg/L | 1 | 6 | 4 | 4 | 4 | 4 | 17 | 5 | 11 | 38 | 6 | 4 | 9 | 7 | 4 | 3 | 2 | NA | NA | NA |
| Chromium | mg/L | 0.01 | 0.15 | 0.18 | 0.18 | 0.15 | 0.18 | 0.01 | <0.01 | <0.01 | <0.01 | 0.21 | 0.05 | 0.02 | 0.02 | 0.04 | 0.07 | 0.05 | 0.001 | 1 | 0.05 |
| Cobalt | mg/L | 0.01 | 0.04 | 0.05 | 0.07 | 0.05 | 0.03 | 0.01 | <0.01 | <0.01 | <0.01 | 0.04 | 0.01 | 0.01 | 0.01 | 0.02 | 0.04 | 0.05 | NA | 1 | NA |
| Copper | mg/L | 0.01 | 0.1 | 0.16 | 0.23 | 0.32 | 0.06 | 0.04 | <0.01 | <0.01 | <0.01 | 0.29 | 0.14 | 0.05 | 0.04 | 0.13 | 0.16 | 0.18 | 0.0014 | 0.5 | 2 |
| Iron | mg/L | 0.05 | 95.9 | 117 | 153 | 96.2 | 64.2 | 5.6 | 0.81 | 1.84 | 1.8 | 146 | 30.4 | 14.1 | 17 | 27.8 | 52.5 | 46.4 | NA | NA | NA |
| Lead | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.0034 | 0.1 | 0.01 |
| Magnesium | mg/L | 1 | 20 | 25 | 27 | 23 | 20 | 4 | 39 | 10 | 40 | 25 | 10 | 5 | 6 | 8 | 14 | 16 | NA | NA | NA |
| Manganese | mg/L | 0.01 | 0.23 | 0.31 | 0.43 | 0.32 | 0.68 | 0.08 | 0.01 | 0.03 | 0.02 | 0.45 | 0.23 | 0.2 | 0.22 | 0.3 | 0.57 | 0.51 | 1.9 | NA | 0.5 |
| Mercury | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0006 | 0.002 | 0.001 |
| Nickel | mg/L | 0.01 | 0.19 | 0.17 | 0.2 | 0.1 | 0.16 | 0.02 | 0.01 | 0.01 | 0.01 | 0.07 | 0.03 | 0.02 | 0.01 | 0.03 | 0.05 | 0.06 | 0.011 | 1 | 0.02 |
| Potassium | mg/L | 1 | 7 | 7 | 6 | 5 | 6 | 2 | 5 | 1 | 14 | 6 | 3 | 2 | 1 | 2 | 2 | 3 | NA | NA | NA |
| Selenium | mg/L | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | <0.01 | <0.01 | 0.02 | 0.01 | 0.01 | <0.01 | 0.02 | 0.01 | 0.01 | 0.011 | 0.02 | 0.01 |
| Sodium | mg/L | 1 | 207 | 198 | 182 | 109 | 109 | 34 | 620 | 116 | 344 | 128 | 124 | 17 | 17 | 35 | 115 | 115 | NA | NA | NA |
| Sulphate | mg/L | 1 | 39 | 33 | 31 | 17 | 20 | 44 | 118 | 23 | 45 | 21 | 27 | 4 | 9 | 6 | 33 | 37 | NA | 1000 | NA |
| Vanadium | mg/L | 0.01 | 0.17 | 0.2 | 0.3 | 0.2 | 0.18 | 0.03 | <0.01 | <0.01 | <0.01 | 0.32 | 0.08 | 0.04 | 0.04 | 0.08 | 0.13 | 0.17 | NA | NA | NA |
| Zinc | mg/L | 0.01 | 0.14 | 0.27 | 0.39 | 0.12 | 0.09 | 0.02 | <0.01 | <0.01 | <0.01 | 0.12 | 0.03 | 0.02 | 0.02 | 0.03 | 0.09 | 0.04 | 0.008 | 20 | NA |
| Total Alkalinity | mg/L | 1 | 6 | 8 | 10 | 15 | 13 | 17 | 4 | 13 | 3 | 16 | 10 | 25 | 22 | 44 | 8 | 6 | NA | NA | NA |
| Final pH | Unit | | 7.9 | 8.2 | 8.5 | 9.1 | 8.4 | 9.1 | 6.8 | 8.6 | 6.8 | 8.9 | 8.6 | 9.4 | 9.3 | 9.8 | 8 | 8.9 | NA | NA | NA |
| Final EC | dS/m | 0.001 | 1.050 | 0.955 | 0.846 | 0.434 | 0.516 | 0.252 | 3.540 | 0.733 | 2.430 | 0.453 | 0.661 | 0.110 | 0.094 | 0.159 | 0.580 | 0.579 | NA | NA | NA |

*Level of protection (%) species = 95%.

**Table B-5 (cont'd)**: Elemental concentrations in leachate for subset of 24 samples, with measurable but not elevated concentrations in yellow and elevated concentrations in red.

| Element | Unit | Detection limit | RWC66 | RWC70 | RWC73 | RWC77 | RWC81 | RWC85 | RWC89 | RWC93 | RWC97 | RWC101 | RWC105 | RWC109 | RWC113 | RWC118 | RWC121 | RWC126 | RWC129 | Guideline | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kopai Crescent | | Bombora | | | | | | | | | | | | | | | | | |
| | | | MD Trans | MD Trans | ALP Fresh | MDQ Trans | MR_FW Trans | MR_FW Fresh | MDQ Trans | MDQ Trans | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Fresh | MDQ Trans | MD Trans | MD Trans | MD Fresh | Freshwater* (ANZECC 2000) | Livestock Drinking (ANZECC 2000) | Human Drinking (NHMRC 2011) |
| | | | 8m-9m | 12m-13m | 426m-428m | 12m-14m | 10m-12m | 151m-153m | 7m-9m | 15m-17m | 89.37m-90.71m | 106m-108.09m | 175m-177m | 182.5m-184m | 552m-554m | 5m-7m | 10m-12m | 16m-18m | 594m-596m | | | |
| Aluminium | mg/L | 0.1 | 63.6 | 47.5 | 2.32 | 31.4 | 44 | 3.94 | 14.6 | 19.6 | 3.15 | 5.02 | 2.42 | 2.18 | 3.11 | 8.27 | 23.4 | 25.6 | 6.86 | 0.05 | 5 | 0.2 |
| Arsenic | mg/L | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.013 | 0.5 | 0.01 |
| Barium | mg/L | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NA | NA | 2 |
| Beryllium | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | NA | NA | 0.06 |
| Boron | mg/L | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.37 | 5 | 4 |
| Cadmium | mg/L | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.0002 | 0.01 | 0.002 |
| Chloride | mg/L | 1 | 188 | 80 | 7 | 85 | 188 | 4 | 63 | 47 | 8 | 4 | 2 | 18 | 3 | 15 | 135 | 60 | 5 | NA | NA | 250 |
| Calcium | mg/L | 1 | 6 | 5 | 7 | 2 | <1 | 8 | 3 | 2 | 11 | 9 | 9 | 12 | 9 | 3 | 3 | 4 | 6 | NA | NA | NA |
| Chromium | mg/L | 0.01 | 0.17 | 0.12 | <0.01 | <0.01 | 0.28 | 0.05 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.04 | 0.1 | 0.03 | 0.001 | 1 | 0.05 |
| Cobalt | mg/L | 0.01 | 0.28 | 0.14 | <0.01 | 0.02 | 0.02 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.03 | 0.02 | <0.01 | NA | 1 | NA |
| Copper | mg/L | 0.01 | 0.39 | 0.67 | <0.01 | 0.1 | 0.1 | <0.01 | 0.02 | 0.03 | 0.01 | <0.01 | <0.01 | 0.04 | <0.01 | 0.05 | 0.08 | 0.22 | 0.01 | 0.0014 | 0.5 | 2 |
| Iron | mg/L | 0.05 | 123 | 104 | 1.57 | 76.2 | 66 | 4.12 | 41.7 | 47.6 | 7.18 | 10.4 | 4.18 | 4.12 | 4.8 | 22 | 40.9 | 47.7 | 8.86 | NA | NA | NA |
| Lead | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.0034 | 0.1 | 0.01 |
| Magnesium | mg/L | 1 | 20 | 17 | 2 | 7 | 17 | 4 | 4 | 4 | 1 | <1 | <1 | <1 | <1 | 3 | 7 | 9 | 7 | NA | NA | NA |
| Manganese | mg/L | 0.01 | 0.32 | 0.54 | 0.03 | 0.2 | 0.45 | 0.07 | 0.11 | 0.1 | 0.09 | 0.14 | 0.06 | 0.04 | 0.08 | 0.08 | 0.09 | 0.11 | 0.12 | 1.9 | NA | 0.5 |
| Mercury | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0006 | 0.002 | 0.001 |
| Nickel | mg/L | 0.01 | 0.27 | 0.2 | <0.01 | <0.01 | 0.18 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | 0.02 | 0.01 | 0.011 | 1 | 0.02 |
| Potassium | mg/L | 1 | 5 | 5 | 10 | 2 | 2 | 6 | 2 | <1 | <1 | <1 | <1 | <1 | 2 | <1 | 1 | 1 | 5 | NA | NA | NA |
| Selenium | mg/L | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | 0.011 | 0.02 | 0.01 |
| Sodium | mg/L | 1 | 140 | 85 | 8 | 78 | 126 | 7 | 58 | 55 | 14 | 7 | 5 | 8 | 4 | 19 | 97 | 68 | 8 | NA | NA | NA |
| Sulphate | mg/L | 1 | 28 | 18 | 1 | 12 | 15 | <1 | 8 | 7 | 20 | <1 | 2 | 2 | <1 | 3 | 14 | 8 | <1 | NA | 1000 | NA |
| Vanadium | mg/L | 0.01 | 0.27 | 0.22 | <0.01 | 0.23 | 0.12 | <0.01 | 0.03 | 0.05 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.08 | 0.12 | 0.1 | 0.02 | NA | NA | NA |
| Zinc | mg/L | 0.01 | 0.2 | 0.18 | <0.01 | 0.04 | 0.04 | <0.01 | 0.03 | 0.03 | 0.03 | 0.02 | <0.01 | <0.01 | 0.01 | <0.01 | 0.02 | 0.02 | 0.01 | 0.008 | 20 | NA |
| Total Alkalinity | mg/L | 1 | 12 | 16 | 27 | 13 | 14 | 28 | 10 | 9 | 22 | 22 | 24 | 30 | 25 | 13 | 13 | 29 | 21 | NA | NA | NA |
| Final pH | Unit | | 8.8 | 9 | 9.5 | 9.2 | 9 | 9.6 | 8.9 | 9 | 9.1 | 9.4 | 9.5 | 8.9 | 9.5 | 9.3 | 9.2 | 9.6 | 9.4 | NA | NA | NA |
| Final EC | dS/m | 0.001 | 0.640 | 0.334 | 0.077 | 0.327 | 0.605 | 0.064 | 0.237 | 0.196 | 0.103 | 0.052 | 0.050 | 0.087 | 0.050 | 0.069 | 0.481 | 0.262 | 0.052 | NA | NA | NA |

*Level of protection (%) species = 95%.

**Table B-6:** ARD classifications for samples tested as part of this study.

| Sample ID | Deposit | Depth From (m) | Depth To (m) | Lithology | Total S (LECO) (%) | Sulfide as $S^{2-}$ (%) | Sulfate as $S\text{-}SO_4^{2-}$ (mg/kg) | Sulfate as $S\text{-}SO_4^{2}$ % | Initial pH | Total Carbon | MPA (kg $H_2SO_4$/t) | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.01 | 0.01 | | | 0.1 | % | | |
| RWC01 | Kopai Crescent | 10 | 11 | MB Trans | 0.04 | 0.01 | 1000 | 0.03 | 6.8 | 0.08 | 1.2 | NAF |
| RWC02 | Kopai Crescent | 11 | 12 | MB Trans | 0.04 | 0.01 | 1010 | 0.03 | 7.5 | | 1.2 | NAF |
| RWC03 | Kopai Crescent | 12 | 13 | MB Trans | 0.03 | 0.01 | 900 | 0.02 | 7.9 | | 0.9 | NAF |
| RWC04 | Kopai Crescent | 13 | 14 | MB Trans | 0.05 | 0.01 | 1300 | 0.04 | 6.9 | | 1.5 | NAF |
| RWC05 | Kopai Crescent | 14 | 15 | MB Trans | 0.04 | 0.01 | 880 | 0.03 | 7.8 | 0.07 | 1.2 | NAF |
| RWC06 | Kopai Crescent | 15 | 16 | MB Trans | 0.05 | 0.01 | 1200 | 0.04 | 7.4 | | 1.5 | NAF |
| RWC07 | Kopai Crescent | 16 | 17 | MB Trans | 0.03 | 0.01 | 660 | 0.02 | 8.3 | | 0.9 | NAF |
| RWC08 | Kopai Crescent | 17 | 18 | MB Trans | 0.04 | 0.01 | 1220 | 0.03 | 7.1 | | 1.2 | NAF |
| RWC09 | Kopai Crescent | 18 | 19 | MB Trans | 0.03 | 0.01 | 840 | 0.02 | 8.3 | 0.11 | 0.9 | NAF |
| RWC10 | Kopai Crescent | 19 | 20 | MB Trans | 0.03 | 0.01 | 620 | 0.02 | 8.5 | | 0.9 | NAF |
| RWC11 | Kopai Crescent | 10 | 11 | MB Trans | 0.03 | 0.01 | 860 | 0.02 | 8.5 | | 0.9 | NAF |
| RWC12 | Kopai Crescent | 11 | 12 | MB Trans | 0.03 | 0.01 | 780 | 0.02 | 8.4 | | 0.9 | NAF |
| RWC13 | Kopai Crescent | 12 | 13 | MB Trans | 0.02 | 0.01 | 520 | 0.01 | 8.6 | 0.05 | 0.6 | NAF |
| RWC14 | Kopai Crescent | 13 | 14 | MB Trans | 0.02 | 0.01 | 610 | 0.01 | 8.6 | | 0.6 | NAF |
| RWC15 | Kopai Crescent | 14 | 15 | MB Trans | 0.02 | 0.01 | 600 | 0.01 | 8.2 | | 0.6 | NAF |

| Sample ID | Deposit | Depth From (m) | Depth To (m) | Lithology | Total S (LECO) (%) | Sulfide as $S^{2-}$ (%) | Sulfate as $S\text{-}SO_4^{2-}$ (mg/kg) | Sulfate as $S\text{-}SO_4^{2}$ % | Initial pH | Total Carbon | MPA (kg $H_2SO_4$/t) | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.01 | 0.01 | | | 0.1 | % | | |
| RWC16 | Kopai Crescent | 10 | 11 | MD Trans | 0.02 | 0.01 | 710 | 0.01 | 7.5 | | 0.6 | NAF |
| RWC17 | Kopai Crescent | 11 | 12 | MD Trans | 0.03 | 0.01 | 680 | 0.02 | 7.6 | 0.18 | 0.9 | NAF |
| RWC18 | Kopai Crescent | 12 | 13 | MD Trans | 0.03 | 0.01 | 620 | 0.02 | 8.2 | | 0.9 | NAF |
| RWC19 | Kopai Crescent | 13 | 14 | MD Trans | 0.02 | 0.01 | 830 | 0.01 | 7.4 | | 0.6 | NAF |
| RWC20 | Kopai Crescent | 14 | 15 | MD Trans | 0.04 | 0.01 | 1100 | 0.03 | 6.4 | | 1.2 | NAF |
| RWC21 | Kopai Crescent | 30 | 31 | MD Fresh | 0.22 | 0.2 | 720 | 0.02 | 9.1 | | 6.7 | NAF |
| RWC22 | Kopai Crescent | 31 | 32 | MD Fresh | 0.42 | 0.37 | 1600 | 0.05 | 7.7 | 0.46 | 12.9 | NAF |
| RWC23 | Kopai Crescent | 32 | 33 | MD Fresh | 0.32 | 0.25 | 2090 | 0.07 | 7.3 | | 9.8 | NAF |
| RWC24 | Kopai Crescent | 7 | 8 | MD Oxide | 0.1 | 0.01 | 2900 | 0.09 | 6.8 | | 3.1 | NAF |
| RWC25 | Kopai Crescent | 8 | 9 | MD Oxide | 0.12 | 0.01 | 3350 | 0.11 | 6.4 | | 3.7 | NAF |
| RWC26 | Kopai Crescent | 9 | 10 | MD Oxide | 0.1 | 0.01 | 3230 | 0.09 | 6.4 | 0.06 | 3.1 | NAF |
| RWC27 | Kopai Crescent | 10 | 11 | MD Trans | 0.03 | 0.02 | 350 | 0.01 | 8.4 | | 0.9 | NAF |
| RWC28 | Kopai Crescent | 11 | 12 | MD Trans | 0.06 | 0.05 | 400 | 0.01 | 7.4 | | 1.8 | NAF |
| RWC29 | Kopai Crescent | 12 | 13 | MD Trans | 0.06 | 0.04 | 510 | 0.02 | 7 | | 1.8 | NAF |
| RWC30 | Kopai Crescent | 13 | 14 | MD Trans | 0.04 | 0.02 | 580 | 0.02 | 6.8 | 0.5 | 1.2 | NAF |
| RWC31 | Kopai Crescent | 14 | 15 | MD Trans | 0.04 | 0.02 | 570 | 0.02 | 6.8 | | 1.2 | NAF |

| Sample ID | Deposit | Depth From (m) | Depth To (m) | Lithology | Total S (LECO) (%) | Sulfide as $S^{2-}$ (%) | Sulfate as $S\text{-}SO_4^{2-}$ (mg/kg) | Sulfate as $S\text{-}SO_4^{2}$ % | Initial pH | Total Carbon | MPA (kg $H_2SO_4$/t) | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.01 | 0.01 | | | 0.1 | % | | |
| RWC32 | Kopai Crescent | 15 | 16 | MD Trans | 0.08 | 0.04 | 1340 | 0.04 | 6.2 | | 2.4 | NAF |
| RWC33 | Kopai Crescent | 16 | 17 | MD Trans | 0.04 | 0.01 | 1010 | 0.03 | 6.3 | | 1.2 | NAF |
| RWC34 | Kopai Crescent | 17 | 18 | MD Trans | 0.05 | 0.01 | 1180 | 0.04 | 6.2 | 0.16 | 1.5 | NAF |
| RWC35 | Kopai Crescent | 18 | 19 | MD Trans | 0.11 | 0.04 | 2190 | 0.07 | 6.2 | | 3.4 | NAF |
| RWC36 | Kopai Crescent | 19 | 20 | MD Trans | 0.03 | 0.01 | 480 | 0.02 | 6.8 | | 0.9 | NAF |
| RWC37 | Kopai Crescent | 5 | 6 | MD Trans | 0.03 | 0.01 | 680 | 0.02 | 8.4 | | 0.9 | NAF |
| RWC38 | Kopai Crescent | 6 | 7 | MD Trans | 0.02 | 0.01 | 540 | 0.01 | 8.4 | 0.26 | 0.6 | NAF |
| RWC39 | Kopai Crescent | 7 | 8 | MD Trans | 0.03 | 0.01 | 700 | 0.02 | 8.1 | | 0.9 | NAF |
| RWC40 | Kopai Crescent | 8 | 9 | MD Trans | 0.04 | 0.01 | 980 | 0.03 | 7.7 | | 1.2 | NAF |
| RWC41 | Kopai Crescent | 9 | 10 | MD Trans | 0.05 | 0.01 | 1100 | 0.04 | 8 | | 1.5 | NAF |
| RWC42 | Kopai Crescent | 10 | 11 | MD Trans | 0.03 | 0.01 | 680 | 0.02 | 6.8 | 0.1 | 0.9 | NAF |
| RWC43 | Kopai Crescent | 11 | 12 | MD Trans | 0.06 | 0.05 | 280 | 0.01 | 8.8 | | 1.8 | NAF |
| RWC44 | Kopai Crescent | 12 | 13 | MD Trans | 0.06 | 0.05 | 330 | 0.01 | 7.5 | | 1.8 | NAF |
| RWC45 | Kopai Crescent | 13 | 14 | MD Trans | 0.14 | 0.1 | 1060 | 0.04 | 7.1 | | 4.3 | NAF |
| RWC46 | Kopai Crescent | 14 | 15 | MD Trans | 0.1 | 0.09 | 280 | 0.01 | 9.2 | 0.21 | 3.1 | NAF |
| RWC47 | Kopai Crescent | 9 | 10 | MD Trans | 0.04 | 0.02 | 630 | 0.02 | 8.3 | | 1.2 | NAF |

| Sample ID | Deposit | Depth From (m) | Depth To (m) | Lithology | Total S (LECO) (%) | Sulfide as $S^{2-}$ (%) | Sulfate as S-$SO_4^{2-}$ (mg/kg) | Sulfate as S-$SO_4^{2}$ % | Initial pH | Total Carbon | MPA (kg $H_2SO_4$/t) | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.01 | 0.01 | | | 0.1 | % | | |
| RWC48 | Kopai Crescent | 10 | 11 | MD Trans | 0.04 | 0.03 | 350 | 0.01 | 7.8 | | 1.2 | NAF |
| RWC49 | Kopai Crescent | 11 | 12 | MD Trans | 0.04 | 0.03 | 310 | 0.01 | 9.3 | | 1.2 | NAF |
| RWC50 | Kopai Crescent | 12 | 13 | MD Trans | 0.04 | 0.03 | 290 | 0.01 | 9.3 | 0.13 | 1.2 | NAF |
| RWC51 | Kopai Crescent | 5 | 6 | MD Trans | 0.03 | 0.01 | 1000 | 0.02 | 8.6 | | 0.9 | NAF |
| RWC52 | Kopai Crescent | 6 | 7 | MD Trans | 0.02 | 0.01 | 310 | 0.01 | 8.4 | | 0.6 | NAF |
| RWC53 | Kopai Crescent | 7 | 8 | MD Trans | 0.02 | 0.01 | 360 | 0.01 | 8.9 | | 0.6 | NAF |
| RWC54 | Kopai Crescent | 8 | 9 | MD Trans | 0.01 | 0.01 | 140 | 0.00 | 10 | 0.29 | 0.3 | NAF |
| RWC55 | Kopai Crescent | 9 | 10 | MD Trans | 0.04 | 0.01 | 940 | 0.03 | 8.8 | | 1.2 | NAF |
| RWC56 | Kopai Crescent | 5 | 6 | MD Trans | 0.03 | 0.01 | 570 | 0.02 | 8.4 | | 0.9 | NAF |
| RWC57 | Kopai Crescent | 6 | 7 | MD Trans | 0.03 | 0.01 | 590 | 0.02 | 7.8 | | 0.9 | NAF |
| RWC58 | Kopai Crescent | 7 | 8 | MD Trans | 0.03 | 0.01 | 700 | 0.02 | 8.1 | 0.25 | 0.9 | NAF |
| RWC59 | Kopai Crescent | 8 | 9 | MD Trans | 0.04 | 0.02 | 520 | 0.02 | 7.8 | | 1.2 | NAF |
| RWC60 | Kopai Crescent | 9 | 10 | MD Trans | 0.03 | 0.02 | 390 | 0.01 | 7.8 | | 0.9 | NAF |
| RWC61 | Kopai Crescent | 15 | 16 | MD Trans | 0.03 | 0.01 | 830 | 0.02 | 7.9 | | 0.9 | NAF |
| RWC62 | Kopai Crescent | 16 | 17 | MD Trans | 0.02 | 0.01 | 840 | 0.01 | 8.2 | 0.04 | 0.6 | NAF |
| RWC63 | Kopai Crescent | 17 | 18 | MD Trans | 0.03 | 0.01 | 890 | 0.02 | 8.3 | | 0.9 | NAF |

| Sample ID | Deposit | Depth From (m) | Depth To (m) | Lithology | Total S (LECO) (%) | Sulfide as $S^{2-}$ (%) | Sulfate as $S\text{-}SO_4^{2-}$ (mg/kg) | Sulfate as $S\text{-}SO_4^{2}$ % | Initial pH | Total Carbon | MPA (kg $H_2SO_4$/t) | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.01 | 0.01 | | | 0.1 | % | | |
| RWC64 | Kopai Crescent | 18 | 19 | MD Trans | 0.02 | 0.01 | 740 | 0.01 | 7.8 | | 0.6 | NAF |
| RWC65 | Kopai Crescent | 19 | 20 | MD Trans | 0.05 | 0.02 | 1020 | 0.03 | 7.8 | | 1.5 | NAF |
| RWC66 | Kopai Crescent | 8 | 9 | MD Trans | 0.02 | 0.01 | 860 | 0.01 | 8.4 | 0.08 | 0.6 | NAF |
| RWC67 | Kopai Crescent | 9 | 10 | MD Trans | 0.03 | 0.01 | 680 | 0.02 | 8.7 | | 0.9 | NAF |
| RWC68 | Kopai Crescent | 10 | 11 | MD Trans | 0.02 | 0.01 | 620 | 0.01 | 8.6 | | 0.6 | NAF |
| RWC69 | Kopai Crescent | 11 | 12 | MD Trans | 0.02 | 0.01 | 560 | 0.01 | 8.6 | | 0.6 | NAF |
| RWC70 | Kopai Crescent | 12 | 13 | MD Trans | 0.01 | 0.01 | 470 | 0.00 | 9 | 0.03 | 0.3 | NAF |
| RWC71 | Bombora | 160.85 | 162.21 | ALP Fresh | 0.18 | 0.16 | 720 | 0.02 | 9.7 | | 5.5 | NAF |
| RWC72 | Bombora | 105.42 | 107.01 | ALP Fresh | 0.16 | 0.15 | 330 | 0.01 | 9.7 | | 4.9 | NAF |
| RWC73 | Bombora | 426 | 428 | ALP Fresh | 0.12 | 0.12 | 130 | 0.00 | 9.7 | 0.8 | 3.7 | NAF |
| RWC74 | Bombora | 5 | 7.1 | MDQ Trans | 0.02 | 0.01 | 320 | 0.01 | 9.2 | | 0.6 | NAF |
| RWC75 | Bombora | 8 | 10 | MDQ Trans | 0.01 | 0.01 | 340 | 0.00 | 8.8 | | 0.3 | NAF |
| RWC76 | Bombora | 10 | 12 | MDQ Trans | 0.01 | 0.01 | 180 | 0.00 | 9.2 | | 0.3 | NAF |
| RWC77 | Bombora | 12 | 14 | MDQ Trans | 0.01 | 0.01 | 300 | 0.00 | 8.8 | 0.02 | 0.3 | NAF |
| RWC78 | Bombora | 14 | 16 | MDQ Trans | 0.04 | 0.03 | 210 | 0.01 | 9.3 | | 1.2 | NAF |
| RWC79 | Bombora | 6 | 8 | MR_FW Trans | 0.04 | 0.01 | 1340 | 0.03 | 7.4 | | 1.2 | NAF |
| RWC80 | Bombora | 8 | 10 | MR_FW Trans | 0.03 | 0.01 | 830 | 0.02 | 7.8 | | 0.9 | NAF |
| RWC81 | Bombora | 10 | 12 | MR_FW Trans | 0.01 | 0.01 | 340 | 0.00 | 8.4 | 0.02 | 0.3 | NAF |
| RWC82 | Bombora | 12 | 14 | MR_FW Trans | 0.02 | 0.01 | 350 | 0.01 | 8.5 | | 0.6 | NAF |
| RWC83 | Bombora | 147 | 149 | MR_FW Fresh | 0.01 | 0.01 | 100 | 0.00 | 9.6 | | 0.3 | NAF |
| RWC84 | Bombora | 149 | 151 | MR_FW Fresh | 0.01 | 0.01 | 100 | 0.00 | 9.6 | | 0.3 | NAF |
| RWC85 | Bombora | 151 | 153 | MR_FW Fresh | 0.01 | 0.01 | 100 | 0.00 | 9.6 | 0.39 | 0.3 | NAF |
| RWC86 | Bombora | 153 | 155 | MR_FW Fresh | 0.01 | 0.01 | 120 | 0.00 | 9.9 | | 0.3 | NAF |
| RWC87 | Bombora | 155 | 157 | MR_FW Fresh | 0.01 | 0.01 | 340 | 0.00 | 9.2 | | 0.3 | NAF |

| Sample ID | Deposit | Depth From (m) | Depth To (m) | Lithology | Total S (LECO) (%) | Sulfide as $S^{2-}$ (%) | Sulfate as $S\text{-}SO_4^{2-}$ (mg/kg) | Sulfate as $S\text{-}SO_4^{2}$ % | Initial pH | Total Carbon | MPA (kg $H_2SO_4$/t) | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.01 | 0.01 | | | 0.1 | % | | |
| RWC88 | Bombora | 5 | 7 | MDQ Trans | 0.02 | 0.01 | 390 | 0.01 | 8.6 | | 0.6 | NAF |
| RWC89 | Bombora | 7 | 9 | MDQ Trans | 0.01 | 0.01 | 280 | 0.00 | 8.7 | 0.02 | 0.3 | NAF |
| RWC90 | Bombora | 9 | 11 | MDQ Trans | 0.01 | 0.01 | 320 | 0.00 | 8.6 | | 0.3 | NAF |
| RWC91 | Bombora | 11 | 13 | MDQ Trans | 0.02 | 0.01 | 280 | 0.01 | 9 | | 0.6 | NAF |
| RWC92 | Bombora | 13 | 15 | MDQ Trans | 0.01 | 0.01 | 240 | 0.00 | 9.2 | | 0.3 | NAF |
| RWC93 | Bombora | 15 | 17 | MDQ Trans | 0.01 | 0.01 | 280 | 0.00 | 9 | 0.02 | 0.3 | NAF |
| RWC94 | Bombora | 6.9 | 9 | MDQ Trans | 0.02 | 0.01 | 330 | 0.01 | 8.5 | | 0.6 | NAF |
| RWC95 | Bombora | 11 | 13 | MDQ Trans | 0.01 | 0.01 | 230 | 0.00 | 9.4 | | 0.3 | NAF |
| RWC96 | Bombora | 78 | 80 | MDQ Fresh | 0.13 | 0.07 | 1830 | 0.06 | 8.4 | | 4.0 | NAF |
| RWC97 | Bombora | 89.37 | 90.71 | MDQ Fresh | 0.42 | 0.41 | 390 | 0.01 | 9.4 | 0.17 | 12.9 | NAF |
| RWC98 | Bombora | 90.71 | 92 | MDQ Fresh | 0.5 | 0.42 | 2310 | 0.08 | 9.5 | | 15.3 | NAF |
| RWC99 | Bombora | 102 | 104 | MDQ Fresh | 0.14 | 0.13 | 170 | 0.01 | 9.9 | | 4.3 | NAF |
| RWC100 | Bombora | 104 | 106 | MDQ Fresh | 0.03 | 0.02 | 160 | 0.01 | 9.9 | | 0.9 | NAF |
| RWC101 | Bombora | 106 | 108.09 | MDQ Fresh | 0.03 | 0.02 | 140 | 0.01 | 9.8 | 0.11 | 0.9 | NAF |
| RWC102 | Bombora | 108.72 | 110 | MDQ Fresh | 0.25 | 0.24 | 250 | 0.01 | 9.8 | | 7.7 | NAF |
| RWC103 | Bombora | 110 | 112 | MDQ Fresh | 0.29 | 0.23 | 1740 | 0.06 | 9.7 | | 8.9 | NAF |
| RWC104 | Bombora | 112 | 114 | MDQ Fresh | 0.05 | 0.04 | 370 | 0.01 | 9.5 | | 1.5 | NAF |
| RWC105 | Bombora | 175 | 177 | MDQ Fresh | 0.16 | 0.13 | 1020 | 0.03 | 9.7 | 0.26 | 4.9 | NAF |
| RWC106 | Bombora | 177 | 179 | MDQ Fresh | 0.2 | 0.16 | 1160 | 0.04 | 9.8 | | 6.1 | NAF |
| RWC107 | Bombora | 179 | 181 | MDQ Fresh | 0.28 | 0.24 | 1140 | 0.04 | 9.6 | | 8.6 | NAF |
| RWC108 | Bombora | 181 | 182.5 | MDQ Fresh | 0.24 | 0.22 | 720 | 0.02 | 9.6 | | 7.3 | NAF |
| RWC109 | Bombora | 182.5 | 184 | MDQ Fresh | 1.97 | 1.76 | 6160 | 0.21 | 9.3 | 0.51 | 60.3 | PAF |
| RWC110 | Bombora | 544.04 | 545.72 | MDQ Fresh | 0.05 | 0.05 | 120 | 0.00 | 9.7 | | 1.5 | NAF |
| RWC111 | Bombora | 545.72 | 547 | MDQ Fresh | 0.02 | 0.02 | 100 | 0.00 | 9.6 | | 0.6 | NAF |
| RWC112 | Bombora | 550 | 552 | MDQ Fresh | 0.13 | 0.12 | 260 | 0.01 | 9.7 | | 4.0 | NAF |
| RWC113 | Bombora | 552 | 554 | MDQ Fresh | 0.2 | 0.19 | 370 | 0.01 | 9.7 | 0.28 | 6.1 | NAF |
| RWC114 | Bombora | 554 | 556 | MDQ Fresh | 0.05 | 0.05 | 100 | 0.00 | 9.7 | | 1.5 | NAF |
| RWC115 | Bombora | 5 | 7 | MDQ Trans | 0.06 | 0.01 | 1750 | 0.05 | 7.8 | | 1.8 | NAF |
| RWC116 | Bombora | 7 | 9 | MDQ Trans | 0.01 | 0.01 | 130 | 0.00 | 9.4 | | 0.3 | NAF |
| RWC117 | Bombora | 9 | 11 | MDQ Trans | 0.02 | 0.02 | 130 | 0.00 | 9.1 | | 0.6 | NAF |

| Sample ID | Deposit | Depth From (m) | Depth To (m) | Lithology | Total S (LECO) (%) | Sulfide as $S^{2-}$ (%) | Sulfate as $S\text{-}SO_4^{2-}$ (mg/kg) | Sulfate as $S\text{-}SO_4^{2}$ % | Initial pH | Total Carbon | MPA (kg $H_2SO_4$/t) | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.01 | 0.01 | | | 0.1 | % | | |
| RWC118 | Bombora | 5 | 7 | MDQ Trans | 0.01 | 0.01 | 100 | 0.00 | 9.6 | 0.02 | 0.3 | NAF |
| RWC119 | Bombora | 7 | 9 | MDQ Trans | 0.02 | 0.01 | 220 | 0.01 | 9 | | 0.6 | NAF |
| RWC120 | Bombora | 9 | 11 | MDQ Trans | 0.01 | 0.01 | 100 | 0.00 | 9.6 | | 0.3 | NAF |
| RWC121 | Bombora | 10 | 12 | MD Trans | 0.01 | 0.01 | 300 | 0.00 | 9.1 | 0.02 | 0.3 | NAF |
| RWC122 | Bombora | 12 | 14 | MD Trans | 0.01 | 0.01 | 250 | 0.00 | 9.6 | | 0.3 | NAF |
| RWC123 | Bombora | 14 | 16 | MD Trans | 0.01 | 0.01 | 300 | 0.00 | 9.6 | | 0.3 | NAF |
| RWC124 | Bombora | 18 | 20 | MD Trans | 0.01 | 0.01 | 300 | 0.00 | 9.9 | | 0.3 | NAF |
| RWC125 | Bombora | 20 | 22 | MD Trans | 0.01 | 0.01 | 340 | 0.00 | 10 | | 0.3 | NAF |
| RWC126 | Bombora | 16 | 18 | MD Trans | 0.02 | 0.01 | 280 | 0.01 | 9.7 | 0.04 | 0.6 | NAF |
| RWC127 | Bombora | 18 | 19.85 | MD Trans | 0.02 | 0.01 | 240 | 0.01 | 10.1 | | 0.6 | NAF |
| RWC128 | Bombora | 592 | 594 | MD Fresh | 0.01 | 0.01 | 120 | 0.00 | 9.8 | | 0.3 | NAF |
| RWC129 | Bombora | 594 | 596 | MD Fresh | 0.01 | 0.01 | 110 | 0.00 | 9.7 | 0.03 | 0.3 | NAF |
| RWC130 | Bombora | 596 | 598 | MD Fresh | 0.09 | 0.05 | 1210 | 0.04 | 9.8 | | 2.8 | NAF |

**Table B-7:** Acid-base accounting values and ARD classifications for samples with recorded total S >0.3%.

| Sample ID | Deposit | Depth From | Depth To | Lithology | Sulfur - Total as S (LECO) | Sulfide as $S_2$- | NAPP | NAG pH (ox) | NAG (pH 4.5) | NAG (pH 7.0) | ANC as $H_2SO_4$ | ANC as $CaCO_3$ | Total Carbon | MPA | ANC:MPA ratio | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | % | % | kg $H_2SO_4$/t | pH Unit | kg $H_2SO_4$/t | kg $H_2SO_4$/t | kg $H_2SO_4$ equiv./t | % $CaCO_3$ | % | kg $H_2SO_4$/t | | |
| | | | | | 0.01 | 0.01 | 0.5 | 0.1 | 0.1 | 0.1 | 0.5 | 0.1 | | 0 | | |
| RWC22 | Kopai Crescent | 31.00 | 32.00 | MD Fresh | 0.38 | 0.37 | -37.90 | 8.70 | <0.1 | <0.1 | 49.50 | 5.00 | 0.46 | 11.63 | 4.26 | NAF |
| RWC23 | Kopai Crescent | 32.00 | 33.00 | MD Fresh | 0.30 | 0.25 | -19.90 | 7.80 | <0.1 | <0.1 | 29.10 | 3.00 | 0.00 | 9.18 | 3.17 | NAF |
| RWC97 | Bombora | 89.37 | 90.71 | MDQ Fresh | 0.42 | 0.41 | -18.00 | 7.40 | <0.1 | <0.1 | 30.20 | 3.10 | 0.17 | 12.85 | 2.35 | NAF |
| RWC98 | Bombora | 90.71 | 92.00 | MDQ Fresh | 0.50 | 0.42 | -6.80 | 5.40 | <0.1 | 1.30 | 20.60 | 2.10 | 0.00 | 15.30 | 1.35 | NAF |
| RWC109 | Bombora | 182.50 | 184.00 | MDQ Fresh | 1.97 | 1.76 | 1.60 | 3.00 | 12.80 | 16.70 | 57.80 | 5.90 | 0.51 | 60.28 | 0.96 | PAF |

## APPENDIX C: ANALYSIS OF FIBROUS CONTENT

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lab@mpl.com.au
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# Certificate of Analysis PFK1267

## Client Details

| | |
|---|---|
| **Client** | Meta Maya Group Pty Ltd |
| **Contact** | Jason Linford |
| **Address** | Unit 5, 78 Catalano Circuit, CANNING VALE, WA, 6155 |

## Sample Details

| | |
|---|---|
| **Your Reference** | Asbestos Bulk ID |
| **Number of Samples** | 13 Aggregate |
| **Date Samples Received** | 19/11/2024 |
| **Date Instructions Received** | 19/11/2024 |

## Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for soils and on an as received basis for other matrices.

## Report Details

| | |
|---|---|
| **Date Results Requested by** | 21/11/2024 |
| **Date of Issue** | 21/11/2024 |

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## Authorisation Details

| | |
|---|---|
| **Asbestos Approved By** | Analysed by Asbestos Approved Analyst: Lalanee Rupasinghe<br>Authorised by Asbestos Approved Signatory: Lalanee Rupasinghe |
| **Results Approved By** | Lalanee Rupasinghe, Asbestos Analyst |
| **Laboratory Manager** | Michael Kubiak |

# Certificate of Analysis PFK1267

## Samples in this Report

| Envirolab ID | Sample ID | Matrix | Date Sampled | Date Received |
|---|---|---|---|---|
| PFK1267-01 | RWC02 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-02 | RWC11 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-03 | RWC21 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-04 | RWC25 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-05 | RWC32 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-06 | RWC56 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-07 | RWC71 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-08 | RWC75 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-09 | RWC79 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-10 | RWC84 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-11 | RWC99 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-12 | RWC123 - waste | Aggregate | 18/11/2024 | 19/11/2024 |
| PFK1267-13 | RWC128 - waste | Aggregate | 18/11/2024 | 19/11/2024 |

# Certificate of Analysis PFK1267

## Asbestos ID in Aggregate

| Client ID | Envirolab ID | Description | Result |
|---|---|---|---|
| RWC02 - waste | PFK1267-01 | 150x150x40mm Rock Dust | **No Asbestos Detected**<br>**No trace fibres detected** |
| RWC11 - waste | PFK1267-02 | 180x150x40mm Rock Dust | **Unknown Mineral Fibre detected#**<br>**Trace Analysis Not Applicable**<br># May or may not be asbestos [see methodology] |
| RWC21 - waste | PFK1267-03 | 150x150x40mm Rock Dust | **Unknown Mineral Fibre detected#**<br>**Trace Analysis Not Applicable**<br># May or may not be asbestos [see methodology] |
| RWC25 - waste | PFK1267-04 | 150x150x40mm Dust | **No Asbestos Detected**<br>**No trace fibres detected** |
| RWC32 - waste | PFK1267-05 | 150x150x40mm Rock Dust | **Unknown Mineral Fibre detected#**<br>**Trace Analysis Not Applicable**<br># May or may not be asbestos [see methodology] |
| RWC56 - waste | PFK1267-06 | 150x150x40mm Rock Dust | **Unknown Mineral Fibre detected#**<br>**Trace Analysis Not Applicable**<br># May or may not be asbestos [see methodology] |
| RWC71 - waste | PFK1267-07 | 150x150x40mm Rock | **No Asbestos Detected**<br>**No trace fibres detected** |
| RWC75 - waste | PFK1267-08 | 150x150x40mm Rock | **No Asbestos Detected**<br>**No trace fibres detected** |
| RWC79 - waste | PFK1267-09 | 150x150x40mm Rock Dust | **Unknown Mineral Fibre detected#**<br>**Trace Analysis Not Applicable**<br># May or may not be asbestos [see methodology] |
| RWC84 - waste | PFK1267-10 | 150x150x40mm Rock | **No Asbestos Detected**<br>**No trace fibres detected** |
| RWC99 - waste | PFK1267-11 | 140x130x50mm Rock | **No Asbestos Detected**<br>**No trace fibres detected** |
| RWC123 - waste | PFK1267-12 | 220x150x60mm Rock | **Unknown Mineral Fibre detected#**<br>**Trace Analysis Not Applicable**<br># May or may not be asbestos [see methodology] |
| RWC128 - waste | PFK1267-13 | 250x150x60mm Rock | **Unknown Mineral Fibre detected#**<br>**Trace Analysis Not Applicable**<br># May or may not be asbestos [see methodology] |

# Certificate of Analysis PFK1267

## Method Summary

| Method ID | Methodology Summary |
|---|---|
| ASB-001_AS4964 | Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004. When mineral fibres of unknown type are detected by polarized light microscopy including dispersion staining, the fibres detected may or may not be asbestos fibres. To confirm the identities, another independent analytical technique may be required. Visible asbestos is defined as asbestos detected below the reporting limit of 0.1g/kg as per AS4964-2004 |

## Result Definitions

| Identifier | Description |
|---|---|
| **NR** | Not reported |
| **NEPM** | National Environment Protection Measure |
| **NS** | Not specified |
| **LCS** | Laboratory Control Sample |
| **RPD** | Relative Percent Difference |
| **>** | Greater than |
| **<** | Less than |
| **PQL** | Practical Quantitation Limit |
| **INS** | Insufficient sample for this test |
| **NA** | Test not required |
| **NT** | Not tested |
| **DOL** | Samples rejected due to particulate overload (air filters only) |
| **RFD** | Samples rejected due to filter damage (air filters only) |
| **RUD** | Samples rejected due to uneven deposition (air filters only) |
| **##** | Indicates a laboratory acceptance criteria outlier, for further details, see Result Comments and/or QC Comments |

## Quality Control Definitions

### Blank

This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, and is determined by processing solvents and reagents in exactly the same manner as for samples.

### Surrogate Spike

Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

### LCS (Laboratory Control Sample)

This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

### Matrix Spike

A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

### Duplicate

This is the complete duplicate analysis of a sample from the process batch. The sample selected should be one where the analyte concentration is easily measurable.

## Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria. Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable. For VOCs in water samples, three vials are required for duplicate or spike analysis.

General Acceptance Criteria (GAC) - Analyte specific criteria applies for some analytes and is reflected in QC recovery tables.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% - see ELN-P05 QAQC tables for details (available on request); <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase. Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was typically insufficient in order to satisfy laboratory QA/QC protocols.

## Miscellaneous Information

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached. We have taken the sampling date as being the date received at the laboratory.

Two significant figures are reported for the majority of tests and with a high degree of confidence, for results <10*PQL, the second significant figure may be in doubt i.e. has a relatively high degree of uncertainty and is provided for information only.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS where sediment/solids are included by default.

Urine Analysis - The BEI values listed are taken from the 2022 edition of *TLVs and BEIs Threshold Limits by ACGIH*.

Air volume measurements are not covered by Envirolab's NATA accreditation.

# Data Quality Assessment Summary PFK1267

## Client Details

| | |
|---|---|
| **Client** | Meta Maya Group Pty Ltd |
| **Your Reference** | Asbestos Bulk ID |
| **Date Issued** | 21/11/2024 |

## Recommended Holding Time Compliance

No recommended holding time exceedances

## Quality Control and QC Frequency

| QC Type | Compliant | Details |
|---|---|---|
| Blank | Yes | No Outliers |
| LCS | Yes | No Outliers |
| Duplicates | Yes | No Outliers |
| Matrix Spike | Yes | No Outliers |
| Surrogates / Extracted Internal Standards | Yes | No Outliers |
| QC Frequency | Yes | No Outliers |

Surrogates/Extracted Internal Standards, Duplicates and/or Matrix Spikes are not always relevant/applicable to certain analyses and matrices. Therefore, said QC measures are deemed compliant in these situations by default. See Laboratory Acceptance Criteria for more information

# Data Quality Assessment Summary PFK1267

## Recommended Holding Time Compliance

| Analysis | Sample Number(s) | Date Sampled | Date Extracted | Date Analysed | Compliant |
|---|---|---|---|---|---|
| Asbestos-Bulk Materials \| Material | 1-13 | 18/11/2024 | 21/11/2024 | 21/11/2024 | Yes |

microanalysis
australia

5 Alvan Street
Mount Lawley
WA 6050
T: 08 9225 5810

**Client:** Landloch
**Job number:** 25_0206
**Lab ID:** 25_0206_001
**Client ID:** **RWC11**
**Analysis:** Fibre characterisation by scanning electron microscopy (SEM) with elemental analysis by energy dispersive spectroscopy (EDS) following AS 4964-2004 (modified for SEM)
**Revision number:** 0
**Comments:** None

**Date received:** 30/01/2025
**Date analysed:** 24/02/2025
**Date reported:** 28/02/2025

## Executive summary

The sample was determined to contain **< 0.01 wt % asbestos** mineral fibre.

## Sample preparation

The sample was supplied to Microanalysis Australia as a bulk sample. The sample was screened at 2 mm, and each size fraction was inspected visually (both with the naked eye and with a low-powered microscope) for fibrous material.

As no fibrous material was visually apparent for immediate pre-selection, a representative sub-sample of the <2 mm fraction was disaggregated and was placed on top of at least one double-sided carbon tab before being carbon coated. Non-conducting samples require coating prior to SEM analysis to prevent charging whilst being analysed by the electron beam.

## Analysis

The sample was analysed using a Carl Zeiss EVO50 scanning electron microscope (SEM) fitted with an Oxford INCA energy dispersive spectrometer (EDS). The sample was scanned at low magnification to identify any possible fibre clusters before the magnification was increased to 2000x magnification for closer examination.

EDS is a semi-quantitative technique (at best) on well prepared, optically flat samples. Factors such as sample unevenness may adversely bias elemental concentration interpretation. EDS has a spatial resolution of ~5 µm meaning spectra from particles less than this size may contain elemental concentrations biased by their surroundings.

All images were acquired using backscatter electrons. Image brightness is proportional to average atomic number – the brighter the pixel, the higher the atomic number of the element.

**Summary**

Following AS 4964, asbestos is defined as:

- Many particles with aspect ratios (i.e. length to width ratios) ranging from 20:1 to 100:1 or higher for particles >5 micrometers in length. Bundles of fibres may have lower aspect ratios;
- Sets of fibre bundles generally less than 0.5, but always less than 1.0 micrometres in width, unless in thick bundles;
- In addition to the mandatory fibrillar crystal growth, one or more, and preferably three of the following aspects:
    - Parallel fibres occurring in bundles;
    - Fibre bundles displaying splayed ends;
    - Matted masses of individual fibres;
    - Fibres showing characteristic curvature.
- Respirable asbestos fibres are defined as:
    - Asbestos fibres less than 3 µm in width, and greater than 5 µm in length, and with a length to width ratio greater than 3 to 1.

**Less than three observed fibres had an elemental composition and morphology indicative of asbestos mineral fibre, according to the definition in AS 4964.**

Depending upon sample condition, composition and fibre type, the detection limit of AS 4964 has been found to lie generally in the range of 1 in 1,000 (0.1 wt %) to 1 in 10,000 (0.01 wt %) parts by weight, equivalent to 1 to 0.1 g/kg.

For this report, a limit of reporting (LoR) of 0.01 wt % has been assumed, as stated in AS 4964.

A selection of images/fields and associated elemental spectra are reported below. The fields are not representative of the area analysed. The images/fields were reported due to their higher fibre count.

| Fibre # | Image/Field # | Diameter (µm) | Length (µm) | Aspect ratio | Major Elements | Minor Elements | Morphology | Assigned mineralogy |
|---|---|---|---|---|---|---|---|---|
| 1 | 1/1 | 0.5 | 7.2 | 14 :1 | O, Si | Mg, Al, Fe, Ca, Na | Irregular ends | Hornblende |
| 2 | 2/3 | 1.2 | 14.2 | 12 :1 | O, Si | Mg, Al, Fe, Ca, Na | Non-parallel sides | Hornblende |
| 3 | 4/7 | 0.7 | 20.9 | 30 :1 | O, Si | Mg, Al, Fe, Ca, Na | Non-parallel sides | Hornblende |
| 4 | 6/10 | 0.7 | 7.2 | 10 :1 | O, Si | Mg, Al, Fe, Ca, Na | Non-parallel sides | Hornblende |
| 5 | 8/13 | 1.3 | 18.6 | 14 :1 | O, Si | Mg, Al, Fe, Ca, Na | Non-parallel sides | Hornblende |
| 6 | 9/15 | 1.0 | 11.4 | 11 :1 | O, Si | Mg, Al, Fe, Ca, Na | Non-parallel sides | Hornblende |
| 7 | 11/17 | 0.4 | 19.7 | 49 :1 | O, Si | Mg, Al, Fe, Ca, Na | Non-parallel sides | Hornblende |

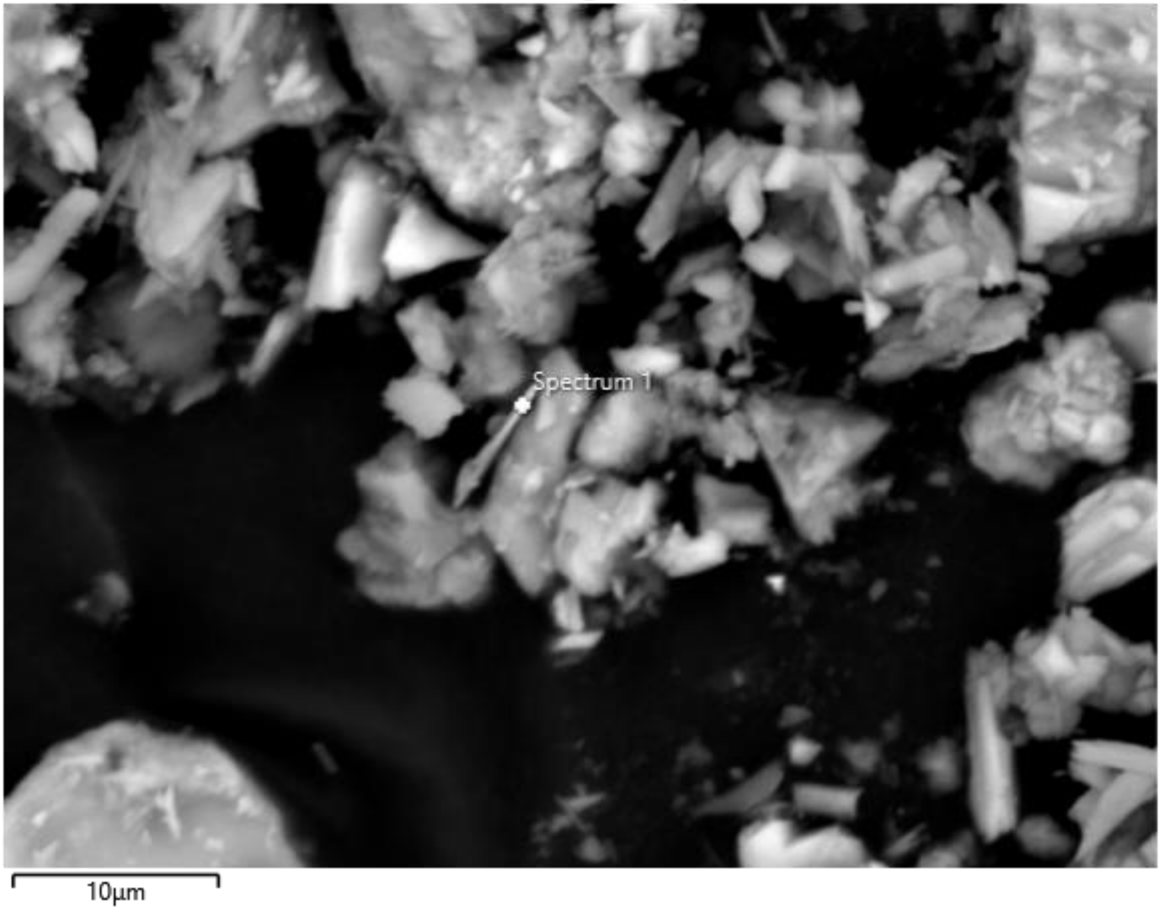
It should be noted that the higher resolution of the SEM may increase the number of fibres observed when compared with optical microscopy. Positive identification of asbestos fibres by SEM EDS uses elemental information that is not available by optical methods.

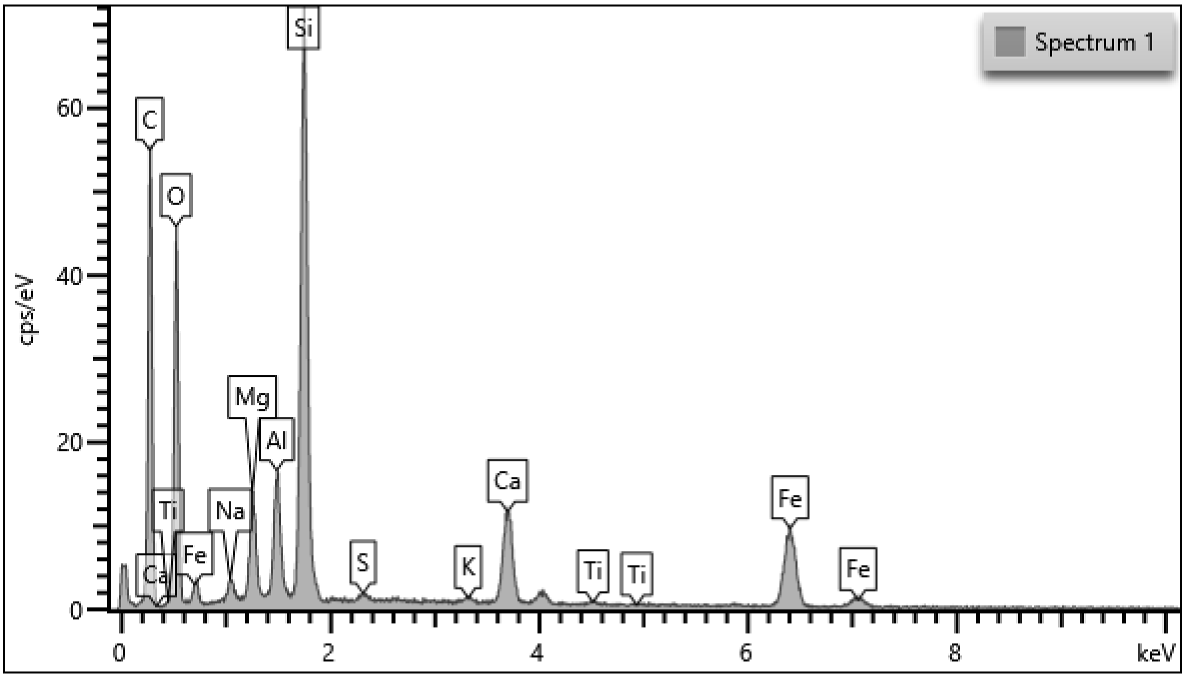
**Analyst:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

**Reported by:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

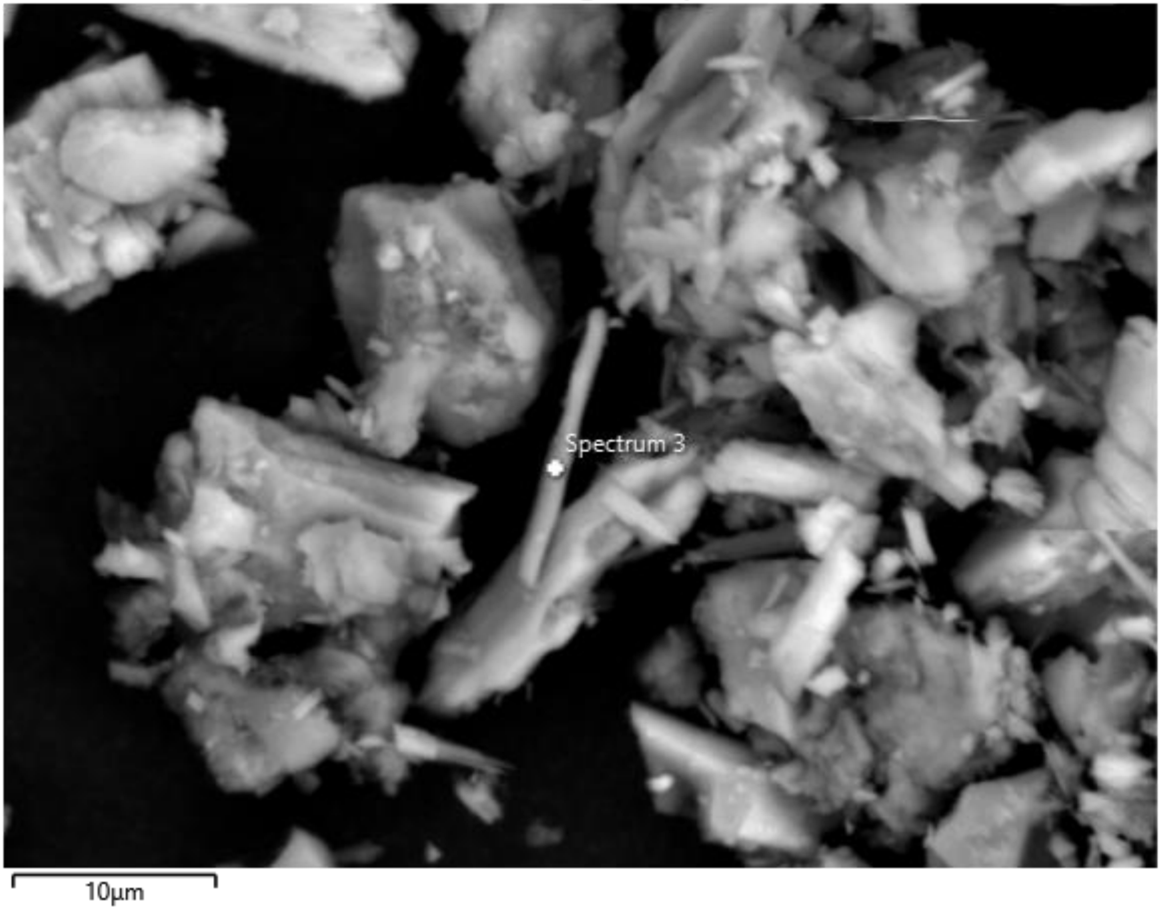
**Approved:** Nimue Pendragon, *B.Sc.(Nanotechnology)*

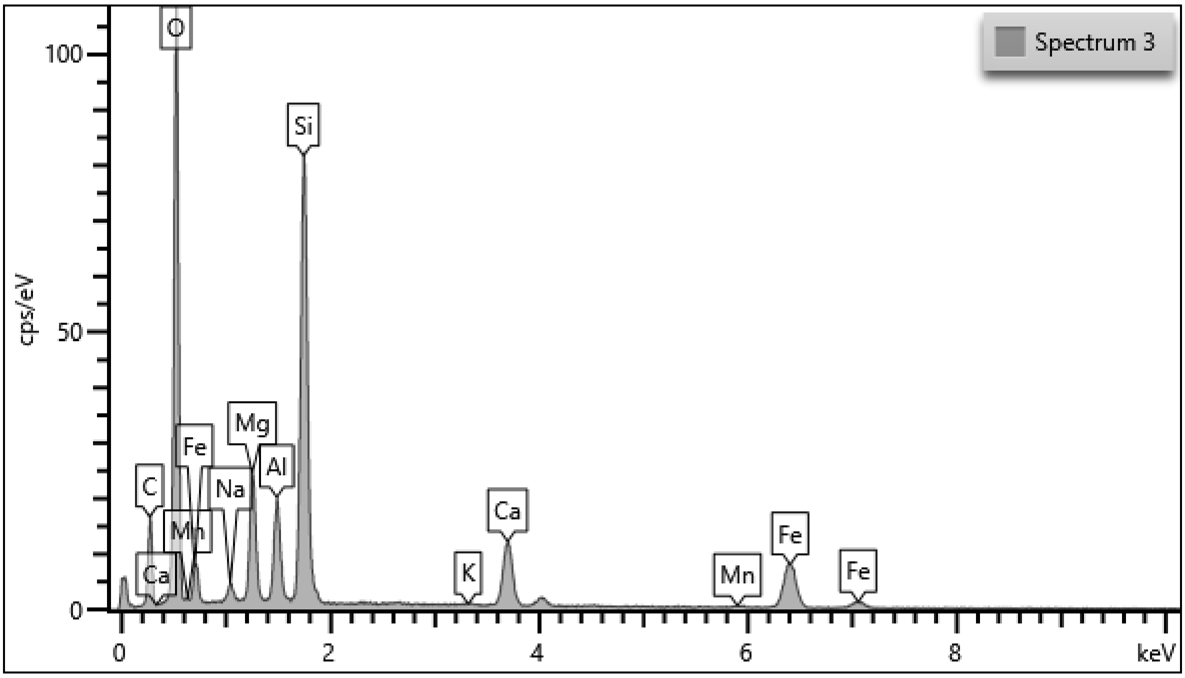
Electron Image 1 (Input1)



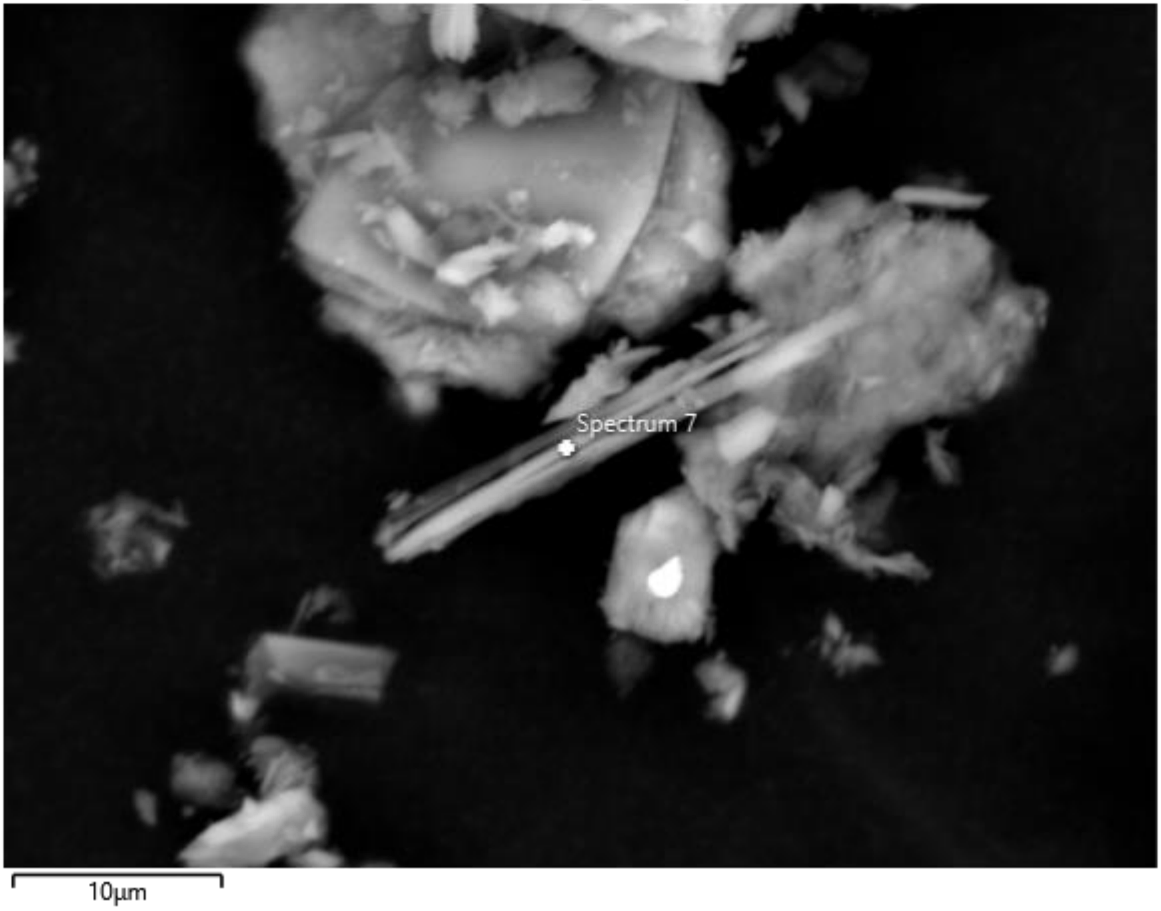


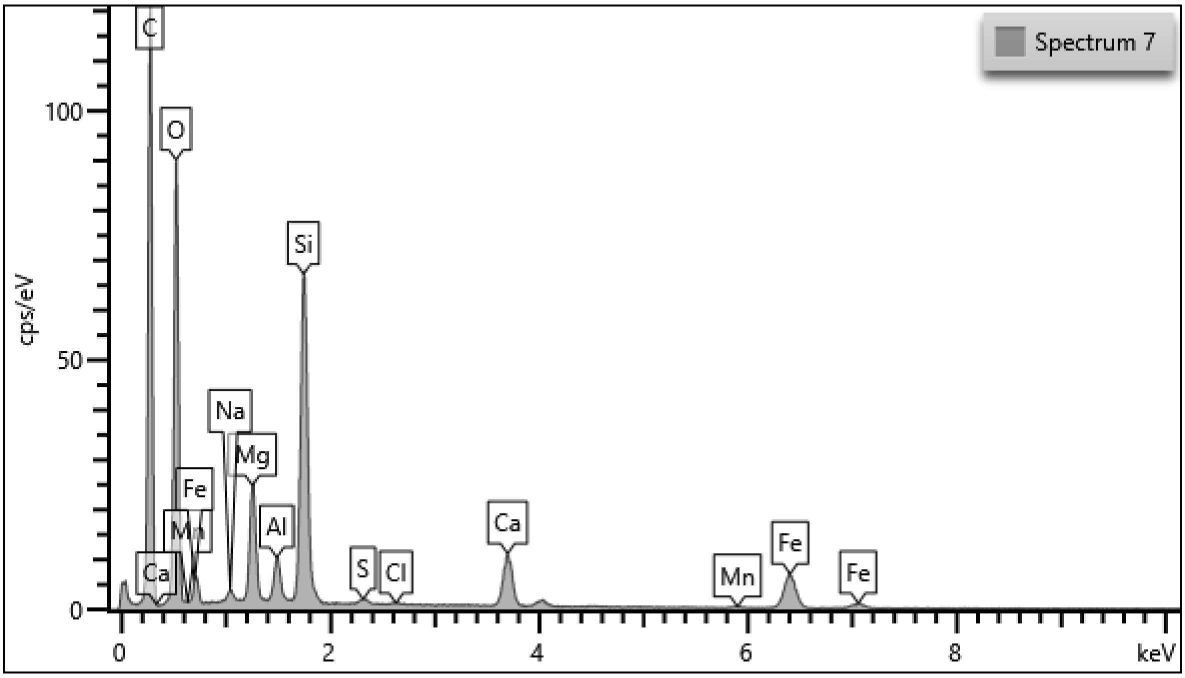
Electron Image 2 (Input1)



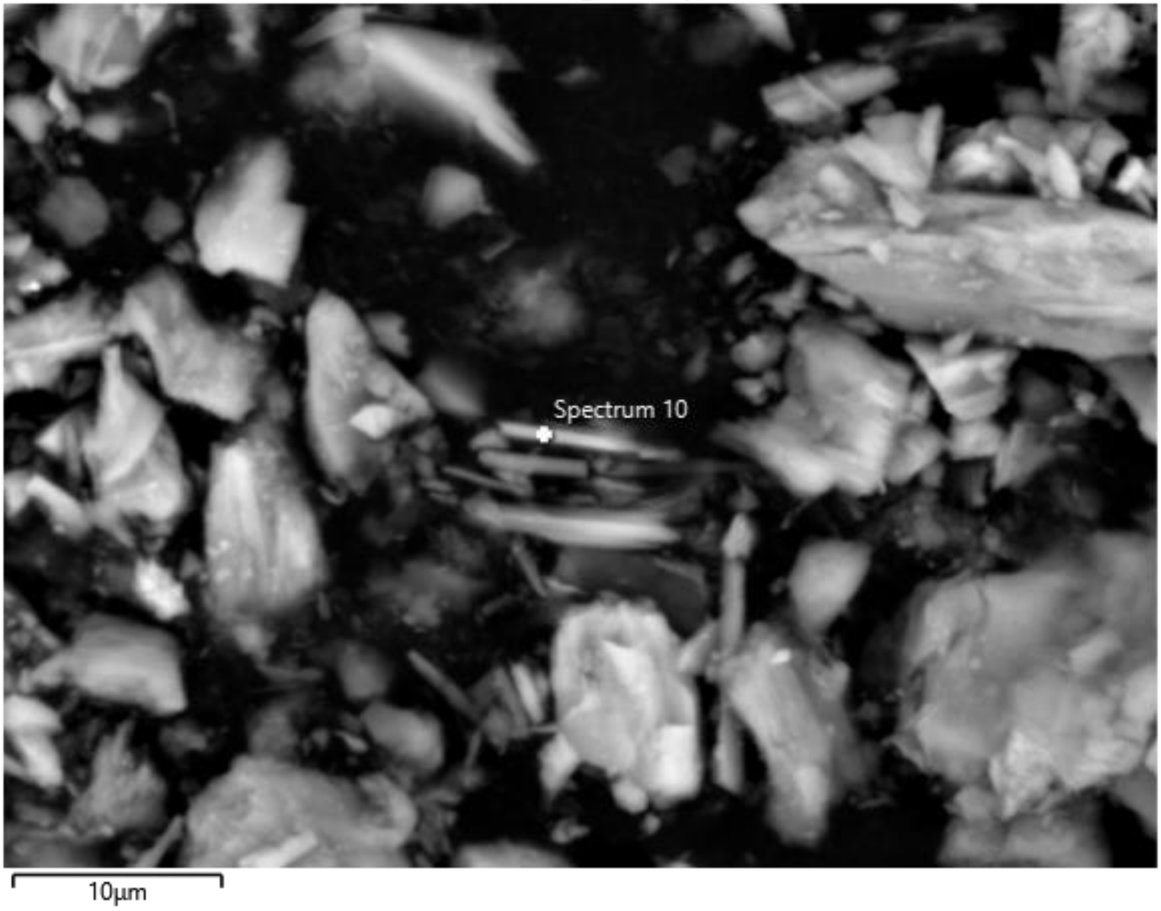


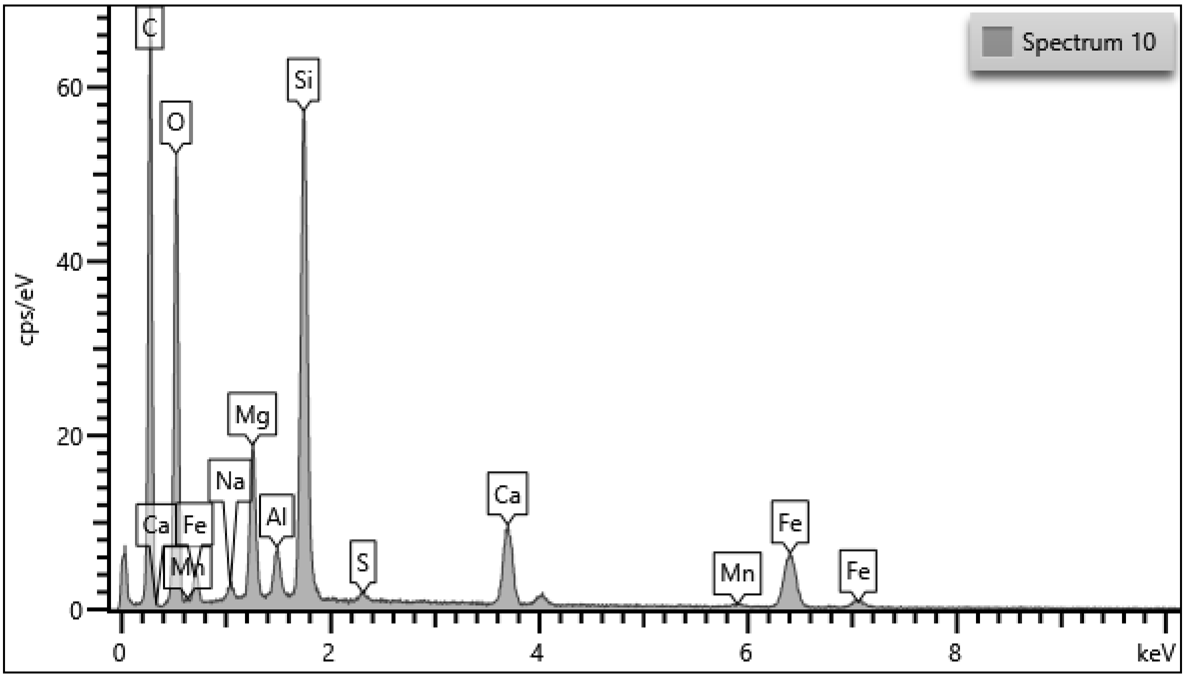
Electron Image 4 (Input1)

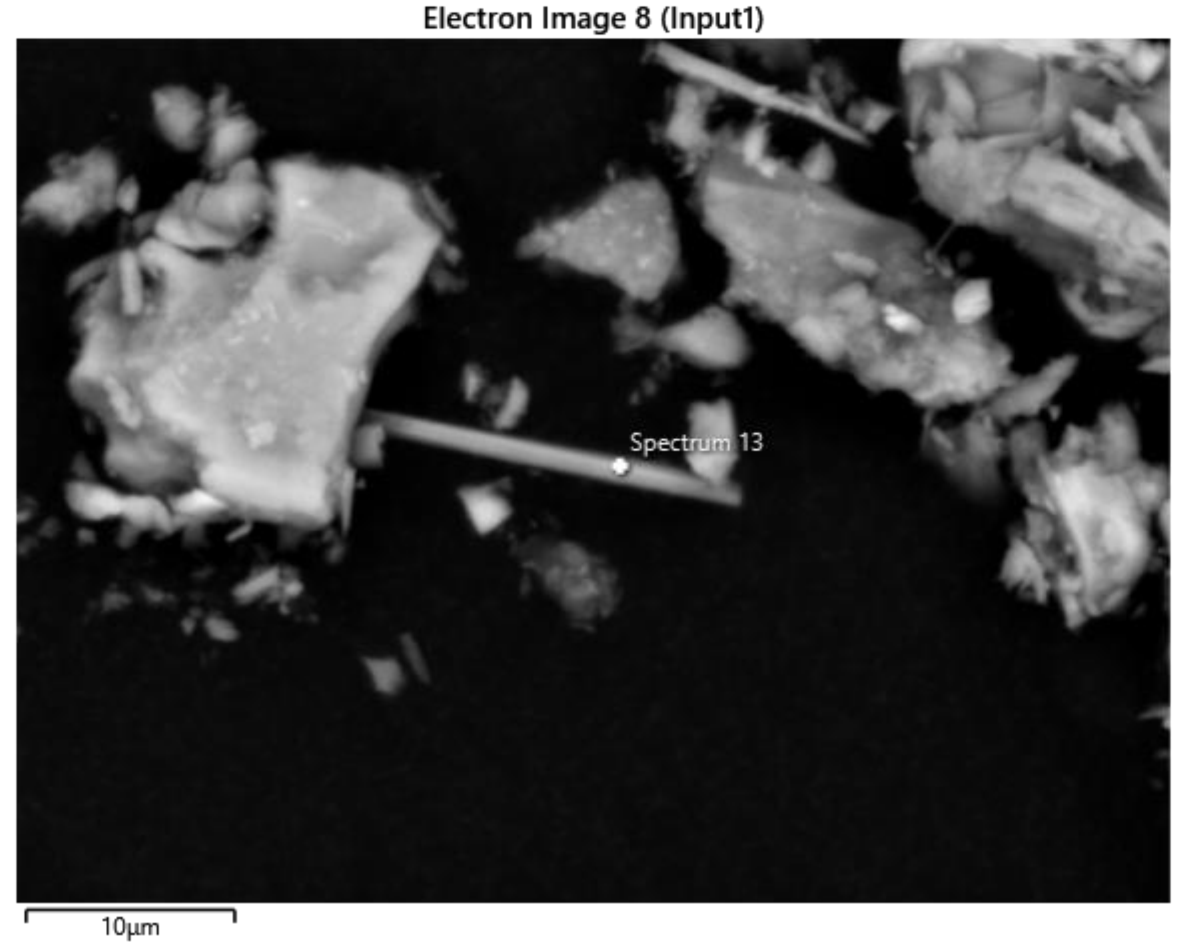


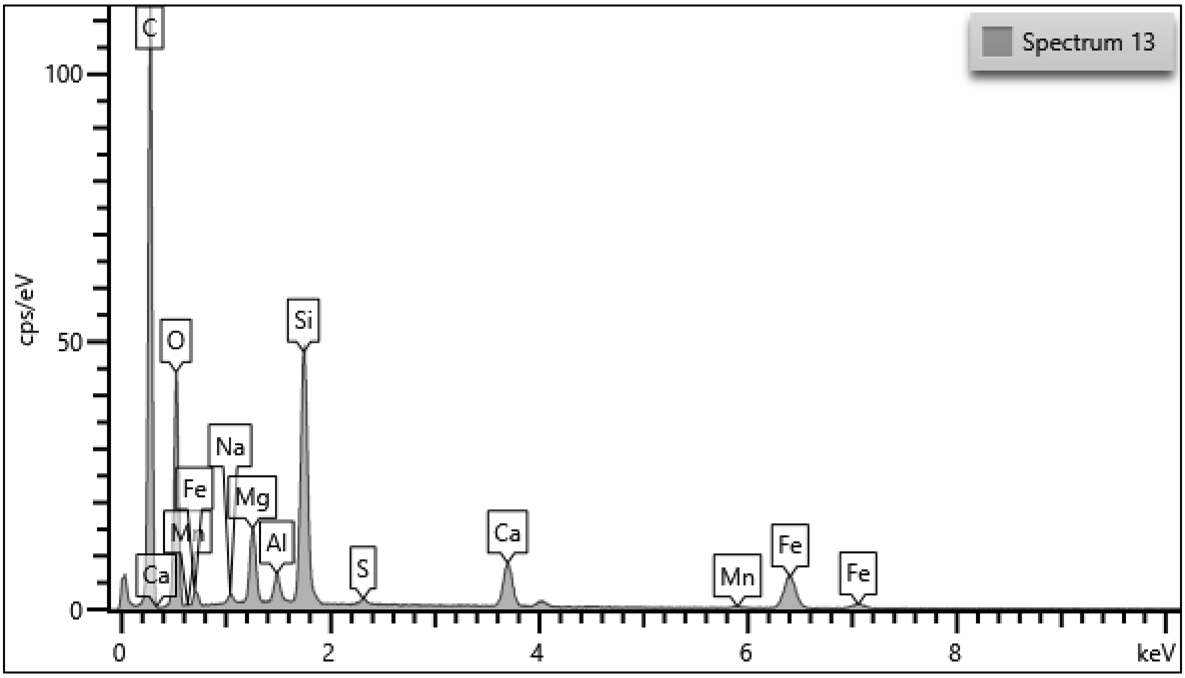


Electron Image 6 (Input1)

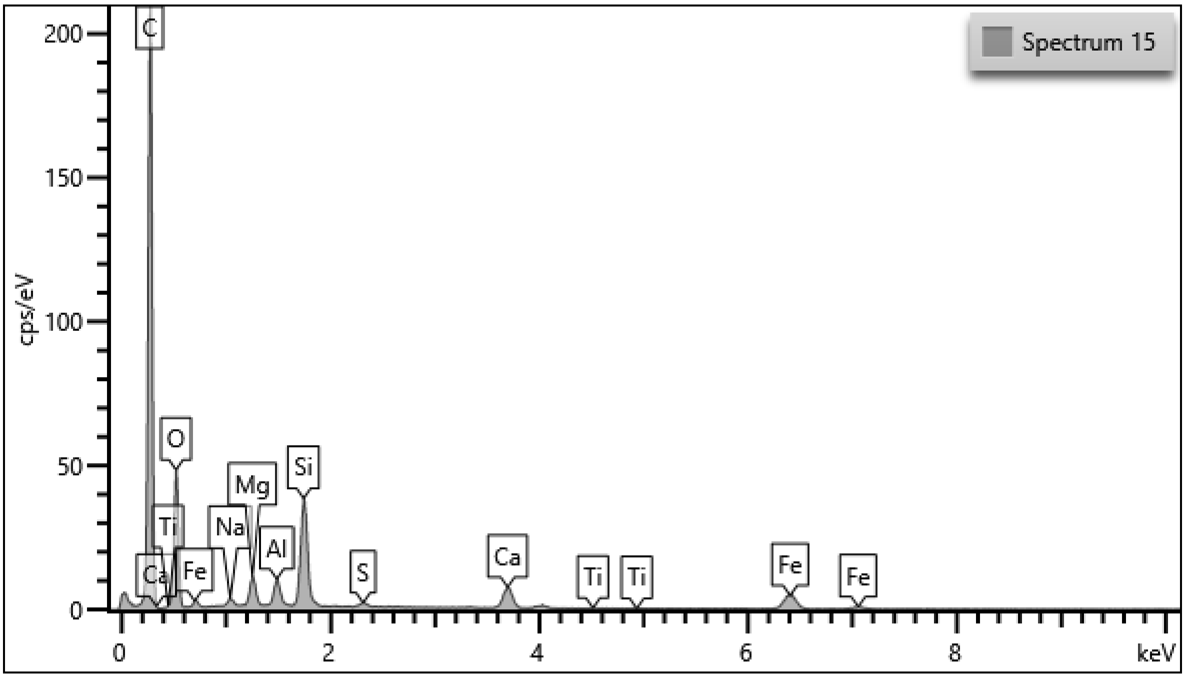




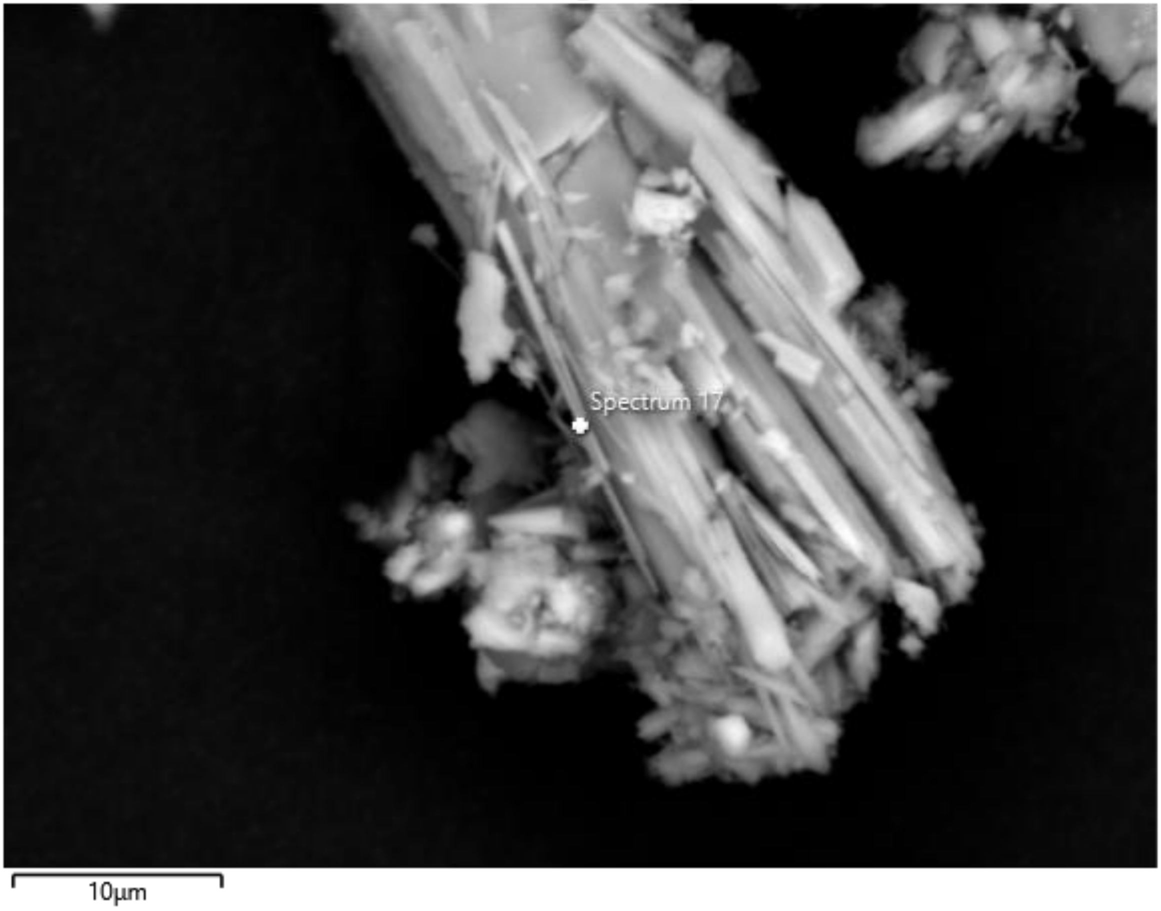

Electron Image 8 (Input1)
Spectrum 13
10µm

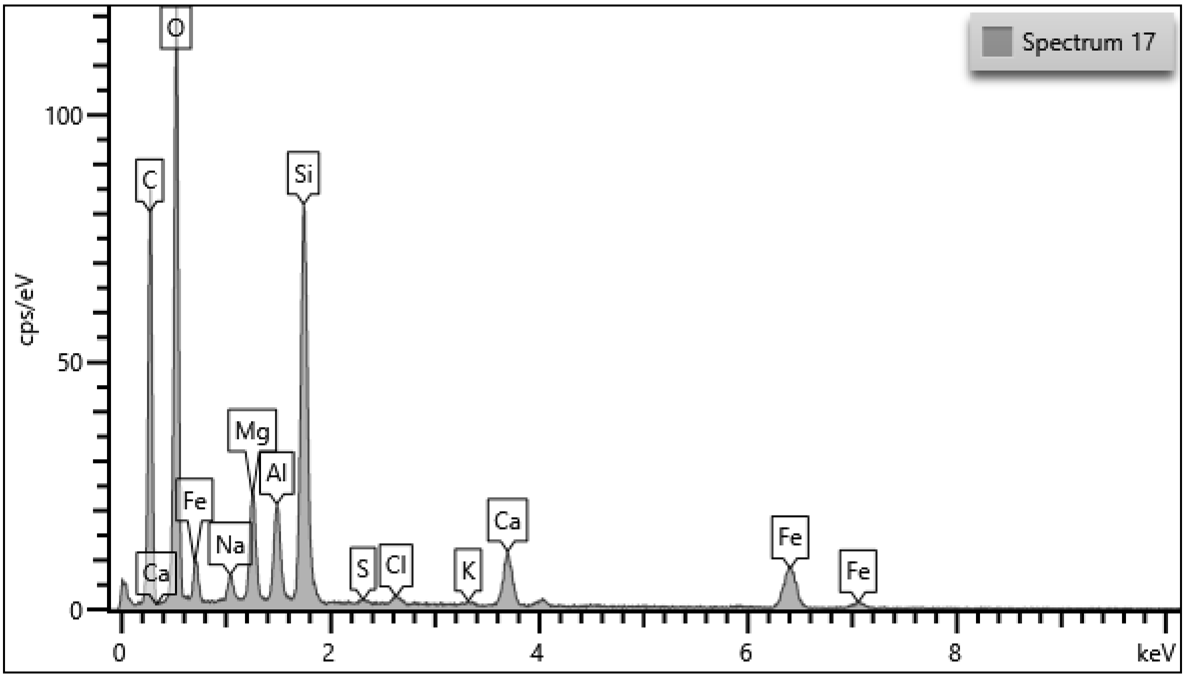

Spectrum 13
cps/eV
100
50
0
C
O
Na
Fe
Mn
Ca
Mg
Al
Si
S
Ca
Mn
Fe
Fe
0
2
4
6
8
keV

Electron Image 9 (Input1)



Electron Image 11 (Input1)





5 Alvan Street
Mount Lawley
WA 6050
T: 08 9225 5810

| | | | |
|---|---|---|---|
| **Client:** | Landloch | **Date received:** | 30/01/2025 |
| **Job number:** | 25_0206 | **Date analysed:** | 24/02/2025 |
| **Lab ID:** | 25_0206_002 | **Date reported:** | 28/02/2025 |
| **Client ID:** | **RWC21** | | |
| **Analysis:** | Fibre characterisation by scanning electron microscopy (SEM) with elemental analysis by energy dispersive spectroscopy (EDS) following AS 4964-2004 (modified for SEM) | | |
| **Revision number:** | 0 | | |
| **Comments:** | None | | |

## Executive summary

The sample was determined to contain **< 0.01 wt % asbestos** mineral fibre.

