



**ILUKA RESOURCES LIMITED**

**TECHNICAL REPORT**

**ILUKA-TR-T18403**

**EL5265 Mannum  
Annual Report**

**07/06/2013 – 06/06/2014**

**BY  
Wesley Jones**

**Date:** 07 August 2014

**AUTHOR KEYWORDS:** Exploration, Murray Basin, Mannum, Heavy Minerals, Loxton Sand, Parilla Sand, Loxton-Parilla Sand, Blanchetown Clay, Geera Clay

ACN: 34 008 675 018

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## LIST OF DIGITAL DATA

|                                          |                            |
|------------------------------------------|----------------------------|
| EL5265_201408_A_01_Annual_Report.pdf     | Annual Report              |
| EL5265_201408_A_02_location.txt          | Surface Location File      |
| EL5265_201408_A_03_Logging_Codes.pdf     | Iluka Logging Codes        |
| EL5265_201408_A_04_lithology.txt         | Lithological Logging Codes |
| EL5265_201408_A_05_geochemistry.txt      | Downhole Geochemistry      |
| EL5265_201408_A_06_survey.txt            | Survey Details             |
| EL5265_201408_A_07_qaqc.txt              | QA/QC Report               |
| EL5265_201408_A_08_Sections.pdf          | Geological Cross Sections  |
| EL5265_201408_A_09_Plans.pdf             | Location Plans             |
| EL5265_201408_A_10_Verification_List.txt | File Verification          |

## **EXECUTIVE SUMMARY**

The following report covers all work completed by Iluka Resources on Exploration Licence EL5265 from the 7<sup>th</sup> of June 2013 to the 6<sup>th</sup> June 2014. EL5265 is south eastern South Australia approximately 65 kilometres east of Adelaide.

A single drilling campaign was completed during July and August 2013. A total of 83 holes was drilled for an advance of 4952.8m during the reporting period.

Minor HM was intersected within drillholes along ST067 with a maximum grade of 7.5m @ 1.5 % HM from 27m in S01906 most of this was Rock and trash mineral upon inspection.

A data review of the 2013 drilling has determined that the Loxton Sands are either not preserved or the Pliocene coast line did not extend this far east in the Murravian Gulf within EL5265.

## 1. INTRODUCTION

The following report is submitted to fulfil the annual reporting requirements for Exploration Licence (EL)5265. It covers the work undertaken by Iluka Resources Ltd over the reporting period from 7<sup>th</sup> June 2013 to the 6<sup>h</sup> June 2014.

### 1.1 Tenure

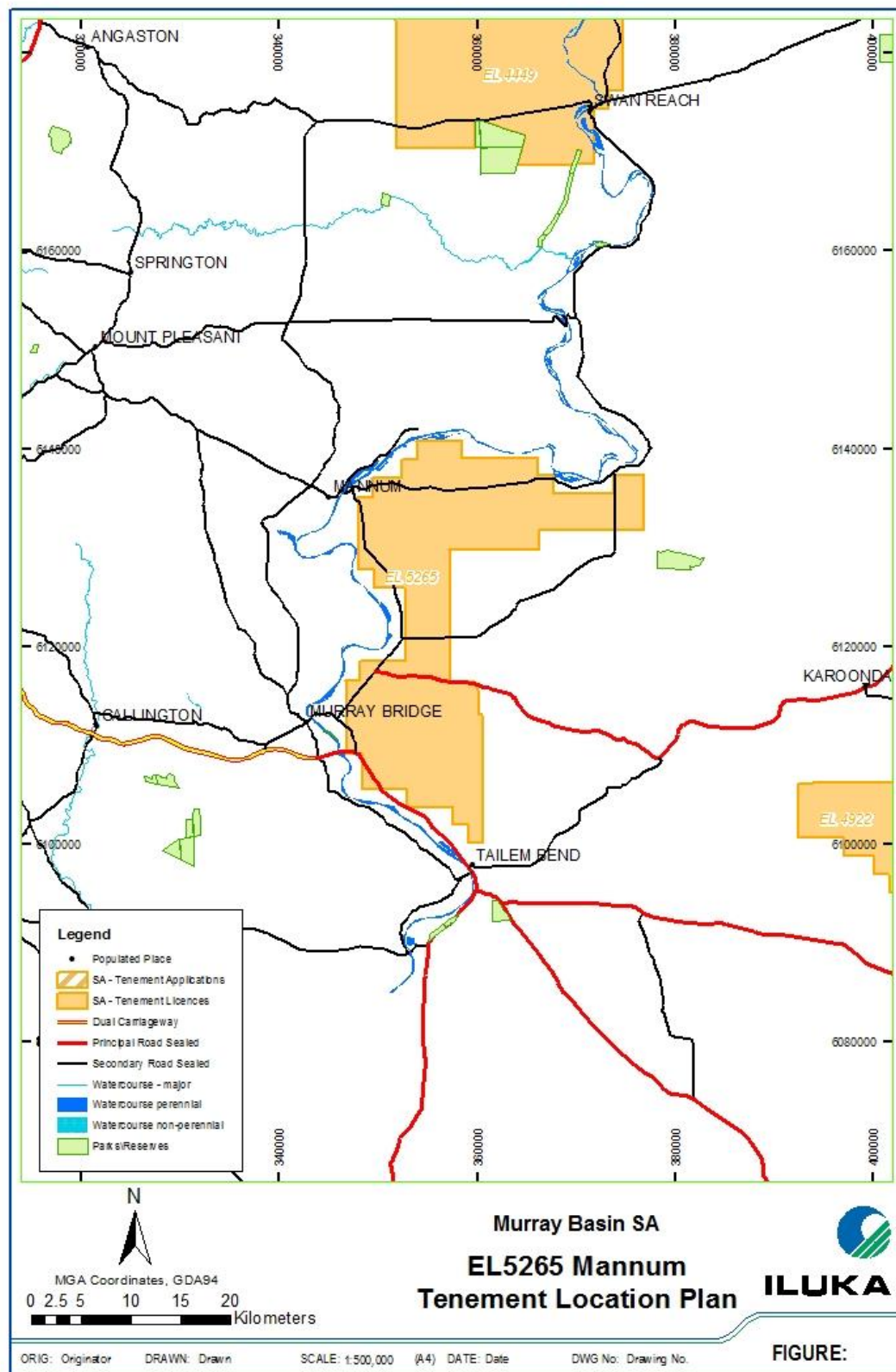
The EL5265 licence area was granted to Iluka Resources Ltd on 7<sup>th</sup> May 2013, for a period of two years over an area totalling 462 square kilometres.

### 1.2 Location

EL5265 is located on the west margin of the Murray Basin, immediately east of the towns of Mannum and Murray Bridge on the eastern side of the current path of the River Murray in Eastern SA. Access to the tenement is via the old Princess Hwy and the Karoonda Hwy. Unsealed private roads provide access to the drill targets. Table 1 shows the Map sheets and current coordinate extent of the license boundary.

**Table 1:** Map sheets enclosing EL5265 and coordinates of the tenement boundary.

| <i>Map Sheets</i> |       |                  |      |
|-------------------|-------|------------------|------|
| <i>1:250,000</i>  |       | <i>1:100,000</i> |      |
| Adelaide Special  | I5409 | Mannum           | 6728 |
| Renmark           | I5410 | Swan Reach       | 6828 |
| Barker            | I5413 | Mobilong         | 6727 |



**Figure 1:** EL5265 Tenement Location Plan

### 1.3 Iluka's Exploration History and Rationale

Iluka Resources exploration rationale in the Murray Basin has been to target the mineralised Loxton-Parilla Sand (LPS) sediments deposited during the Pliocene marine regression, concentrating on higher grade, coarse-grained strands in regions of favourable mineral assemblage. The exploration for heavy mineral sand deposits has been performed using two techniques as described below;

The first technique utilises filtered airborne magnetics as a first pass coverage of the licence to delineate direct drill targets from magnetic anomalies. The magnetic information is derived from both airborne magnetic surveys commissioned by Iluka Resources, and state government based magnetic data.

The second technique involves the planning of drilling traverses based on previous drilling data, regional structural contour maps, detailed digital terrain models, and the utilisation of airborne magnetics. Drilling traverses usually commence with wide-spaced holes to investigate the broad geological setting, and then infilling to close-spaced drilling as required by geology and mineral intersections.

## 2. GEOLOGY

### 2.1 Regional Geology

The Murray Basin has been described as a shallow, intracratonic Cainozoic basin covering an area of 300,000 km<sup>2</sup> in south eastern South Australia, south-western New South Wales and north-western Victoria (Brown & Stephenson, 1991). The Murray Basin is flanked by low mountain ranges of Proterozoic and Palaeozoic rocks.

Much of the sedimentary sequence within the basin is the result of repeated marine incursions from the southwest, with the latest transgressive-regressive event resulting in deposition of the Late Miocene to Late Pliocene Loxton-Parilla Sand (LPS). These sediments were deposited in shallow-marine, littoral and fluvial conditions and comprise fine to coarse-grained, generally well-sorted sand, with minor clay, silt and gravel and host the Murray Basin mineral sand deposits (Brown & Stephenson, 1991).

Overlying the LPS in the northern and eastern Murray Basin is the Shepparton Formation. This deposit style consists of mixed fluvial channel and floodplain deposits, including some aeolian sediments. The lithology of the Shepparton Formation varies between gravel and clay. The source material varies between regions, leading to the subdivision of the unit based on geomorphic forms and soils, but all are consistent with Riverine Plain sedimentation (Brown & Stephenson, 1991).

A unit of greenish grey Blanchetown Clay disconformably overlies the Parilla Sand in many parts of the basin. The unconformity is often marked by a weathering profile that is locally siliceous or lateritic and termed the Karoonda Surface (Brown & Stephenson, 1991). The Blanchetown Clay is a fluvio-lacustrine deposit with most sedimentation taking place in a large freshwater lake. Within South Australia, the unit was deposited together with the Bungunna Limestone (Douglas and Ferguson, 1988).

Disconformably overlying the Blanchetown Clays is the Quaternary Woorinen Formation. This formation is described as consisting of "red-brown siliceous silty sand, red calcareous silty clay and sandy clay" (Brown & Stephenson, 1991). It is generally 2-3m thick, but contains east-west longitudinal dunes that can locally be considerably thicker. The Woorinen Formation was deposited in an aeolian environment. Other aeolian landforms have been identified on the basin, particularly the Lowan/Molineaux Sands occurring in the western part of the Murray Basin. These Dune Fields occur as three tongues otherwise known as the Sunset Desert, Big Desert and Little Desert. The dune patterns and types are different from the tear shaped east-west dunes of the Woorinen Formation (Douglas and Ferguson, 1988).

Disconformably overlying the Blanchetown clay on the western and north western basin margins is the Pooraka Formation. This formation generally forms "low to high-angle alluvial and colluvial fans adjacent to basin margins" (Brown and Stephenson, 1991) and ranges from 1 to 5m in thickness. As the material within the Pooraka formation is sourced from the surrounding Curnamona Province and Adelaidean sediments it is classified as a composite morphotectonic unit.

## 2.2 Local Geology

Along the north western margin off the Murray Basin, Murray Basin sediments on-lap a succession of metasediments, volcanic and granite rocks of Neoproterozoic to Early Palaeozoic age of the Adelaide Geosyncline. Towards the end of late Cambrian times, folding metamorphism and emplacement of granite during the Delamerian Orogeny affected both the Cambrian and Precambrian rocks of the Adelaide Geosyncline west of the Torrens Hinge Zone. This zone is known as the Delamerian fold belt. Aeromagnetic images of the northern Murray Basin display a large arcuate zone of curvilinear magnetic high anomalies stretching from south of the Broken Hill Block to the southwest towards the eastern Mount Lofty Ranges (Rankin et. al. 1991). It is likely that this structurally complex region was active during the deposition of the Murray Basin sediments. If the faults were active during the deposition of the Loxton-Parilla Sand (LPS), there is the potential for localised stacked sequences as a result of minor marine transgressions or still stand positions.

Exploration for heavy mineral sand within the Murray Basin is focused on intersecting the littoral marine sediments of the Pliocene aged Loxton-Parilla Sand, in particular sediment of relict strandlines that commonly host placer deposits of heavy mineral sand. This beach facies unit is very well developed, with well defined foreshore - surfzone - lowershore regressive sequence. The best heavy mineral accumulations manifest themselves within the foreshore within this unit. The tenement straddles a set of prominent east-west trending dune ridges which represent the dunal facies of the LPS and are the main target of drilling in the tenement area.

The diverse range of lithologies comprising the geosyncline includes many medium- to high-grade metamorphic and intrusive units that are unstable at surface conditions and therefore friable and readily eroded. These rocks could have made a significant contribution to the sediment load within the Murravian Gulf, including available heavy minerals.

### 3. EXPLORATION METHODS

#### 3.1 Drilling

All drilling was carried out with a Wallis Drilling Pty Ltd owned and operated reverse circulation air core drill rig. Drill hole collars were surveyed by RTK DGPS and GPS to an accuracy of  $\pm 1\text{m}$  and  $\pm 10\text{m}$  respectively and are included with the report as an electronic file (see EL5265\_201408\_A\_02\_location.txt). Rods were NQ in size giving approximately 10cm diameter holes.

Drilling was conducted at 1.5m sampling throughout the entire hole.

A 1 to 2 kg split was taken by rotary splitter for logging and laboratory analysis. A subsample was taken from each sample for logging and panning. The logging procedure involved using wet panning to remove the clay fraction from the sample and then hydraulic separation to estimate the percentage of heavy mineral.