## Sample preparation

The sample was supplied to Microanalysis Australia as a bulk sample. The sample was screened at 2 mm, and each size fraction was inspected visually (both with the naked eye and with a low-powered microscope) for fibrous material.

As no fibrous material was visually apparent for immediate pre-selection, a representative sub-sample of the <2 mm fraction was disaggregated and was placed on top of at least one double-sided carbon tab before being carbon coated. Non-conducting samples require coating prior to SEM analysis to prevent charging whilst being analysed by the electron beam.

## Analysis

The sample was analysed using a Carl Zeiss EVO50 scanning electron microscope (SEM) fitted with an Oxford INCA energy dispersive spectrometer (EDS). The sample was scanned at low magnification to identify any possible fibre clusters before the magnification was increased to 2000x magnification for closer examination.

EDS is a semi-quantitative technique (at best) on well prepared, optically flat samples. Factors such as sample unevenness may adversely bias elemental concentration interpretation. EDS has a spatial resolution of ~5 µm meaning spectra from particles less than this size may contain elemental concentrations biased by their surroundings.

All images were acquired using backscatter electrons. Image brightness is proportional to average atomic number – the brighter the pixel, the higher the atomic number of the element.

**Summary**

Following AS 4964, asbestos is defined as:

- Many particles with aspect ratios (i.e. length to width ratios) ranging from 20:1 to 100:1 or higher for particles >5 micrometers in length. Bundles of fibres may have lower aspect ratios;
- Sets of fibre bundles generally less than 0.5, but always less than 1.0 micrometres in width, unless in thick bundles;
- In addition to the mandatory fibrillar crystal growth, one or more, and preferably three of the following aspects:
    - Parallel fibres occurring in bundles;
    - Fibre bundles displaying splayed ends;
    - Matted masses of individual fibres;
    - Fibres showing characteristic curvature.
- Respirable asbestos fibres are defined as:
    - Asbestos fibres less than 3 µm in width, and greater than 5 µm in length, and with a length to width ratio greater than 3 to 1.

**Less than three observed fibres had an elemental composition and morphology indicative of asbestos mineral fibre, according to the definition in AS 4964.**

Depending upon sample condition, composition and fibre type, the detection limit of AS 4964 has been found to lie generally in the range of 1 in 1,000 (0.1 wt %) to 1 in 10,000 (0.01 wt %) parts by weight, equivalent to 1 to 0.1 g/kg.

For this report, a limit of reporting (LoR) of 0.01 wt % has been assumed, as stated in AS 4964.

A selection of images/fields and associated elemental spectra are reported below. The fields are not representative of the area analysed. The images/fields were reported due to their higher fibre count.

| Fibre # | Image/Field # | Diameter (µm) | Length (µm) | Aspect ratio | Major Elements | Minor Elements | Morphology | Assigned mineralogy |
|---|---|---|---|---|---|---|---|---|
| 1 | 15/23 | 1.5 | 11.9 | 8 :1 | O, Si | Mg, Al, Fe, Ca, Na | Non-parallel sides | Hornblende |
| 2 | 16/24 | 0.5 | 5.4 | 11 :1 | O, Si | Mg, Al, Fe, Ca, Na | Irregular ends | Hornblende |
| 3 | 17/26 | 0.4 | 9.9 | 25 :1 | O, Si | Mg, Al, Fe, Ca, Na | Irregular ends | Hornblende |
| 4 | 18/27 | 0.6 | 10.3 | 17 :1 | O, Si | Mg, Al, Fe, Ca, Na | Irregular ends | Hornblende |
| 5 | 19/28 | 0.4 | 5.5 | 14 :1 | O, Si | Mg, Al, Fe, Ca, Na | Irregular ends | Hornblende |
| 6 | 21/33 | 1.1 | 9.6 | 9 :1 | O, Si | Mg, Al, Fe, Ca, Na | Non-parallel sides | Hornblende |
| 7 | 11/37 | 0.9 | 8.1 | 9 :1 | O, Si | Mg, Al, Fe, Ca, Na | Irregular ends | Hornblende |

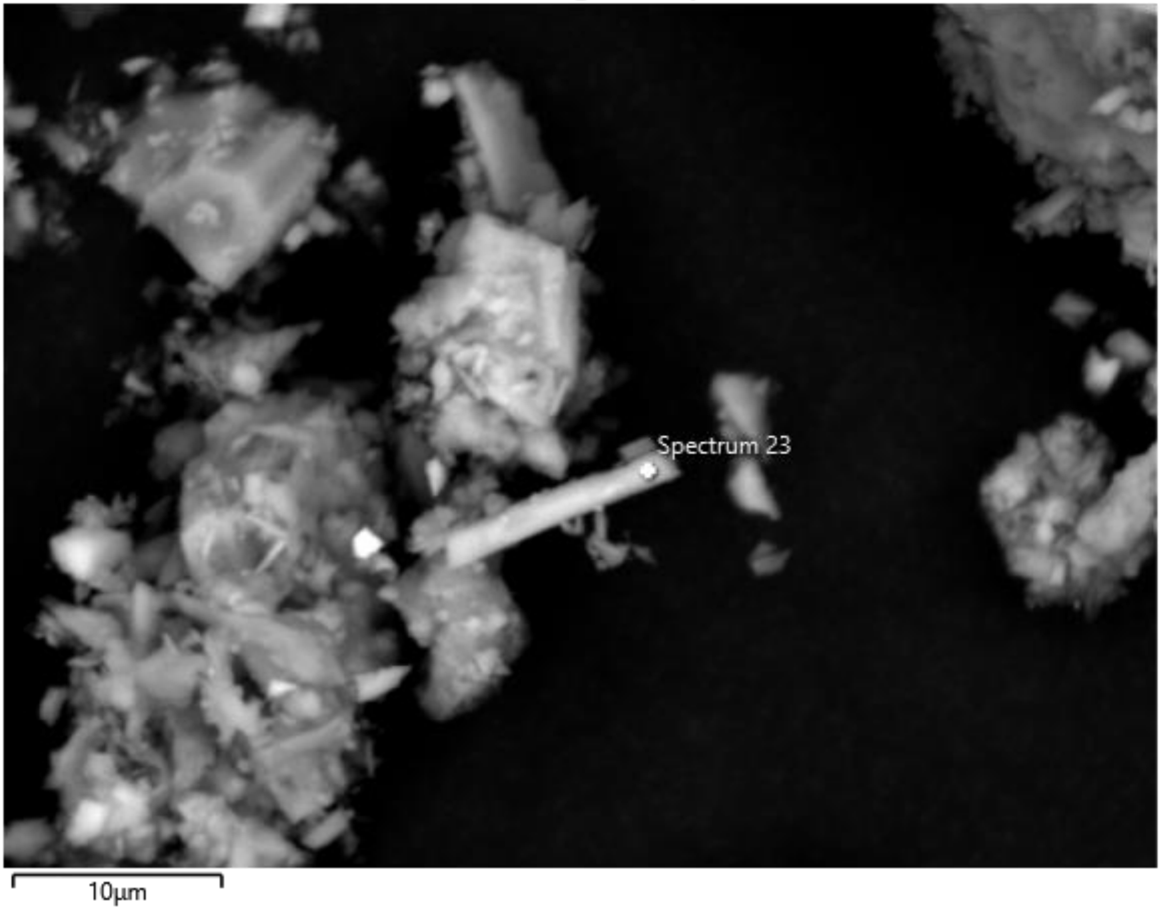
It should be noted that the higher resolution of the SEM may increase the number of fibres observed when compared with optical microscopy. Positive identification of asbestos fibres by SEM EDS uses elemental information that is not available by optical methods.

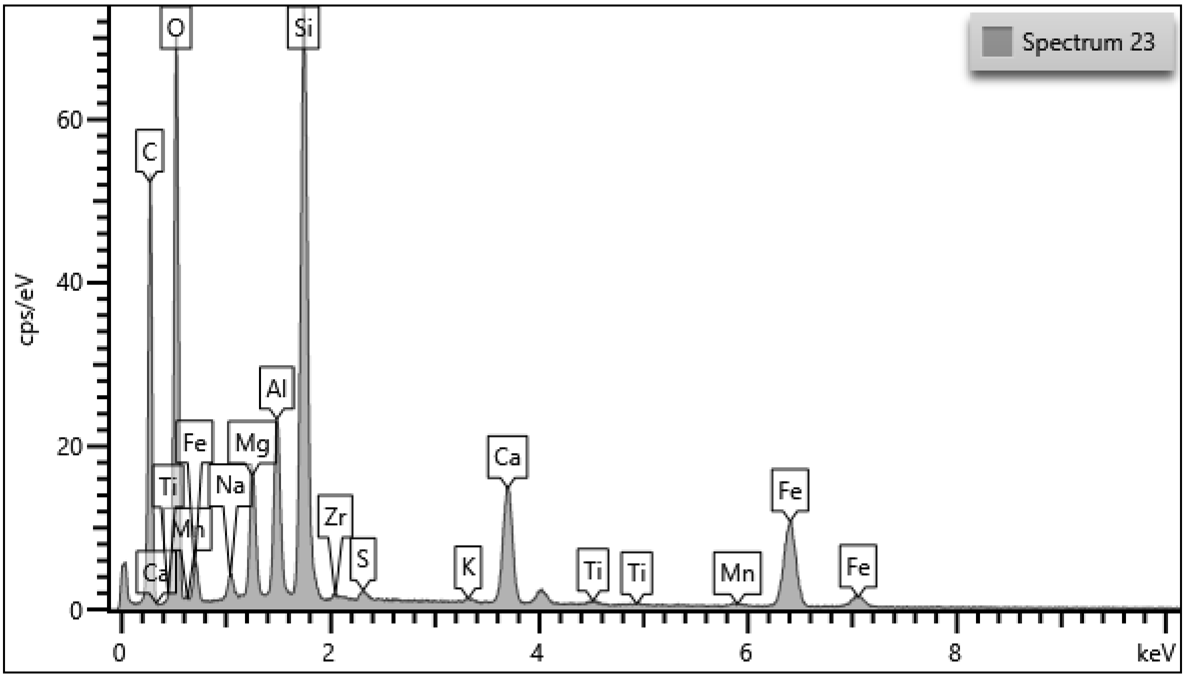
**Analyst:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

**Reported by:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

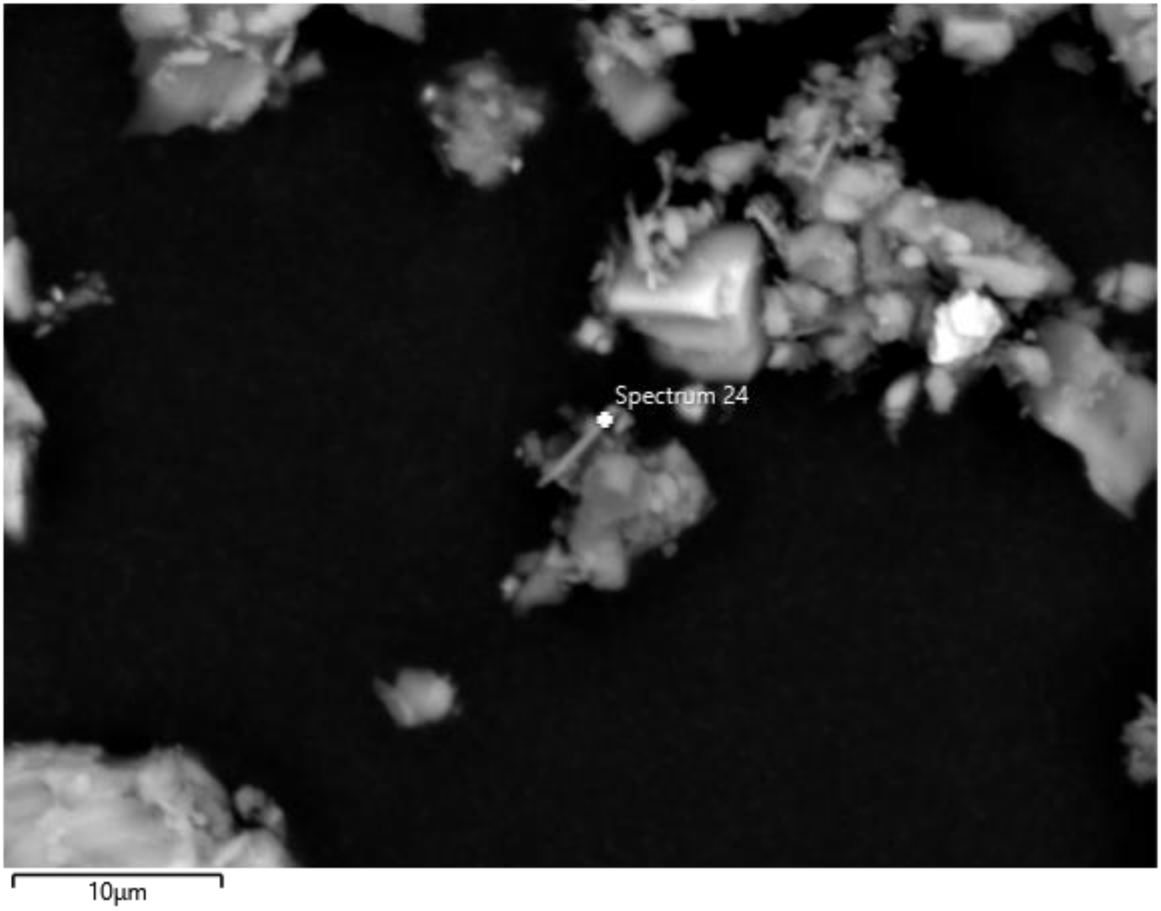
**Approved:** Nimue Pendragon, *B.Sc.(Nanotechnology)*

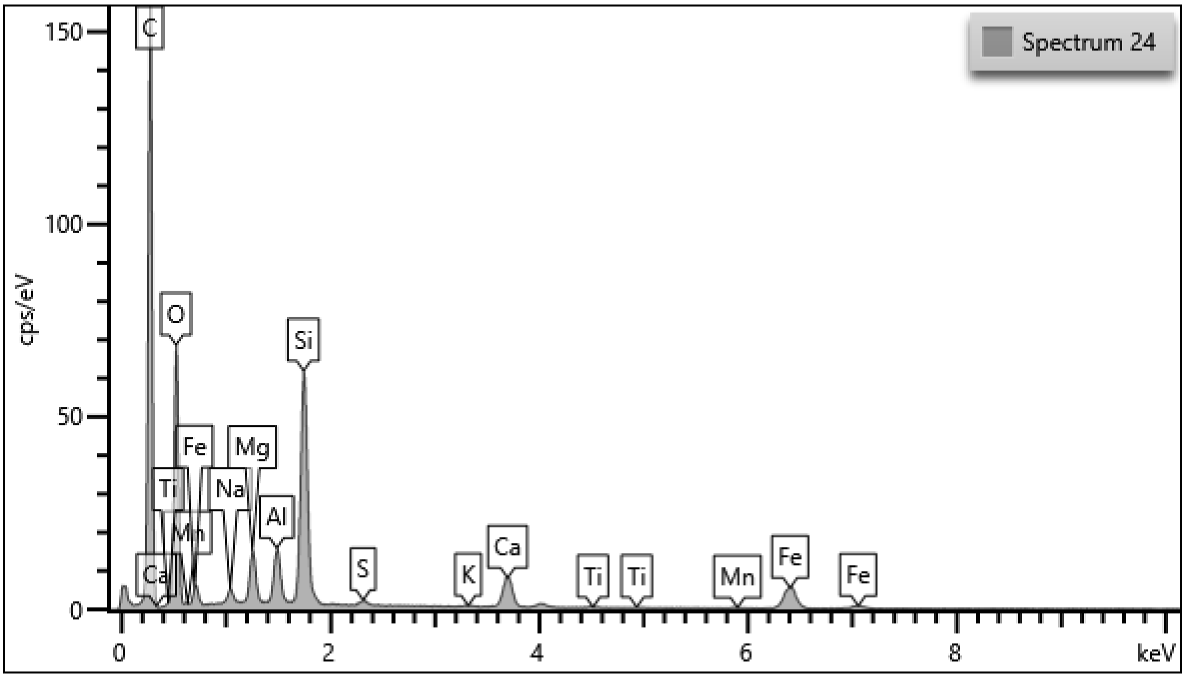
Electron Image 15 (Input1)



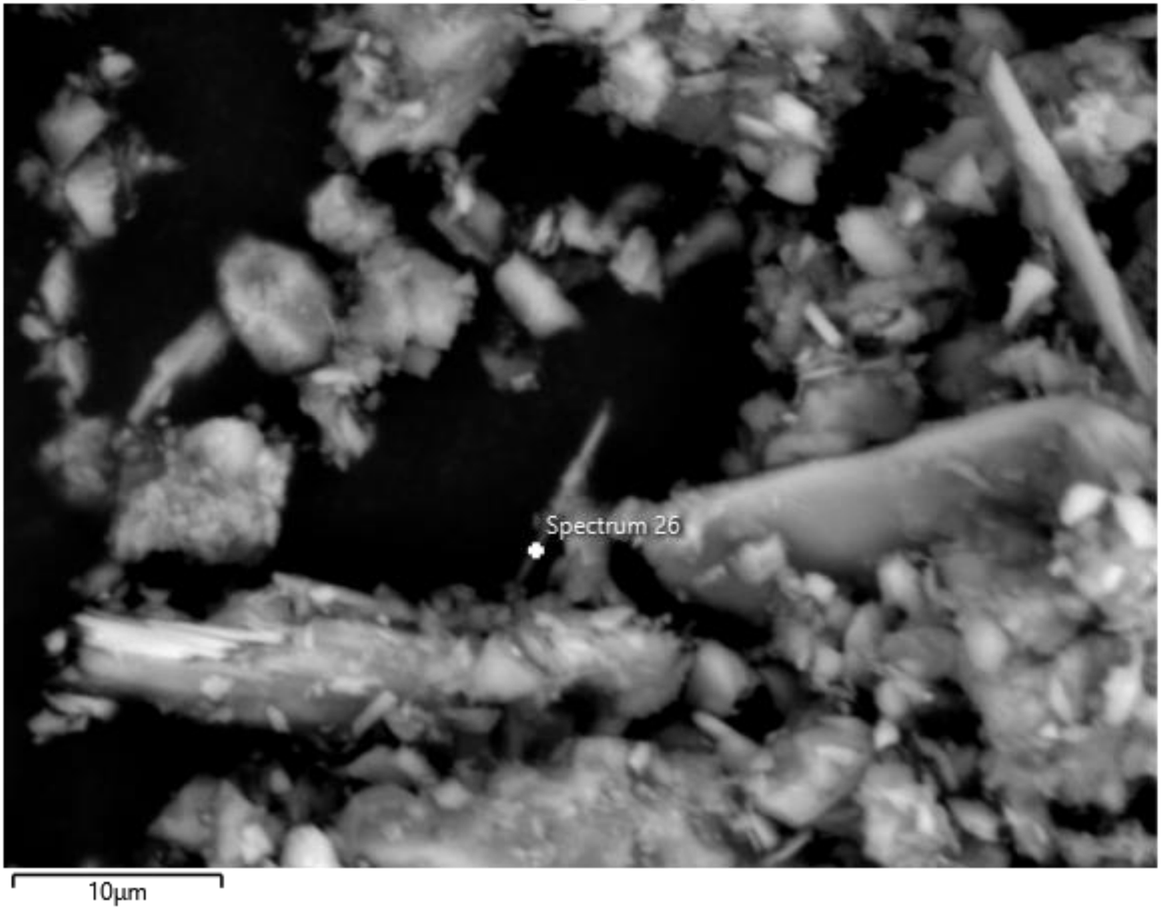


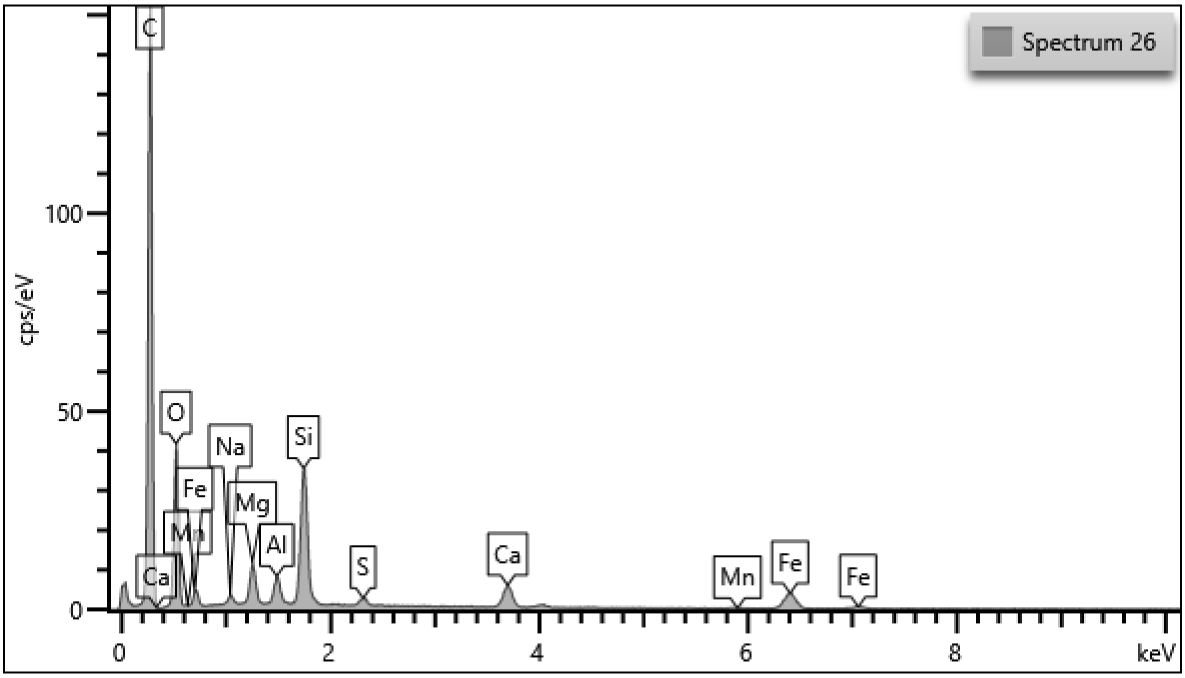
Electron Image 16 (Input1)



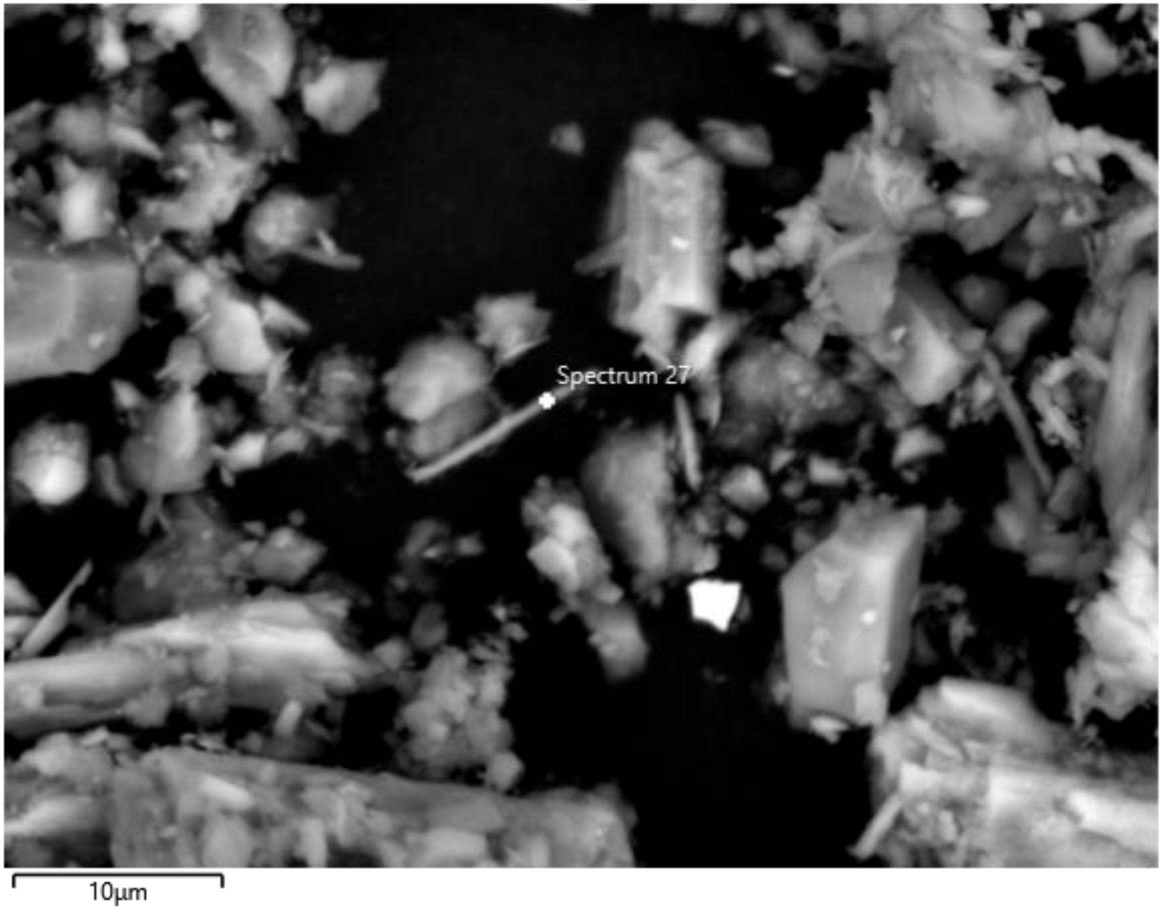


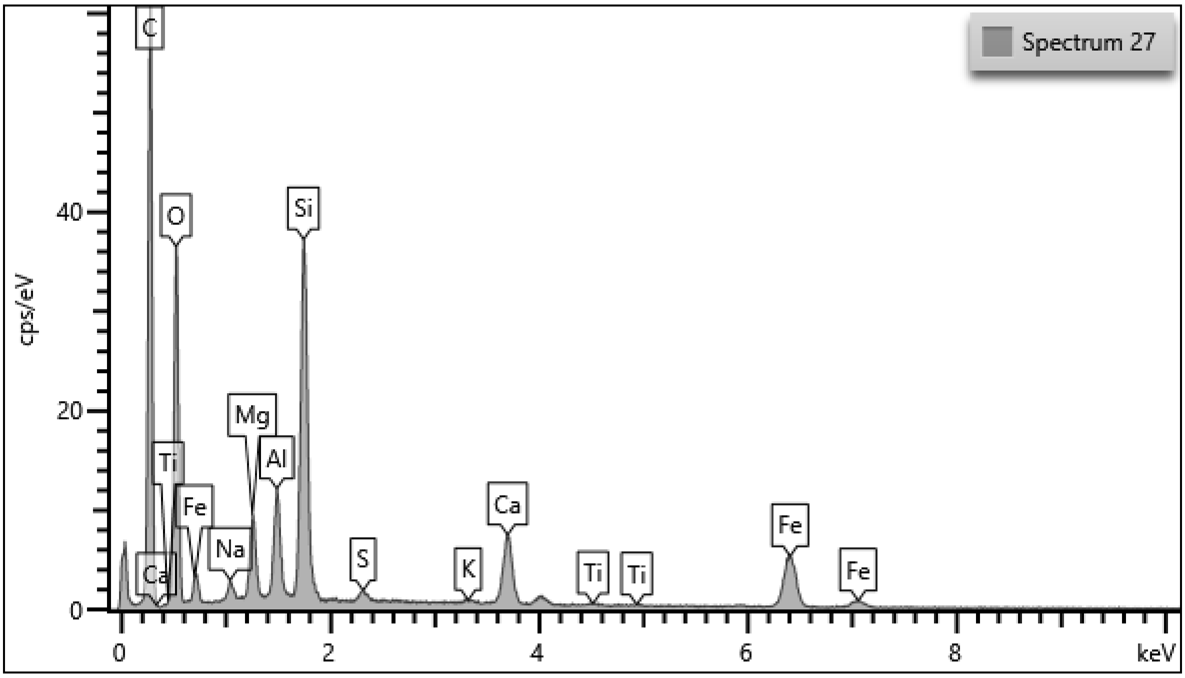
Electron Image 17 (Input1)



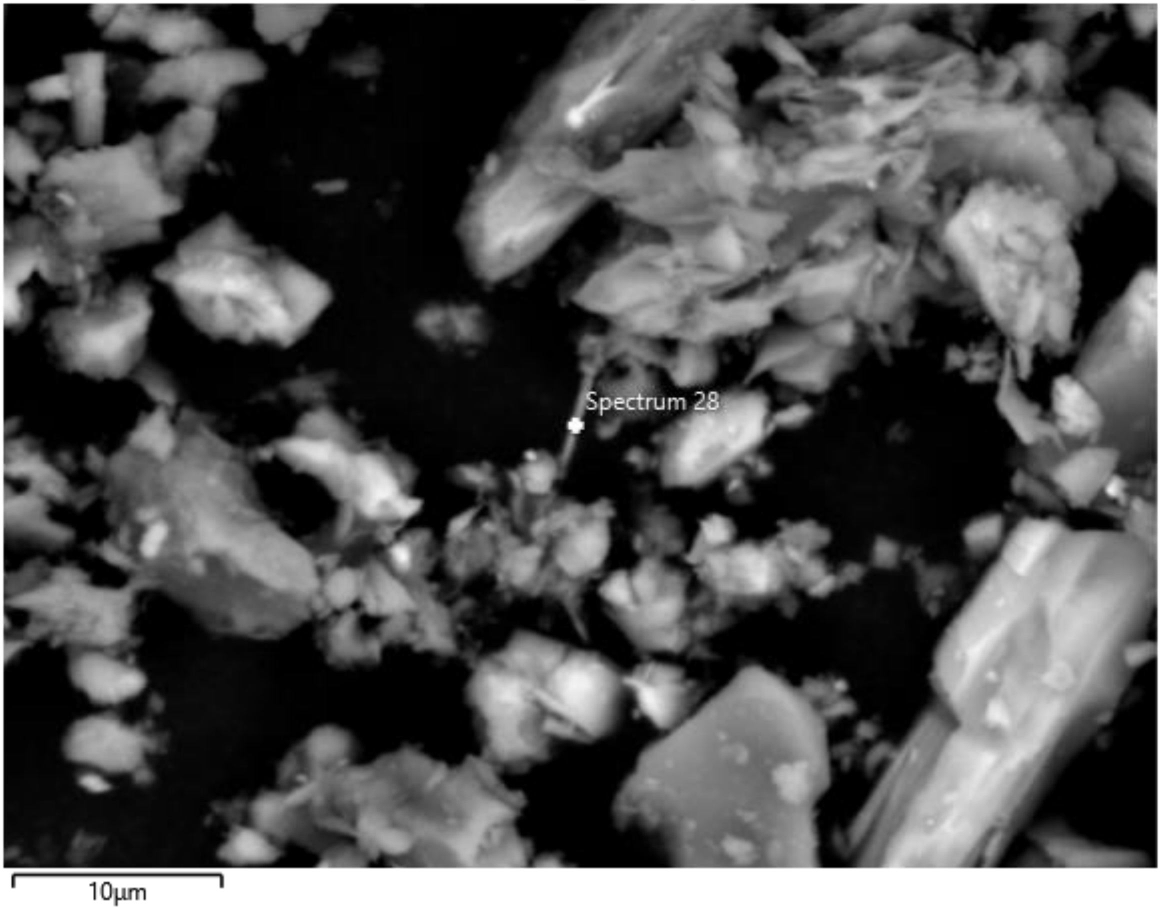


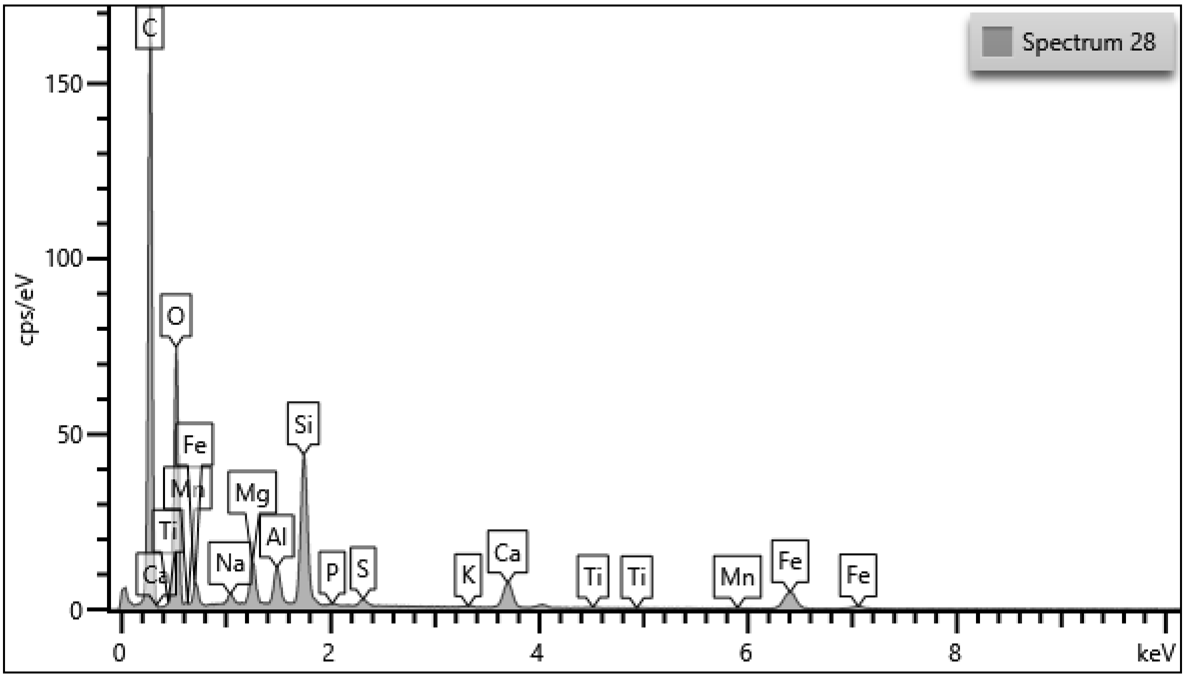
Electron Image 18 (Input1)



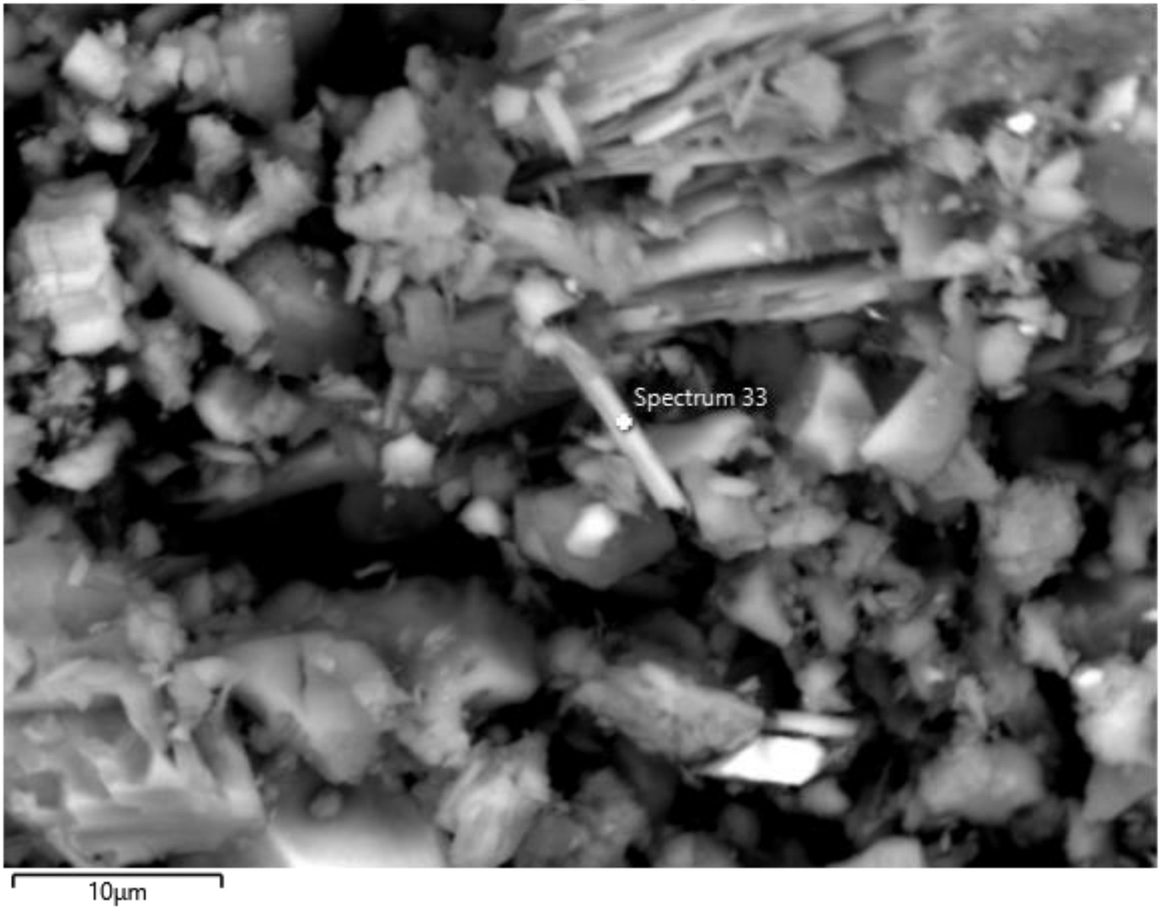


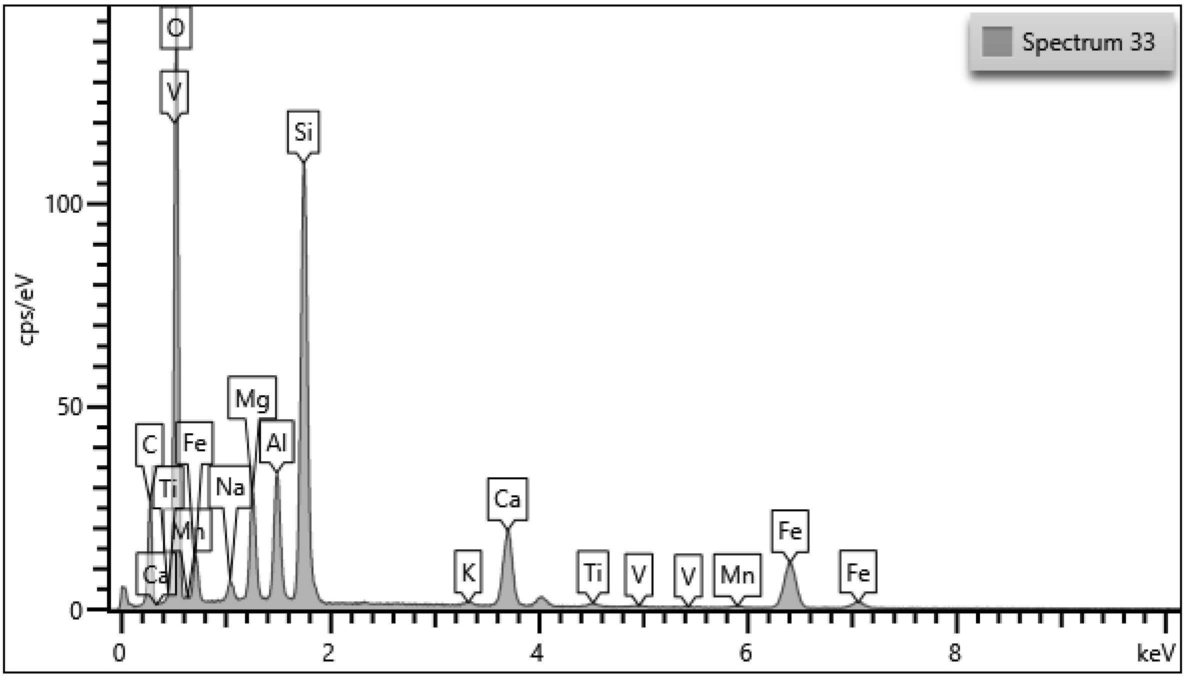
Electron Image 19 (Input1)



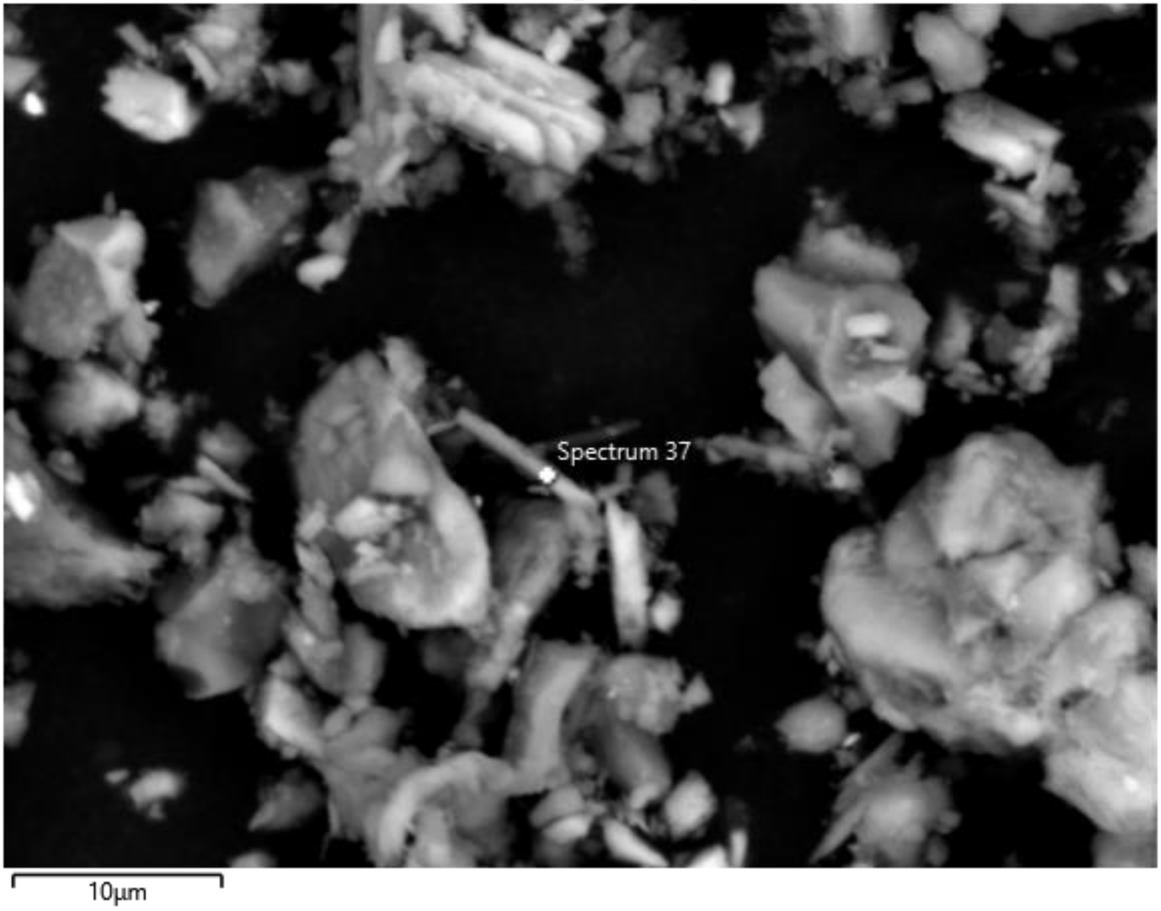


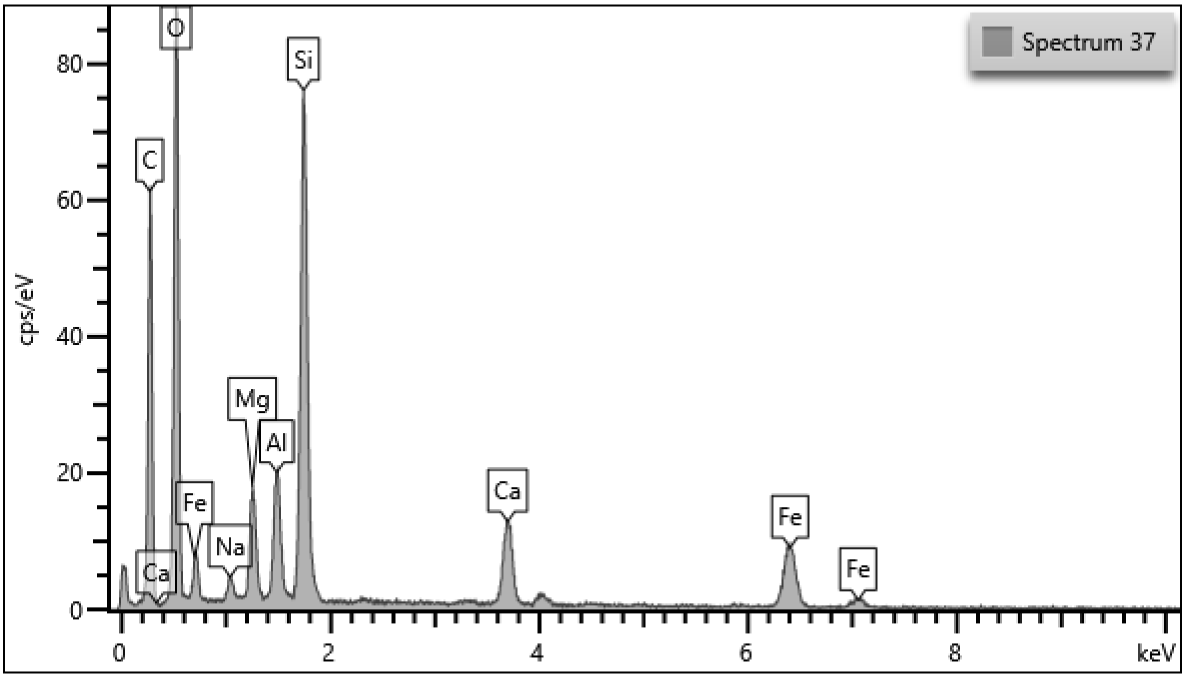
Electron Image 21 (Input1)





Electron Image 25 (Input1)





| | | | |
|---|---|---|---|
| **Client:** | Landloch | **Date received:** | 30/01/2025 |
| **Job number:** | 25_0206 | **Date analysed:** | 24/02/2025 |
| **Lab ID:** | 25_0206_003 | **Date reported:** | 28/02/2025 |
| **Client ID:** | **RWC32** | | |
| **Analysis:** | Fibre characterisation by scanning electron microscopy (SEM) with elemental analysis by energy dispersive spectroscopy (EDS) following AS 4964-2004 (modified for SEM) | | |
| **Revision number:** | 0 | | |
| **Comments:** | None | | |

**Executive summary**

The sample was determined to contain **< 0.01 wt % asbestos** mineral fibre.