For approximately one in six drillholes, an additional sample was collected for the Department of Manufacturing, Innovation, Trade, Resources and Energy (DMITRE) core library. These samples were collected following guidelines listed within the M41 Earth Resources Information Sheet.

The ease with which clay and silt was liberated from the sample was logged on a scale of very easy to impossible (see EL5265\_201408\_A\_03\_Logging\_Codes.pdf) and the percentage of clay and silt ("Slimes") was also recorded. The presence and type of cemented fragments was recorded with an estimate of percentage ("Rock").

The ease with which the drill penetrated the ground was recorded on a scale of 1 to 5 ("Hardness"). Colour, dominant grain size, max grain size and sorting were also recorded. All geology logs are digitally included with this report (see EL5265\_201408\_A\_04\_lithology.txt).

#### 3.2 Heavy Mineral Determination

Two hundred and seventy eight samples collected were assayed for heavy mineral (HM) content at Iluka's laboratory in Hamilton using the Method I procedure. Upon receipt, samples were dried, weighed, attritioned, then wet screened to remove the slime ( $-53\mu\text{m}$ ) fraction. The samples were again dried, weighed, and screened to remove the fraction greater than 2 mm (oversize) and were further screened at 710 microns and the remaining subsample of the  $-710\mu\text{m} + 53\mu\text{m}$  fraction underwent HM separation using LST (a solution of lithium polytungstate) at a specific gravity of 2.85. The weights were then used to calculate percent slimes, percent oversize and percent HM for the entire sample.

Final assay results are included in the attached digital file (EL5265\_201408\_A\_05\_geochemistry.txt).



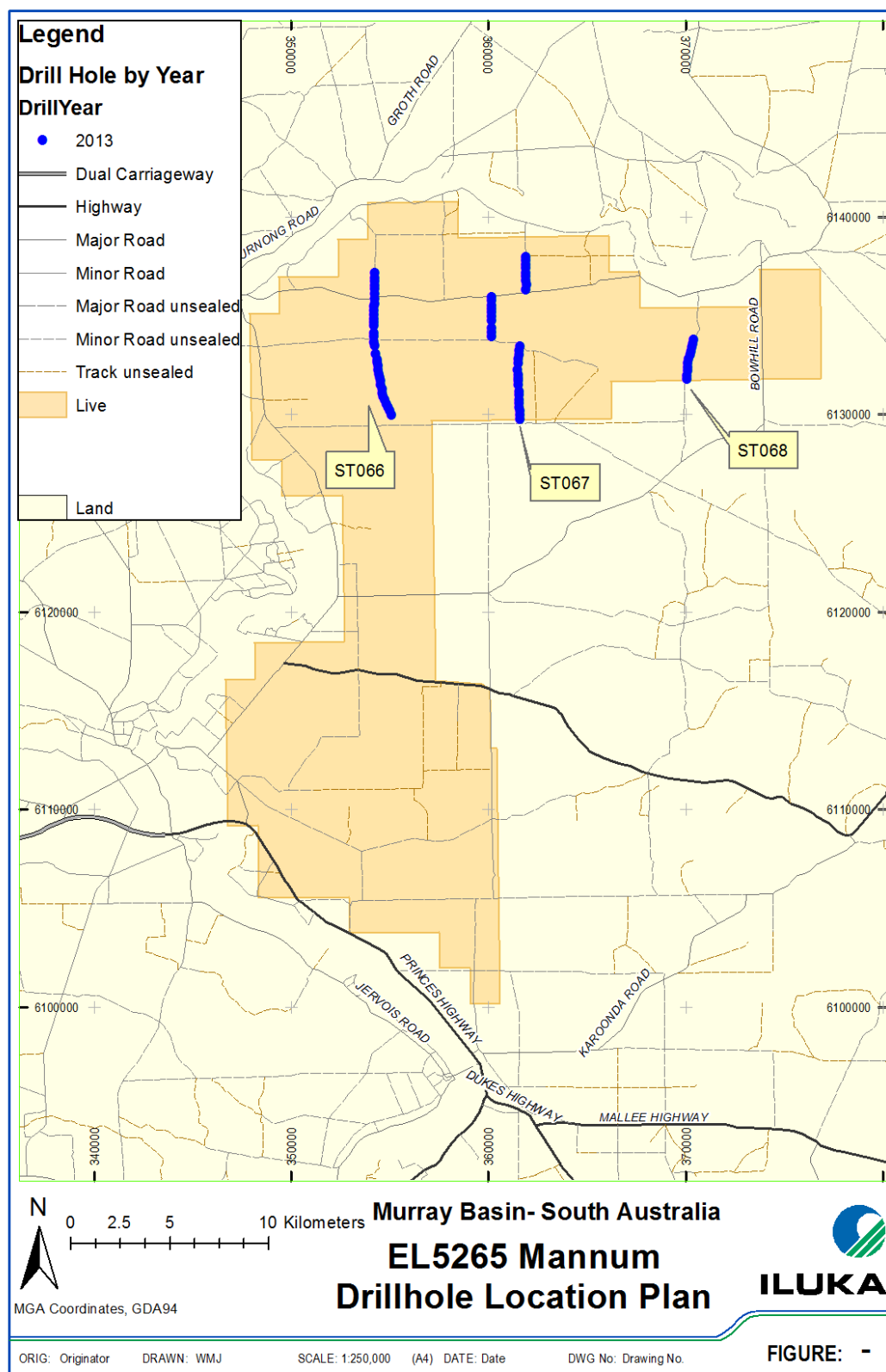
### **3.3 QAQC**

Field standards, duplicate samples and twin hole drill holes are routinely collected during Iluka drill programmes. The drilling completed on EL5265 was grassroots exploration. Therefore, only field standards were submitted for QAQC. Standards were submitted following the standard Iluka protocol with approximately one standard submitted for every 40 samples assayed. QAQC details are submitted in digital form in EL5265\_201408\_A\_06\_qaqc.txt.

## **4. EXPLORATION WORK COMPLETED**

A total of 83 holes were drilled across EL5265 during July and August 2013 for an advance of 4952.8m. Drilling was conducted along three traverses (ST066-ST068) on roadsides and private properties.

Geological cross sections and drill hole location plans are included in EL5265\_201408\_A\_08\_Sections.pdf and EL5265\_201408\_A\_09\_Plans.pdf (Fig 2) respectively.



**Figure 2: EL5265 Drill Hole Location Plan**

#### **4.1 Traverse ST066**

A total of 35 holes (S01856-S01890) were drilled along ST066. Drillholes typically intersected from surface, up to 13.5m of recent dunal sands and inter-dunal clays; between 9 and 72m of dunal facies LPS sands; overlying very fine grained offshore sands (S01873, S01883-86) terminating in calcareous sands and sandstones and limestone of the Murray Group at depths between 35 and 84m. No significant mineralisation was intersected in drillholes along ST066 with only minor HM (<0.8) intersected within the dunal facies sands.

#### **4.2 Traverse ST067**

A total of 37 holes (S01891-S01927) were drilled along ST067. Drilling intersected from surface between 13.5m of calcrete, recent dunal sands and inter-dunal clays; 16.5m to 46.5m of LPS dunal facies sands; up to 12m of very fine grained lowershore sand (S01901-S01924); terminating in Murray Group calcareous sandstone and limestone's at depths between 27m in the south (S01981) and 81m on dunal ridges in the centre of the traverse (S01899).

Minor HM was intersected within LPS dunal facies sands some drillholes along ST067 with maximum intersects of 9m @ 1 % HM / 28.5m in S01904, 15m @ 1.3% HM from 18m in S01905 and 7.5m @ 1.5 % HM / 27m in S01906. Sachet scanning of assayed samples revealed poor assemblage with a low VHM fraction of less than 2% with the HM fraction dominated by iron oxides, rock and trash minerals.

#### **4.3 Traverse ST068**

A total of 11 holes (S01928-38) were drilled along ST068. Drillholes intersected from surface 3-4.5m of calcrete; 4.5-9m of lacustrine clays; 19.5-37.5m of dunal facies LPS sands; up to 9m of foreshore facies LPS sands (S01928-29, S01231-32); between 6 and 15m of fine grained lowershore facies LPS sands terminating in Murray Group calcareous sandstones at depths between 48m and 62m. S01938 was terminated at 1.5m in very hard calcrete. No significant mineralisation was intersected.

### **5. CONCLUSION**

A single drilling campaign was completed during July and August 2013. A total of 83 holes was drilled for an advance of 4952.8m during the reporting period.

Minor HM was intersected within drillholes along ST067 with a maximum grade of 7.5m @ 1.5 % HM from 27m in S01906 most of this was Rock and trash mineral upon inspection.

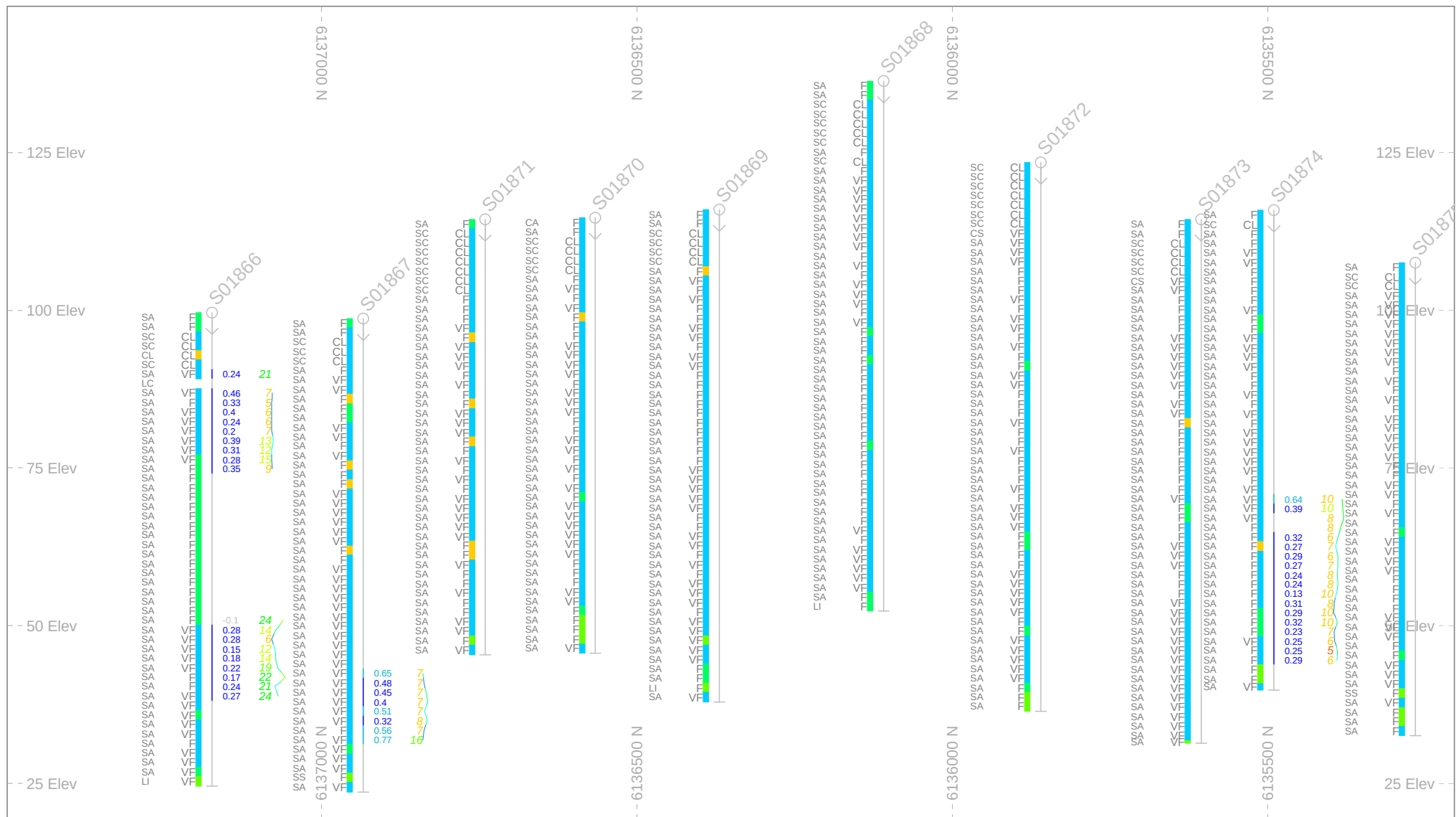
A data review of the 2013 drilling has determined that the Loxton Sands are either not preserved or the Pliocene coast line did not extend this far east in the Murravian Gulf within EL5265.

## 6. REFERENCES

Brown, C.M. and Stephenson, A.E., 1991. *Geology of the Murray Basin Southeastern Australia*, Bureau of Mineral Resources, Geology and Geophysics Bulletin 235

Douglas, J.G & Ferguson, J.A (Eds), 1988: *Chapter 8 – Tertiary* by C. Abele et al, in *Geology of Victoria*, Victorian Division Geological Society of Australia Incorporated, Melbourne, pp 265-272.

Rankin, L.R., Clough, B.J. and Gatehouse, C.G., 1991. *Mafic Suites in Nasement Beneath the Murray Basin: New Data for the Early Palaeozoic History of the Tasman Orogenic Province*. PIRSA report book no 91/44 (DME 281/89)



**ILUKA RESOURCES LTD**  
ABN 34 008 675 018

EL5265 Mannum

GDA94 MGA 54

**S01 (Holes)**

- [ABSENT]
- [G]
- [M]
- [P]
- [VG]
- [VP]

**HM**

- 0.0-0.5
- 0.5-1.5
- 1.5-3.0
- 3.0-4.5
- 4.5-6.0
- 6.0-8.0
- 8.0-10.0
- 10.0-15.0
- 15.0-25.0
- 25.0-40.0

**Drillhole: OS**

- 0.0-0.5
- 0.5-1.5
- 1.5-3.0
- 3.0-4.5
- 4.5-6.0
- 6.0-8.0
- 8.0-10.0
- 10.0-15.0
- 15.0-25.0
- 25.0-40.0

**Legend**

Lithology: Far left

Dominant grain size: Left

Sorting: Left

Slimes: Right

Oversize: Far right

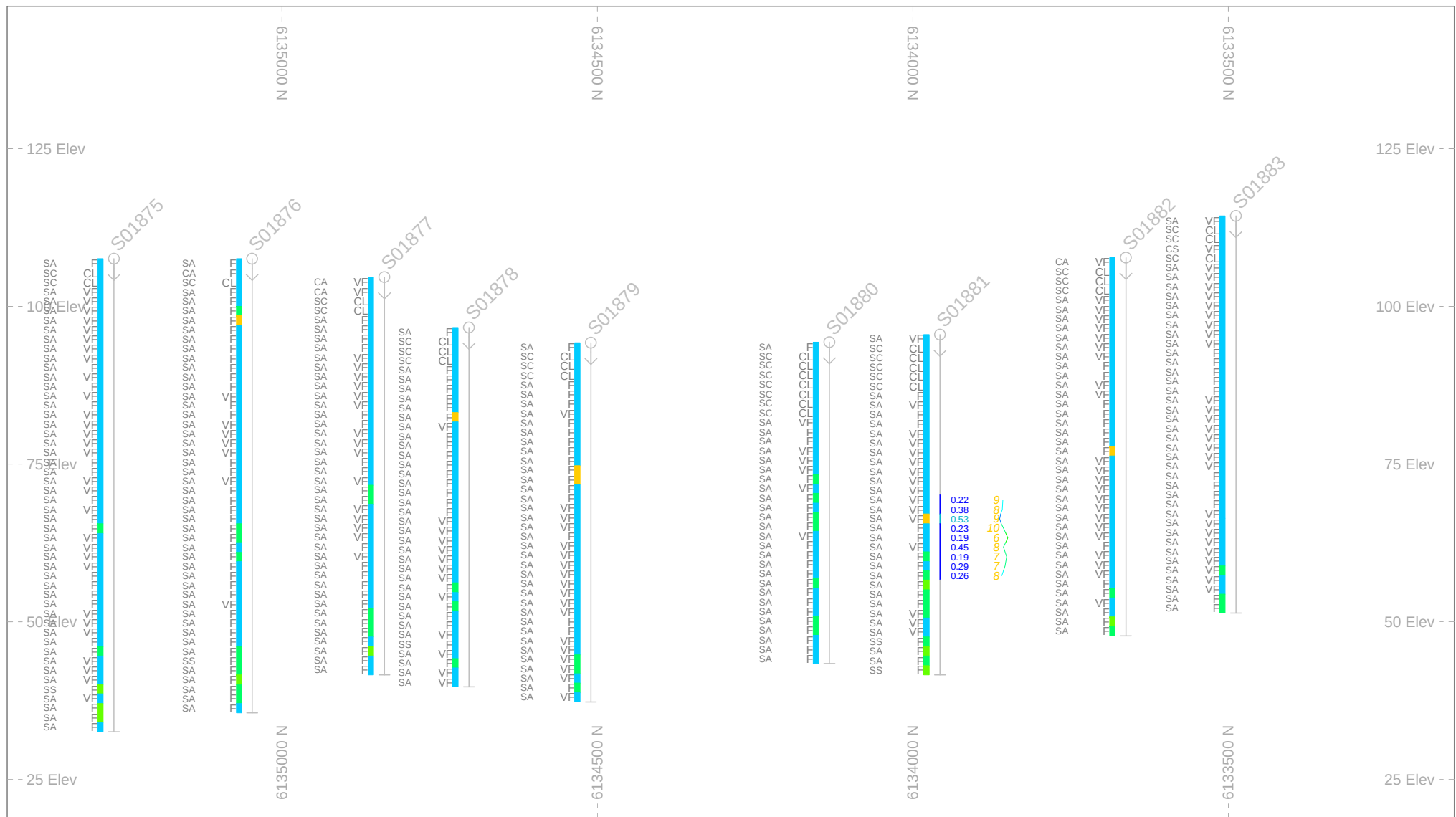
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Section 1 of 9

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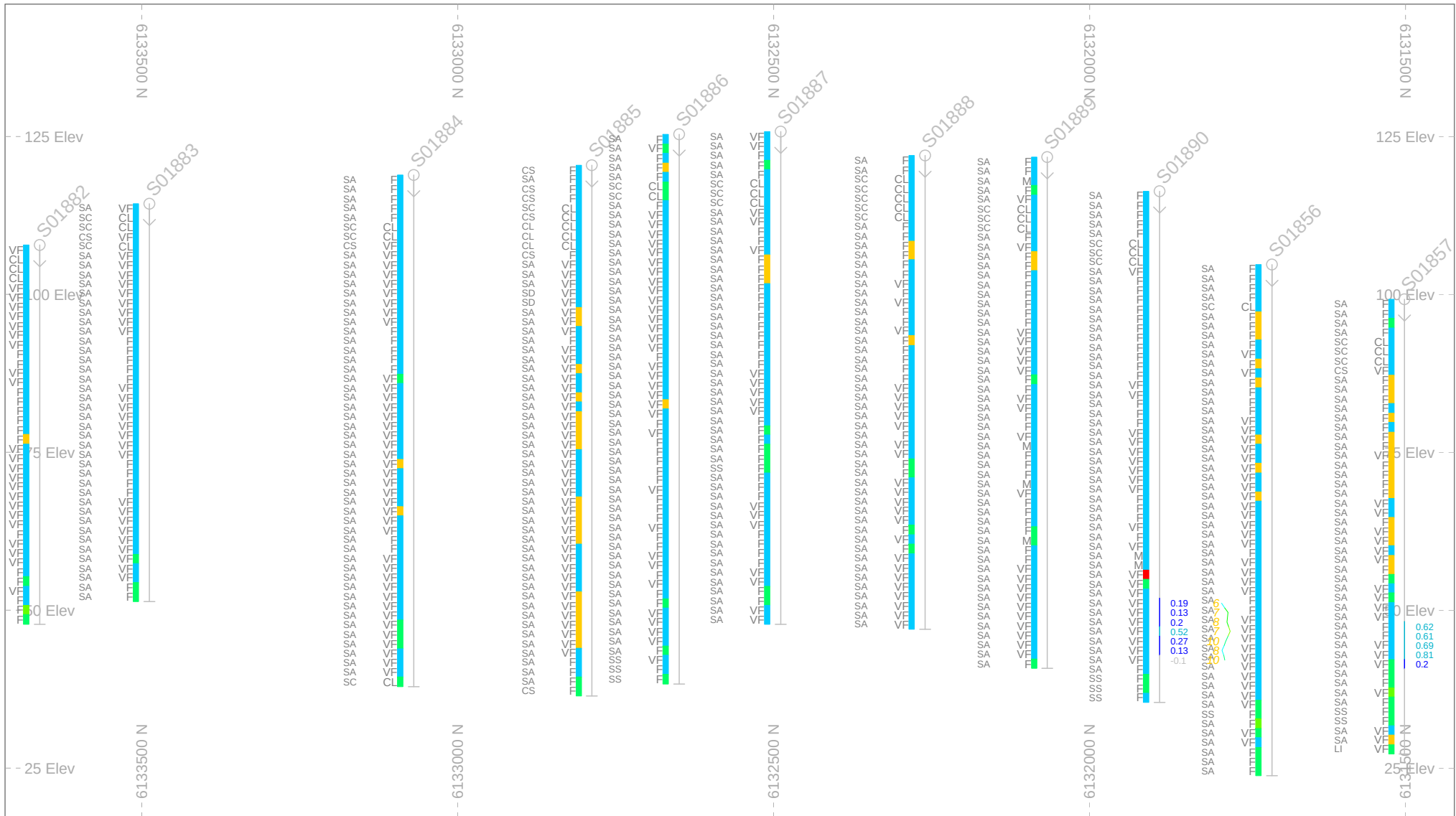


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| <b>ILUKA RESOURCES LTD</b><br>ABN 34 008 675 018 | <br><b>ILUKA</b> | <b>S01 (Holes)</b><br>[ABSENT]<br>[G]<br>[M]<br>[P]<br>[VG]<br>[VP] | <b>HM</b><br>[ABSENT/NEGATIVE]<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Drillhole: OS</b><br>[ABSENT/NEGATIVE]<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Legend</b><br>Lithology: Far left<br>Dominant grain size: Left<br>Sorting: Left<br>Slimes: Right<br>Oversize: Far right | <b>ST066 B</b> |  |  |
|                                                  |                                                                                                     | Section 2 of 9                                                      |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |                |  |  |
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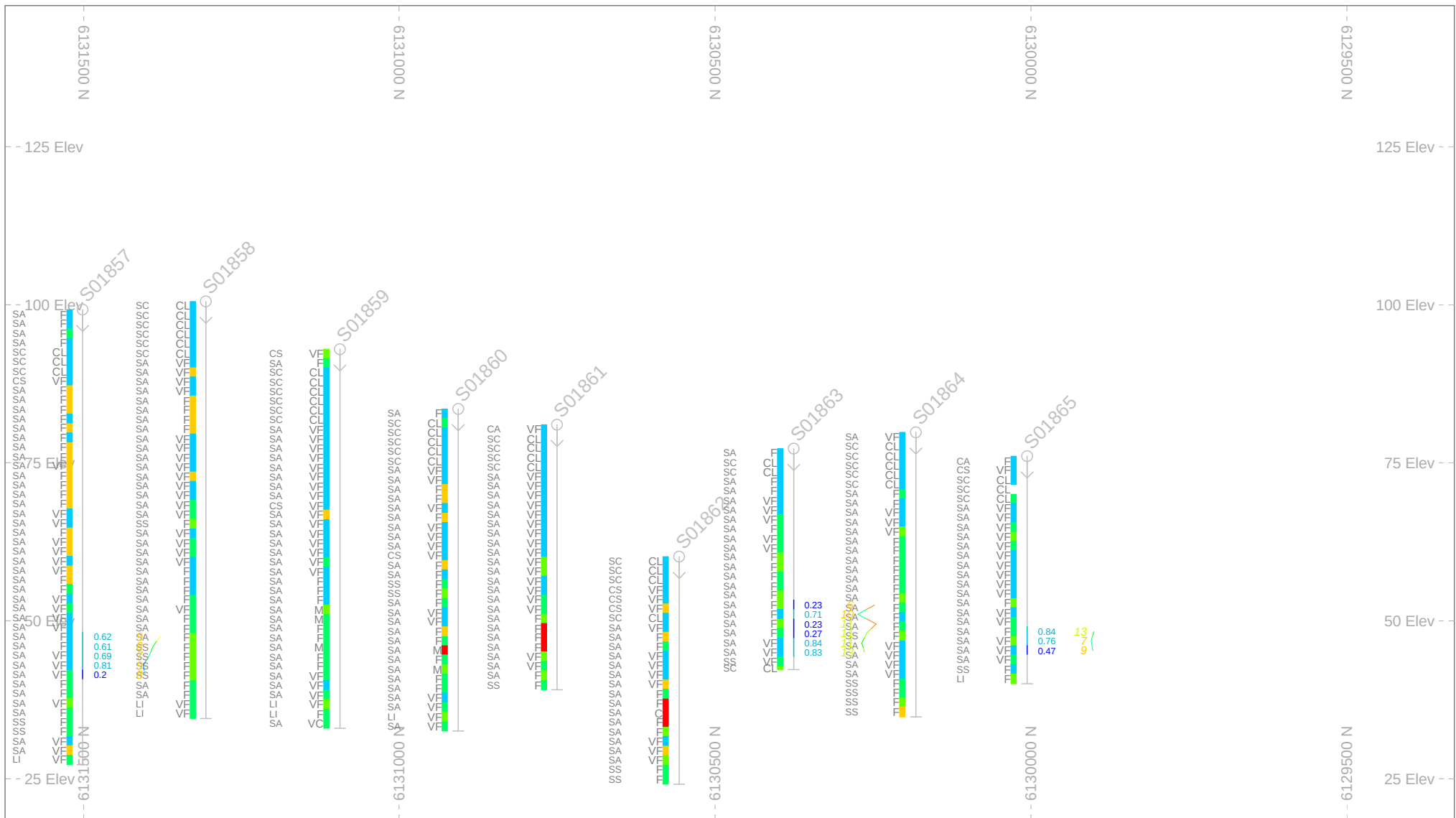
GDA94 MGA 54