**Sample preparation**

The sample was supplied to Microanalysis Australia as a bulk sample. The sample was screened at 2 mm, and each size fraction was inspected visually (both with the naked eye and with a low-powered microscope) for fibrous material.

As no fibrous material was visually apparent for immediate pre-selection, a representative sub-sample of the <2 mm fraction was disaggregated and was placed on top of at least one double-sided carbon tab before being carbon coated. Non-conducting samples require coating prior to SEM analysis to prevent charging whilst being analysed by the electron beam.

**Analysis**

The sample was analysed using a Carl Zeiss EVO50 scanning electron microscope (SEM) fitted with an Oxford INCA energy dispersive spectrometer (EDS). The sample was scanned at low magnification to identify any possible fibre clusters before the magnification was increased to 2000x magnification for closer examination.

EDS is a semi-quantitative technique (at best) on well prepared, optically flat samples. Factors such as sample unevenness may adversely bias elemental concentration interpretation. EDS has a spatial resolution of ~5 µm meaning spectra from particles less than this size may contain elemental concentrations biased by their surroundings.

All images were acquired using backscatter electrons. Image brightness is proportional to average atomic number – the brighter the pixel, the higher the atomic number of the element.

**Summary**

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- Sets of fibre bundles generally less than 0.5, but always less than 1.0 micrometres in width, unless in thick bundles;
- In addition to the mandatory fibrillar crystal growth, one or more, and preferably three of the following aspects:
  - Parallel fibres occurring in bundles;
  - Fibre bundles displaying splayed ends;
  - Matted masses of individual fibres;
  - Fibres showing characteristic curvature.
- Respirable asbestos fibres are defined as:
  - Asbestos fibres less than 3 µm in width, and greater than 5 µm in length, and with a length to width ratio greater than 3 to 1.

**Less than 5 observed fibres had an elemental composition and morphology indicative of asbestos mineral fibre, according to the definition in AS 4964.**

Depending upon sample condition, composition and fibre type, the detection limit of AS 4964 has been found to lie generally in the range of 1 in 1,000 (0.1 wt %) to 1 in 10,000 (0.01 wt %) parts by weight, equivalent to 1 to 0.1 g/kg.

For this report, a limit of reporting (LoR) of 0.01 wt % has been assumed, as stated in AS 4964.

A selection of images/fields and associated elemental spectra are reported below. The fields are not representative of the area analysed. The images/fields were reported due to their higher fibre count.

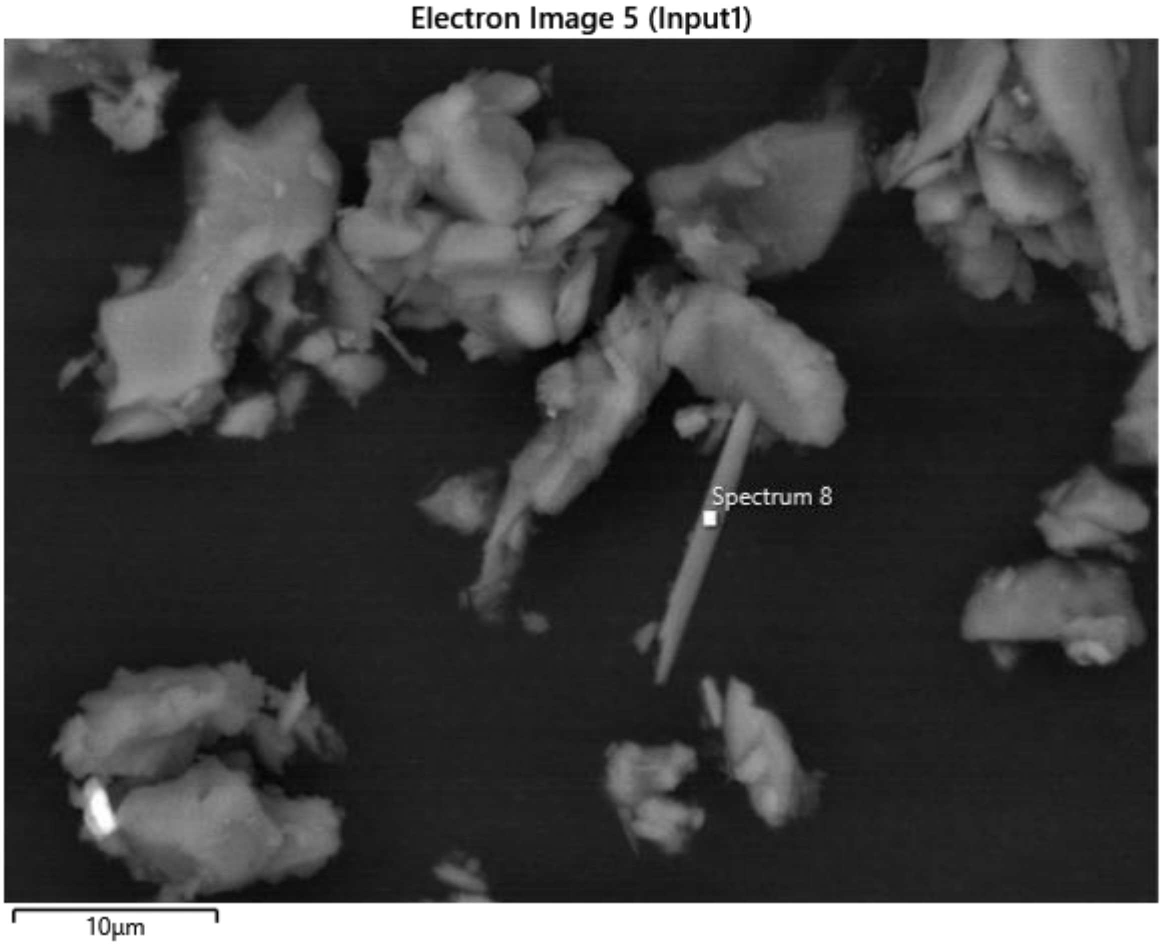
| Fibre # | Image/Field # | Diameter (µm) | Length (µm) | Aspect ratio | Major Elements | Minor Elements | Morphology | Assigned mineralogy |
|---|---|---|---|---|---|---|---|---|
| 1 | 5/8 | 1.1 | 14.6 | 13 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |
| 2 | 7/11 | 1.0 | 14.2 | 14 :1 | O, Si | Al, Mg, Fe | Irregular ends | Chlorite group |
| 3 | 8/12 | 0.6 | 6.6 | 11 :1 | O, Si | Mg, Fe, Ca | Parallel sides | Actinolite |
| 4 | 10/14 | 1.7 | 9.8 | 6 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 5 | 11/15 | 0.7 | 9.3 | 13 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |
| 6 | 12/16 | 0.6 | 10.6 | 18 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |
| 7 | 14/19 | 1.5 | 11.6 | 8 :1 | O, Si | Mg, Ca, Fe, Al, Na | Irregular ends | Hornblende |

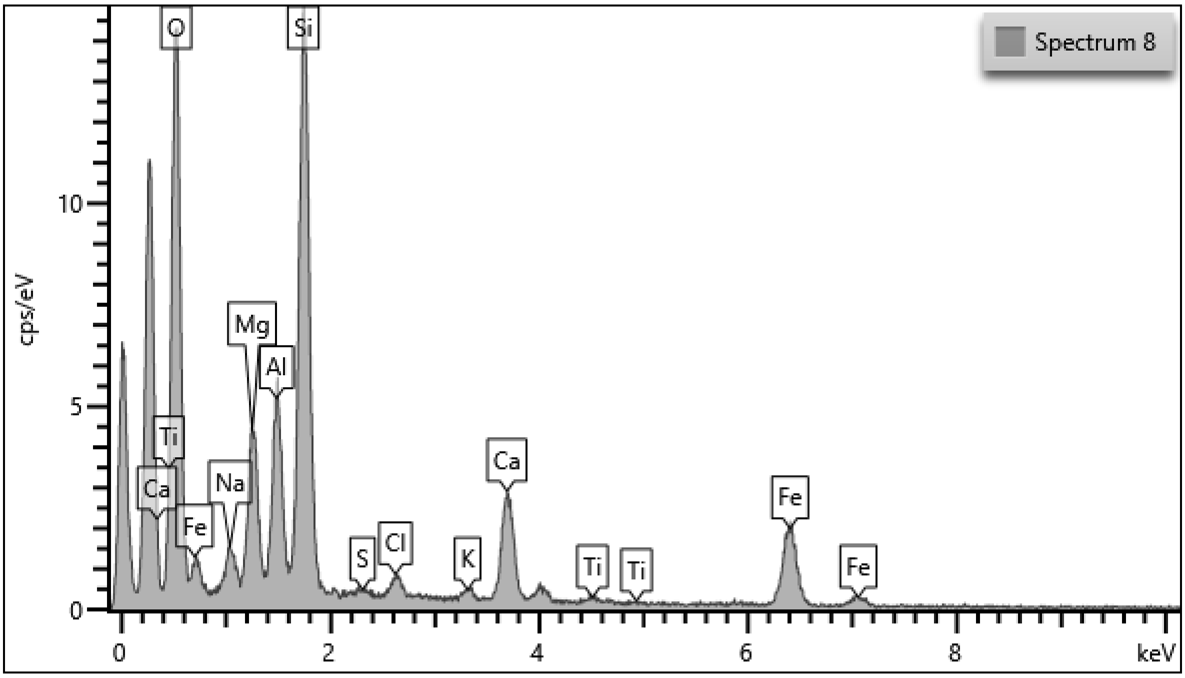
It should be noted that the higher resolution of the SEM may increase the number of fibres observed when compared with optical microscopy. Positive identification of asbestos fibres by SEM EDS uses elemental information that is not available by optical methods.

**Analyst:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

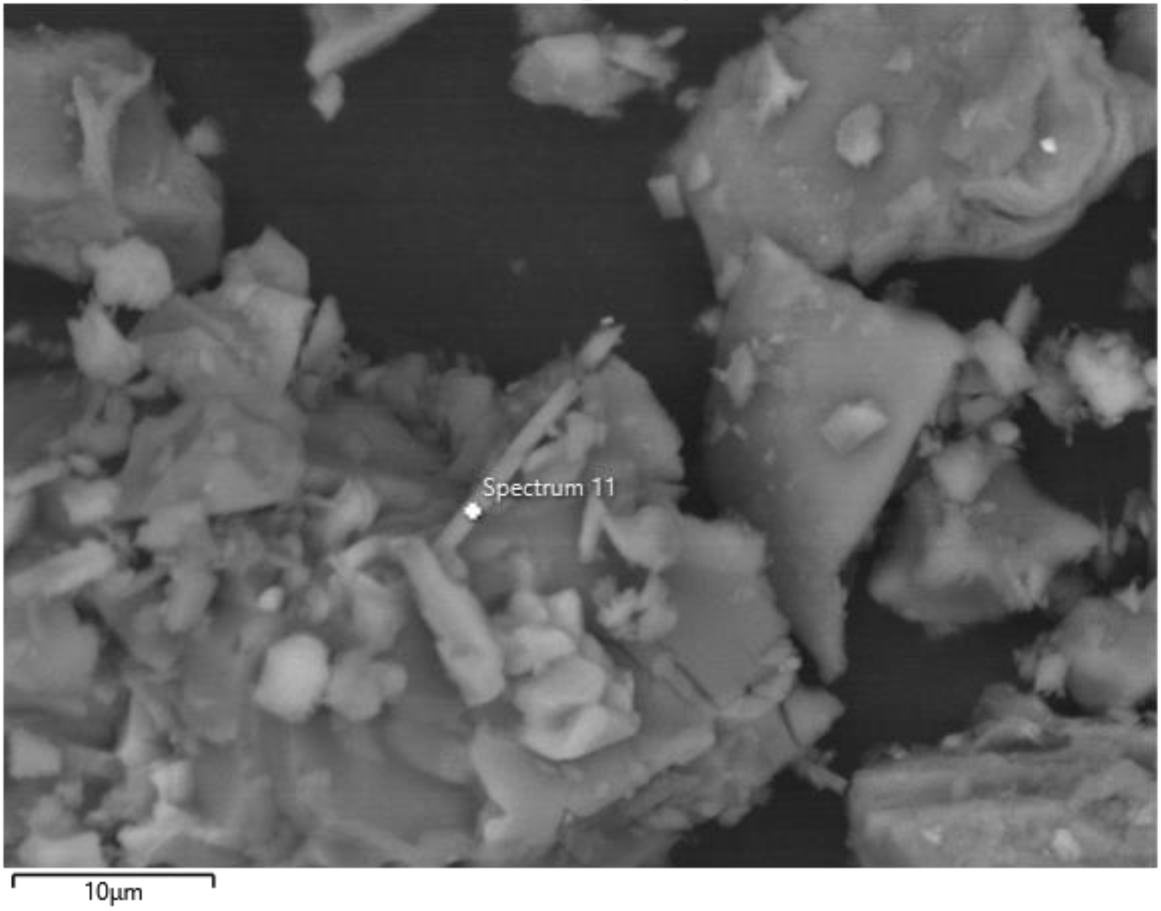
**Reported by:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

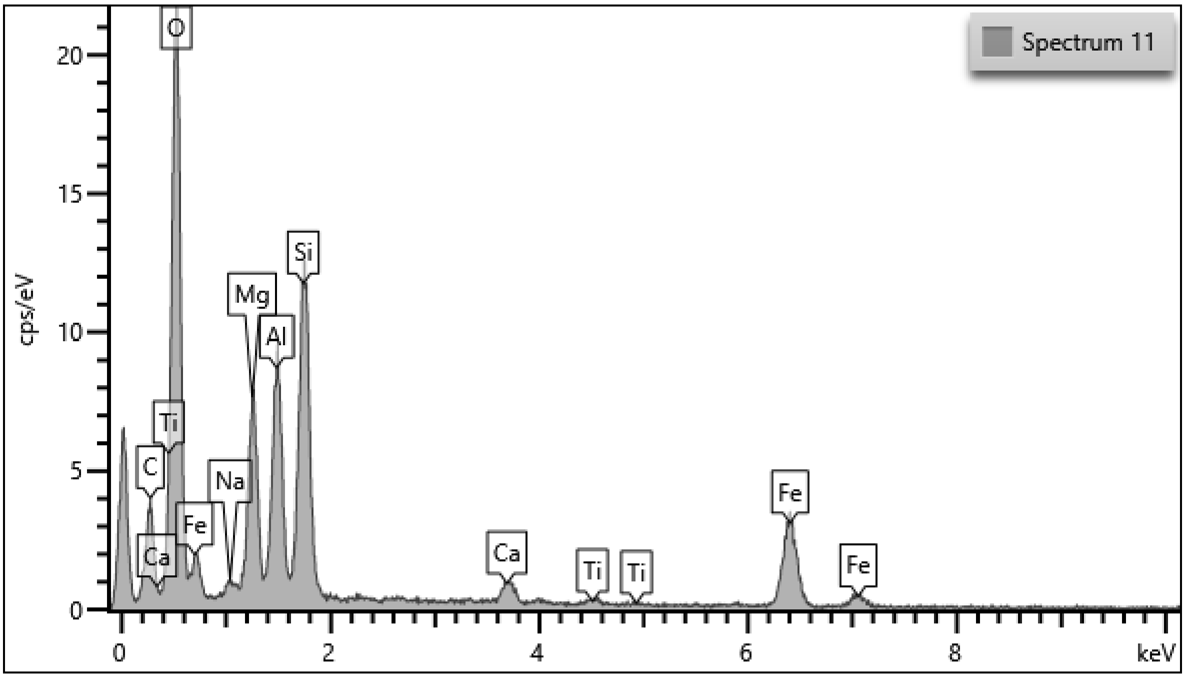
**Approved:** Nimue Pendragon, *B.Sc.(Nanotechnology)*


Electron Image 5 (Input1)
Spectrum 8
10µm

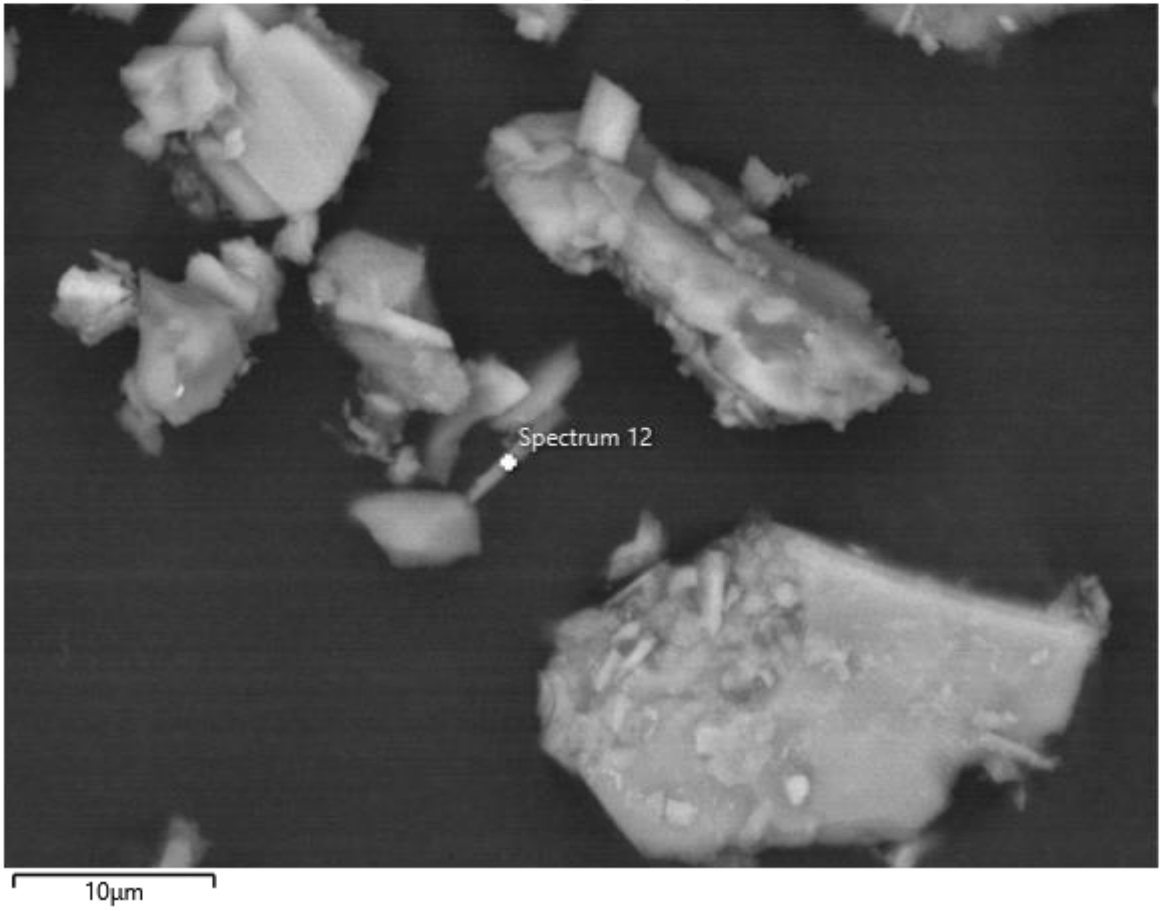

Spectrum 8
cps/eV
O
Si
Mg
Al
Ti
Ca
Na
Fe
S
Cl
K
Ca
Ti
Ti
Fe
Fe
0
5
10
0
2
4
6
8
keV

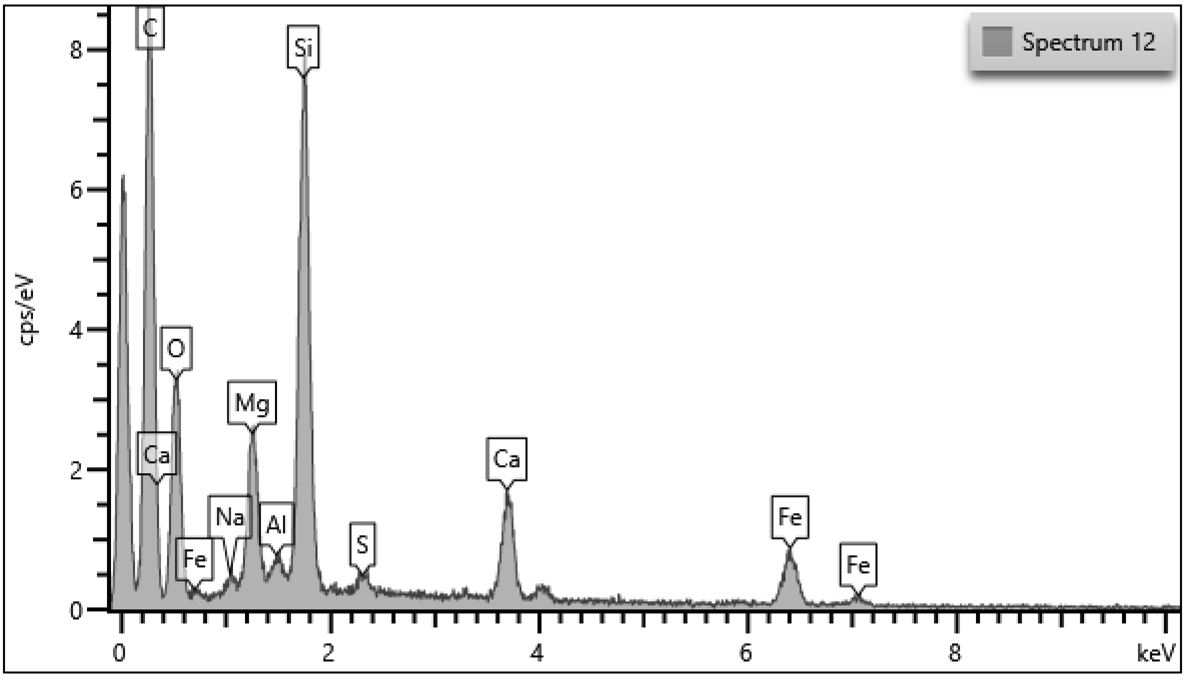
Electron Image 7 (Input1)



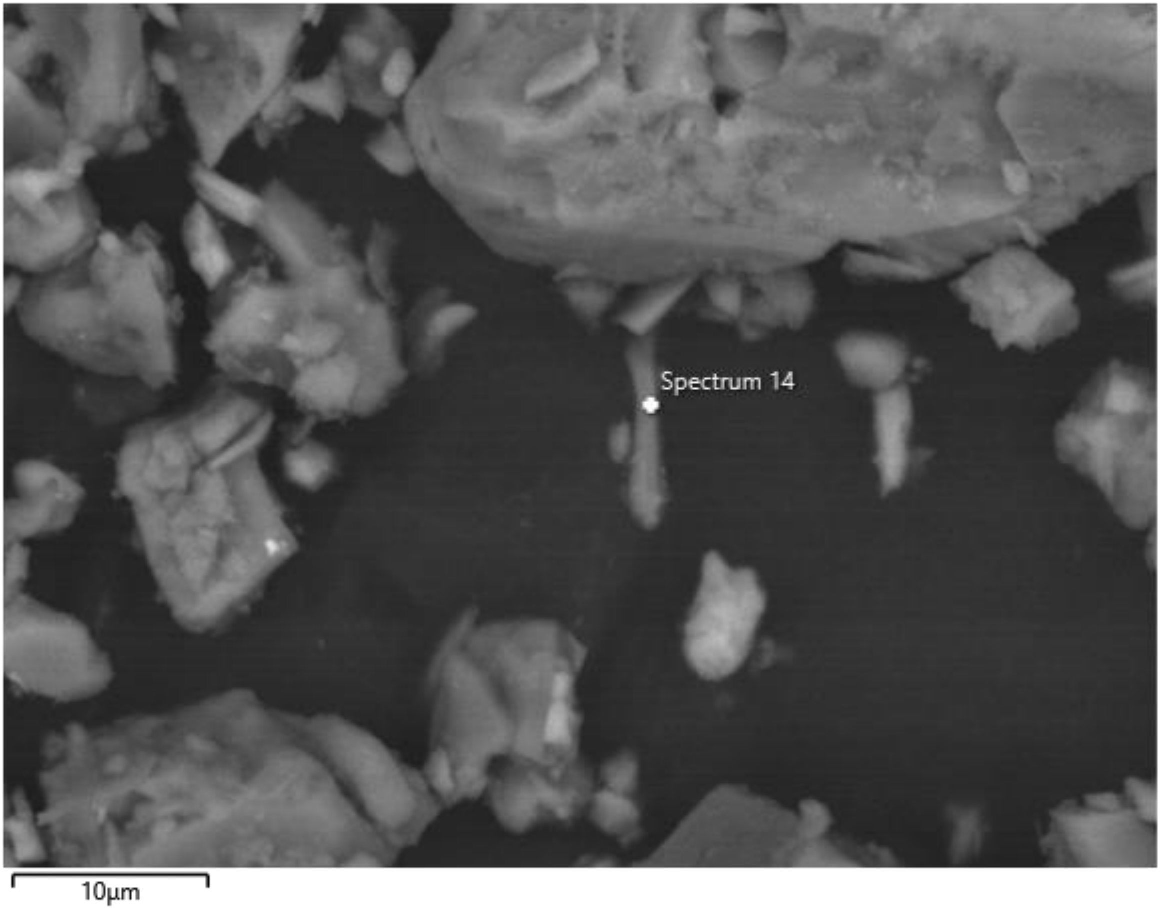


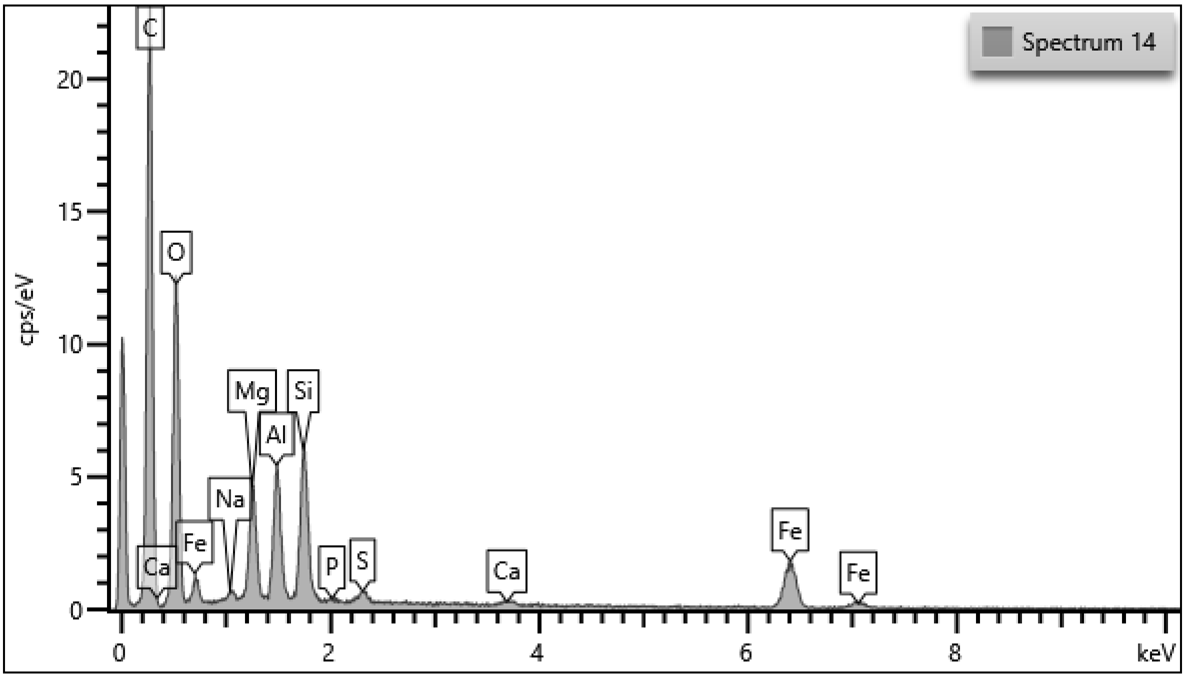
Electron Image 8 (Input1)



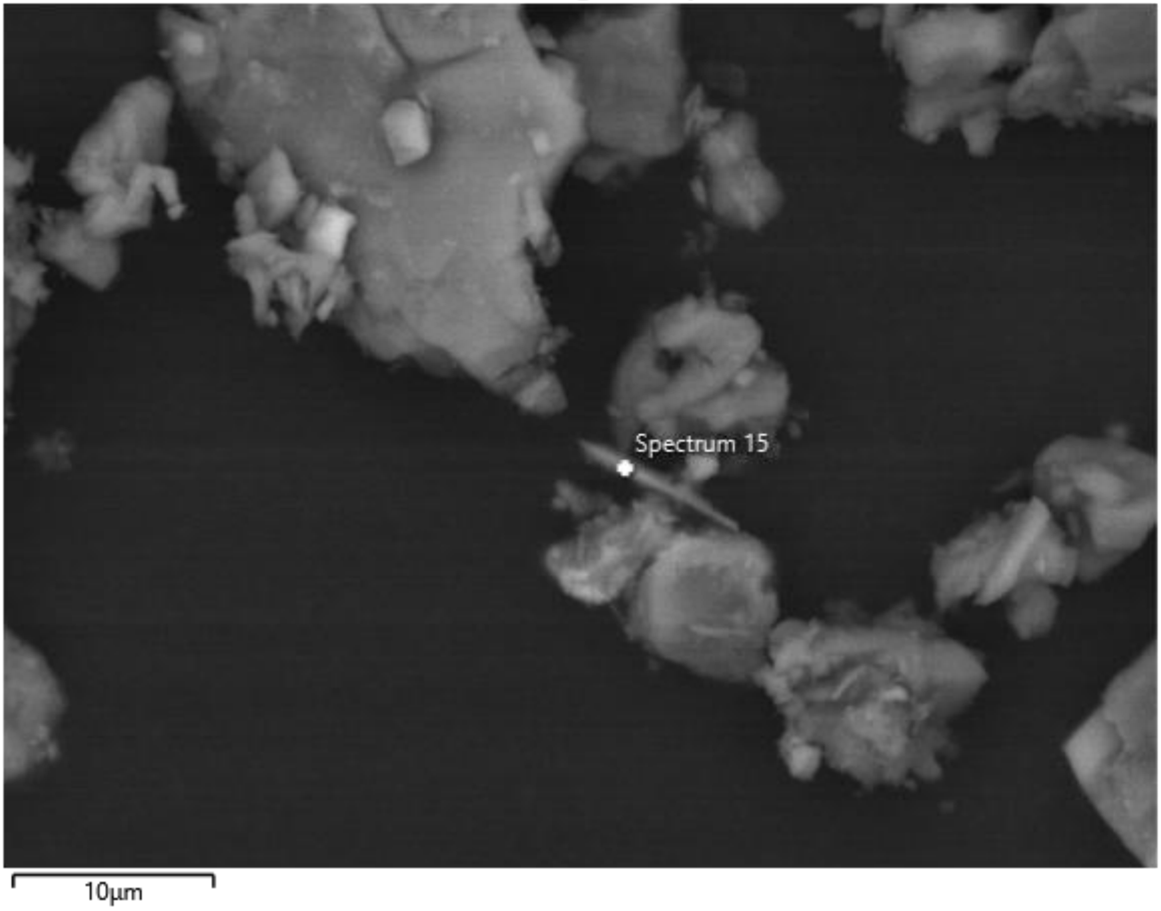


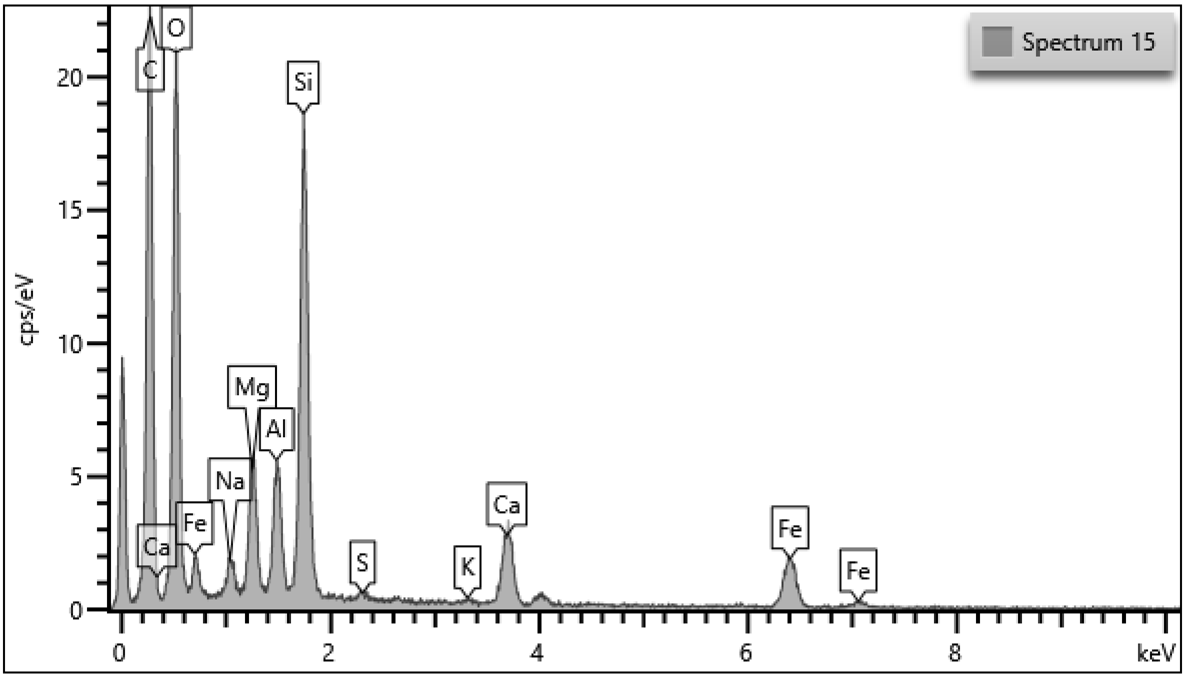
Electron Image 10 (Input1)



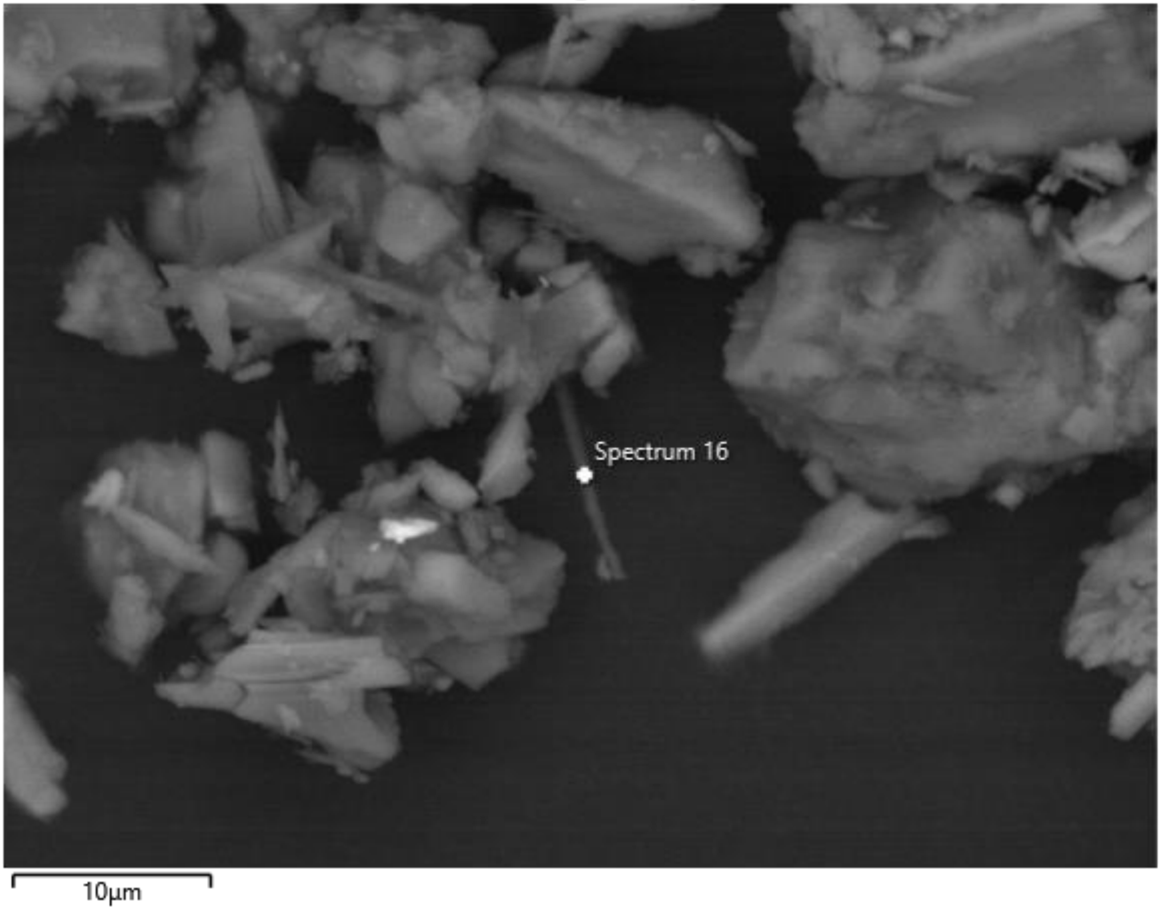


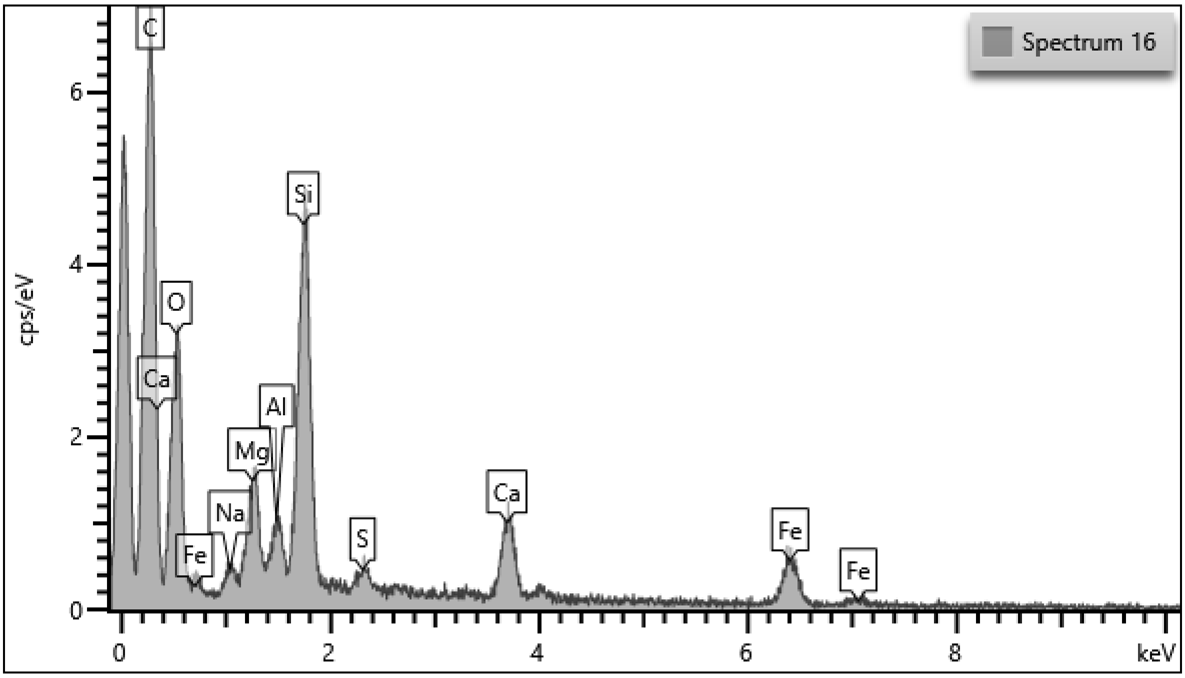
Electron Image 11 (Input1)