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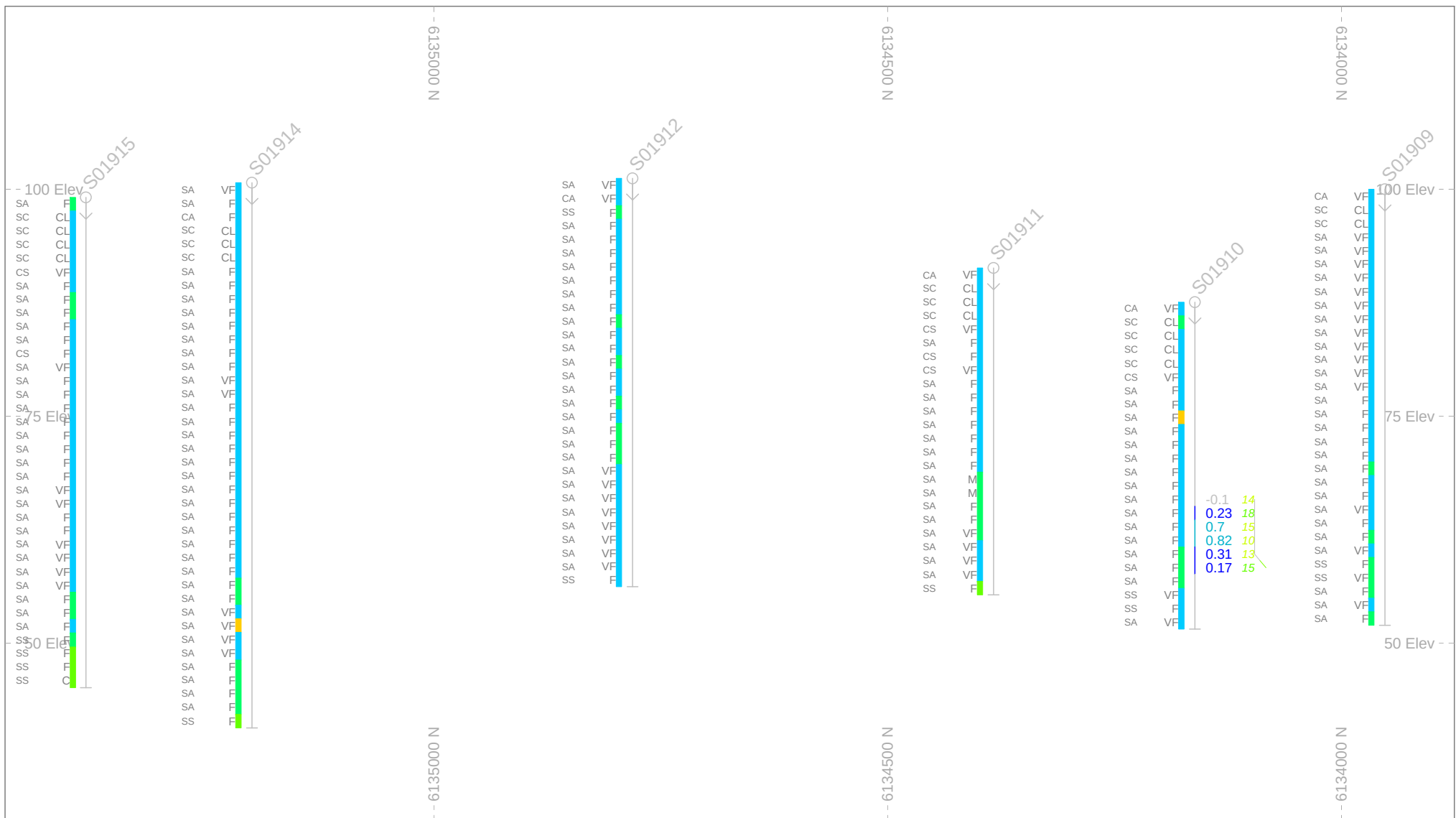


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| <b>ILUKA RESOURCES LTD</b><br>ABN 34 008 675 018<br><br>EL5265 Mannum<br><br>GDA94 MGA 54 |  | <b>SO1 (Holes)</b><br>[ABSENT]<br>[G]<br>[M]<br>[P]<br>[VG]<br>[VP] | <b>HM</b><br>ABSENT/NEGATIVE<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Drillhole: OS</b><br>ABSENT/NEGATIVE<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Legend</b><br>Lithology: Far left<br>Dominant grain size: Left<br>Sorting: Left<br>Slimes: Right<br>Oversize: Far right | <b>ST066 C</b> |                |             |
|                                                                                           |  | Section 3 of 9                                                      |                                                                                                                                                   |                                                                                                                                                              |                                                                                                                            |                | Date: 15/08/14 | Time: 08:17 |
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|                                                  |  |                    |     |           |                      |                                                                                                                            |                |      |                |  |  |
|--------------------------------------------------|--|--------------------|-----|-----------|----------------------|----------------------------------------------------------------------------------------------------------------------------|----------------|------|----------------|--|--|
| <b>ILUKA RESOURCES LTD</b><br>ABN 34 008 675 018 |  | <b>SO1 (Holes)</b> |     | <b>HM</b> | <b>Drillhole: OS</b> | <b>Legend</b><br>Lithology: Far left<br>Dominant grain size: Left<br>Sorting: Left<br>Slimes: Right<br>Oversize: Far right | <b>ST066 D</b> |      |                |  |  |
|                                                  |  | [ABSENT]           | [G] | [M]       | [P]                  |                                                                                                                            | [VG]           | [VP] | Section 4 of 9 |  |  |
|                                                  |  |                    |     |           |                      |                                                                                                                            |                |      |                |  |  |
| EL5265 Mannum                                    |  | GDA94 MGA 54       |     |           |                      |                                                                                                                            |                |      |                |  |  |





ILUKA RESOURCES LTD  
ABN 34 008 675 018

EL5265 Mannum

GDA94 MGA 54

0100020003000400050006000

1:100000

SO1 (Holes)

[ABSENT]  
[G]  
[M]  
[P]  
[VG]  
[VP]

HM

ABSENT/NEGATIVE  
0.0-0.5  
0.5-1.5  
1.5-3.0  
3.0-4.5  
4.5-6.0  
6.0-8.0  
8.0-10.0  
10.0-15.0  
15.0-25.0  
25.0-40.0  
40.0

Drillhole: OS

ABSENT/NEGATIVE  
0.0-0.5  
0.5-1.5  
1.5-3.0  
3.0-4.5  
4.5-6.0  
6.0-8.0  
8.0-10.0  
10.0-15.0  
15.0-25.0  
25.0-40.0  
40.0

Legend

Lithology: Far left  
Dominant grain size: Left  
Sorting: Left  
Slimes: Right  
Oversize: Far right

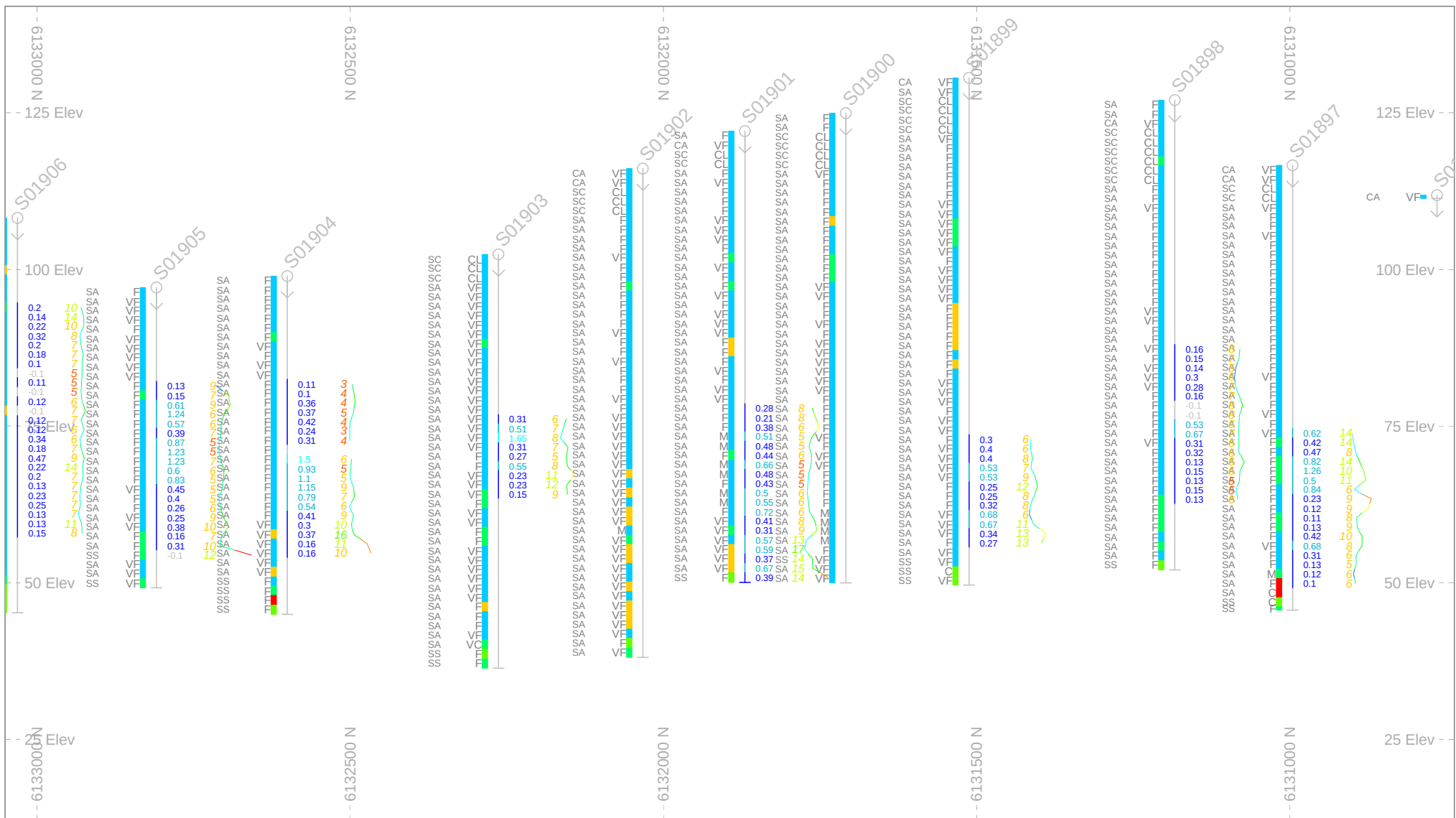
ST067 A

Section 5 of 9

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Time: 08:17





ILUKA RESOURCES LTD  
ABN 34 008 675 018

EL5265 Mannum

GDA94 MGA 54

0 1000 2000 3000 4000 5000 6000

**SO1 (Holes)**  
[ABSENT]  
[G]  
[M]  
[P]  
[VG]  
[VP]

**HM**  
ABSENT/NEGATIVE  
0.0-0.5  
0.5-1.5  
1.5-3.0  
3.0-4.5  
4.5-6.0  
6.0-8.0  
8.0-10.0  
10.0-15.0  
15.0-25.0  
25.0-40.0

**Drillhole: OS**  
ABSENT/NEGATIVE  
0.0-0.5  
0.5-1.5  
1.5-3.0  
3.0-4.5  
4.5-6.0  
6.0-8.0  
8.0-10.0  
10.0-15.0  
15.0-25.0  
25.0-40.0

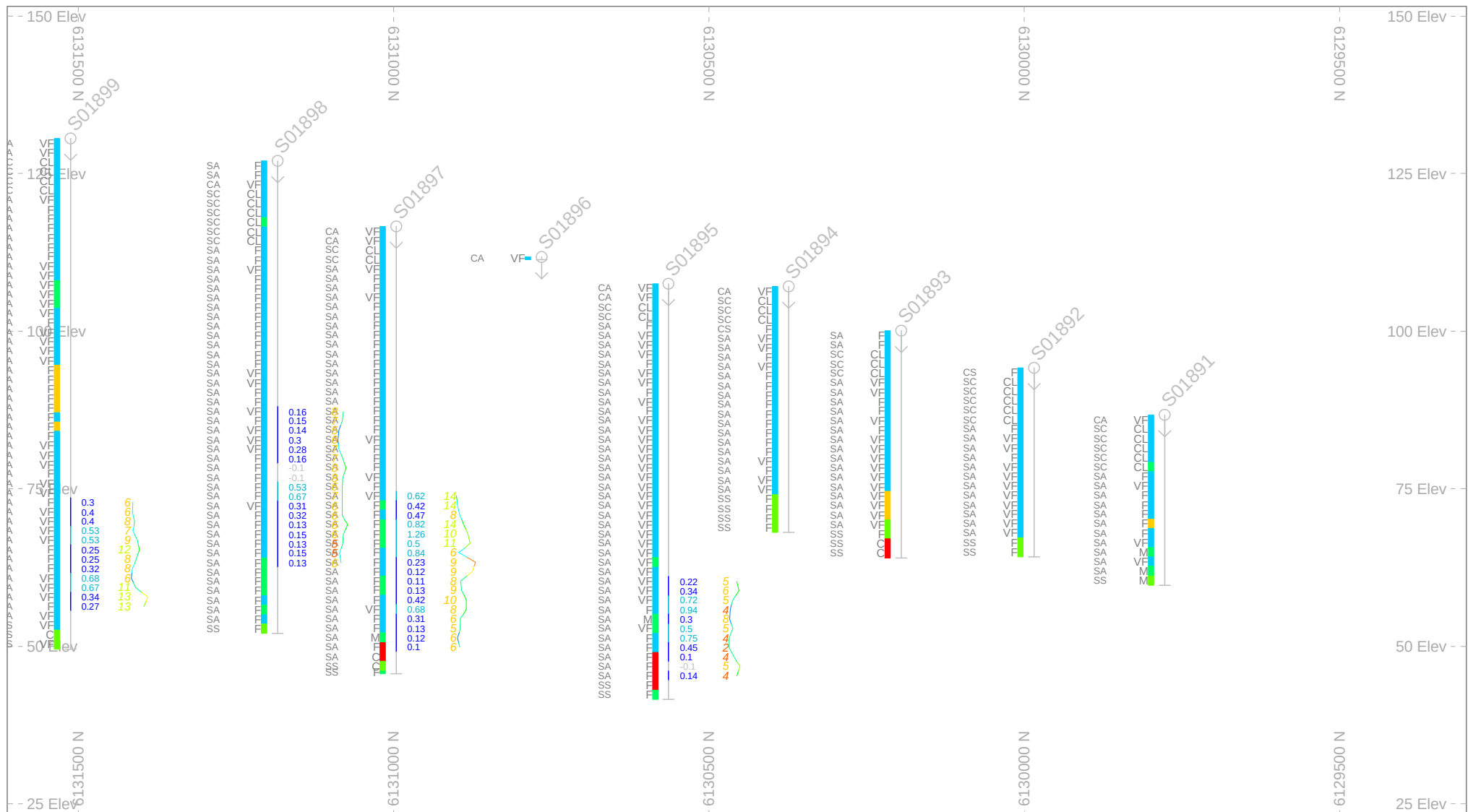
**Legend**  
Lithology: Far left  
Dominant grain size: Left  
Sorting: Left  
Slimes: Right  
Oversize: Far right

ST067 C

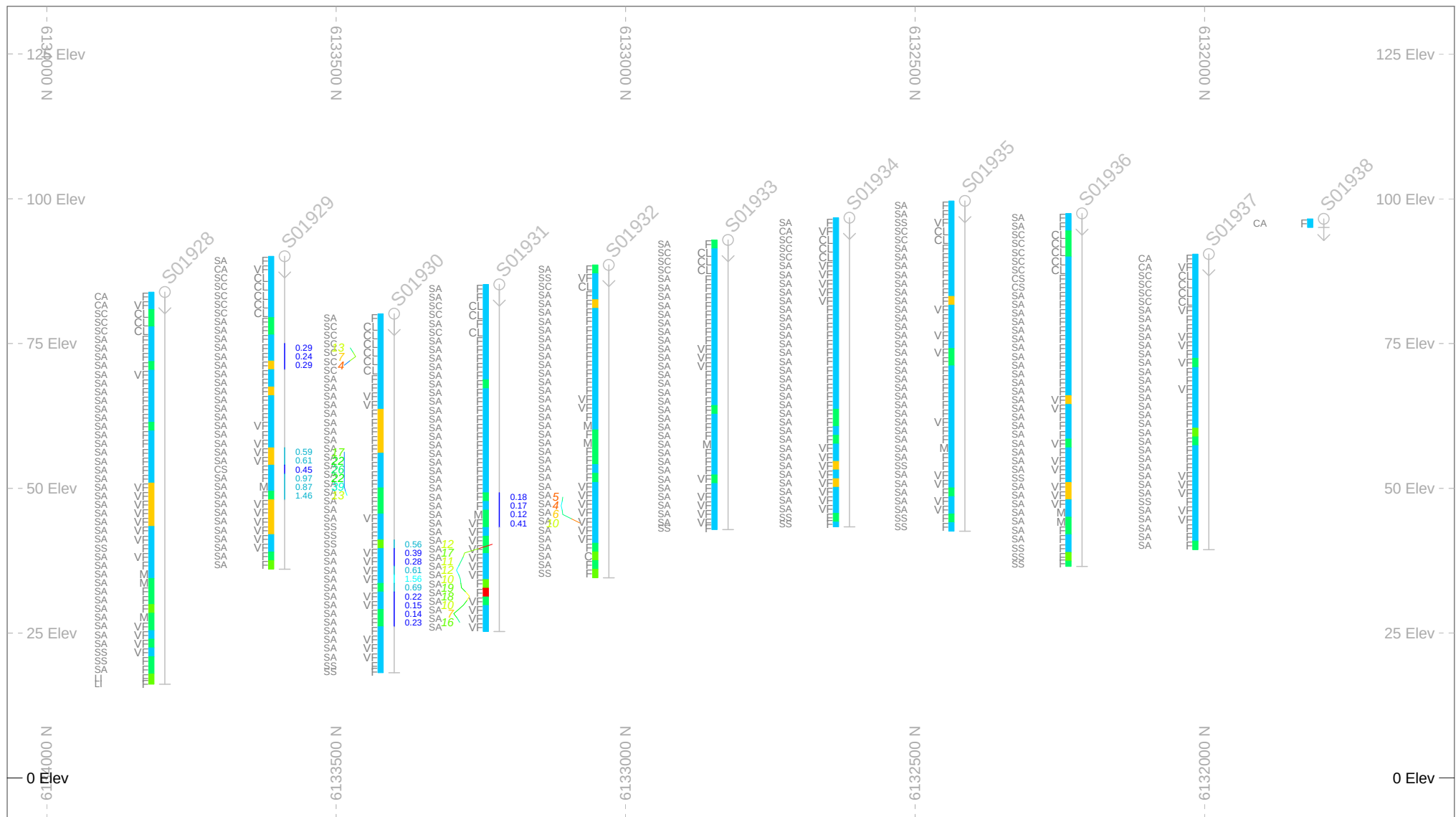
Section 7 of 9

Date: 15/08/14

Time: 08:17



|                                                                                           |  |                                                                     |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |                |  |  |
|-------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------|--|--|
| <b>ILUKA RESOURCES LTD</b><br>ABN 34 008 675 018<br><br>EL5265 Mannum<br><br>GDA94 MGA 54 |  | <b>S01 (Holes)</b><br>[ABSENT]<br>[G]<br>[M]<br>[P]<br>[VG]<br>[VP] | <b>HM</b><br>[ABSENT/NEGATIVE]<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Drillhole: OS</b><br>[ABSENT/NEGATIVE]<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Legend</b><br>Lithology: Far left<br>Dominant grain size: Left<br>Sorting: Left<br>Slimes: Right<br>Oversize: Far right | <b>ST067 D</b> |  |  |
|                                                                                           |  | Section 8 of 9                                                      |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |                |  |  |
|                                                                                           |  |                                                                     |                                                                                                                                                     | Date: 15/08/14                                                                                                                                                 | Time: 08:17                                                                                                                |                |  |  |



ILUKA RESOURCES LTD  
ABN 34 008 675 018

  
**ILUKA**

EL5265 Mannum

GDA94 MGA 54

0100020003000400050006000

1:100000

ST068

Section 9 of 9

Date: 15/08/14

Time: 08:17

### Metadata used in Iluka Resources Ltd Surface Location Files

| Name       | Type* | Size | Decimals | Description                             |
|------------|-------|------|----------|-----------------------------------------|
| HOLE_ID    | C     | 10   | 0        | Hole Name                               |
| LATITUDE   | N     | 12   | 6        | Latitude                                |
| LONGITUDE  | N     | 12   | 6        | Longitude                               |
| RL         | N     | 7    | 2        | AHDRL Elevation                         |
| DATUM      | C     | 5    | 0        | Datum Name                              |
| SURV_METH  | C     | 10   | 0        | Survey Method                           |
| SURV_COMP  | C     | 10   | 0        | Survey Company                          |
| SURV_NAM   | C     | 10   | 0        | Surveyor Name                           |
| PEG_VAR    | C     | 1    | 0        | Variation from Peg                      |
| UTM_NORTH  | N     | 12   | 2        | Northing MGA (GDA94) datum              |
| UTM_EAST   | N     | 12   | 2        | Easting MGA (GDA94) datum               |
| UTM_GRIDID | C     | 10   | 0        | Universal Transverse Mercator Grid Name |
| LOCAL_E    | N     | 12   | 2        | Local Grid Easting                      |
| LOCAL_N    | N     | 12   | 2        | Local Grid Northing                     |
| LOCAL_GRID | C     | 20   | 0        | Local Grid Name                         |
| DRILL_TYPE | C     | 5    | 0        | Drilling Method                         |
| HOLE_SIZE  | C     | 3    | 0        | Hole Diameter                           |
| AZIMUTH    | N     | 1    | 0        | Azimuth of Drill String                 |
| DIP        | N     | 3    | 0        | Dip of Drill String                     |
| SAMP_SPLIT | C     | 5    | 0        | Percentage of Sample Taken              |
| TWIN       | C     | 1    | 0        | Twin Hole                               |
| TWIN OF    | C     | 10   | 0        | Twin Hole Original                      |
| TD         | N     | 6    | 1        | Depth of Hole                           |
| TENURE_REF | C     | 10   | 0        | Exploration Licence                     |
| STATE      | C     | 5    | 0        | State                                   |
| COMPANY    | C     | 10   | 0        | Exploration Company                     |
| PROJECT    | C     | 30   | 0        | Regional Project Area                   |
| DEPOSIT    | C     | 30   | 0        | Deposit                                 |
| GRID_LINE  | C     | 12   | 0        | Grid Line Name                          |
| TRAVERSE   | C     | 20   | 0        | Traverse Name                           |
| ANOMALY    | C     | 20   | 0        | Anomaly Name                            |
| PEG_ID     | C     | 12   | 0        | Peg Name                                |
| PAN        | C     | 1    | 0        | Confirmation of Panning                 |
| LOGGER     | C     | 15   | 0        | Logger Name                             |
| DRILL_CO   | C     | 10   | 0        | Drilling Company                        |
| DRILL_RIG  | C     | 10   | 0        | Drilling Rig                            |
| DATE       | C     | 10   | 0        | Date                                    |
| COMMENTS   | C     | 30   | 0        | Comments                                |
| VIS_VAL    | C     | 1    | 0        | Visual Validation of Data               |

\* C = Character  
N=Numeric

### Metadata used in Iluka Resources Ltd Lithological Logging Files

| Name      | Type | Size | Decimals | Description                        |
|-----------|------|------|----------|------------------------------------|
| HOLE_ID   | C    | 10   | 0        | Hole Name                          |
| PROJECT   | C    | 30   | 0        | Regional Project Area              |
| FROM      | N    | 5    | 1        | Depth From                         |
| TO        | N    | 5    | 1        | Depth To                           |
| SAMPLE_ID | C    | 10   | 0        | Sample Name                        |
| AS        | C    | 3    | 0        | Assay                              |
| SAMP_QUAL | C    | 1    | 0        | Quality of Sample                  |
| WATER     | C    | 1    | 0        | Sample Moisture                    |
| E_SL      | N    | 3    | 0        | Estimated Slimes Percentage        |
| WA        | C    | 2    | 0        | Washability of Sample              |
| CO1       | C    | 3    | 0        | Primary Sample Colour              |
| LI1       | C    | 3    | 0        | Primary Lithology                  |
| DGS1      | C    | 2    | 0        | Primary Dominant Grain Size        |
| CGS1      | C    | 2    | 0        | Primary Maximum Grain Size         |
| SO1       | C    | 2    | 0        | Primary Sorting                    |
| LINK      | C    | 2    | 0        | Link to Second Lithology           |
| CO2       | C    | 3    | 0        | Secondary Colour                   |
| LI2       | C    | 3    | 0        | Secondary Lithology                |
| E_LI2     | N    | 3    | 0        | Percentage of Secondary Lithology  |
| DGS2      | C    | 2    | 0        | Secondary Dominant Grain Size      |
| CGS2      | C    | 2    | 0        | Secondary Maximum Grain Size       |
| SO2       | C    | 2    | 0        | Secondary Sorting                  |
| IND       | C    | 4    | 0        | Induration                         |
| E_IND     | N    | 3    | 0        | Percentage of Induration in Sample |
| H         | N    | 1    | 0        | Hardness of Induration             |
| E_HM      | N    | 5    | 1        | Estimated HM percentage            |
| HMGS      | C    | 2    | 0        | HM Grain Size                      |
| QU        | C    | 3    | 0        | Qualifiers                         |
| COMMENTS  | C    | 30   | 0        | Comments                           |
| FM        | C    | 3    | 0        | Formation                          |

### Metadata used in Iluka Resources Ltd Assay Files

| Name      | Type | Size | Decimals | Description            |
|-----------|------|------|----------|------------------------|
| HOLE_ID   | C    | 10   | 0        | Hole Name              |
| FROM      | N    | 5    | 1        | Depth From             |
| TO        | N    | 5    | 1        | Depth To               |
| SAMPLE_ID | C    | 10   | 0        | Sample Name            |
| OS        | N    | 5    | 2        | Oversize Percentage    |
| SANDC     | N    | 5    | 2        | Coarse Sand Percentage |
| SAND      | N    | 5    | 2        | Sand Percentage        |
| SLIMES    | N    | 5    | 2        | Slimes Percentage      |
| HM        | N    | 5    | 2        | HM Percentage          |