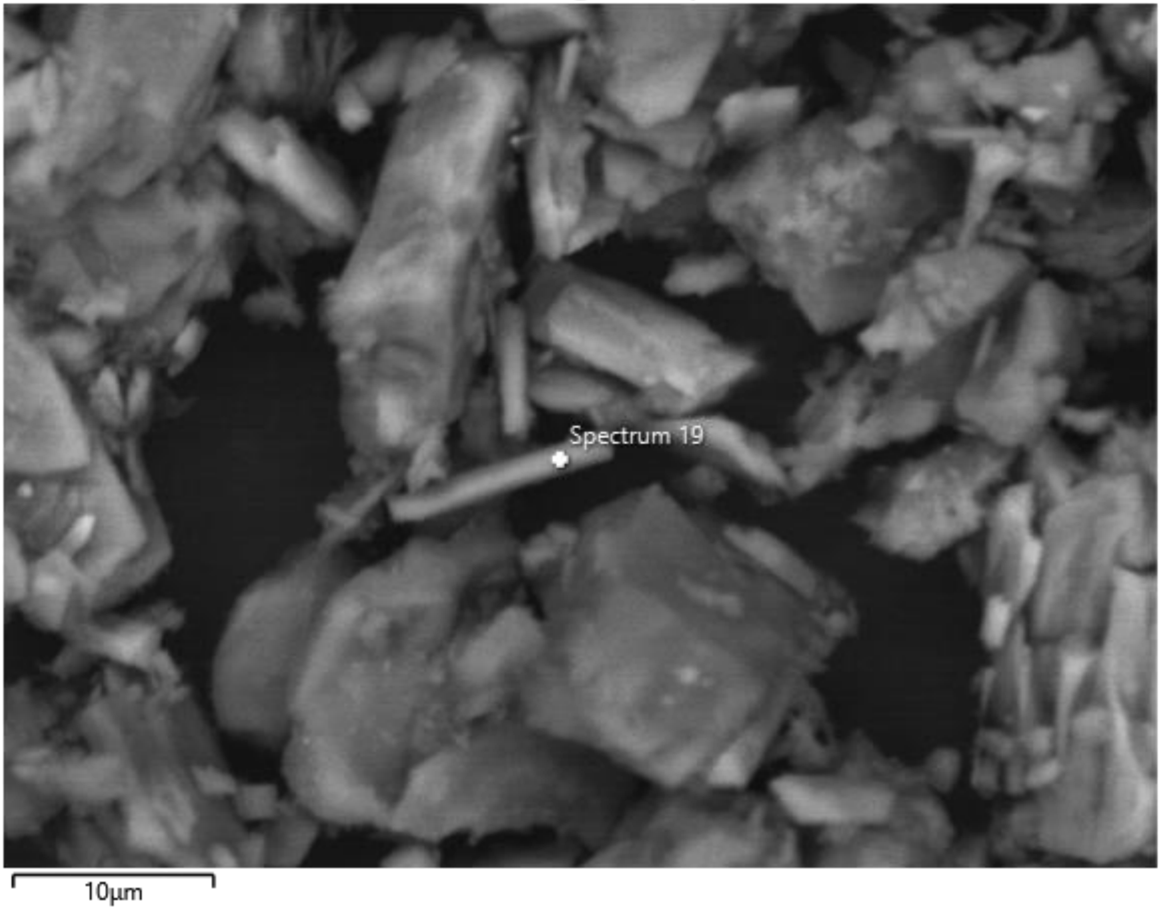


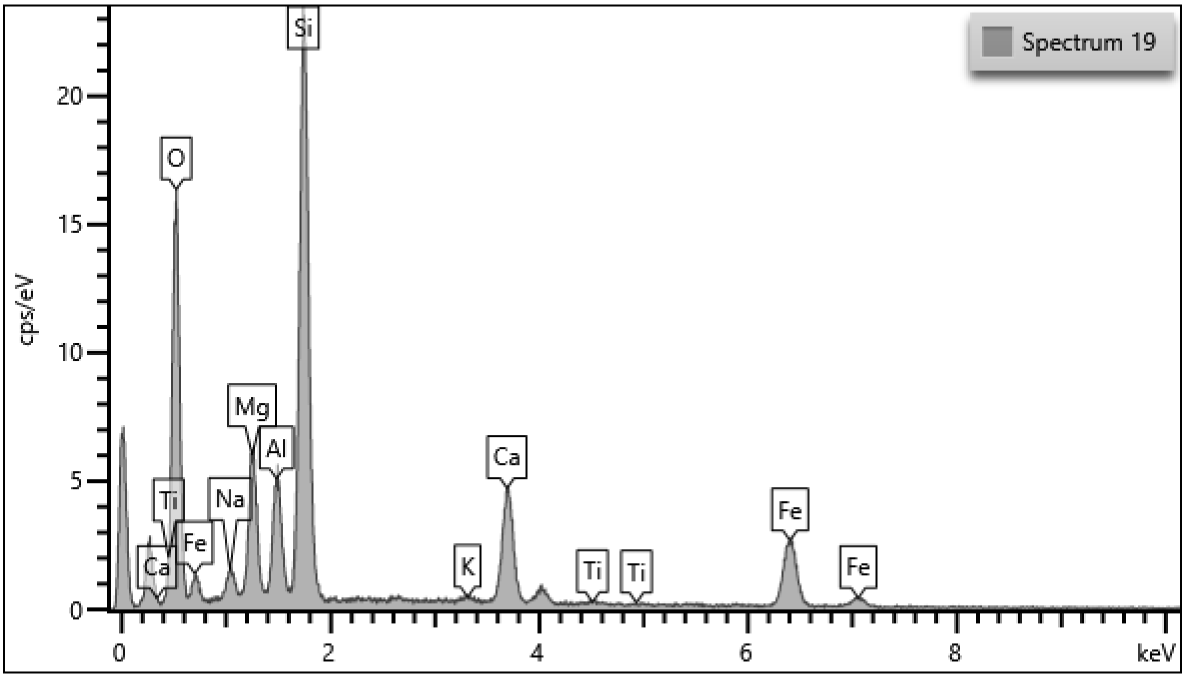
Electron Image 12 (Input1)





Electron Image 14 (Input1)





| | | | |
|---|---|---|---|
| **Client:** | Landloch | **Date received:** | 30/01/2025 |
| **Job number:** | 25_0206 | **Date analysed:** | 28/02/2025 |
| **Lab ID:** | 25_0206_004 | **Date reported:** | 28/02/2025 |
| **Client ID:** | **RWC56** | | |
| **Analysis:** | Fibre characterisation by scanning electron microscopy (SEM) with elemental analysis by energy dispersive spectroscopy (EDS) following AS 4964-2004 (modified for SEM) | | |
| **Revision number:** | 0 | | |
| **Comments:** | None | | |

## Executive summary

The sample was determined to contain **< 0.01 wt % asbestos** mineral fibre.

## Sample preparation

The sample was supplied to Microanalysis Australia as a bulk sample. The sample was screened at 2 mm, and each size fraction was inspected visually (both with the naked eye and with a low-powered microscope) for fibrous material.

As no fibrous material was visually apparent for immediate pre-selection, a representative sub-sample of the <2 mm fraction was disaggregated and was placed on top of at least one double-sided carbon tab before being carbon coated. Non-conducting samples require coating prior to SEM analysis to prevent charging whilst being analysed by the electron beam.

## Analysis

The sample was analysed using a Carl Zeiss EVO50 scanning electron microscope (SEM) fitted with an Oxford INCA energy dispersive spectrometer (EDS). The sample was scanned at low magnification to identify any possible fibre clusters before the magnification was increased to 2000x magnification for closer examination.

EDS is a semi-quantitative technique (at best) on well prepared, optically flat samples. Factors such as sample unevenness may adversely bias elemental concentration interpretation. EDS has a spatial resolution of ~5 µm meaning spectra from particles less than this size may contain elemental concentrations biased by their surroundings.

All images were acquired using backscatter electrons. Image brightness is proportional to average atomic number – the brighter the pixel, the higher the atomic number of the element.

**Summary**

Following AS 4964, asbestos is defined as:

- Many particles with aspect ratios (i.e. length to width ratios) ranging from 20:1 to 100:1 or higher for particles >5 micrometers in length. Bundles of fibres may have lower aspect ratios;
- Sets of fibre bundles generally less than 0.5, but always less than 1.0 micrometres in width, unless in thick bundles;
- In addition to the mandatory fibrillar crystal growth, one or more, and preferably three of the following aspects:
  - Parallel fibres occurring in bundles;
  - Fibre bundles displaying splayed ends;
  - Matted masses of individual fibres;
  - Fibres showing characteristic curvature.
- Respirable asbestos fibres are defined as:
  - Asbestos fibres less than 3 µm in width, and greater than 5 µm in length, and with a length to width ratio greater than 3 to 1.

**Less than 5 observed fibres had an elemental composition and morphology indicative of asbestos mineral fibre, according to the definition in AS 4964.**

Depending upon sample condition, composition and fibre type, the detection limit of AS 4964 has been found to lie generally in the range of 1 in 1,000 (0.1 wt %) to 1 in 10,000 (0.01 wt %) parts by weight, equivalent to 1 to 0.1 g/kg.

For this report, a limit of reporting (LoR) of 0.01 wt % has been assumed, as stated in AS 4964.

A selection of images/fields and associated elemental spectra are reported below. The fields are not representative of the area analysed. The images/fields were reported due to their higher fibre count.

| Fibre # | Image/Field # | Diameter (µm) | Length (µm) | Aspect ratio | Major Elements | Minor Elements | Morphology | Assigned mineralogy |
|---|---|---|---|---|---|---|---|---|
| 1 | 2/3 | 1.3 | 14.1 | 11 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |
| 2 | 3/4 | 1.3 | 9.8 | 8 :1 | O, Si | Mg, Ca, Fe | Irregular ends | Actinolite |
| 3 | 4/6 | 0.8 | 13.2 | 17 :1 | O, Si | Mg, Ca, Fe, Al, Na | Irregular ends | Hornblende |
| 4 | 6/9 | 1.2 | 9.1 | 8 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 5 | 8/11 | 1.0 | 9.2 | 9 :1 | O, Si | Mg, Ca, Fe, Al, Na | Irregular ends | Hornblende |
| 6 | 9/12 | 1.0 | 15.5 | 16 :1 | O, Si | Mg, Ca, Fe, Al, Na | Irregular ends | Hornblende |
| 7 | 11/14 | 1.3 | 20.8 | 16 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |

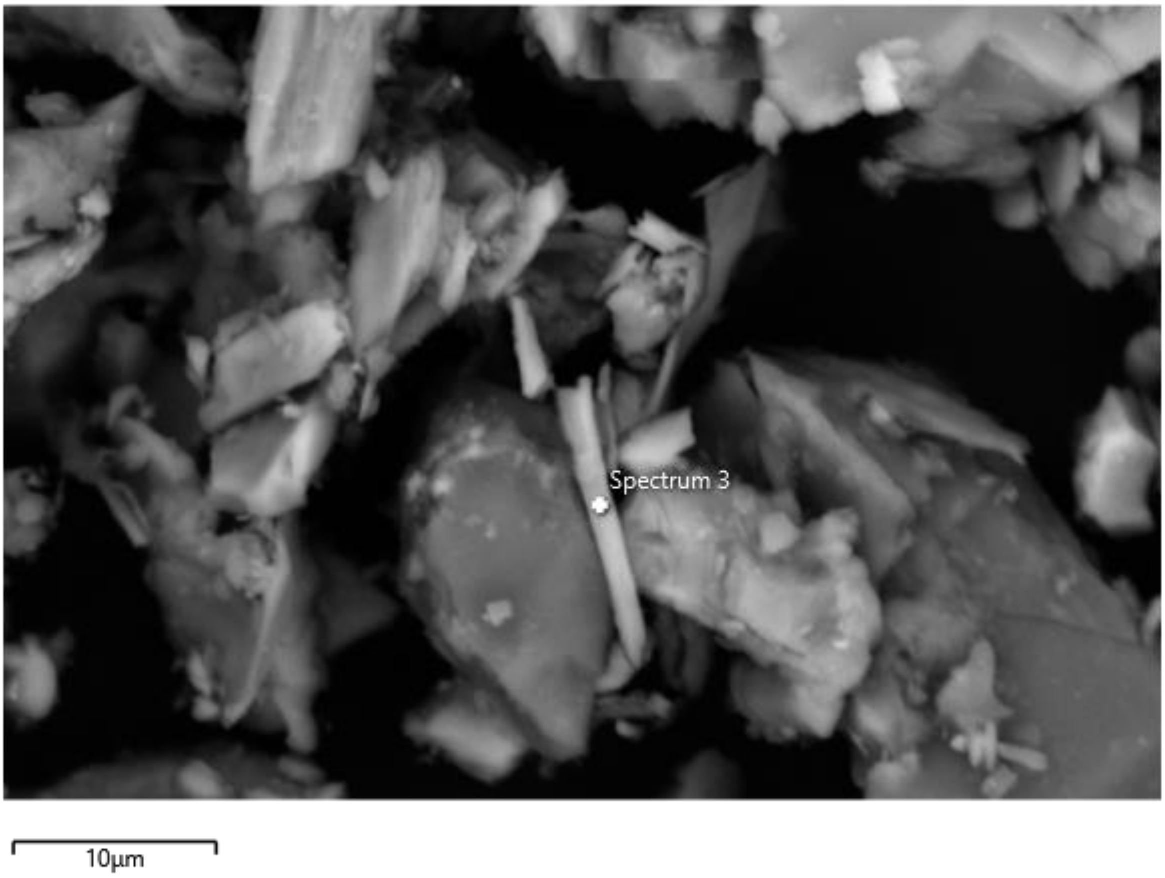
It should be noted that the higher resolution of the SEM may increase the number of fibres observed when compared with optical microscopy. Positive identification of asbestos fibres by SEM EDS uses elemental information that is not available by optical methods.

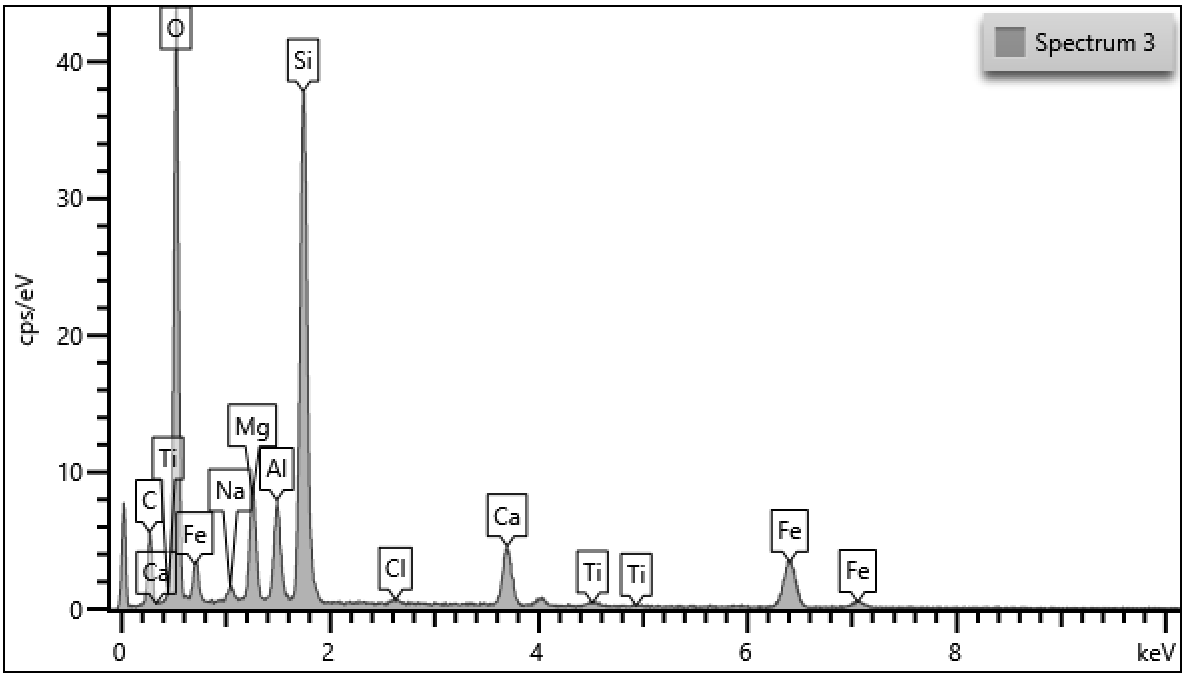
**Analyst:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

**Reported by:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

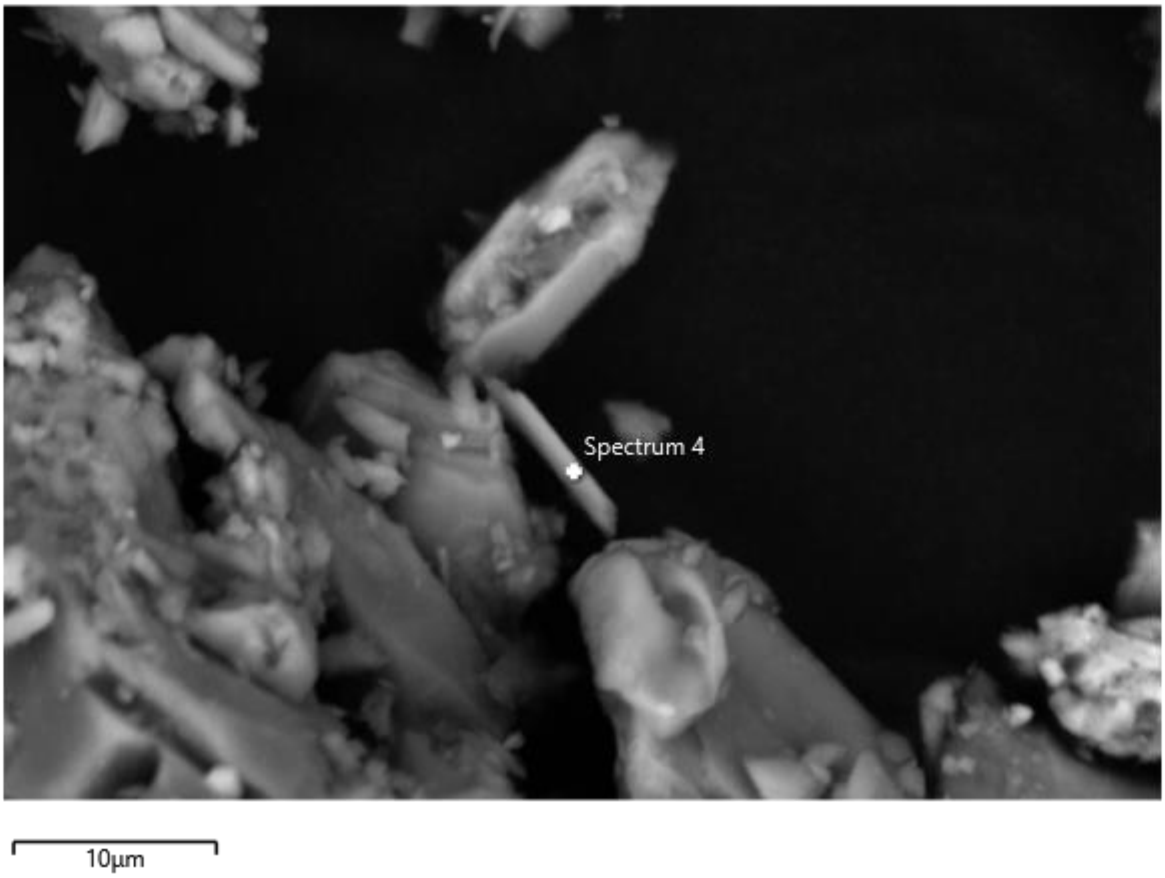
**Approved:** Nimue Pendragon, *B.Sc.(Nanotechnology)*

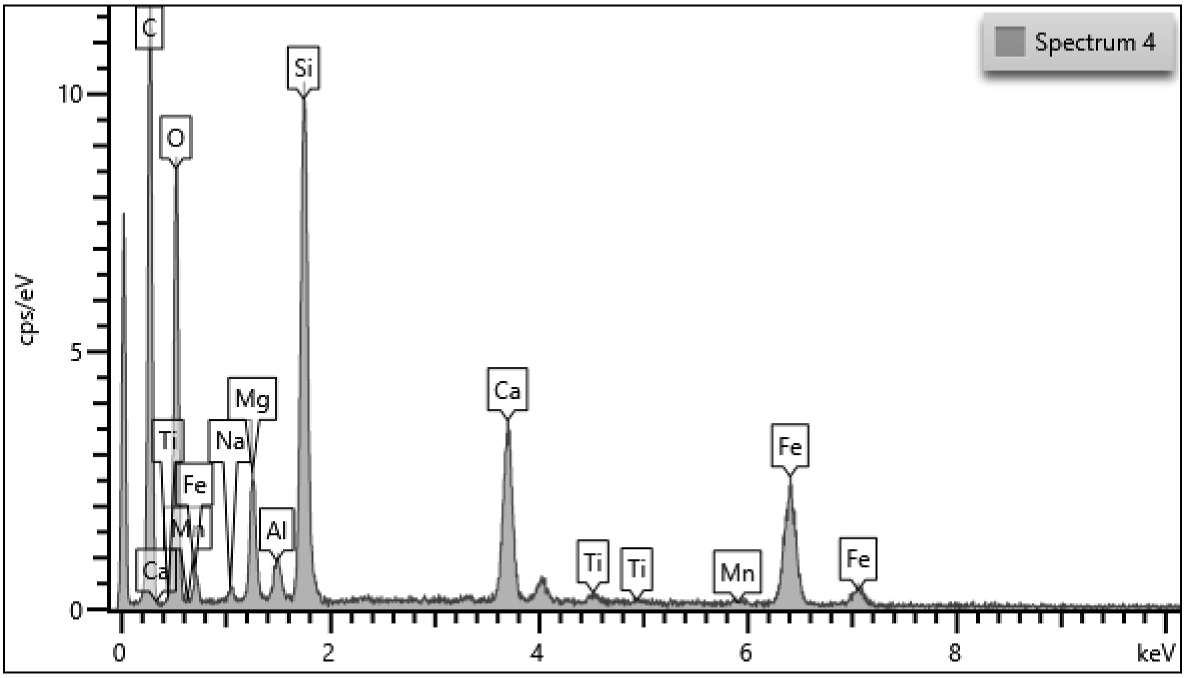
Electron Image 2 (SE)



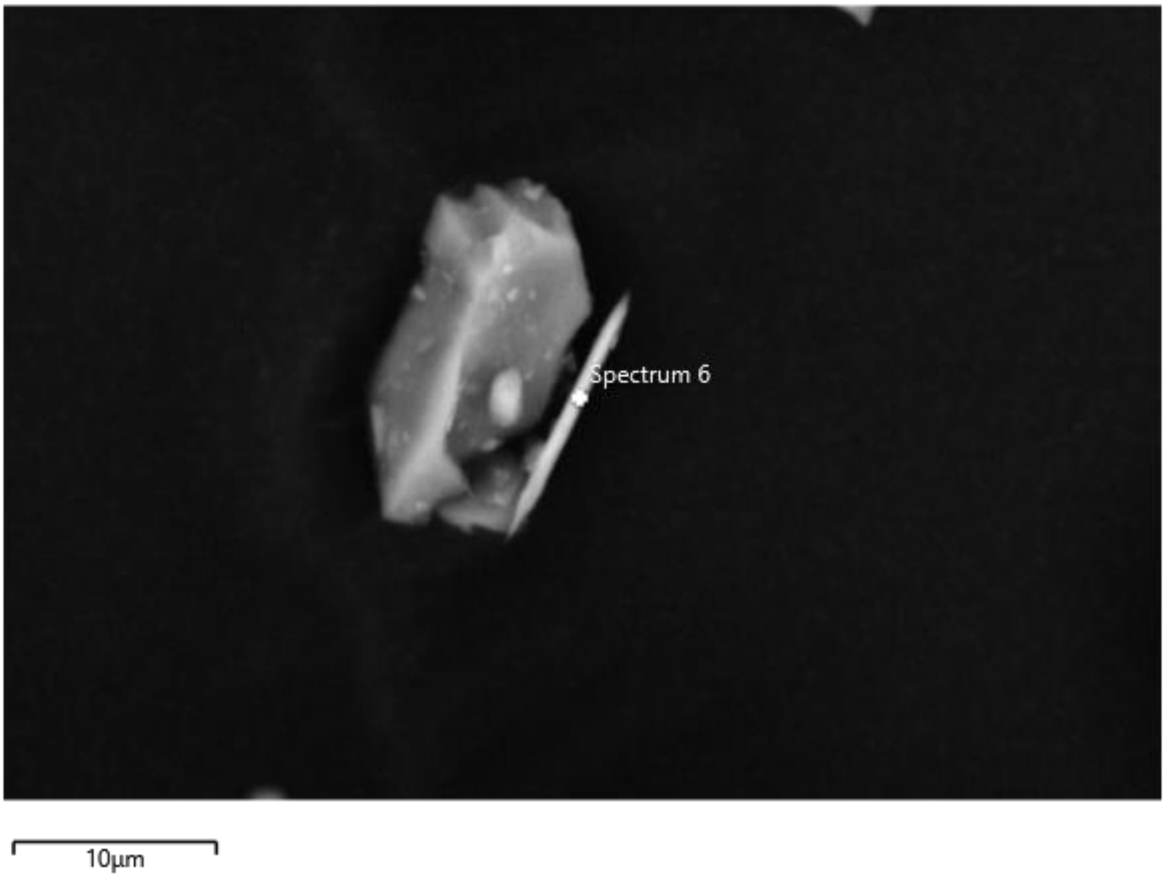


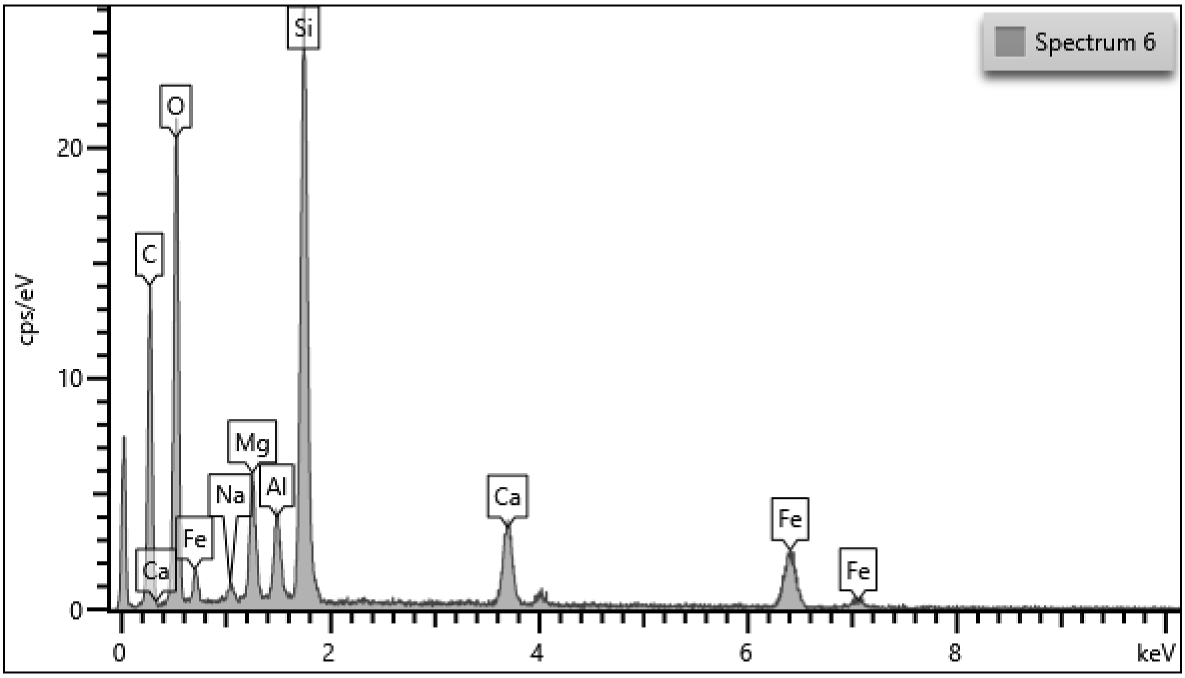
Electron Image 3 (SE)



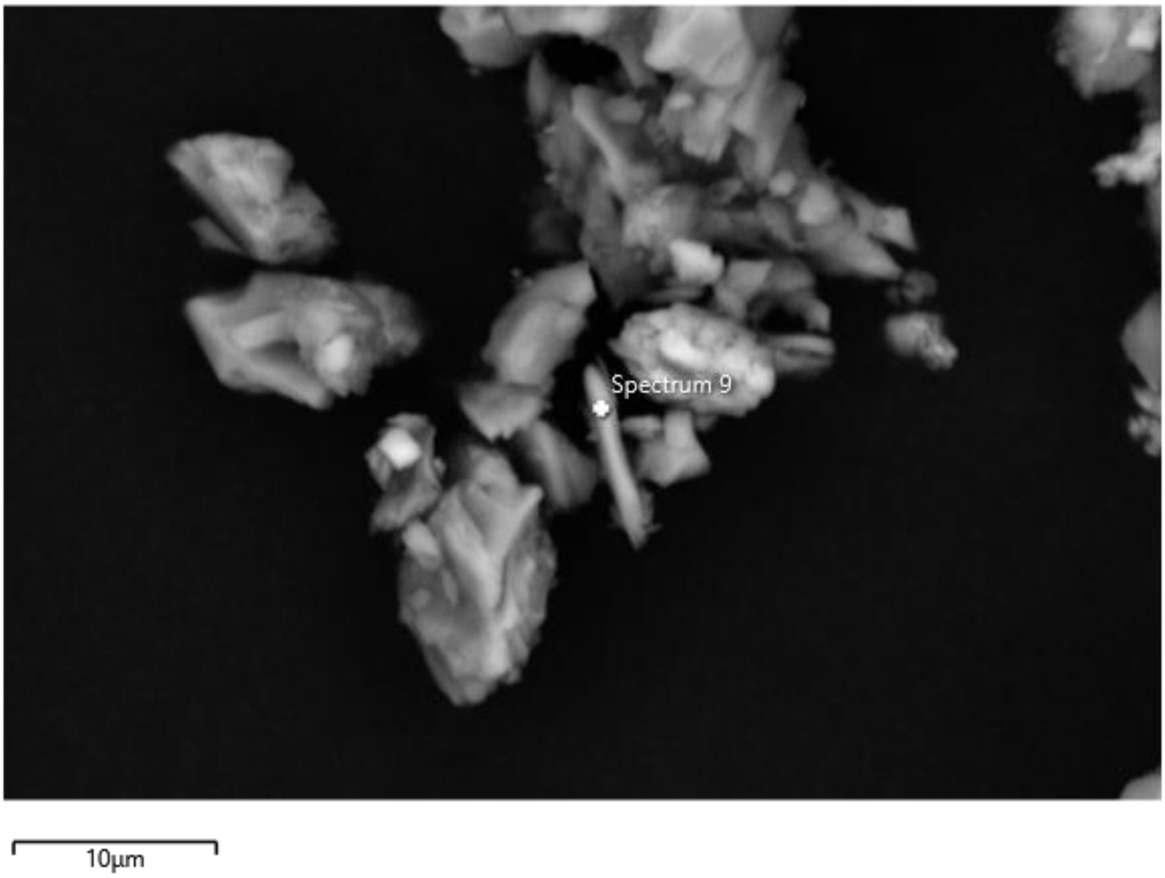


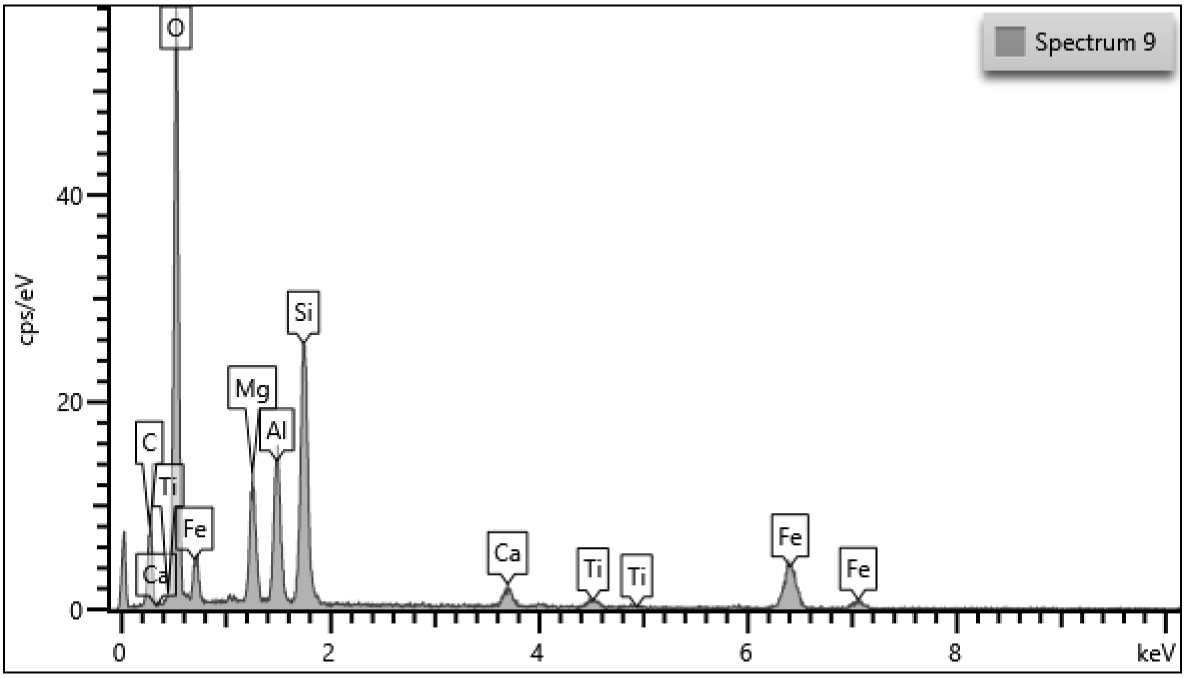
Electron Image 4 (SE)



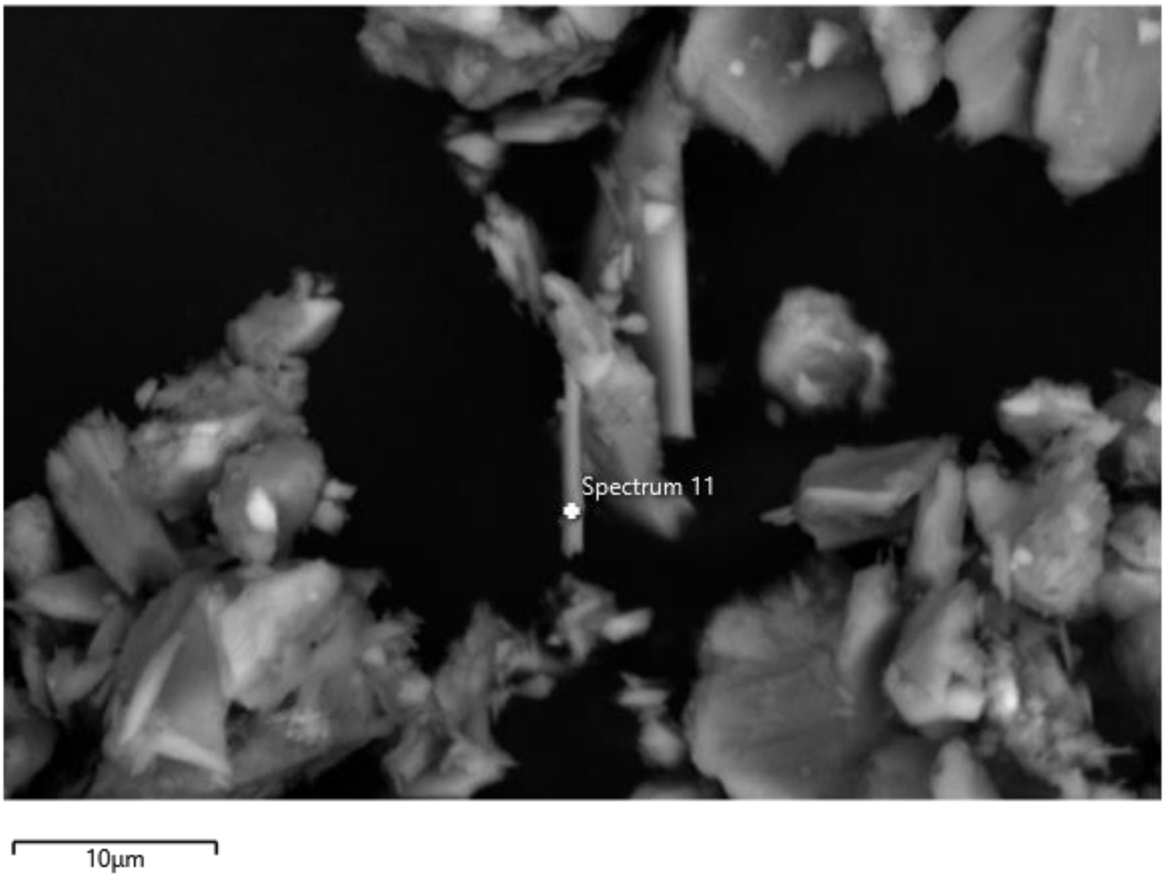


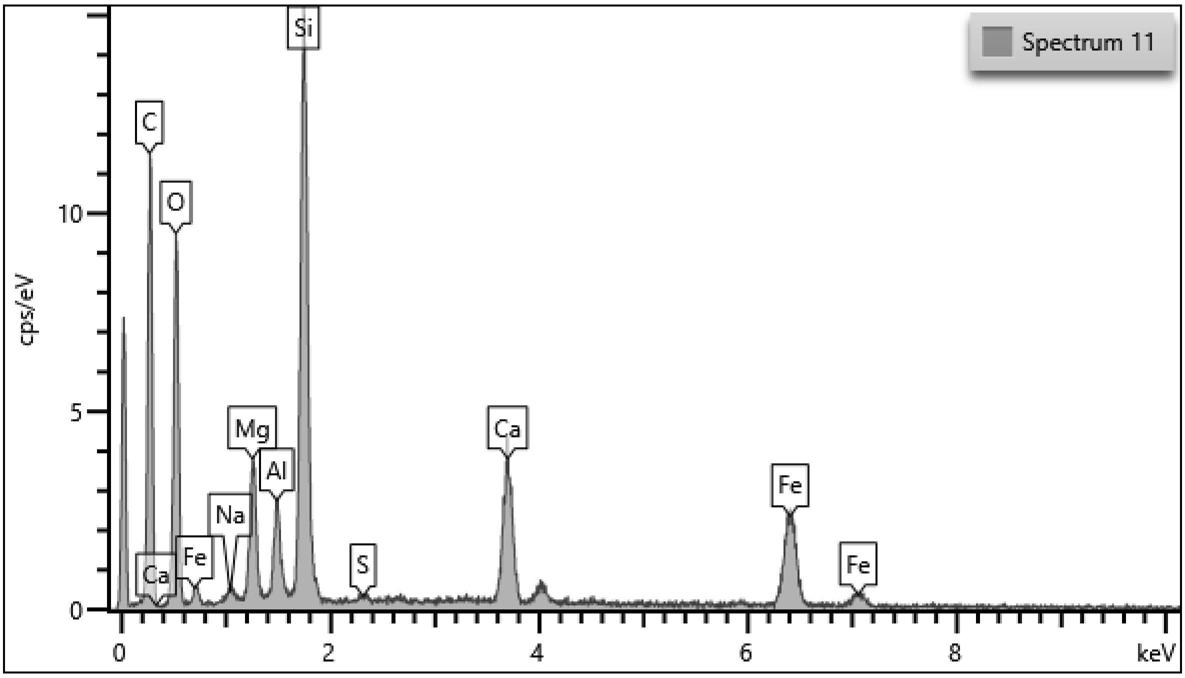
Electron Image 6 (SE)



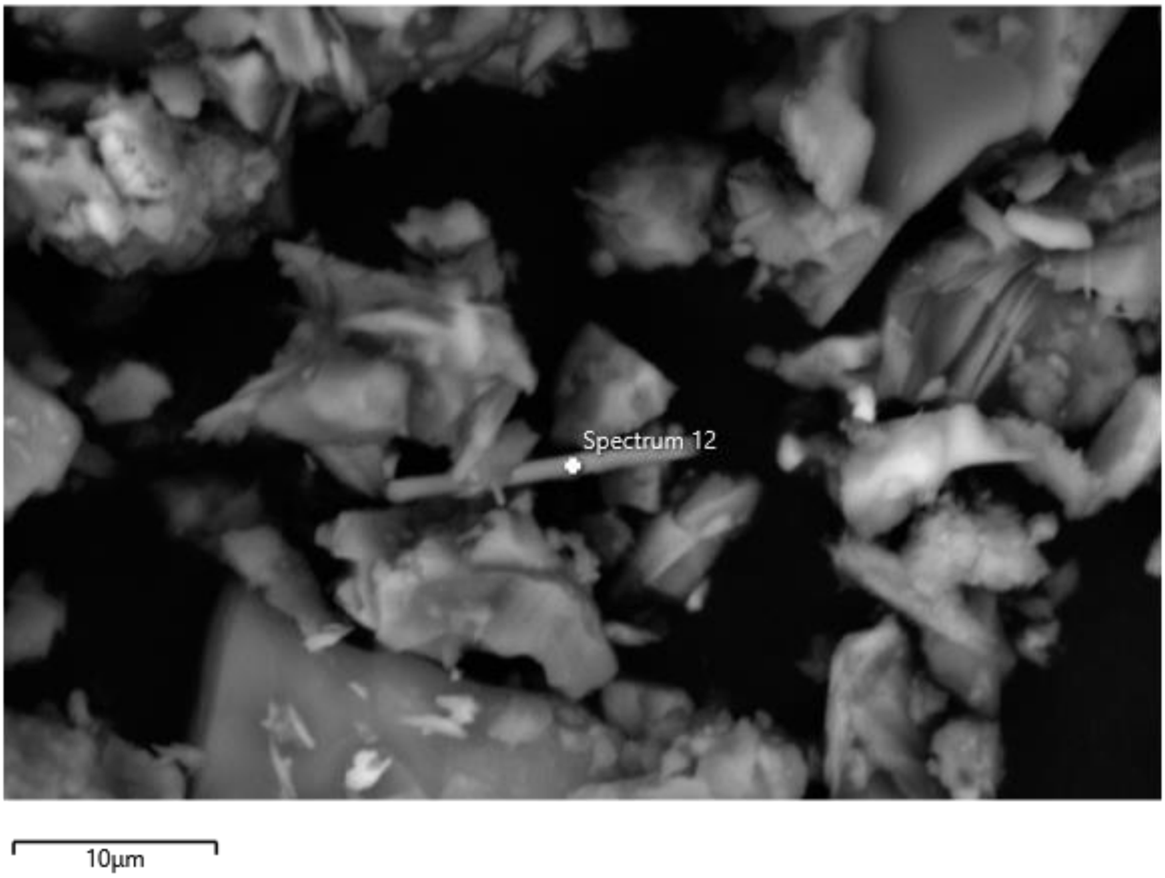


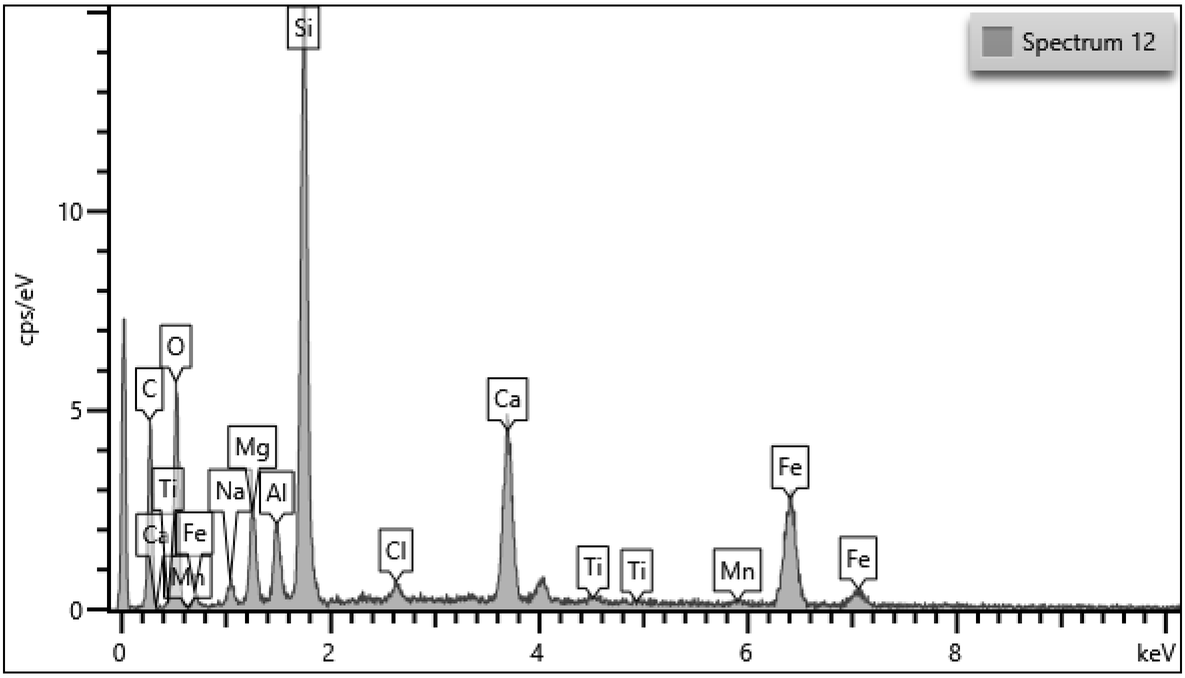
Electron Image 8 (SE)



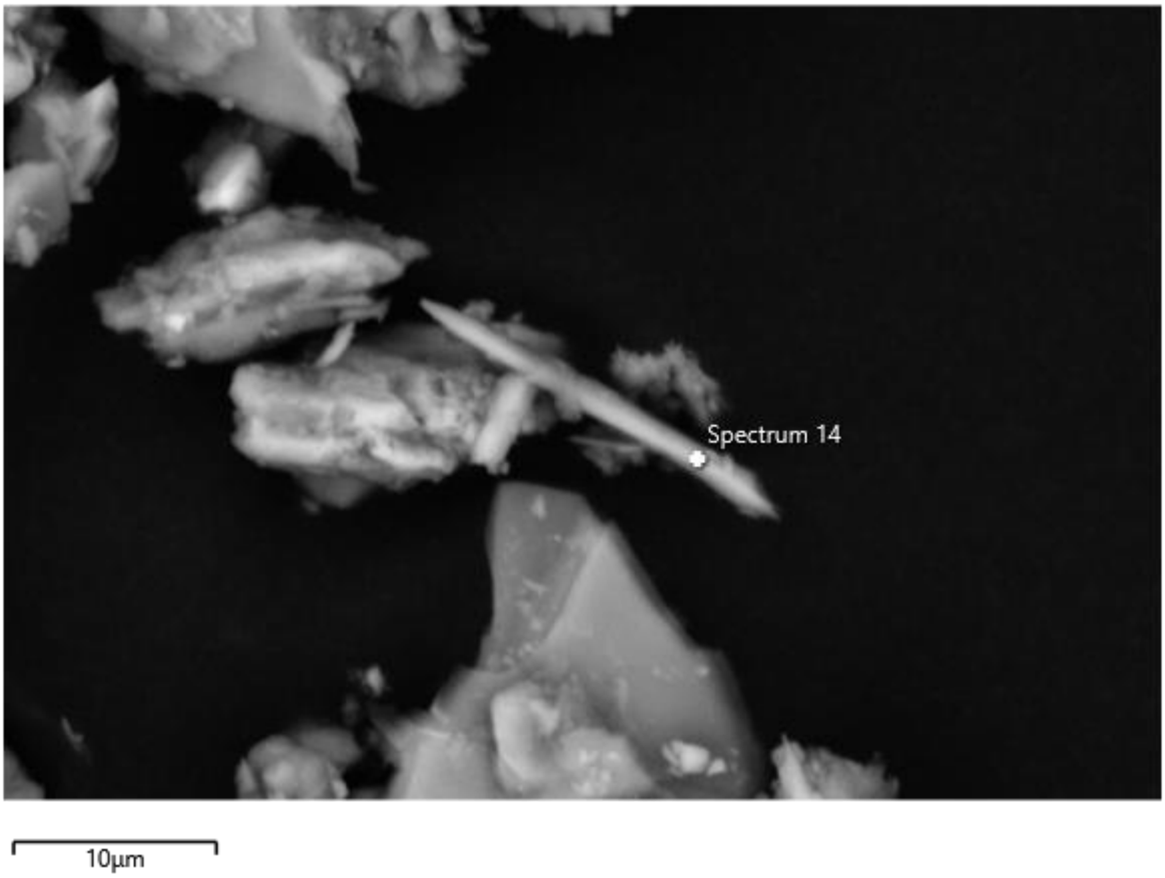


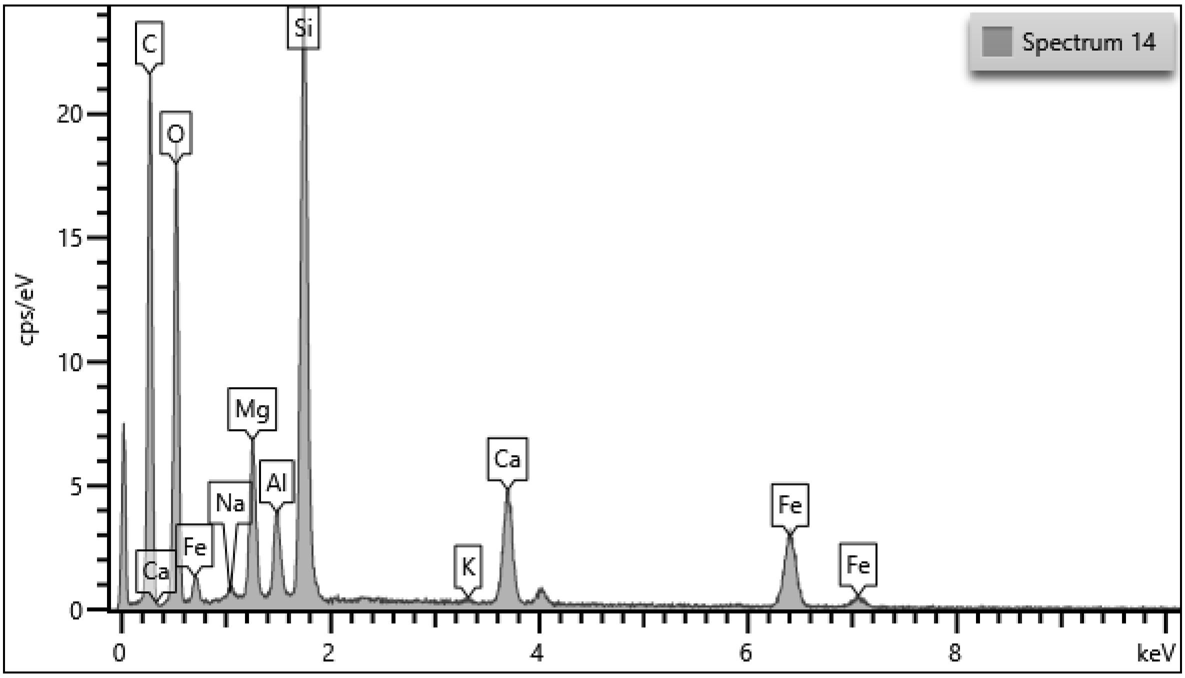
Electron Image 9 (SE)





Electron Image 11 (SE)





microanalysis australia

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**Client:** Landloch
**Job number:** 25_0206
**Lab ID:** 25_0206_005
**Client ID:** **RWC79**
**Analysis:** Fibre characterisation by scanning electron microscopy (SEM) with elemental analysis by energy dispersive spectroscopy (EDS) following AS 4964-2004 (modified for SEM)
**Revision number:** 0
**Comments:** None

**Date received:** 30/01/2025
**Date analysed:** 28/02/2025
**Date reported:** 28/02/2025

## Executive summary

The sample was determined to contain **< 0.01 wt % asbestos** mineral fibre.

## Sample preparation

The sample was supplied to Microanalysis Australia as a bulk sample. The sample was screened at 2 mm, and each size fraction was inspected visually (both with the naked eye and with a low-powered microscope) for fibrous material.

As no fibrous material was visually apparent for immediate pre-selection, a representative sub-sample of the <2 mm fraction was disaggregated and was placed on top of at least one double-sided carbon tab before being carbon coated. Non-conducting samples require coating prior to SEM analysis to prevent charging whilst being analysed by the electron beam.

## Analysis

The sample was analysed using a Carl Zeiss EVO50 scanning electron microscope (SEM) fitted with an Oxford INCA energy dispersive spectrometer (EDS). The sample was scanned at low magnification to identify any possible fibre clusters before the magnification was increased to 2000x magnification for closer examination.

EDS is a semi-quantitative technique (at best) on well prepared, optically flat samples. Factors such as sample unevenness may adversely bias elemental concentration interpretation. EDS has a spatial resolution of ~5 µm meaning spectra from particles less than this size may contain elemental concentrations biased by their surroundings.

All images were acquired using backscatter electrons. Image brightness is proportional to average atomic number – the brighter the pixel, the higher the atomic number of the element.

**Summary**

Following AS 4964, asbestos is defined as:

- Many particles with aspect ratios (i.e. length to width ratios) ranging from 20:1 to 100:1 or higher for particles >5 micrometers in length. Bundles of fibres may have lower aspect ratios;
- Sets of fibre bundles generally less than 0.5, but always less than 1.0 micrometres in width, unless in thick bundles;
- In addition to the mandatory fibrillar crystal growth, one or more, and preferably three of the following aspects:
  - Parallel fibres occurring in bundles;
  - Fibre bundles displaying splayed ends;
  - Matted masses of individual fibres;
  - Fibres showing characteristic curvature.
- Respirable asbestos fibres are defined as:
  - Asbestos fibres less than 3 µm in width, and greater than 5 µm in length, and with a length to width ratio greater than 3 to 1.

**Less than 5 observed fibres had an elemental composition and morphology indicative of asbestos mineral fibre, according to the definition in AS 4964.**

Depending upon sample condition, composition and fibre type, the detection limit of AS 4964 has been found to lie generally in the range of 1 in 1,000 (0.1 wt %) to 1 in 10,000 (0.01 wt %) parts by weight, equivalent to 1 to 0.1 g/kg.

For this report, a limit of reporting (LoR) of 0.01 wt % has been assumed, as stated in AS 4964.

A selection of images/fields and associated elemental spectra are reported below. The fields are not representative of the area analysed. The images/fields were reported due to their higher fibre count.

| Fibre # | Image/Field # | Diameter (µm) | Length (µm) | Aspect ratio | Major Elements | Minor Elements | Morphology | Assigned mineralogy |
|---|---|---|---|---|---|---|---|---|
| 1 | 13/16 | 0.8 | 8.7 | 11 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 2 | 14/17 | 1.4 | 10.2 | 7 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 3 | 15/18 | 1.5 | 13.1 | 9 :1 | Na, Cl | - | Non-parallel sides | Halite |
| 4 | 16/20 | 1.2 | 27.2 | 23 :1 | Na, Cl | Si, Al | Non-parallel sides | Halite |
| 5 | 17/21 | 0.9 | 12.1 | 13 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 6 | 19/24 | 1.5 | 17.1 | 11 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 7 | 21/26 | 2.0 | 19.2 | 10 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |

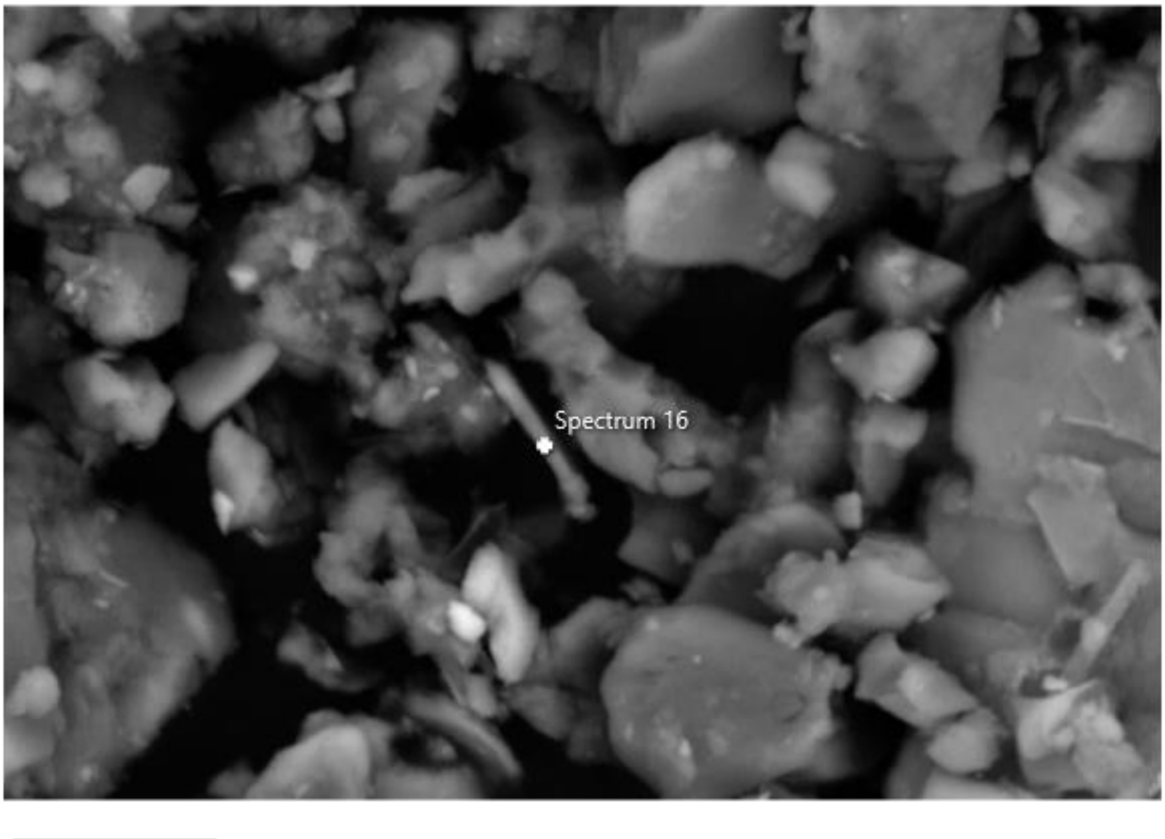
It should be noted that the higher resolution of the SEM may increase the number of fibres observed when compared with optical microscopy. Positive identification of asbestos fibres by SEM EDS uses elemental information that is not available by optical methods.

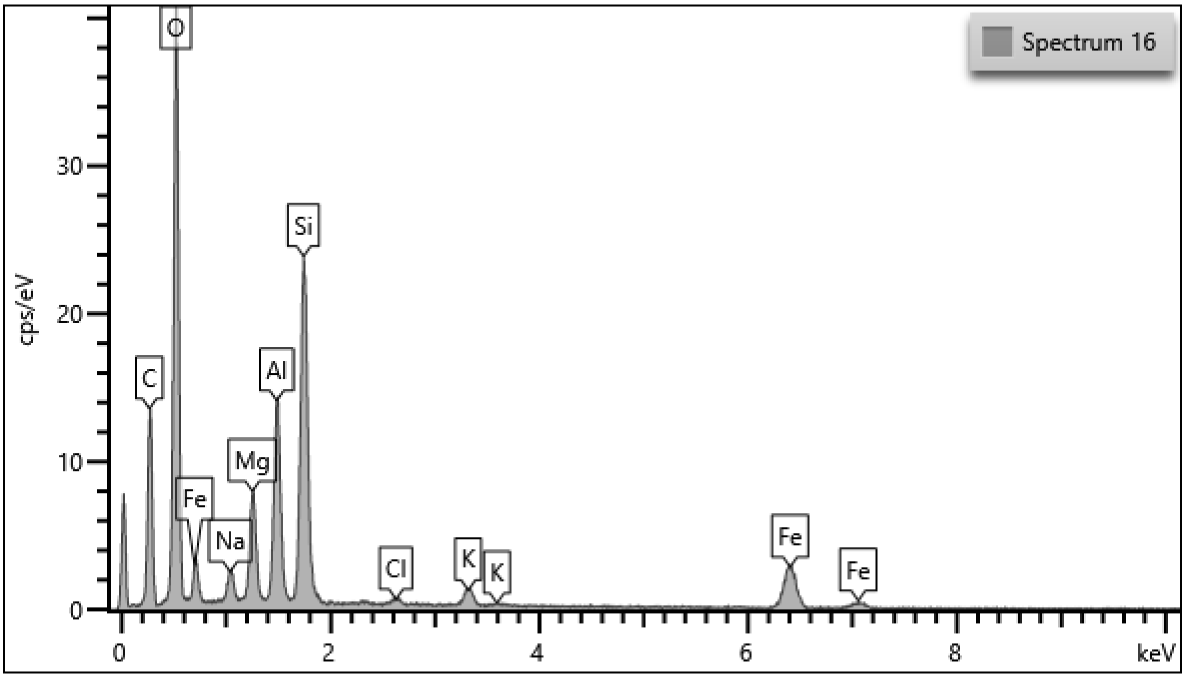
**Analyst:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

**Reported by:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

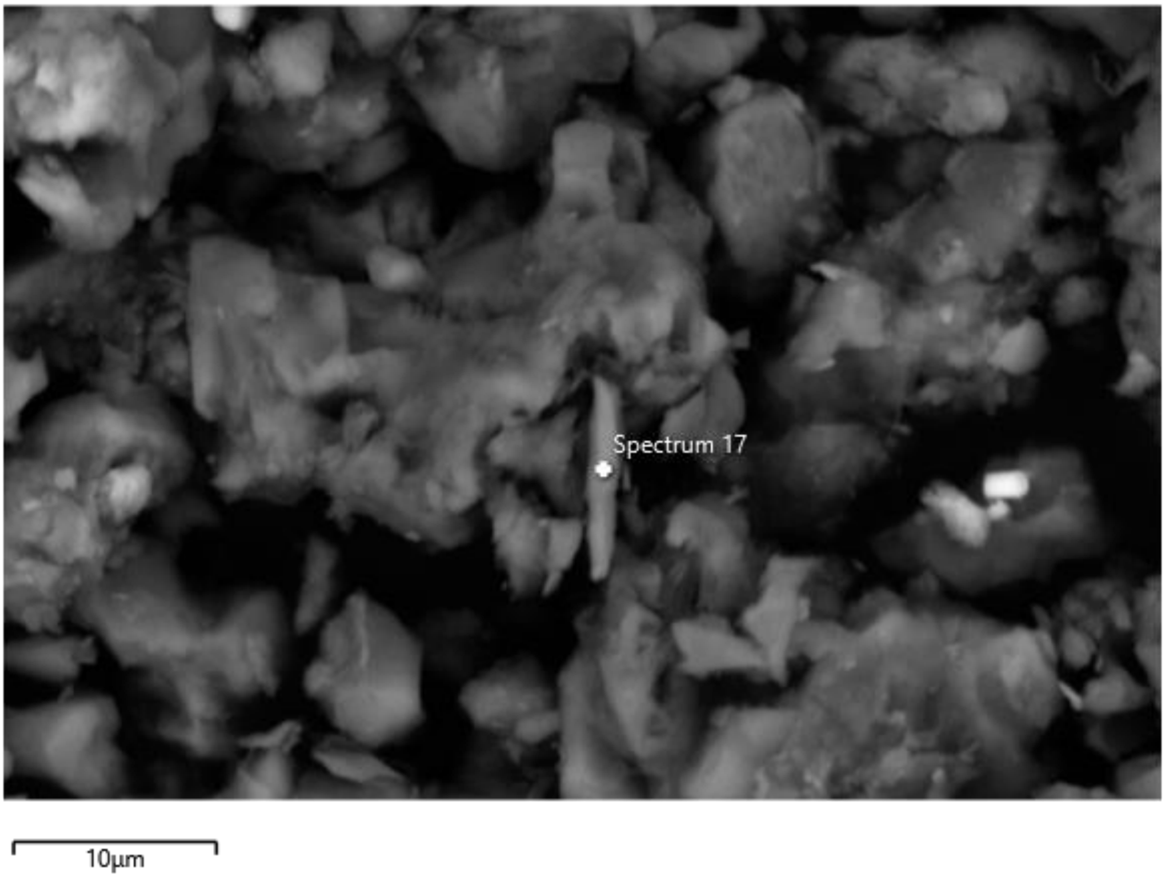
**Approved:** Nimue Pendragon, *B.Sc.(Nanotechnology)*

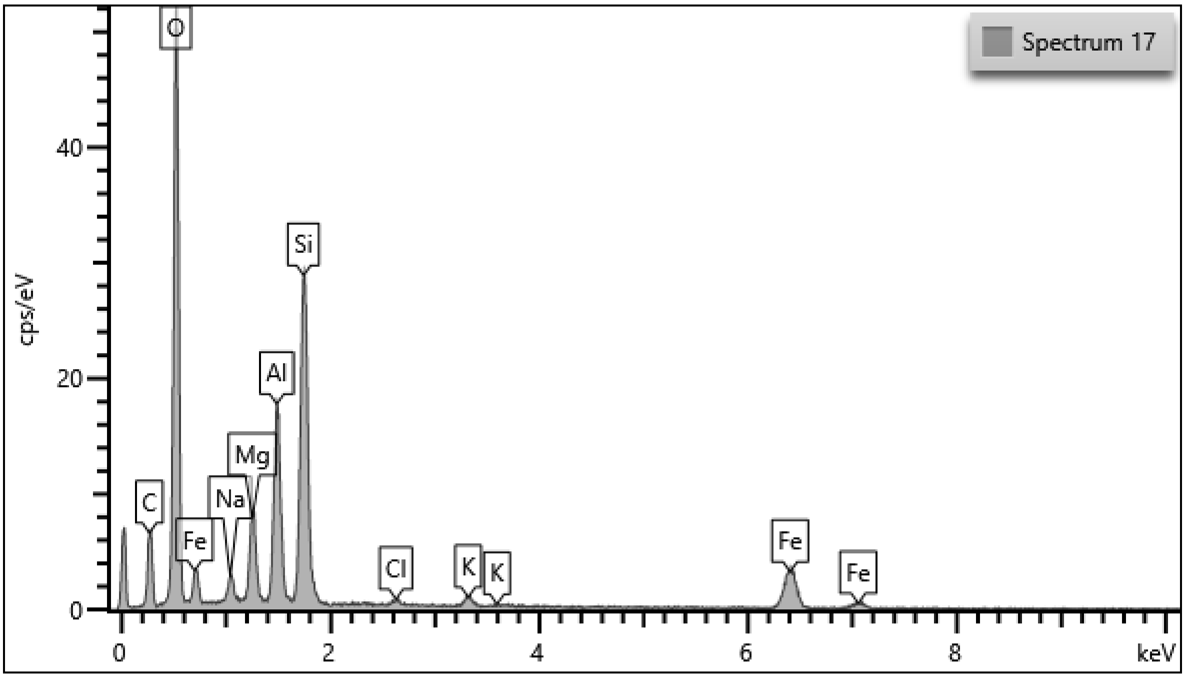
Electron Image 13 (SE)



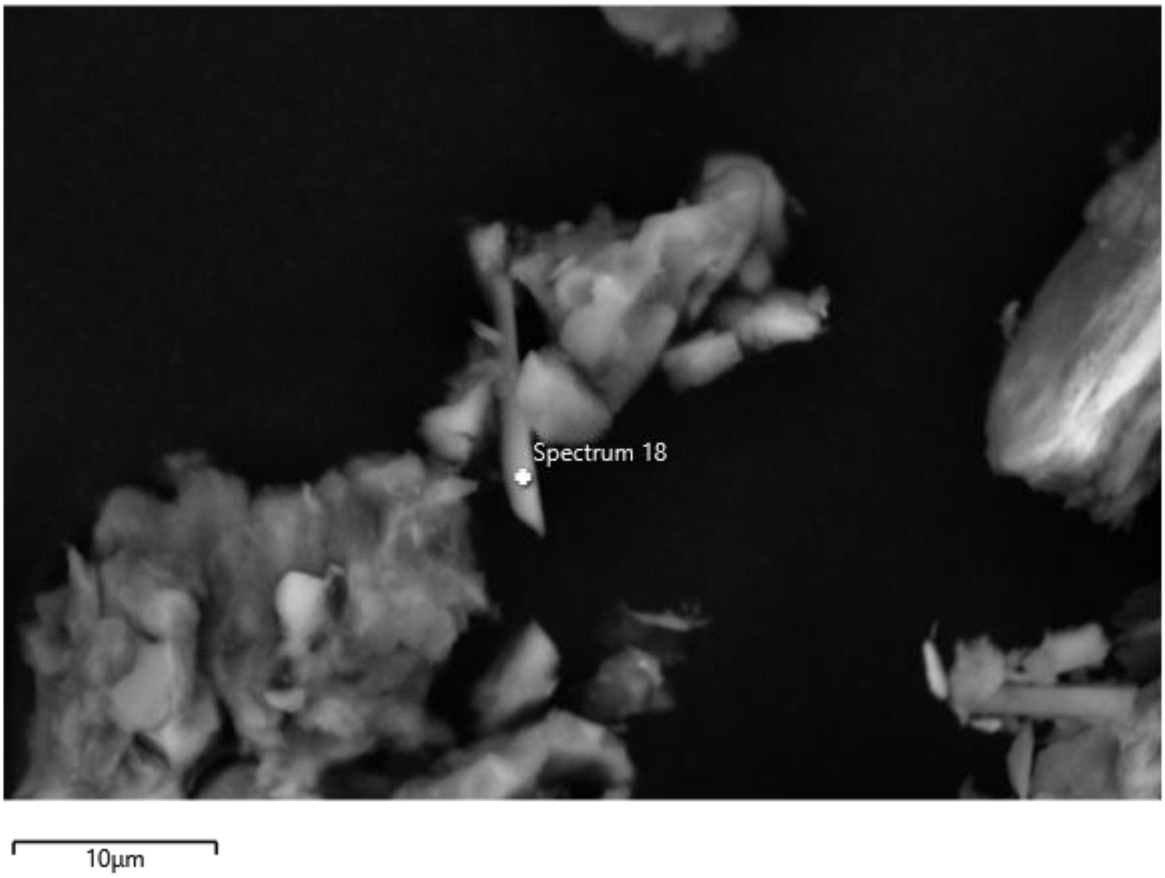


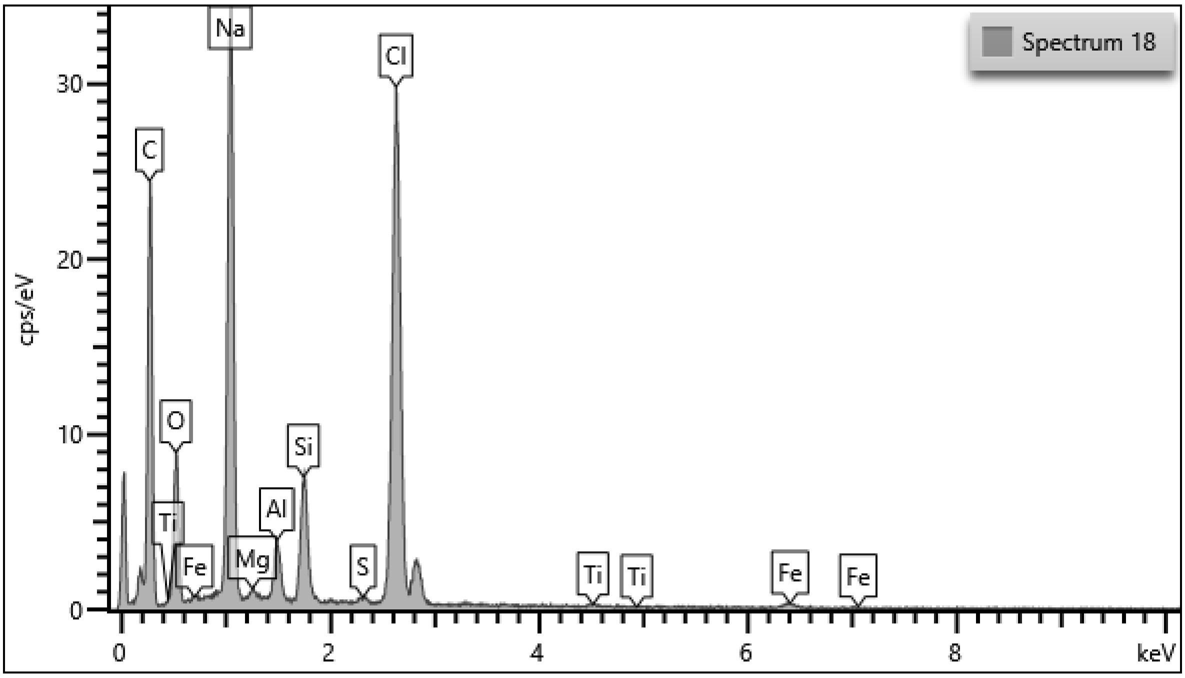
Electron Image 14 (SE)



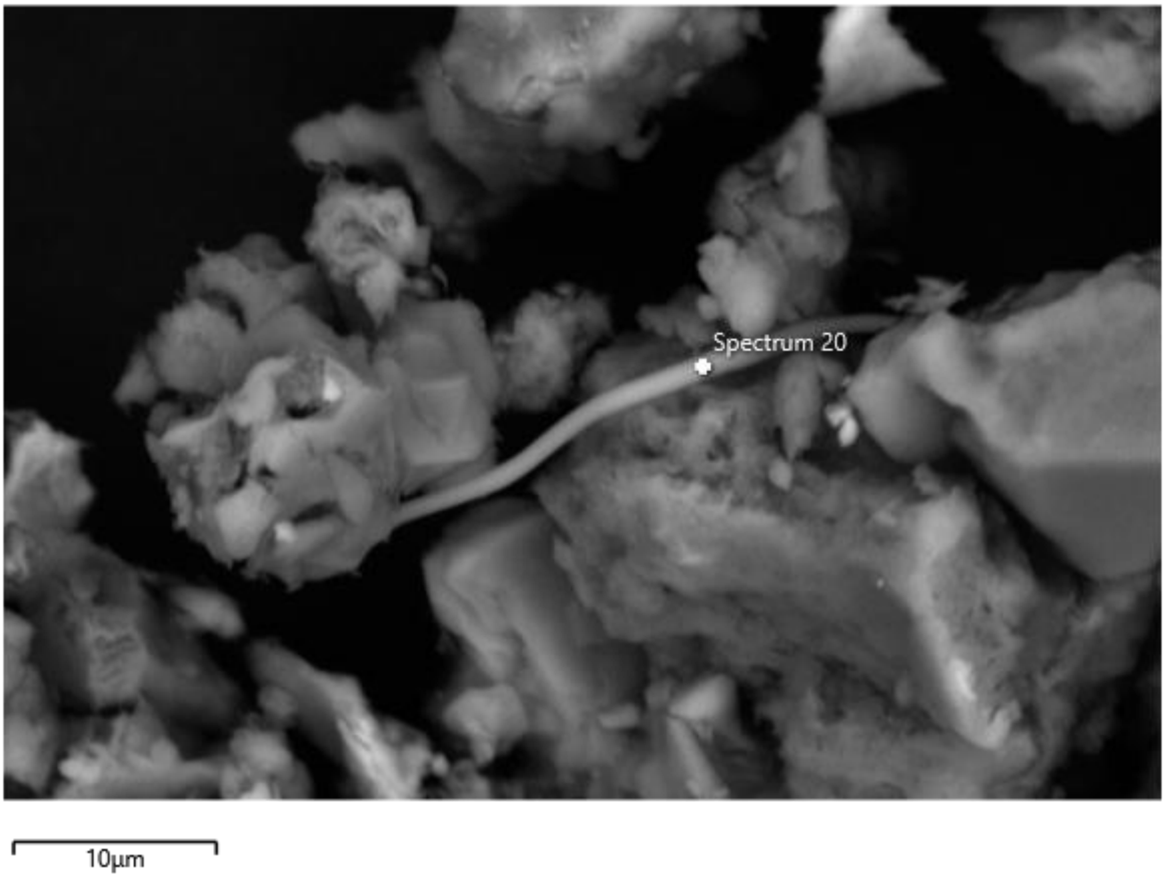


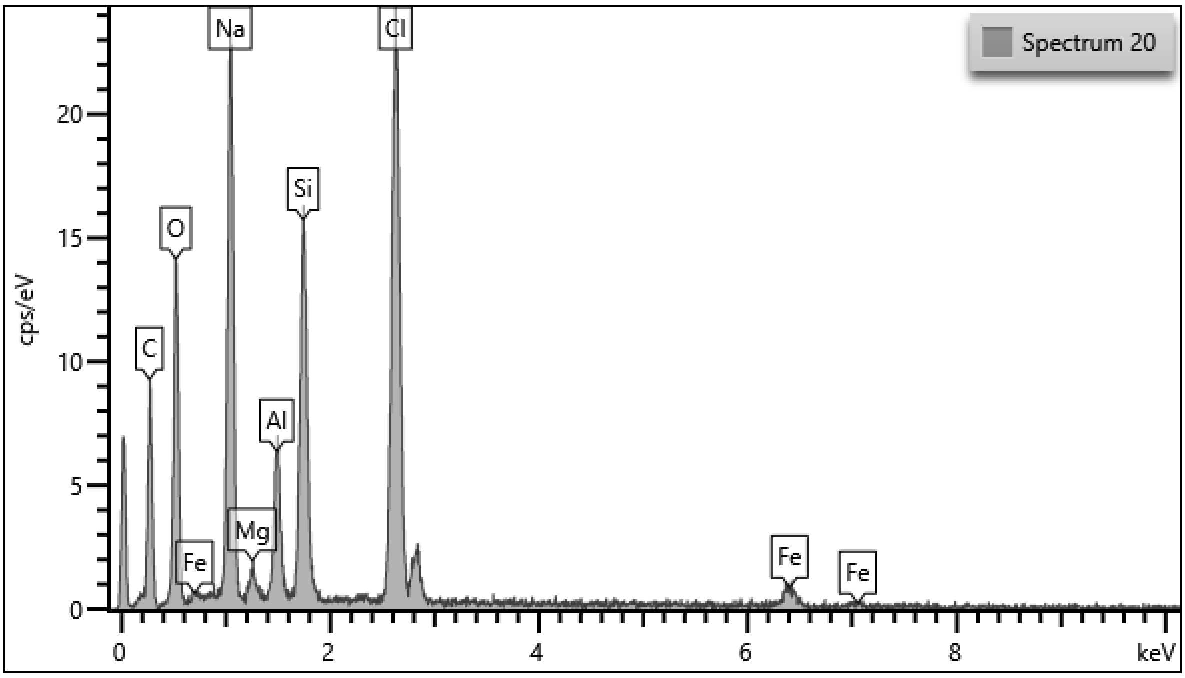
Electron Image 15 (SE)



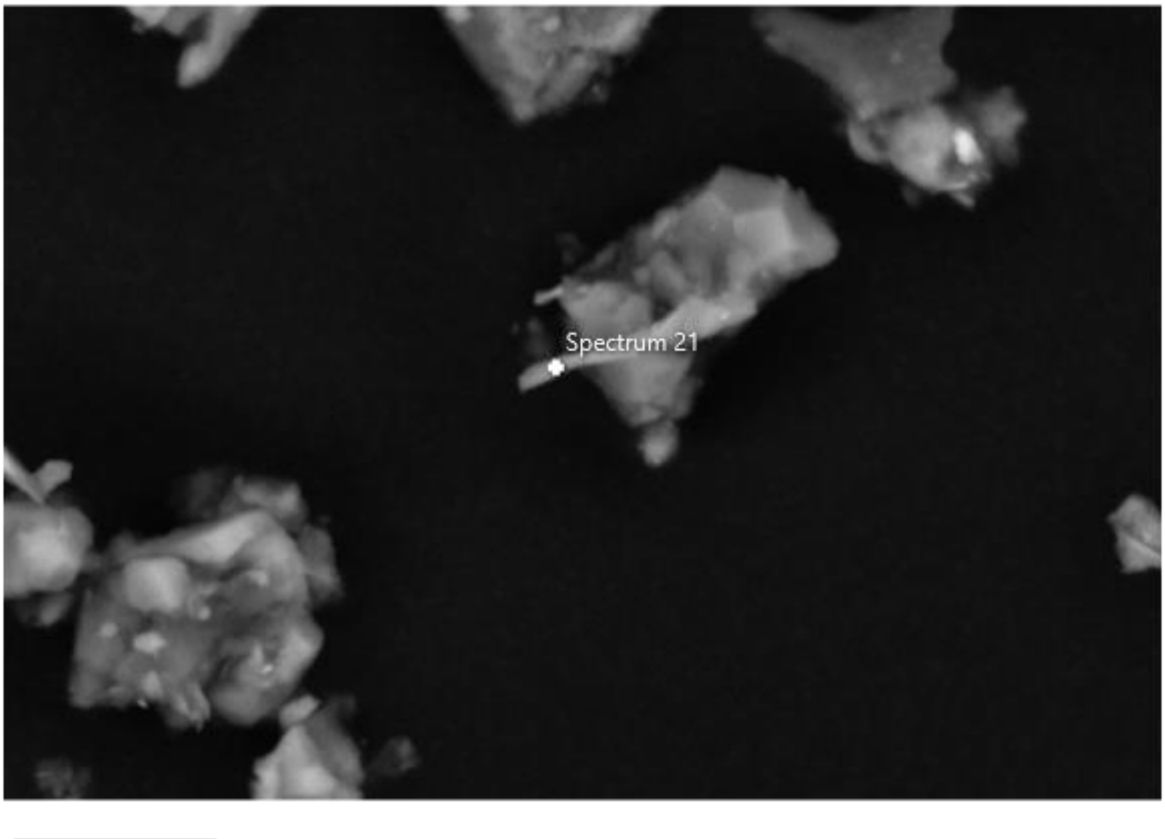


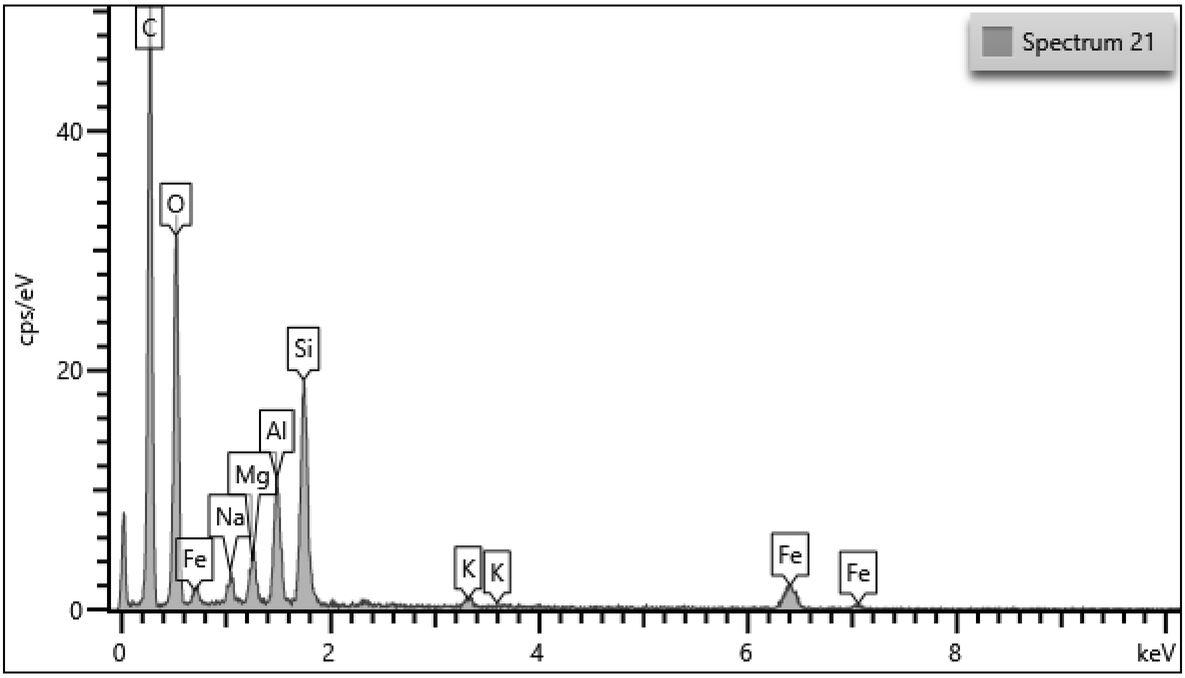
Electron Image 16 (SE)