## CODES

| CODE | ASSAY          |
|------|----------------|
| Y    | YES - HM ASSAY |
| N    | NO - HM ASSAY  |
| M    | MULTI ELEMENT  |
| D    | DUPLICATE      |
| 3P   | STANDARD       |
| E3   | STANDARD       |
| HG1  | STANDARD       |
| HG2  | STANDARD       |
| HG3  | STANDARD       |
| HG4  | STANDARD       |

| CODE | GRAINSIZE   |
|------|-------------|
| CL   | CLAY        |
| GR   | GRIT        |
| PB   | PEBBLE      |
| SI   | SILT        |
| VF   | VERY FINE   |
| F    | FINE        |
| M    | MEDIUM      |
| C    | COARSE      |
| VC   | VERY COARSE |

| CODE  | SURVEY COMPANY |
|-------|----------------|
| PDS   | Peter Danson   |
| ILUKA | Iluka          |

| CODE     | SURVEY METHOD |
|----------|---------------|
| GPS      | GPS           |
| DGPS RTK | DGPS RTK      |
| OTHER    | OTHER         |

| CODE | WATER    |
|------|----------|
| D    | DRY      |
| M    | MOIST    |
| W    | WET      |
| I    | INJECTED |

| CODE | COMPANY             |
|------|---------------------|
| ILU  | ILUKA RESOURCES LTD |

| CODE   | DRILLING COMPANY    |
|--------|---------------------|
| WALLIS | WALLIS DRILLING LTD |
| ILUKA  | ILUKA RESOURCES LTD |

| CODE       | DRILL RIG |
|------------|-----------|
| CUSTOM     | CUSTOM    |
| MANTIS1    | MANTIS1   |
| MANTIS2    | MANTIS2   |
| MANTIS3    | MANTIS3   |
| DELTA15    | DELTA15   |
| DELTA28    | DELTA28   |
| WALLD29    | DELTA29   |
| WALLIS D30 | DELTA30   |
| DELTA32    | DELTA32   |
| DELTA5     | DELTA5    |
| DELTA7     | DELTA7    |
| WARMAN     | WARMAN    |

| CODE    | DRILL TYPE                      |
|---------|---------------------------------|
| RCAC    | REVERSE CIRCULATION<br>AIR CORE |
| AU      | AUGER                           |
| RAB     | ROTARY AIR BLAST                |
| DIAMOND | DIAMOND                         |
| RC      | REVERSE CIRCULATION             |

| CODE | FORMATION          |
|------|--------------------|
| TFS  | TOP OF FORESHORE   |
| TLS  | TOP OF LOWERSHORE  |
| TSZ  | TOP OF SURFZONE    |
| TLI  | TOP OF LIMESTONE   |
| DU   | DUNAL              |
| WT   | TOP OF WATER TABLE |

---



| <b>CODE</b> | <b>INDURATION<br/>HARDNESS</b> |
|-------------|--------------------------------|
| 1           | VERY SOFT                      |
| 2           | SOFT                           |
| 3           | MEDIUM                         |
| 4           | HARD                           |
| 5           | VERY HARD                      |

| <b>CODE</b> | <b>HM GRAINSIZE</b> |
|-------------|---------------------|
| F           | FINE                |
| VF          | VERY FINE           |
| FM          | FINE-MEDIUM         |
| M           | MEDIUM              |
| MC          | MEDIUM-COARSE       |
| C           | COARSE              |
| VC          | VERY COARSE         |

| <b>CODE</b> | <b>HOLE SIZE</b> |
|-------------|------------------|
| BQ          | 60mm             |
| NQ          | 75.8mm           |

| <b>CODE</b> | <b>INDURATION</b>                                |
|-------------|--------------------------------------------------|
| FE          | FERRUGINOUS<br>INDURATION                        |
| SI          | SILICEOUS INDURATION<br>CALCAREOUS<br>INDURATION |
| CC          | INDURATION                                       |
| PY          | PYRITIC INDURATION                               |

| <b>CODE</b> | <b>LITHOLOGY</b> |
|-------------|------------------|
| BA          | BASALT           |
| CA          | CALCRETE         |
| CL          | CLAY             |
| CT          | CLAY STONE       |
| YS          | CLAY-SILT        |
| CS          | CLAYEY SAND      |
| CO          | COAL             |
| CG          | CONGLOMERATE     |
| DO          | DOLOMITE         |
| GA          | GRANITE          |
| GR          | GRAVEL           |
| GY          | GYPSUM           |

|     |                  |
|-----|------------------|
| HM  | HEAVY MINERAL    |
| IC  | INDURATED CLAY   |
| IR  | IRONSTONE        |
| LA  | LATERITE         |
| LI  | LIMESTONE        |
| LS  | LOMESAND         |
| LC  | LOST CORE        |
| MU  | MUDSTONE         |
| PY  | PYRITE           |
| QU  | QUARTZ           |
| RK  | ROCK UNKNOWN     |
| SA  | SAND             |
| SS  | SANDSTONE        |
| SC  | SANDY CLAY       |
| SAP | SAPROLITE        |
| ST  | SCHIST           |
| SH  | SHALE            |
| SE  | SILCRETE         |
| SI  | SILT             |
| SIS | SILTSTONE        |
| SD  | SILTY-SAND       |
| SY  | SILTY-CLAY       |
| SYS | SILTY-CLAY-SAND  |
| SDY | SILTY-SANDY-CLAY |
| SL  | SLATE            |
| SLM | SLIME            |
| SO  | SOIL             |

| <b>CODE</b> | <b>LINK</b> |
|-------------|-------------|
| TO          | TO          |
| AN          | AND         |

| <b>CODE</b> | <b>PEG VARIATION</b> |
|-------------|----------------------|
| Y           | YES                  |
| N           | NO                   |
| P           | PICK-UP              |

| <b>CODE</b> | <b>QUALIFIER</b>        |
|-------------|-------------------------|
| AT          | ABUNDANT BLACK<br>TRASH |
| CB          | CARBONACEOUS            |
| CT          | COMMON BLACK TRASH      |
| FE          | FERRUGINOUS             |

|     |                             |
|-----|-----------------------------|
| LA  | LATERITIC                   |
| MI  | MICACEOUS                   |
| MO  | MOTTLED                     |
| MT  | MINOR BLACK TRASH           |
| OX  | OXIDISED                    |
| PY  | PYRITIC                     |
| WE  | WEATHERED                   |
| SI  | SILICEOUS                   |
| CC  | CALCAREOUS                  |
| CE  | CARBONATE                   |
| GY  | GYPSUM                      |
| OR  | ORGANIC                     |
| ALF | ABUNDANT LATERITIC<br>FINES |
| CLF | COMMON LATERITIC<br>FINES   |
| MLF | MINOR LATERITIC FINES       |
| BM  | BASEMENT                    |
| TL  | TAILINGS                    |
| SL  | SLIMES                      |
| CV  | CAVEN                       |

| CODE | SAMPLE QUALITY |
|------|----------------|
| G    | GOOD           |
| M    | MODERATE       |
| P    | POOR           |

| CODE  | SAMPLE SPLIT      |
|-------|-------------------|
| 25_75 | 25% SAMPLE SPLIT  |
| 50_50 | 50% SAMPLE SPLIT  |
| 100   | 100% SAMPLE SPLIT |

| CODE | SORTING   |
|------|-----------|
| G    | GOOD      |
| M    | MODERATE  |
| P    | POOR      |
| VG   | VERY GOOD |
| VP   | VERY POOR |

| CODE | WASHABILITY |
|------|-------------|
| IM   | IMPOSSIBLE  |
| M    | MODERATE    |

|    |                      |
|----|----------------------|
| MD | MODERATELY DIFFICULT |
| ME | MODERATELY EASY      |
| VD | VERY DIFFICULT       |
| VE | VERY EASY            |

| CODE | COLOUR            |
|------|-------------------|
| BK   | BLACK             |
| BL   | BLUE              |
| BR   | BROWN             |
| BB   | BROWN-BLACK       |
| BC   | BROWN-CREAM       |
| BO   | BROWN-ORANGE      |
| BW   | BROWN-WHITE       |
| BY   | BROWN-YELLOW      |
| BU   | BUFF              |
| CR   | CREAM             |
| CO   | CREAM-ORANGE      |
| RC   | CREAM-RED         |
| DBK  | DARK BLACK        |
| DBL  | DARK BLUE         |
| DBR  | DARK BROWN        |
| DBB  | DARK BROWN-BLACK  |
| DBC  | DARK BROWN-CREAM  |
| DBO  | DARK BROWN-ORANGE |
| DBW  | DARK BROWN-WHITE  |
| DBY  | DARK BROWN-YELLOW |
| DBU  | DARK BUFF         |
| DCR  | DARK CREAM        |
| DCO  | DARK CREAM-ORANGE |
| DRC  | DARK CREAM-RED    |
| DGN  | DARK GREEN        |
| DNB  | DARK GREEN-BROWN  |
| DNY  | DARK GREEN-YELLOW |
| DGR  | DARK GREY         |
| DGK  | DARK GREY-BLACK   |
| DGB  | DARK GREY-BROWN   |
| DGC  | DARK GREY-CREAM   |
| DGG  | DARK GREY-GREEN   |
| DGO  | DARK GREY-ORANGE  |
| DGP  | DARK GREY-PINK    |
| DGD  | DARK GREY-RED     |
| DGW  | DARK GREY-WHITE   |
| DGY  | DARK GREY-YELLOW  |
| DMU  | DARK MUSTARD      |
| DOR  | DARK ORANGE       |

|     |                    |     |                     |
|-----|--------------------|-----|---------------------|
| DOB | DARK ORANGE-BROWN  | LCO | LIGHT CREAM-ORANGE  |
| DOW | DARK ORANGE-WHITE  | LRC | LIGHT CREAM-RED     |
| DOY | DARK ORANGE-YELLOW | LGN | LIGHT GREEN         |
| DPI | DARK PINK          | LNB | LIGHT GREEN-BROWN   |
| DPB | DARK PINK BROWN    | LNK | LIGHT GREEN-YELLOW  |
| DPC | DARK PINK-CREAM    | LGR | LIGHT GREY          |
| DPO | DARK PINK-ORANGE   | LGK | LIGHT GREY-BLACK    |
| DPW | DARK PINK-WHITE    | LGB | LIGHT GREY-BROWN    |
| DPU | DARK PURPLE        | LGC | LIGHT GREY-CREAM    |
| DRE | DARK RED           | LGG | LIGHT GREY-GREEN    |
| DRK | DARK RED-BLACK     | LGO | LIGHT GREY-ORANGE   |
| DRB | DARK RED-BROWN     | LGP | LIGHT GREY-PINK     |
| DRO | DARK RED-ORANGE    | LGD | LIGHT GREY-RED      |
| DRP | DARK RED-PINK      | LGW | LIGHT GREY-WHITE    |
| DRW | DARK RED-WHITE     | LGK | LIGHT GREY-YELLOW   |
| DRY | DARK RED-YELLOW    | LMU | LIGHT MUSTARD       |
| DWH | DARK WHITE         | LOR | LIGHT ORANGE        |
| DWC | DARK WHITE-CREAM   | LOB | LIGHT ORANGE-BROWN  |
| DYE | DARK YELLOW        | LOW | LIGHT ORANGE-WHITE  |
| DYB | DARK YELLOW-BROWN  | LOY | LIGHT ORANGE-YELLOW |
| DYG | DARK YELLOW-GREEN  | LPI | LIGHT PINK          |
| DYW | DARK YELLOW-WHITE  | LPB | LIGHT PINK BROWN    |
| GN  | GREEN              | LPC | LIGHT PINK-CREAM    |
| NB  | GREEN-BROWN        | LPO | LIGHT PINK-ORANGE   |
| NY  | GREEN-YELLOW       | LPW | LIGHT PINK-WHITE    |
| GR  | GREY               | LPU | LIGHT PURPLE        |
| GK  | GREY-BLACK         | LRE | LIGHT RED           |
| GB  | GREY-BROWN         | LRK | LIGHT RED-BLACK     |
| GC  | GREY-CREAM         | LRB | LIGHT RED-BROWN     |
| GG  | GREY-GREEN         | LRO | LIGHT RED-ORANGE    |
| GO  | GREY-ORANGE        | LRP | LIGHT RED-PINK      |
| GP  | GREY-PINK          | LRW | LIGHT RED-WHITE     |
| GD  | GREY-RED           | LRK | LIGHT RED-YELLOW    |
| GW  | GREY-WHITE         | LWH | LIGHT WHITE         |
| GY  | GREY-YELLOW        | LWC | LIGHT WHITE-CREAM   |
| KH  | KHARKI             | LYE | LIGHT YELLOW        |
| LBK | LIGHT BLACK        | LYB | LIGHT YELLOW-BROWN  |
| LBL | LIGHT BLUE         | LYG | LIGHT YELLOW-GREEN  |
| LBR | LIGHT BROWN        | LYW | LIGHT YELLOW-WHITE  |
| LBB | LIGHT BROWN-BLACK  | MU  | MUSTARD             |
| LBC | LIGHT BROWN-CREAM  | OR  | ORANGE              |
| LBO | LIGHT BROWN-ORANGE | OB  | ORANGE-BROWN        |
| LBW | LIGHT BROWN-WHITE  | OW  | ORANGE-WHITE        |
| LBY | LIGHT BROWN-YELLOW | OY  | ORANGE-YELLOW       |
| LBU | LIGHT BUFF         | PI  | PINK                |
| LCR | LIGHT CREAM        | PB  | PINK BROWN          |

|    |             |
|----|-------------|
| PC | PINK-CREAM  |
| PO | PINK-ORANGE |
| PW | PINK-WHITE  |
| PU | PURPLE      |
| RE | RED         |
| RK | RED-BLACK   |
| RB | RED-BROWN   |
| RO | RED-ORANGE  |
| RP | RED-PINK    |
| RW | RED-WHITE   |

|    |               |
|----|---------------|
| RY | RED-YELLOW    |
| WH | WHITE         |
| WC | WHITE-CREAM   |
| YE | YELLOW        |
| YB | YELLOW-BROWN  |
| YG | YELLOW-GREEN  |
| YO | YELLOW-ORANGE |
| YR | YELLOW-RED    |
| YW | YELLOW-WHITE  |



**ILUKA RESOURCES LIMITED**

**TECHNICAL REPORT**

**ILUKA-TR-T18403**

**EL5265 Mannum  
Final Technical Report**

**07/06/2013 – 20/02/2015**

**BY  
Wesley Jones**

**Date:** 3/02/2015

**AUTHOR KEYWORDS:** Exploration, Murray Basin, Mannum, Heavy Minerals, Loxton Sand, Parilla Sand, Loxton-Parilla Sand, Blanchetown Clay, Geera Clay

ACN: 34 008 675 018

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Figure 2: EL5265 Drill Hole location plan 1:250,000

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Table 1: Map sheets enclosing EL5251 and coordinates of the tenement boundary

## LIST OF DIGITAL DATA

|                                          |                            |
|------------------------------------------|----------------------------|
| EL5265_201311_F_01_Annual_Report.pdf     | Annual Report              |
| EL5265_201311_F_02_Logging_Codes.pdf     | Iluka Logging Codes        |
| EL5265_201311_F_03_location.txt          | Surface Location File      |
| EL5265_201311_F_04_lithology.txt         | Lithological Logging Codes |
| EL5265_201311_F_05_geochemistry.txt      | Downhole Geochemistry      |
| EL5265_201311_F_06_survey.txt            | Survey Details             |
| EL5265_201311_F_07_qaqc.txt              | QA/QC Report               |
| EL5265_201311_F_08_Sections.pdf          | Geological Cross Sections  |
| EL5265_201311_F_09_Plans.pdf             | Location Plans             |
| EL5265_201311_F_10_Verification_List.txt | File Verification          |

## **EXECUTIVE SUMMARY**

The following report covers all work completed by Iluka Resources on Exploration Licence EL5265 from the 7<sup>th</sup> June 2013 to the 11<sup>th</sup> December 2014. EL5265 is south eastern South Australia approximately 65 kilometres east of Adelaide.

A single drilling campaign was completed during July and August 2013. A total of 83 holes were drilled for an advance of 4952.8m during the reporting period.

Minor HM was intersected within drillholes along ST067 with a maximum grade of 15m @ 1.2% HM from 28.5m.

A data review of the 2013 drilling has determined that the Loxton Sands are either not preserved or the Pliocene coast line did not extend this far east in the Murravian Gulf within EL5265.

## 1. INTRODUCTION

The following report is submitted to fulfil the annual reporting requirements for Exploration Licence (EL)5265. It covers the work undertaken by Iluka Resources Ltd over the reporting period from 7<sup>th</sup> June 2013 to the 11<sup>th</sup> December 2014.

### 1.1 Tenure

The EL5265 licence area was granted to Iluka Resources Ltd on 7<sup>th</sup> May 2013, for a period of two years over an area totalling 462 square kilometres. A full surrender of the tenement was undertaken on the 11<sup>th</sup> of December 2014.

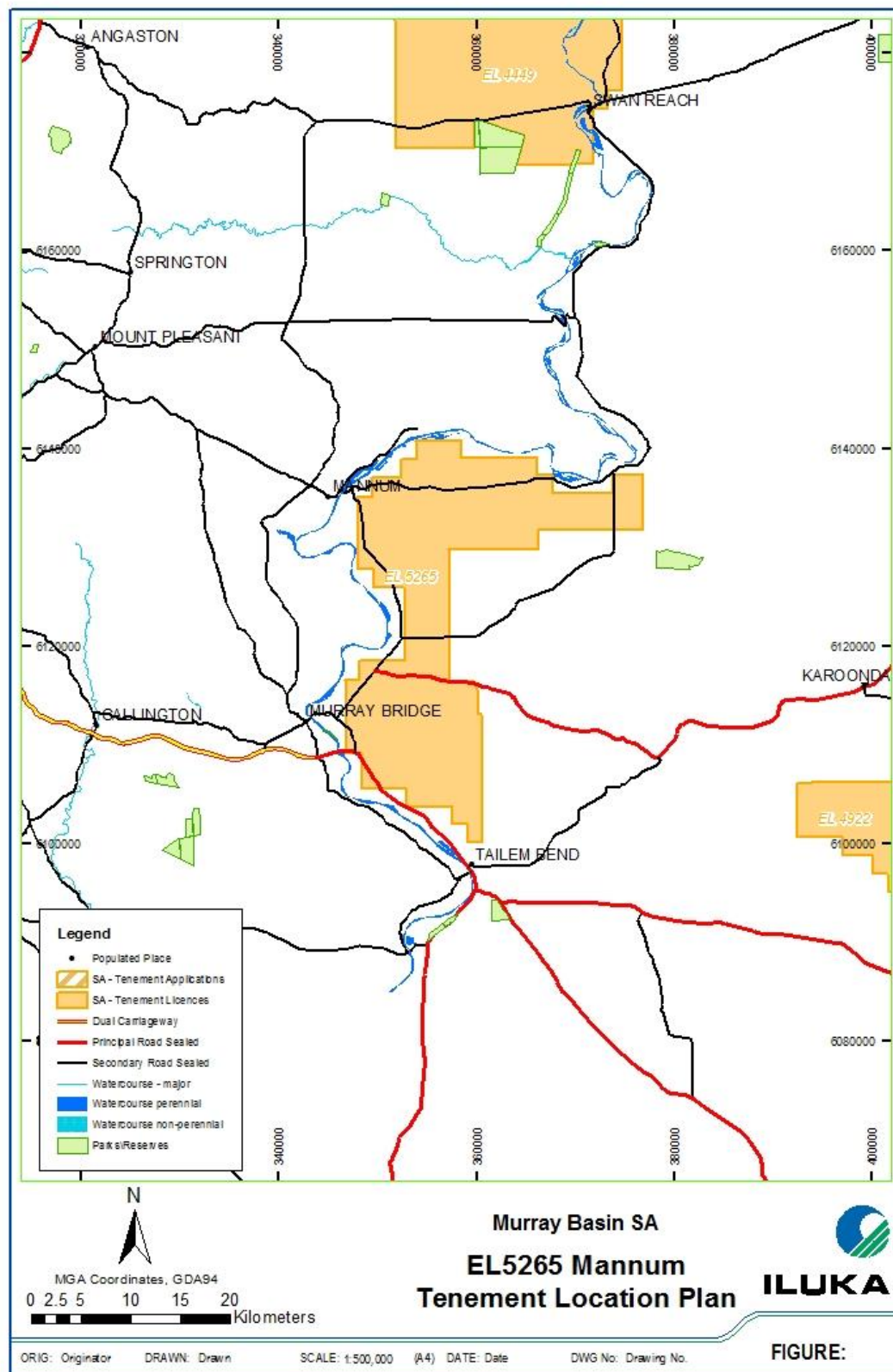
### 1.2 Location

EL5625 is located on the west margin of the Murray Basin, immediately east of the towns of Mannum and Murray Bridge on the eastern side of the current path of the River Murray in Eastern SA. Access to the tenement is via the old Princess Hwy and the Karoonda Hwy. Unsealed private roads provide access to the drill targets. Table 1 shows the Map sheets and current coordinate extent of the license boundary.

**Table 1:** Map sheets enclosing EL5265 and coordinates of the tenement boundary.

| <i>Map Sheets</i> |       |                  |      |
|-------------------|-------|------------------|------|
| <i>1:250,000</i>  |       | <i>1:100,000</i> |      |
| Adelaide Special  | I5409 | Mannum           | 6728 |
| Renmark           | I5410 | Swan Reach       | 6828 |
| Barker            | I5413 | Mobilong         | 6727 |





**Figure 1:** EL5265 Tenement Location Plan

### 1.3 Iluka's Exploration History and Rationale

Iluka Resources exploration rationale in the Murray Basin has been to target the mineralised Loxton-Parilla Sand (LPS) sediments deposited during the Pliocene marine regression, concentrating on higher grade, coarse-grained strands in regions of favourable mineral assemblage. The exploration for heavy mineral sand deposits has been performed using two techniques as described below;

The first technique utilises filtered airborne magnetics as a first pass coverage of the licence to delineate direct drill targets from magnetic anomalies. The magnetic information is derived from both airborne magnetic surveys commissioned by Iluka Resources, and state government based magnetic data.

The second technique involves the planning of drilling traverses based on previous drilling data, regional structural contour maps, detailed digital terrain models, and the utilisation of airborne magnetics. Drilling traverses usually commence with wide-spaced holes to investigate the broad geological setting, and then infilling to close-spaced drilling as required by geology and mineral intersections.

## 2. GEOLOGY

### 2.1 Regional Geology

The Murray Basin has been described as a shallow, intracratonic Cainozoic basin covering an area of 300,000 km<sup>2</sup> in south eastern South Australia, south-western New South Wales and north-western Victoria (Brown & Stephenson, 1991). The Murray Basin is flanked by low mountain ranges of Proterozoic and Palaeozoic rocks.

Much of the sedimentary sequence within the basin is the result of repeated marine incursions from the southwest, with the latest transgressive-regressive event resulting in deposition of the Late Miocene to Late Pliocene Loxton-Parilla Sand (LPS). These sediments were deposited in shallow-marine, littoral and fluvial conditions and comprise fine to coarse-grained, generally well-sorted sand, with minor clay, silt and gravel and host the Murray Basin mineral sand deposits (Brown & Stephenson, 1991).

Overlying the LPS in the northern and eastern Murray Basin is the Shepparton Formation. This deposit style consists of mixed fluvial channel and floodplain deposits, including some aeolian sediments. The lithology of the Shepparton Formation varies between gravel and clay. The source material varies between regions, leading to the subdivision of the unit based on geomorphic forms and soils, but all are consistent with Riverine Plain sedimentation (Brown & Stephenson, 1991).

A unit of greenish grey Blanchetown Clay disconformably overlies the Parilla Sand in many parts of the basin. The unconformity is often marked by a weathering profile that is locally siliceous or lateritic and termed the Karoonda Surface (Brown & Stephenson, 1991). The Blanchetown Clay is a fluvio-lacustrine deposit with most sedimentation taking place in a large freshwater lake. Within South Australia, the unit was deposited together with the Bungunna Limestone (Douglas and Ferguson, 1988).

Disconformably overlying the Blanchetown Clays is the Quaternary Woorinen Formation. This formation is described as consisting of "red-brown siliceous silty sand, red calcareous silty clay and sandy clay" (Brown & Stephenson, 1991). It is generally 2-3m thick, but contains east-west longitudinal dunes that can locally be considerably thicker. The Woorinen Formation was deposited in an aeolian environment. Other aeolian landforms have been identified on the basin, particularly the Lowan/Molineaux Sands occurring in the western part of the Murray Basin. These Dune Fields occur as three tongues otherwise known as the Sunset Desert, Big Desert and Little Desert. The dune patterns and types are different from the tear shaped east-west dunes of the Woorinen Formation (Douglas and Ferguson, 1988).

Disconformably overlying the Blanchetown clay on the western and north western basin margins is the Pooraka Formation. This formation generally forms "low to high-angle alluvial and colluvial fans adjacent to basin margins" (Brown and Stephenson, 1991) and ranges from 1 to 5m in thickness. As the material within the Pooraka formation is sourced from the surrounding Curnamona Province and Adelaidean sediments it is classified as a composite morphotectonic unit.

## 2.2 Local Geology

Along the north western margin off the Murray Basin, Murray Basin sediments on-lap a succession of metasediments, volcanic and granite rocks of Neoproterozoic to Early Palaeozoic age of the Adelaide Geosyncline. Towards the end of late Cambrian times, folding metamorphism and emplacement of granite during the Delamerian Orogeny affected both the Cambrian and Precambrian rocks of the Adelaide Geosyncline west of the Torrens Hinge Zone. This zone is known as the Delamerian fold belt. Aeromagnetic images of the northern Murray Basin display a large arcuate zone of curvilinear magnetic high anomalies stretching from south of the Broken Hill Block to the southwest towards the eastern Mount Lofty Ranges (Rankin et. al. 1991). It is likely that this structurally complex region was active during the deposition of the Murray Basin sediments. If the faults were active during the deposition of the Loxton-Parilla Sand (LPS), there is the potential for localised stacked sequences as a result of minor marine transgressions or still stand positions.

Exploration for heavy mineral sand within the Murray Basin is focused on intersecting the littoral marine sediments of the Pliocene aged Loxton-Parilla Sand, in particular sediment of relict strandlines that commonly host placer deposits of heavy mineral sand. This beach facies unit is very well developed, with well defined foreshore - surfzone - lowershore regressive sequence. The best heavy mineral accumulations manifest themselves within the foreshore within this unit. The tenement straddles a set of prominent east-west trending dune ridges which represent the dunal facies of the LPS and are the main target of drilling in the tenement area.

The diverse range of lithologies comprising the geosyncline includes many medium- to high-grade metamorphic and intrusive units that are unstable at surface conditions and therefore friable and readily eroded. These rocks could have made a significant contribution to the sediment load within the Murravian Gulf, including available heavy minerals.