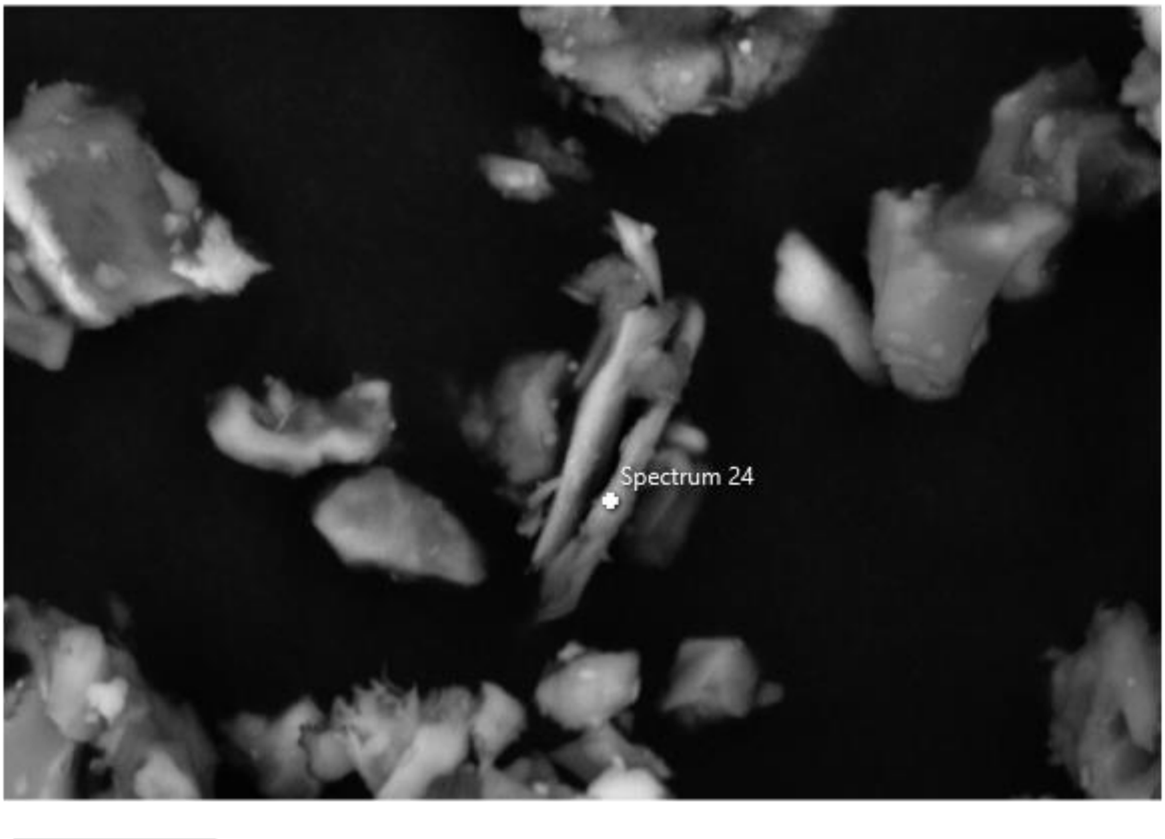


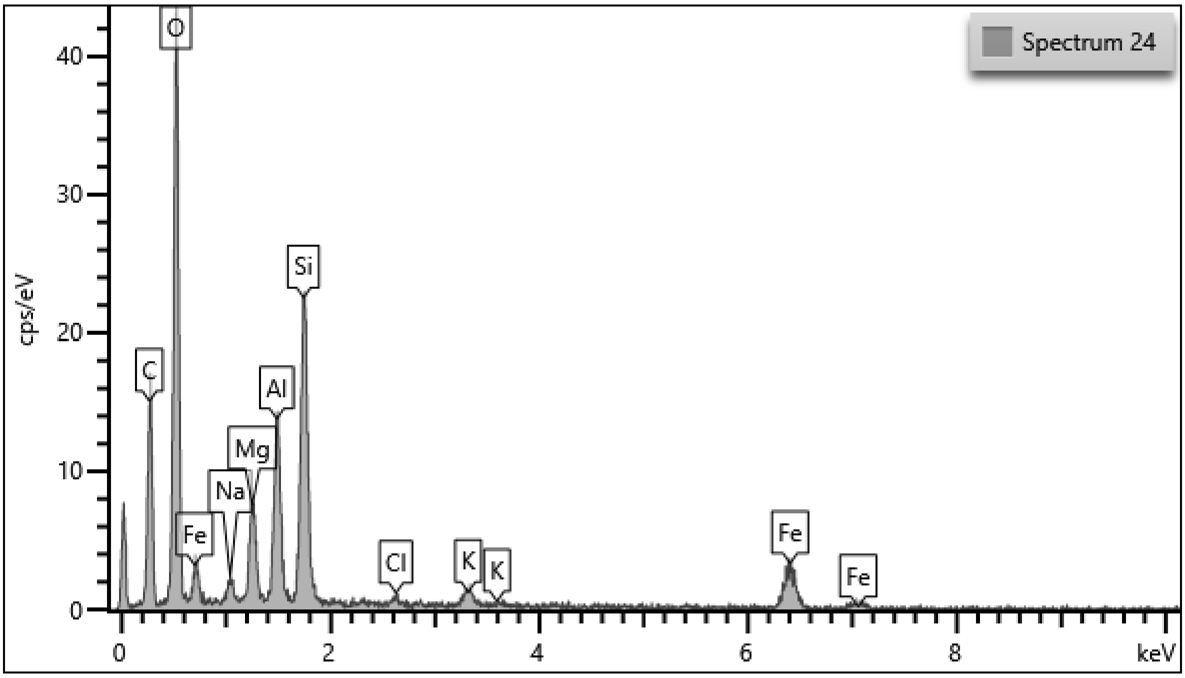
Electron Image 17 (SE)



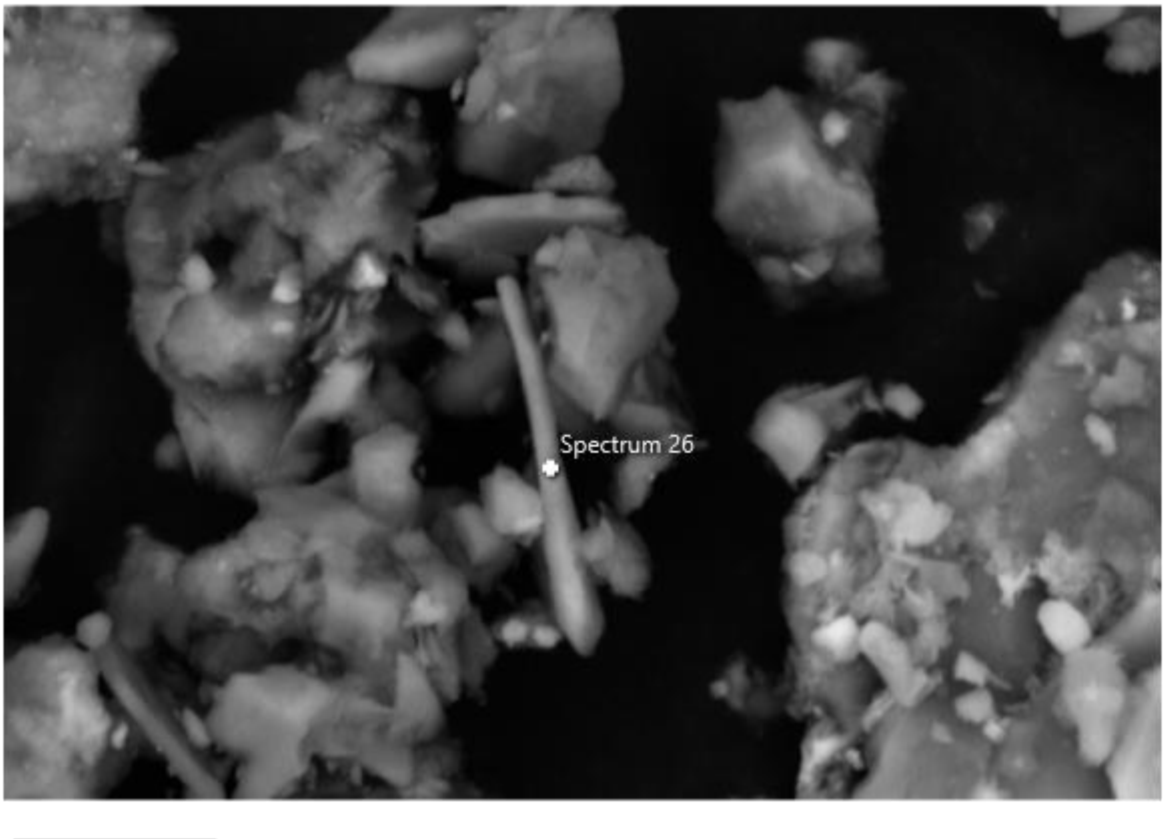


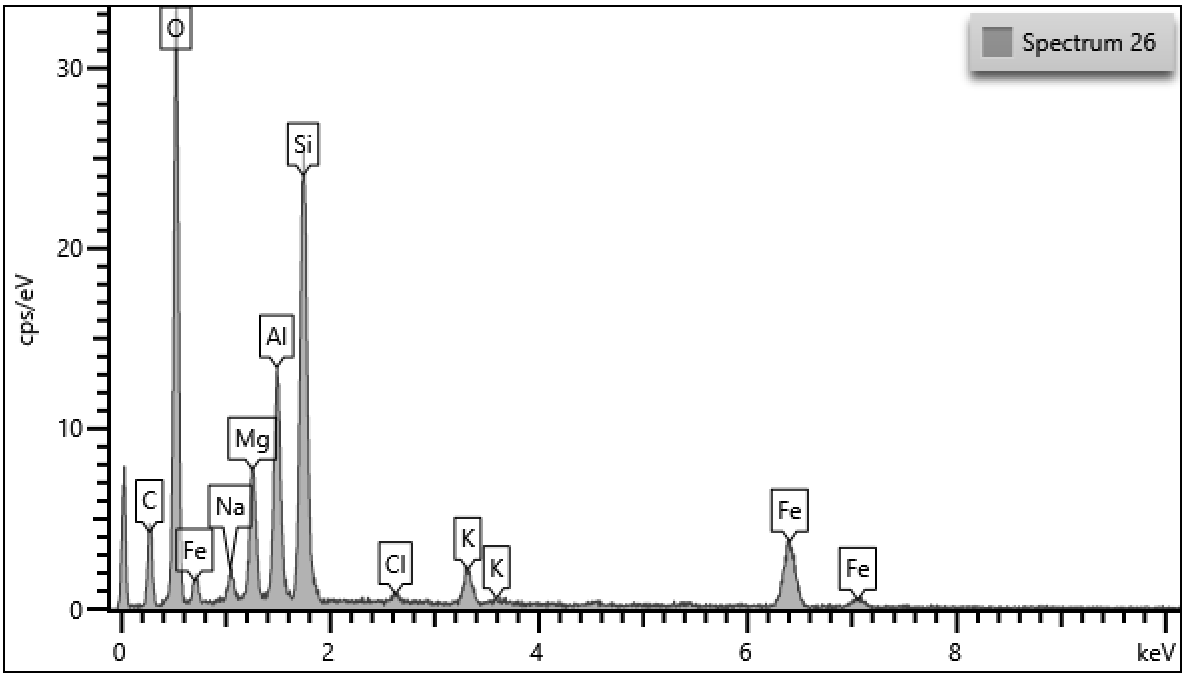
Electron Image 19 (SE)





Electron Image 21 (SE)





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**Client:** Landloch
**Job number:** 25_0206
**Lab ID:** 25_0206_006
**Client ID:** **RWC123**
**Analysis:** Fibre characterisation by scanning electron microscopy (SEM) with elemental analysis by energy dispersive spectroscopy (EDS) following AS 4964-2004 (modified for SEM)
**Revision number:** 0
**Comments:** None

**Date received:** 30/01/2025
**Date analysed:** 28/02/2025
**Date reported:** 28/02/2025

## Executive summary

The sample was determined to contain **< 0.01 wt % asbestos** mineral fibre.

## Sample preparation

The sample was supplied to Microanalysis Australia as a bulk sample. The sample was screened at 2 mm, and each size fraction was inspected visually (both with the naked eye and with a low-powered microscope) for fibrous material.

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## Analysis

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All images were acquired using backscatter electrons. Image brightness is proportional to average atomic number – the brighter the pixel, the higher the atomic number of the element.

**Summary**

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- Sets of fibre bundles generally less than 0.5, but always less than 1.0 micrometres in width, unless in thick bundles;
- In addition to the mandatory fibrillar crystal growth, one or more, and preferably three of the following aspects:
    - Parallel fibres occurring in bundles;
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- Respirable asbestos fibres are defined as:
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A selection of images/fields and associated elemental spectra are reported below. The fields are not representative of the area analysed. The images/fields were reported due to their higher fibre count.

| Fibre # | Image/Field # | Diameter (µm) | Length (µm) | Aspect ratio | Major Elements | Minor Elements | Morphology | Assigned mineralogy |
|---|---|---|---|---|---|---|---|---|
| 1 | 22/27 | 1.4 | 12.5 | 9 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |
| 2 | 23/28 | 1.5 | 24.1 | 16 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 3 | 24/29 | 2.9 | 16.1 | 6 :1 | O, Si | Al, Na | Non-parallel sides | Albite |
| 4 | 25/30 | 1.2 | 15.4 | 13 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |
| 5 | 27/32 | 1.0 | 23.9 | 24 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |
| 6 | 28/33 | 0.3 | 6.7 | 22 :1 | Na, Cl | - | Non-parallel sides | Halite |
| 7 | 29/34 | 1.2 | 20.9 | 17 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |

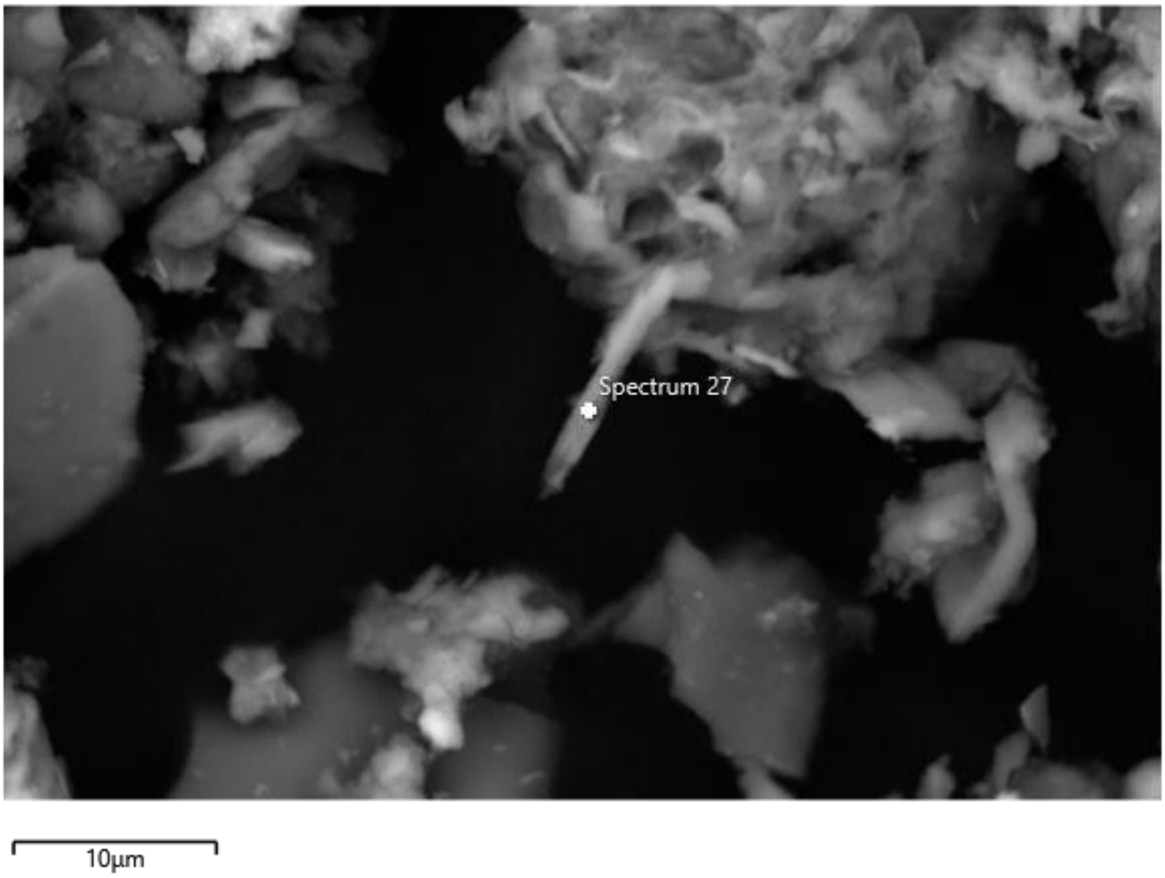
It should be noted that the higher resolution of the SEM may increase the number of fibres observed when compared with optical microscopy. Positive identification of asbestos fibres by SEM EDS uses elemental information that is not available by optical methods.

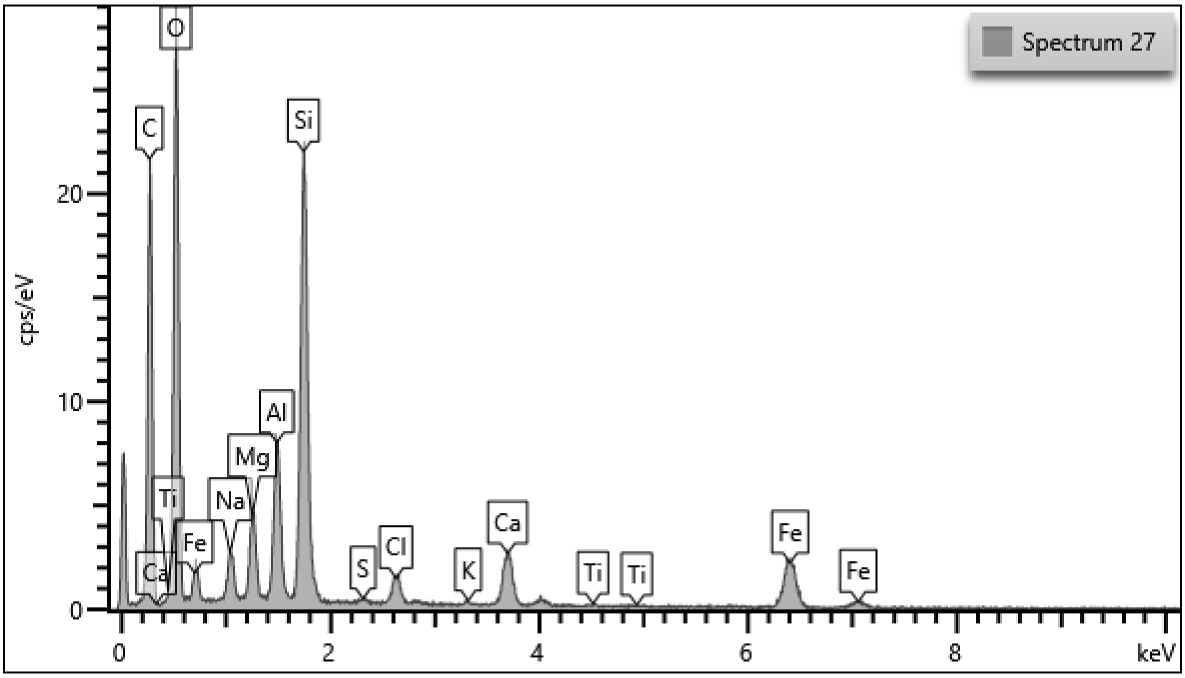
**Analyst:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

**Reported by:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

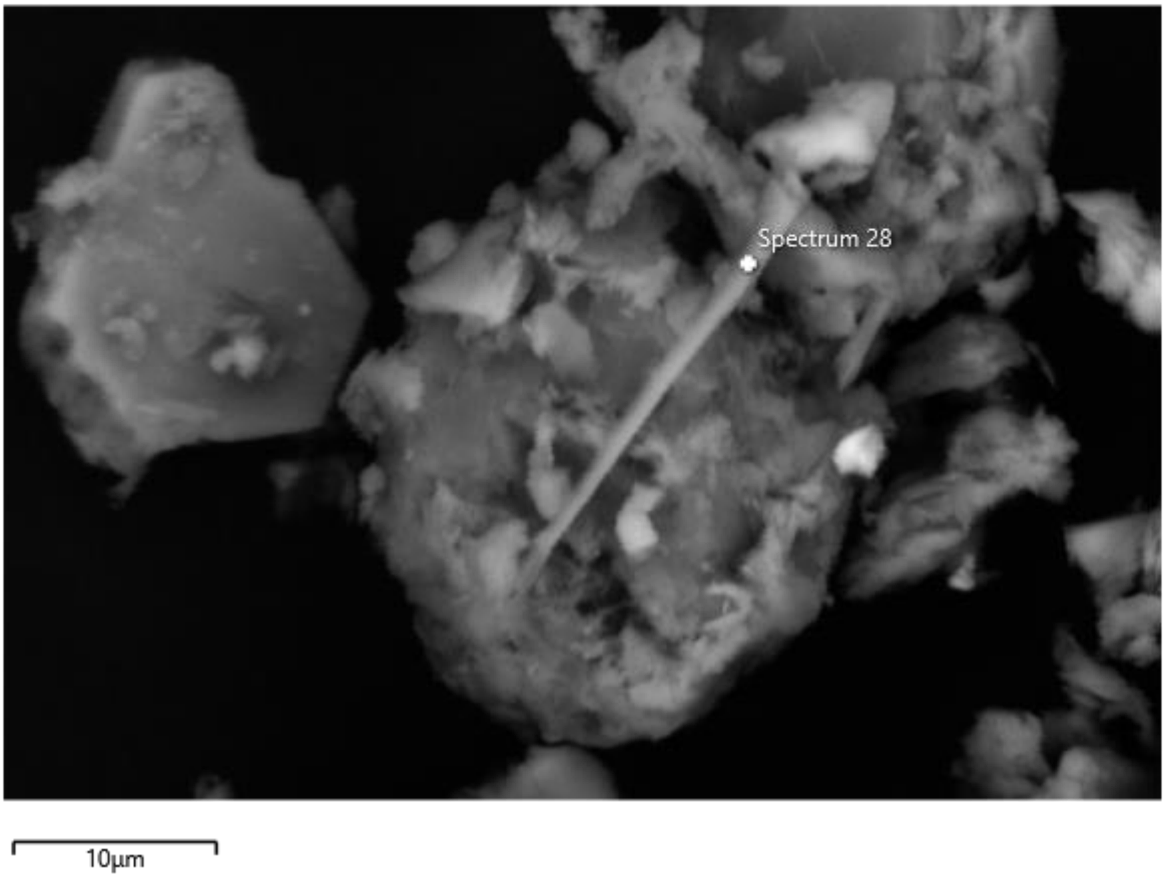
**Approved:** Nimue Pendragon, *B.Sc.(Nanotechnology)*

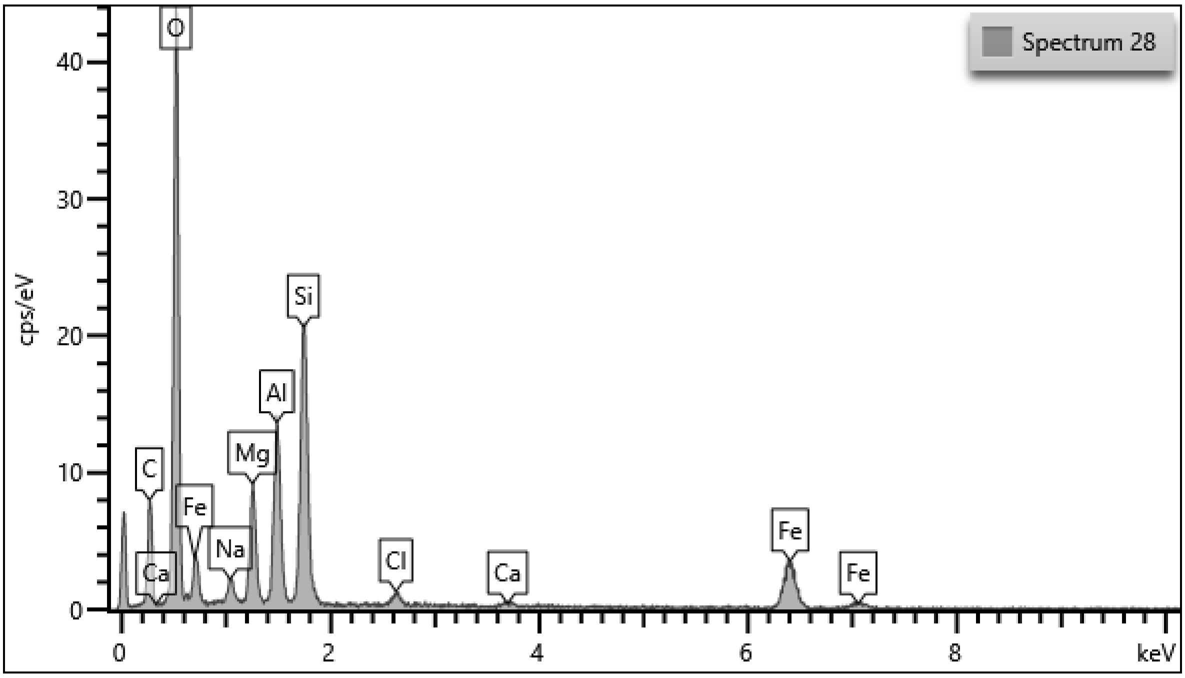
Electron Image 22 (SE)



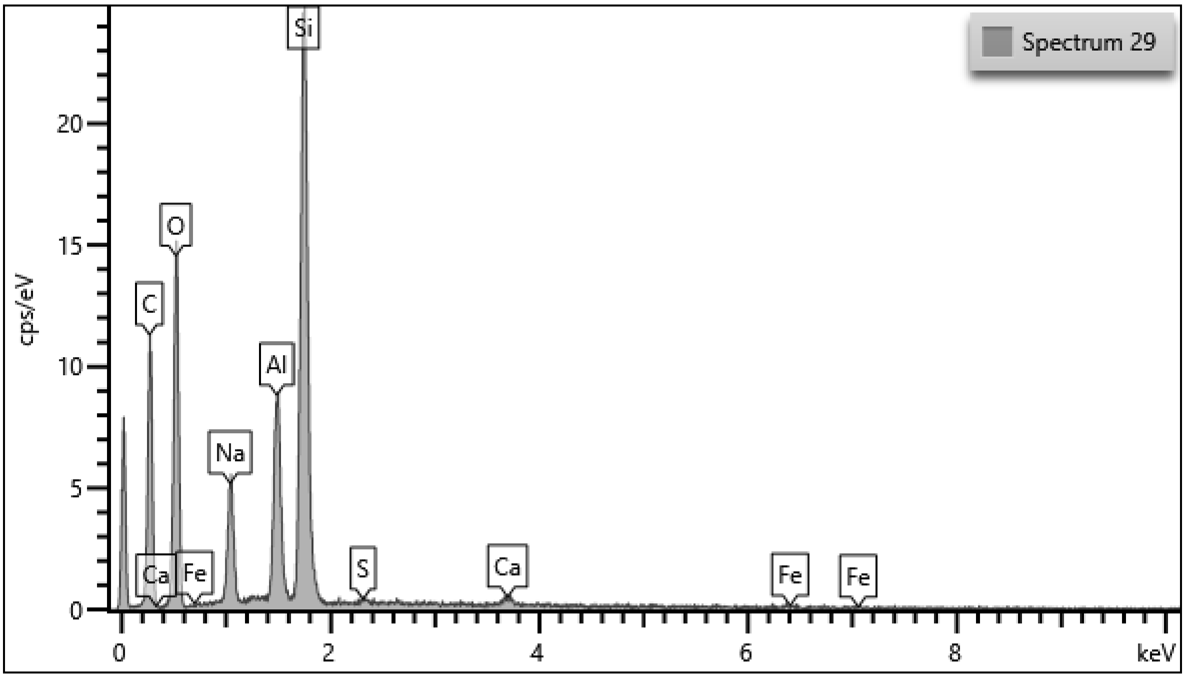


Electron Image 23 (SE)

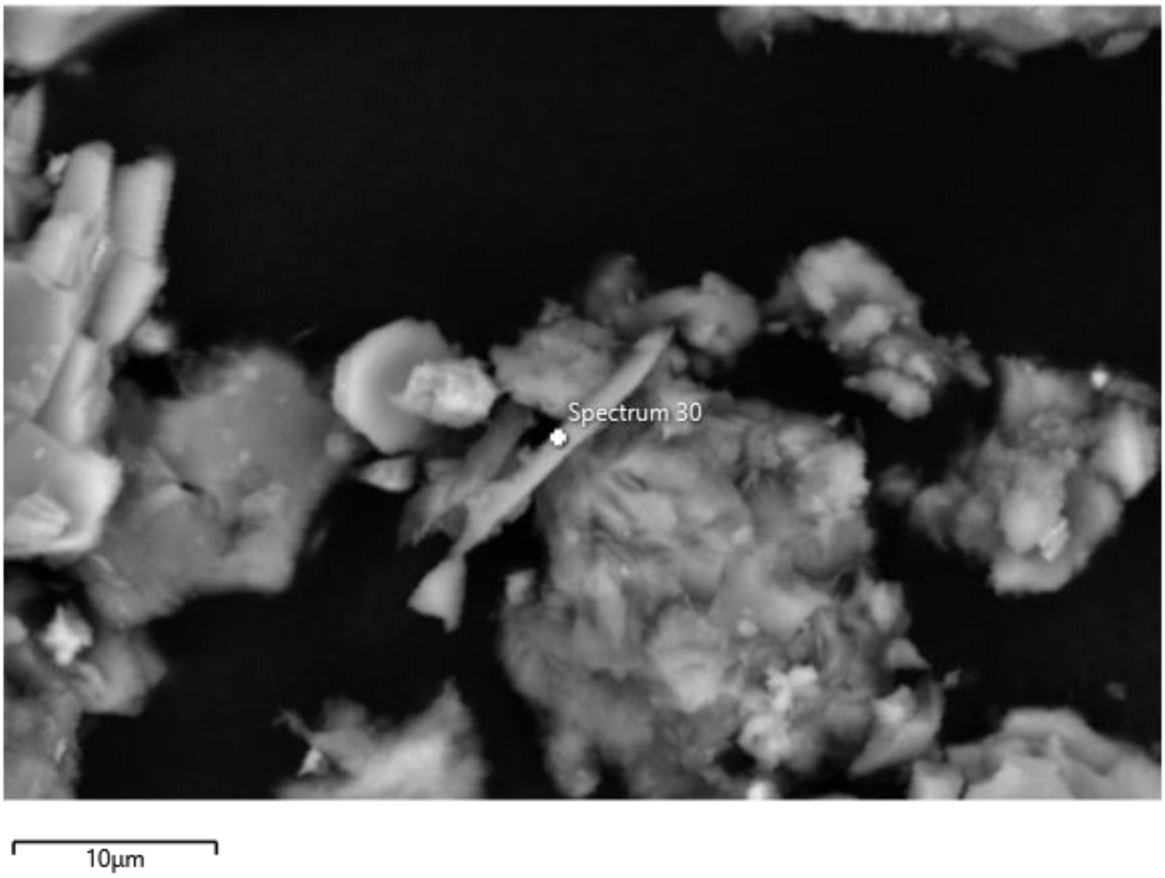


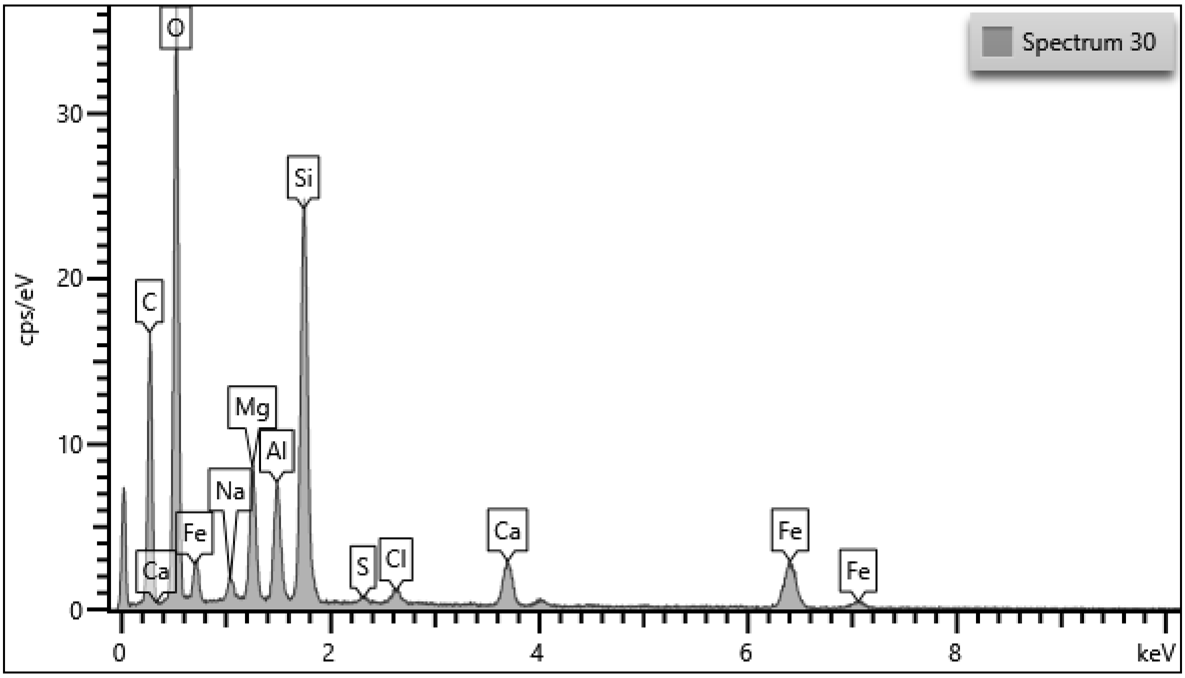


Electron Image 24 (SE)

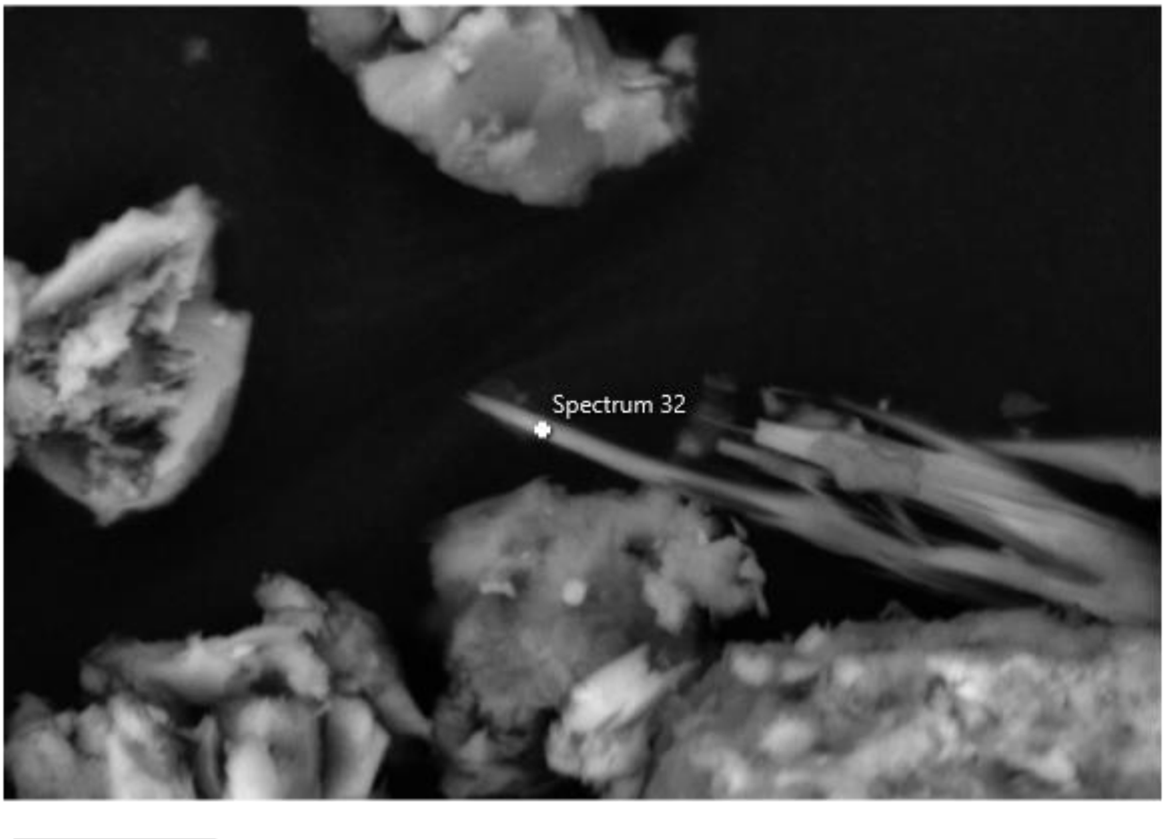


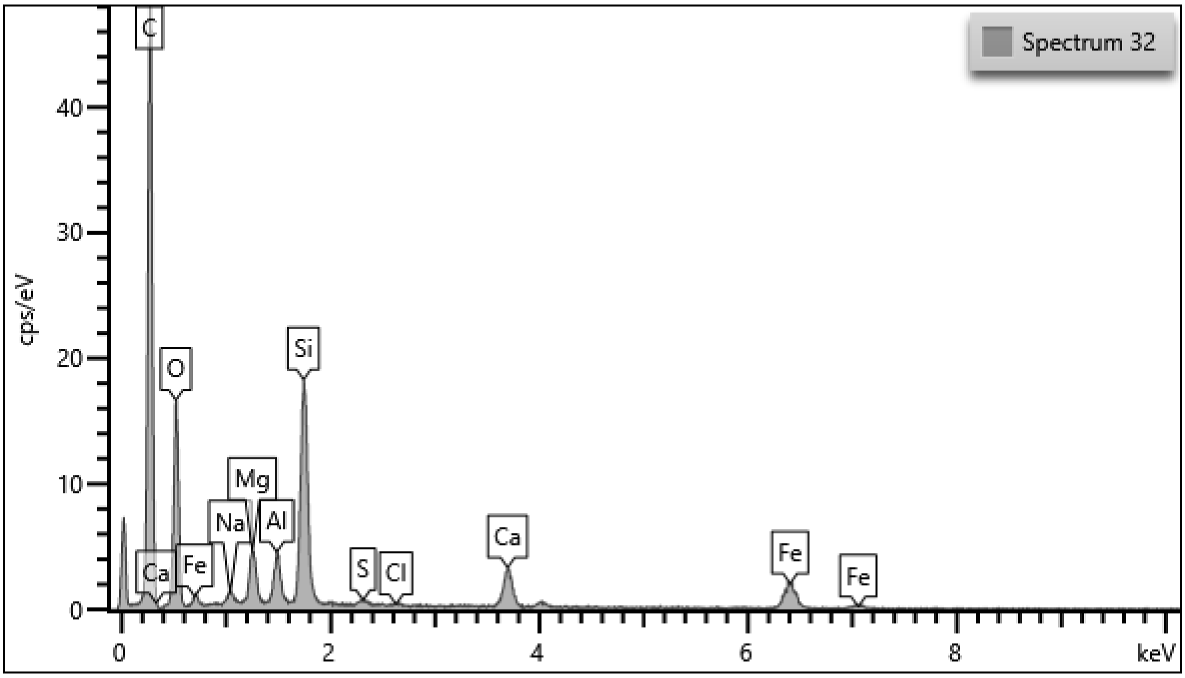
Electron Image 25 (SE)



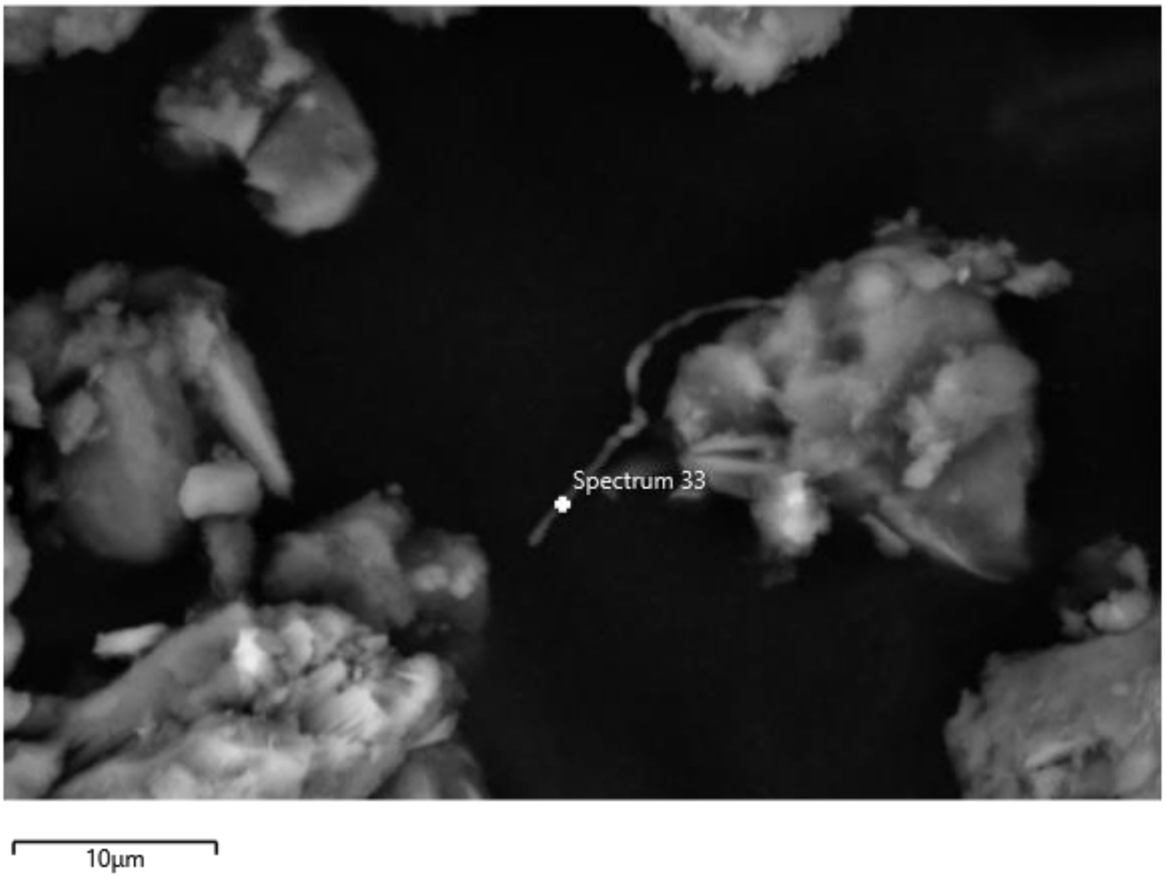


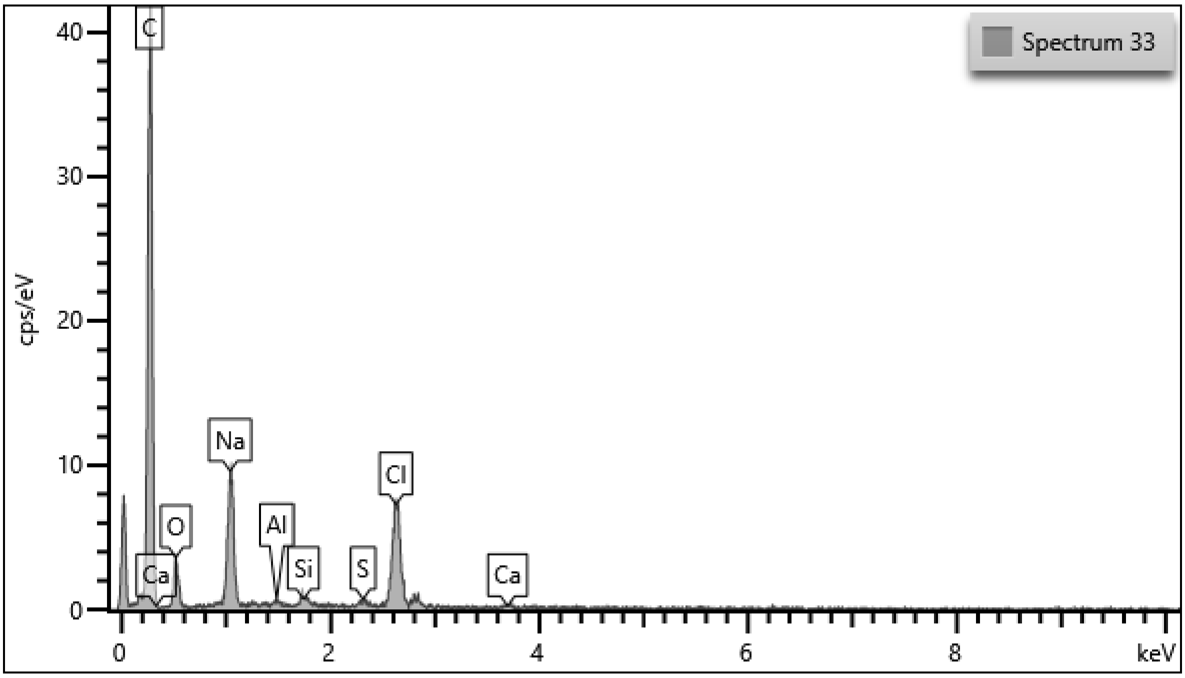
Electron Image 27 (SE)





Electron Image 28 (SE)





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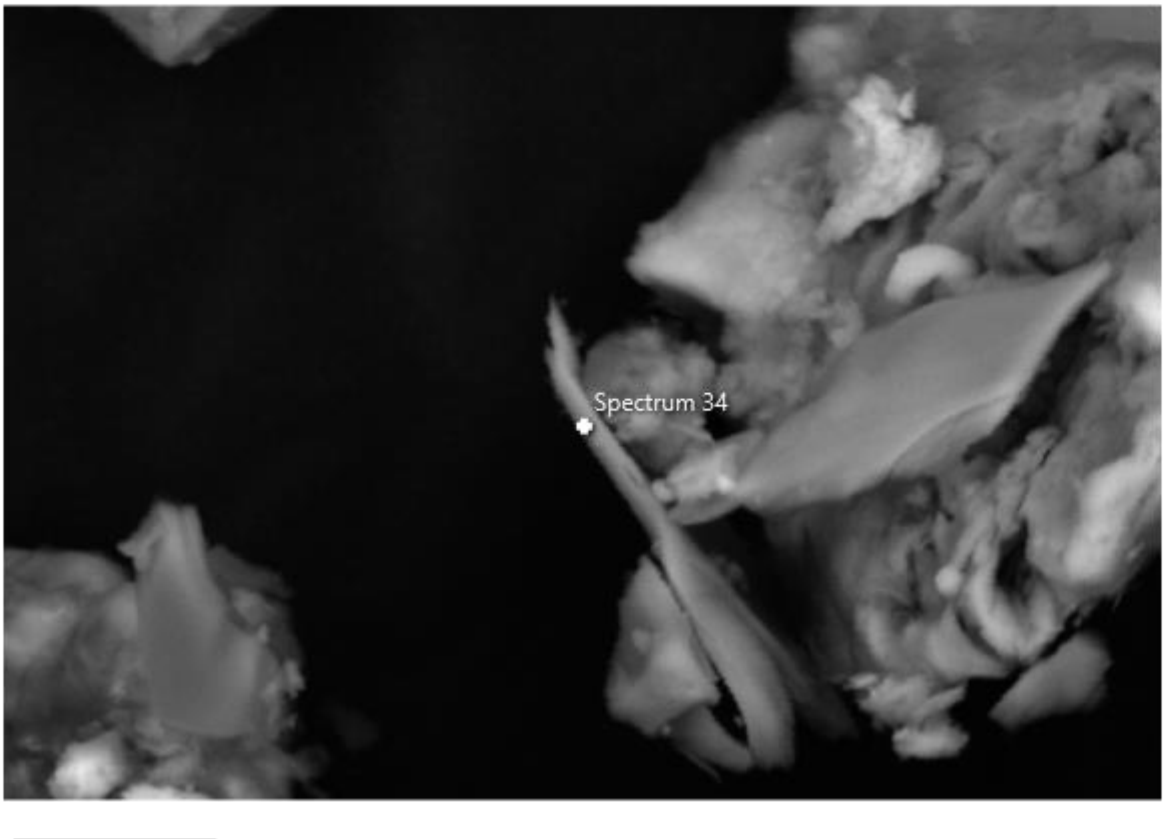

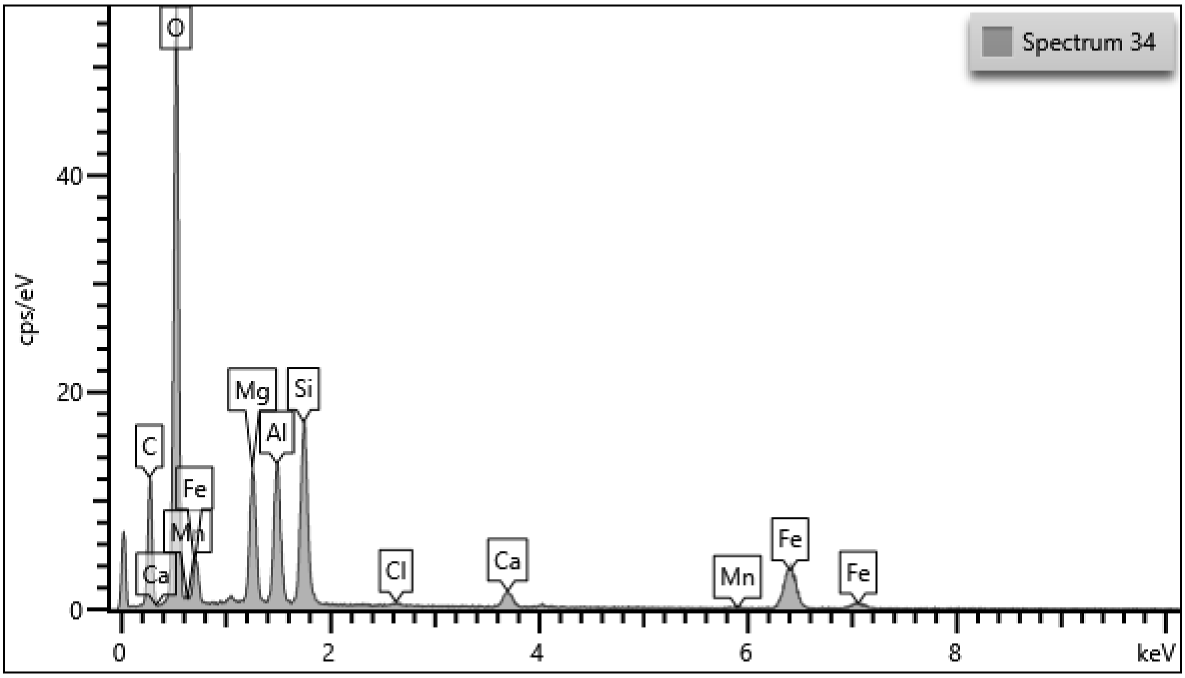

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**Client:** Landloch
**Job number:** 25_0206
**Lab ID:** 25_0206_007
**Client ID:** **RWC128**
**Analysis:** Fibre characterisation by scanning electron microscopy (SEM) with elemental analysis by energy dispersive spectroscopy (EDS) following AS 4964-2004 (modified for SEM)
**Revision number:** 0
**Comments:** None

**Date received:** 30/01/2025
**Date analysed:** 28/02/2025
**Date reported:** 28/02/2025

## Executive summary

The sample was determined to contain **< 0.01 wt % asbestos** mineral fibre.

## Sample preparation

The sample was supplied to Microanalysis Australia as a bulk sample. The sample was screened at 2 mm, and each size fraction was inspected visually (both with the naked eye and with a low-powered microscope) for fibrous material.

As no fibrous material was visually apparent for immediate pre-selection, a representative sub-sample of the <2 mm fraction was disaggregated and was placed on top of at least one double-sided carbon tab before being carbon coated. Non-conducting samples require coating prior to SEM analysis to prevent charging whilst being analysed by the electron beam.

## Analysis

The sample was analysed using a Carl Zeiss EVO50 scanning electron microscope (SEM) fitted with an Oxford INCA energy dispersive spectrometer (EDS). The sample was scanned at low magnification to identify any possible fibre clusters before the magnification was increased to 2000x magnification for closer examination.

EDS is a semi-quantitative technique (at best) on well prepared, optically flat samples. Factors such as sample unevenness may adversely bias elemental concentration interpretation. EDS has a spatial resolution of ~5 µm meaning spectra from particles less than this size may contain elemental concentrations biased by their surroundings.

All images were acquired using backscatter electrons. Image brightness is proportional to average atomic number – the brighter the pixel, the higher the atomic number of the element.

**Summary**

Following AS 4964, asbestos is defined as:

- Many particles with aspect ratios (i.e. length to width ratios) ranging from 20:1 to 100:1 or higher for particles >5 micrometers in length. Bundles of fibres may have lower aspect ratios;
- Sets of fibre bundles generally less than 0.5, but always less than 1.0 micrometres in width, unless in thick bundles;
- In addition to the mandatory fibrillar crystal growth, one or more, and preferably three of the following aspects:
    - Parallel fibres occurring in bundles;
    - Fibre bundles displaying splayed ends;
    - Matted masses of individual fibres;
    - Fibres showing characteristic curvature.
- Respirable asbestos fibres are defined as:
    - Asbestos fibres less than 3 µm in width, and greater than 5 µm in length, and with a length to width ratio greater than 3 to 1.

**Less than 5 observed fibres had an elemental composition and morphology indicative of asbestos mineral fibre, according to the definition in AS 4964.**

Depending upon sample condition, composition and fibre type, the detection limit of AS 4964 has been found to lie generally in the range of 1 in 1,000 (0.1 wt %) to 1 in 10,000 (0.01 wt %) parts by weight, equivalent to 1 to 0.1 g/kg.

For this report, a limit of reporting (LoR) of 0.01 wt % has been assumed, as stated in AS 4964.

A selection of images/fields and associated elemental spectra are reported below. The fields are not representative of the area analysed. The images/fields were reported due to their higher fibre count.

| Fibre # | Image/Field # | Diameter (µm) | Length (µm) | Aspect ratio | Major Elements | Minor Elements | Morphology | Assigned mineralogy |
|---|---|---|---|---|---|---|---|---|
| 1 | 32/37 | 1.6 | 22.8 | 14 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 2 | 33/38 | 0.5 | 6.7 | 13 :1 | O, Fe | - | Non-parallel sides | Iron oxide |
| 3 | 34/40 | 1.9 | 7.8 | 4 :1 | O, Si | Mg, Ca, Fe, Al, Na | Non-parallel sides | Hornblende |
| 4 | 35/41 | 0.7 | 10.3 | 15 :1 | O, Si | Mg, Ca, Fe, Al, Na | Irregular ends | Hornblende |
| 5 | 36/42 | 0.7 | 11.3 | 16 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |
| 6 | 38/44 | 1.2 | 12.2 | 10 :1 | O, Si | Mg, Ca, Fe, Al, Na | Irregular ends | Hornblende |
| 7 | 41/48 | 1.9 | 15.4 | 8 :1 | O, Si | Al, Mg, Fe | Non-parallel sides | Chlorite group |

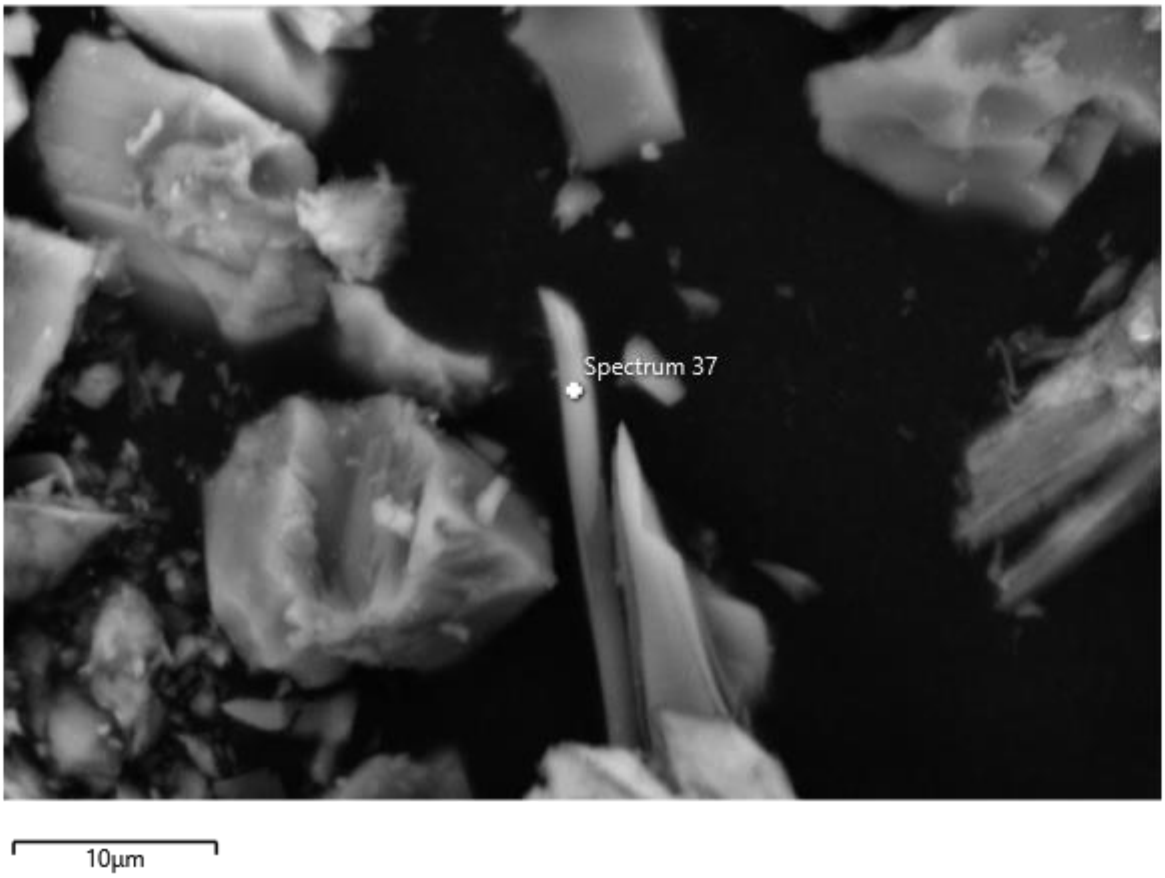
It should be noted that the higher resolution of the SEM may increase the number of fibres observed when compared with optical microscopy. Positive identification of asbestos fibres by SEM EDS uses elemental information that is not available by optical methods.

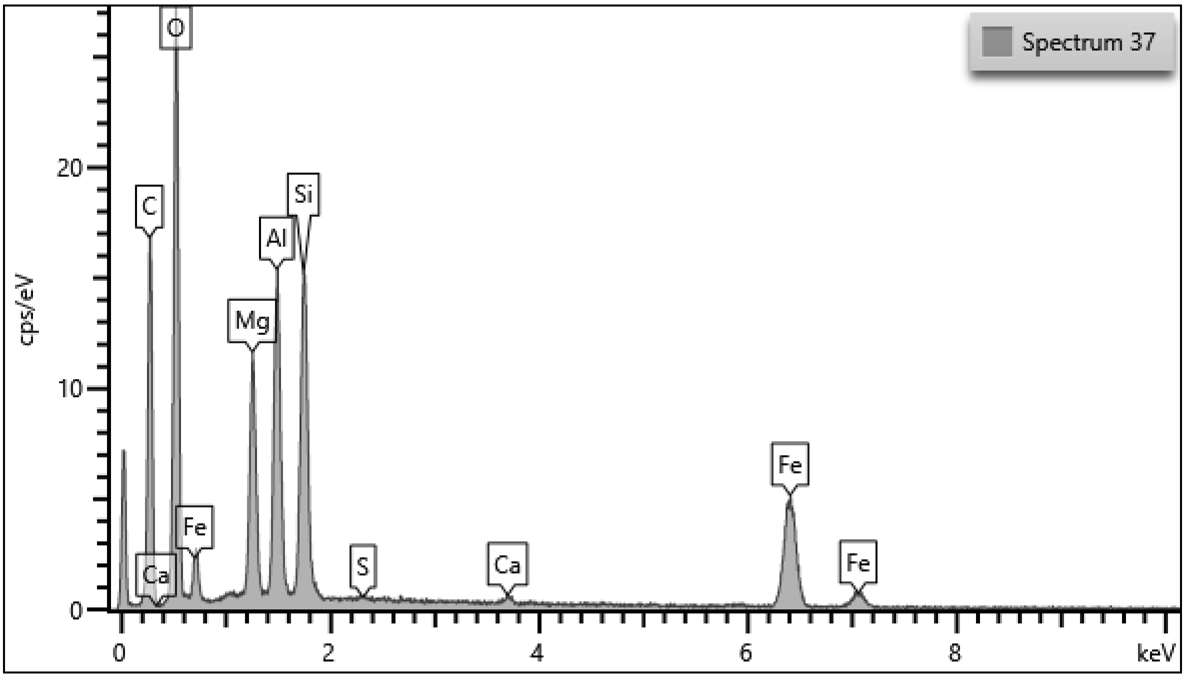
**Analyst:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

**Reported by:** Damon Blakey, *B.Sc. (Forensic Biology and Toxicology)*

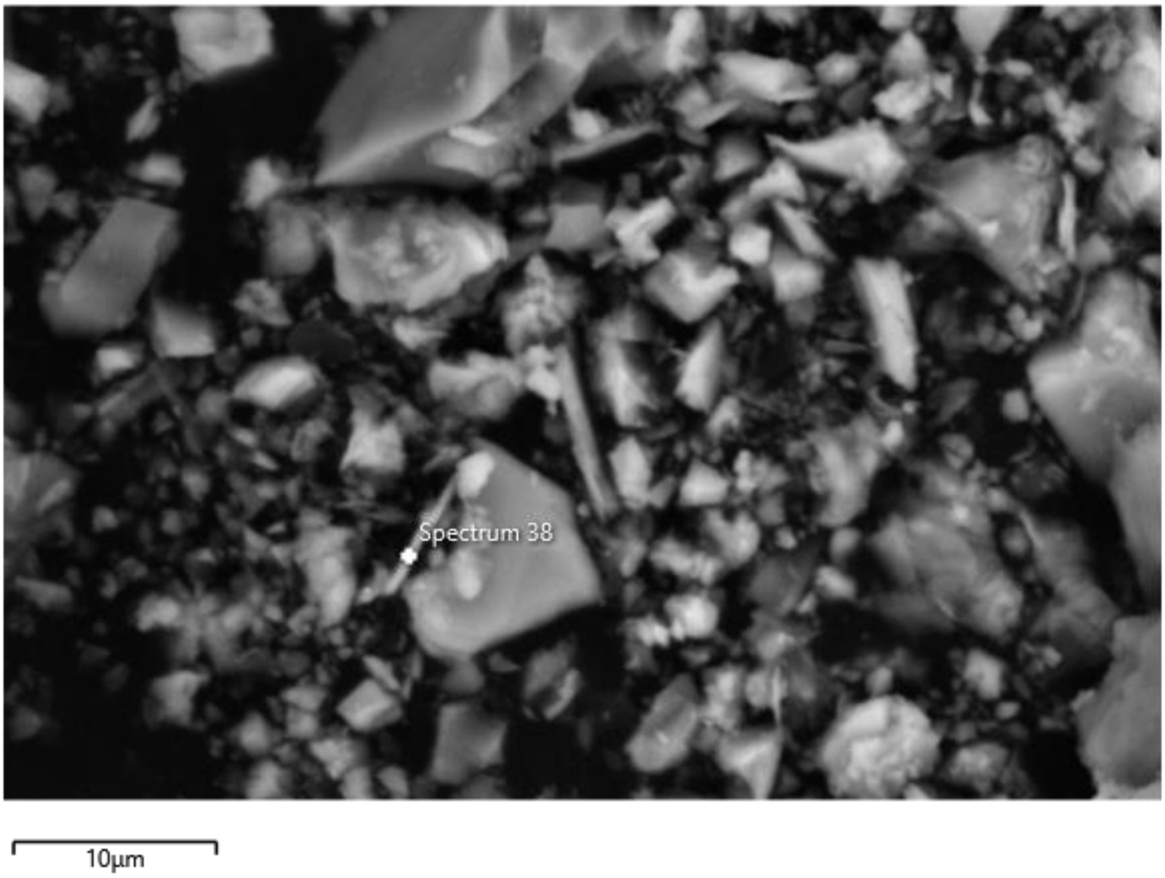
**Approved:** Nimue Pendragon, *B.Sc.(Nanotechnology)*

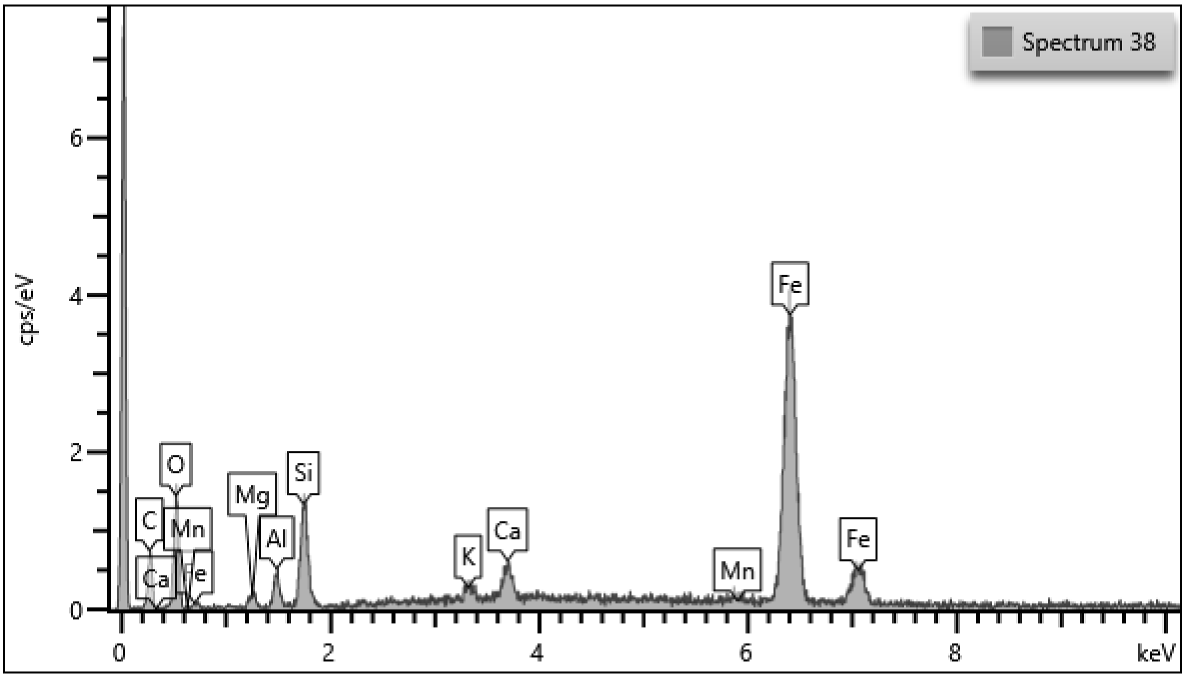
Electron Image 32 (SE)





Electron Image 33 (SE)





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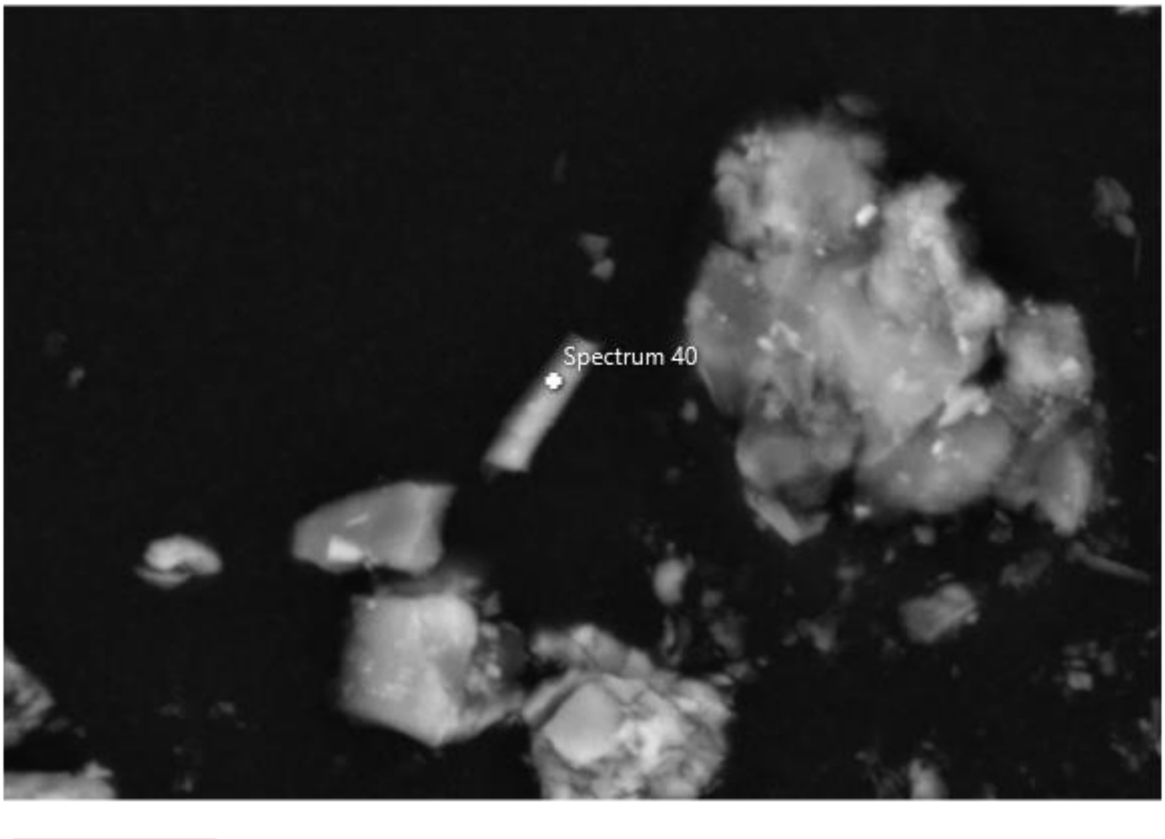

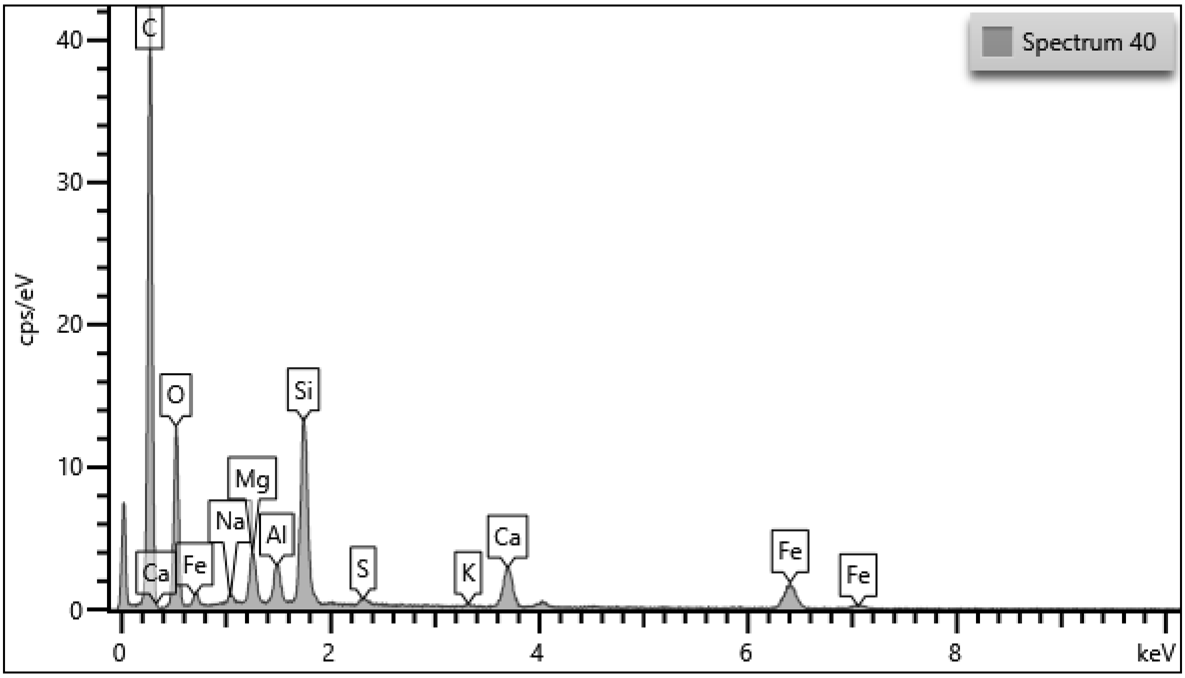

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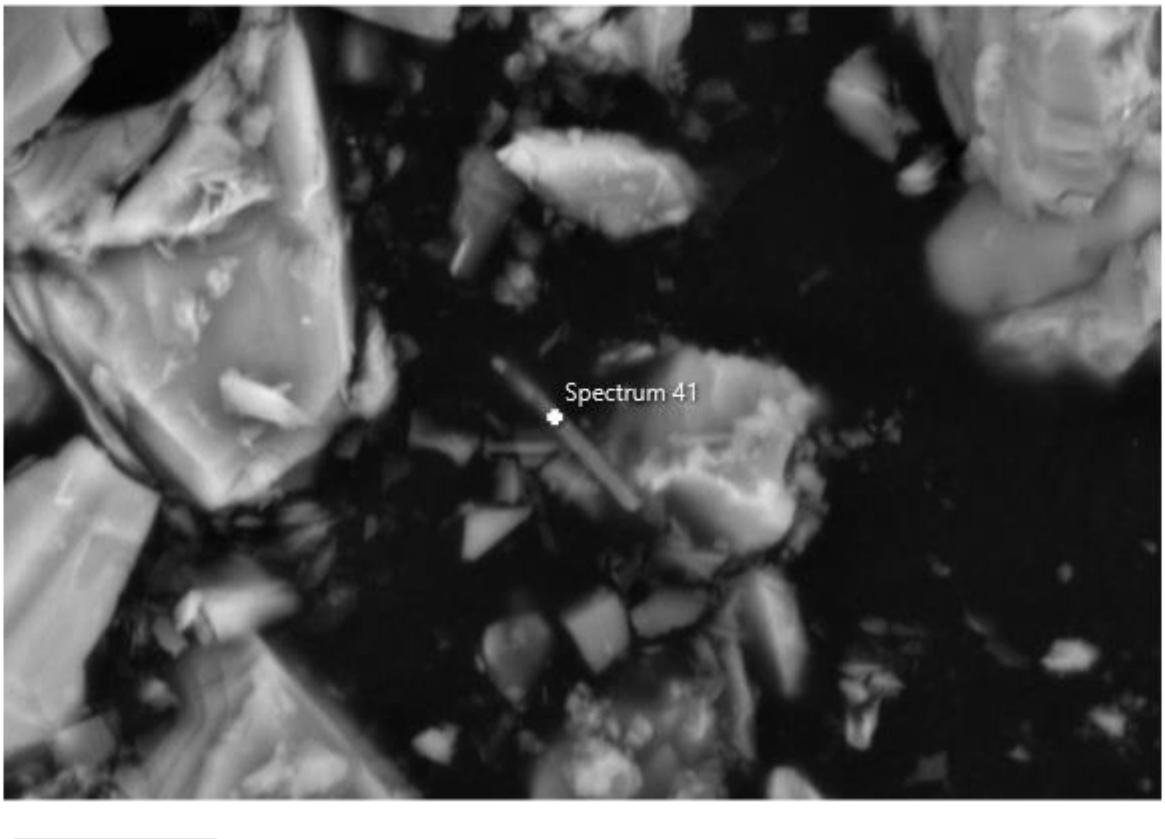

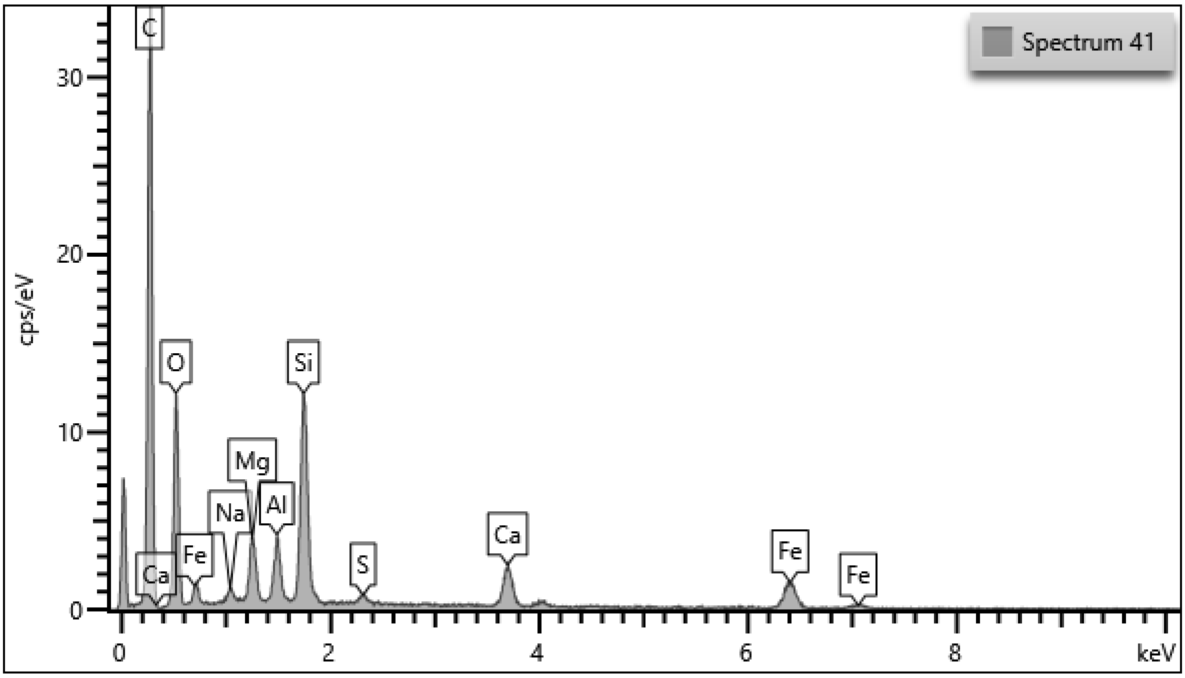

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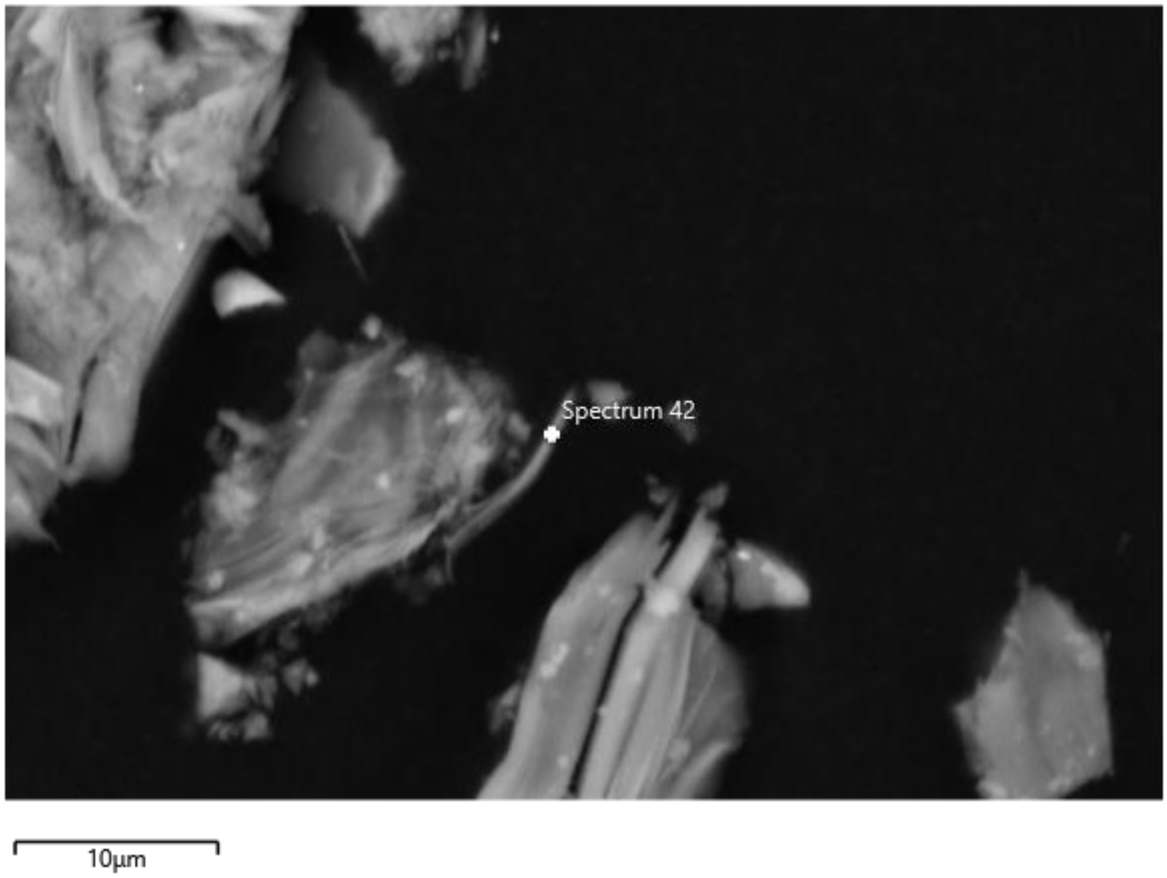

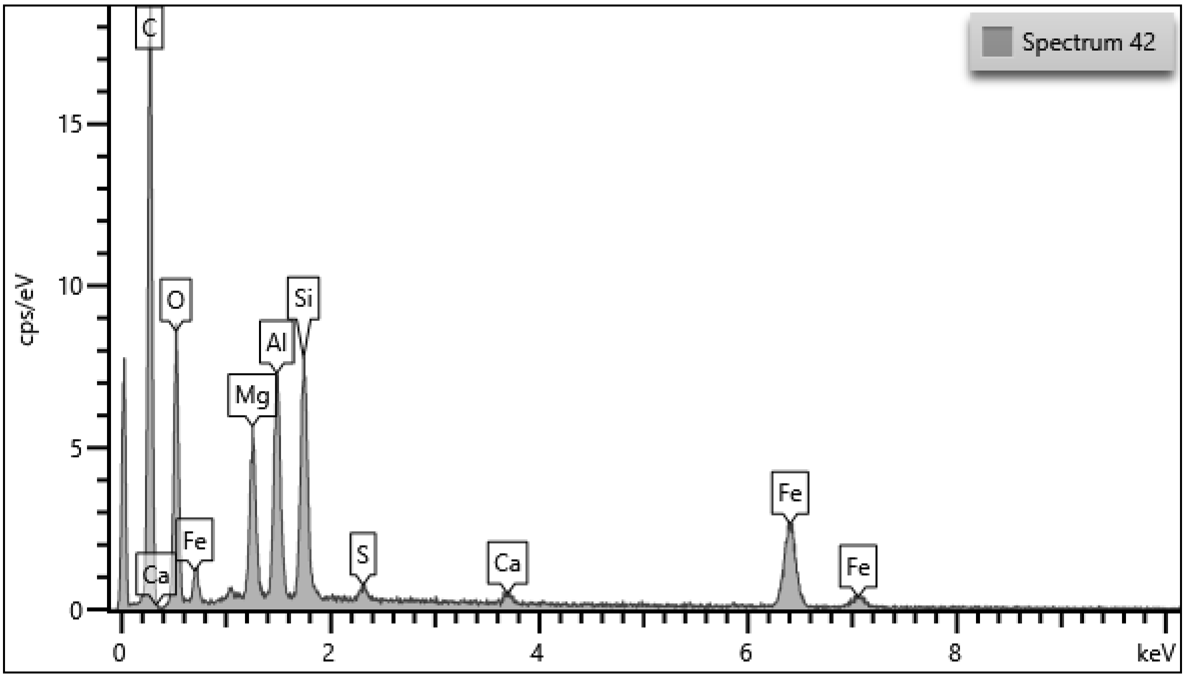

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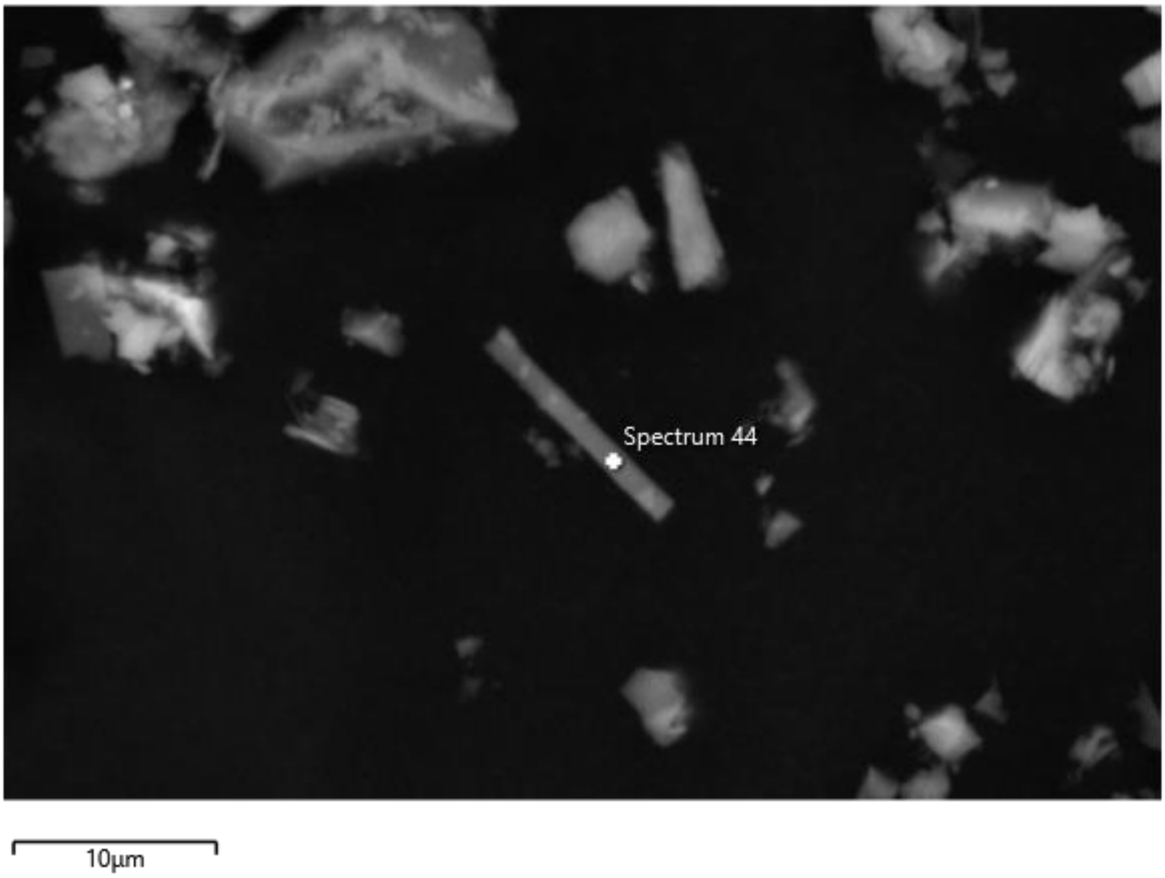

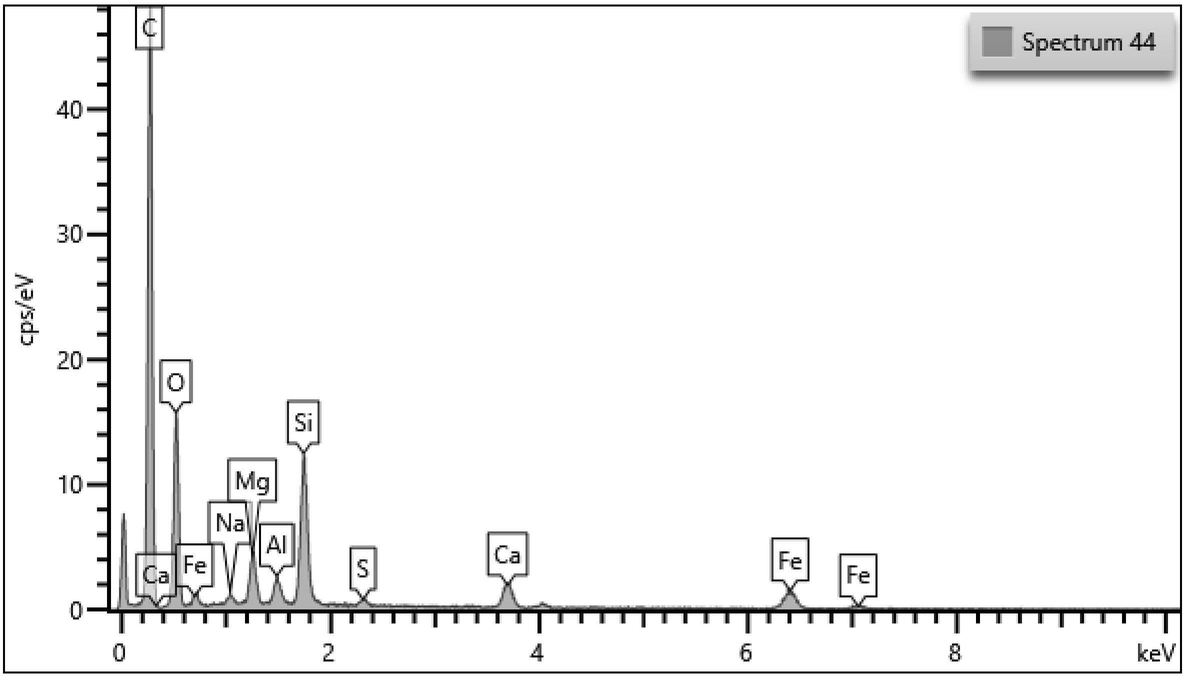

Electron Image 41 (SE)