### **3. EXPLORATION METHODS**

#### **3.1 Drilling**

All drilling was carried out with a Wallis Drilling Pty Ltd owned and operated reverse circulation air core drill rig. Drill hole collars were surveyed by RTK DGPS and GPS to an accuracy of  $\pm 1\text{m}$  and  $\pm 10\text{m}$  respectively and are included with the report as an electronic file (see EL5265\_201412\_F\_03\_location.txt). Rods were NQ in size giving approximately 10cm diameter holes.

Drilling was conducted at 1.5m sampling throughout the entire hole.

A 1 to 2 kg split was taken by rotary splitter for logging and laboratory analysis. A subsample was taken from each sample for logging and panning. The logging procedure involved using wet panning to remove the clay fraction from the sample and then hydraulic separation to estimate the percentage of heavy mineral.

For approximately one in six drillholes, an additional sample was collected for the Department of Manufacturing, Innovation, Trade, Resources and Energy (DMITRE) core library. These samples were collected following guidelines listed within the M41 Earth Resources Information Sheet and were dispatched to PIRSA in late 2012.

The ease with which clay and silt was liberated from the sample was logged on a scale of very easy to impossible (see EL5265\_201412\_F\_02\_Logging\_Codes.pdf) and the percentage of clay and silt ("Slimes") was also recorded. The presence and type of cemented fragments was recorded with an estimate of percentage ("Rock").

The ease with which the drill penetrated the ground was recorded on a scale of 1 to 5 ("Hardness"). Colour, dominant grain size, max grain size and sorting were also recorded. All geology logs are digitally included with this report (see EL5265\_201412\_F\_04\_lithology.txt).

#### **3.2 Heavy Mineral Determination**

Two hundred and seventy eight samples collected were assayed for heavy mineral (HM) content at Iluka's laboratory in Hamilton using the Method I procedure. Upon receipt, samples were dried, weighed, attritioned, then wet screened to remove the slime ( $-53\mu\text{m}$ ) fraction. The samples were again dried, weighed, and screened to remove the fraction greater than 2 mm (oversize) and were further screened at 710 microns and the remaining subsample of the  $-710\mu\text{m} + 53\mu\text{m}$  fraction underwent HM separation using LST (a solution of lithium polytungstate) at a specific gravity of 2.85. The weights were then used to calculate percent slimes, percent oversize and percent HM for the entire sample.

Final assay results are included in the attached digital file (EL5265\_201412\_F\_05\_geochemistry.txt).

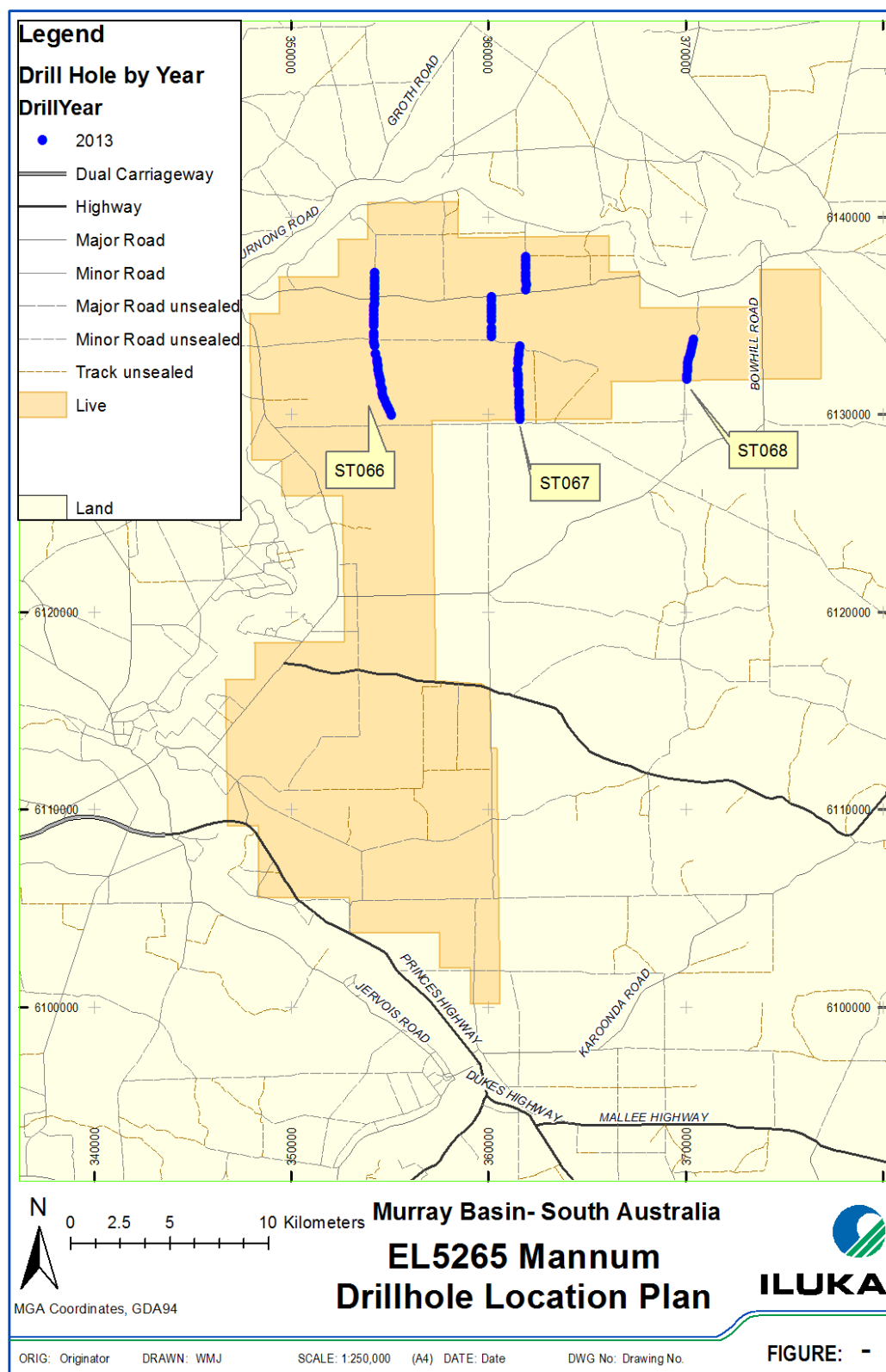
### **3.3 QAQC**

Field standards, duplicate samples and twin hole drill holes are routinely collected during Iluka drill programmes. The drilling completed on EL5265 was grassroots exploration. Therefore, only field standards were submitted for QAQC. Standards were submitted following the standard Iluka protocol with approximately one standard submitted for every 40 samples assayed. QAQC details are submitted in digital form in EL5265\_201412\_F\_07\_qaqc.txt.

## **4. EXPLORATION WORK COMPLETED**

A total of 83 holes were drilled across EL5265 during July and August 2013 for an advance of 4952.8m. Drilling was conducted along three traverses (ST066-ST068) on roadsides and private properties.

Geological cross sections and drill hole location plans are included in EL5265\_201412\_F\_08\_Sections.pdf and EL5265\_201412\_F\_09\_Plans.pdf (Fig 2) respectively.



**Figure 2: EL5265 Drill Hole Location Plan**

#### 4.1 Traverse ST066

A total of 35 holes (S01856-S01890) were drilled along ST066. Drillholes typically intersected from surface, up to 13.5m of recent dunal sands and inter-dunal clays; between 9 and 72m of dunal facies LPS sands; overlying very fine grained offshore sands (S01873, S01883-86) terminating in calcareous sands and sandstones and limestone of the Murray Group at depths between 35 and 84m. No significant mineralisation was intersected in drillholes along ST066 with only minor HM (<0.8) intersected within the dunal facies sands.

#### 4.2 Traverse ST067

A total of 37 holes (S01891-S01927) were drilled along ST067. Drilling intersected from surface between 13.5m of calcrete, recent dunal sands and inter-dunal clays; 16.5m to 46.5m of LPS dunal facies sands; up to 12m of very fine grained lowershore sand (S01901-S01924); terminating in Murray Group calcareous sandstone and limestone's at depths between 27m in the south (S01981) and 81m on dunal ridges in the centre of the traverse (S01899).

Minor HM was intersected within LPS dunal facies sands some drillholes along ST067 with maximum intersects of 9m @ 1 % HM / 28.5m in S01904, 15m @ 1.3% HM from 18m in S01905 and 7.5m @ 1.5 % HM / 27m in S01906. Sachet scanning of assayed samples revealed poor assemblage with a low VHM fraction of less than 2% with the HM fraction dominated by iron oxides, rock and trash minerals.

#### 4.3 Traverse ST068

A total of 11 holes (S01928-38) were drilled along ST068. Drillholes intersected from surface 3-4.5m of calcrete; 4.5-9m of lacustrine clays; 19.5-37.5m of dunal facies LPS sands; up to 9m of foreshore facies LPS sands (S01928-29, S01231-32); between 6 and 15m of fine grained lowershore facies LPS sands terminating in Murray Group calcareous sandstones at depths between 48m and 62m. S01938 was terminated at 1.5m in very hard calcrete. No significant mineralisation was intersected.

### 5. CONCLUSION

A single drilling campaign was completed during July and August 2013. A total of 83 holes was drilled for an advance of 4952.8m during the reporting period.

Minor HM was intersected within drillholes along ST067 with a maximum grade of 7.5m @ 1.5 % HM from 27m in S01906 most of this was Rock and trash mineral upon inspection.

A data review of the 2013 drilling has determined that the Loxton Sands are either not preserved or the Pliocene coast line did not extend this far east in the Murravian Gulf within EL5265.

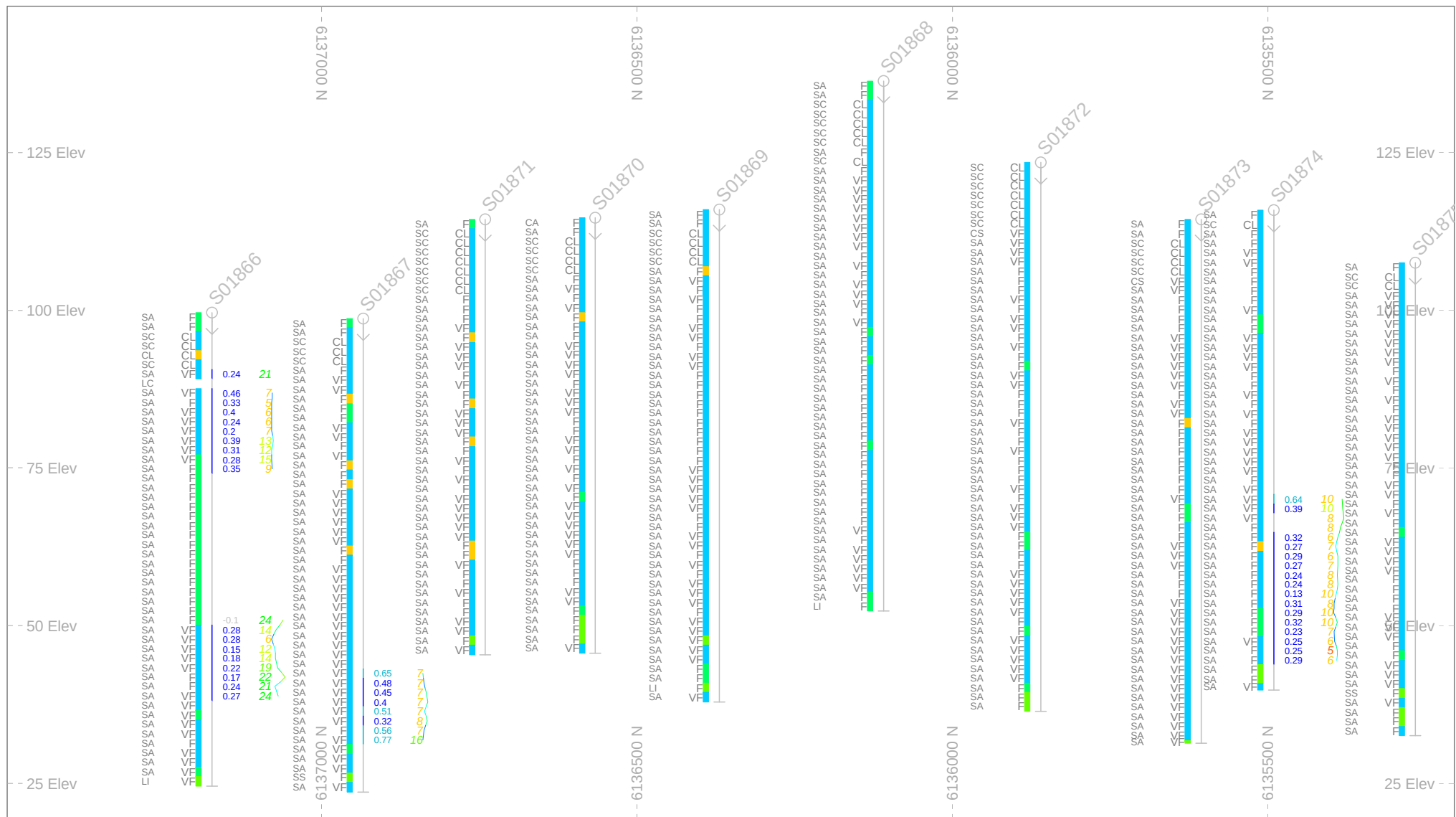
### 6. REFERENCES

Brown, C.M. and Stephenson, A.E., 1991. *Geology of the Murray Basin Southeastern Australia*, Bureau of Mineral Resources, Geology and Geophysics Bulletin 235

Douglas, J.G & Ferguson, J.A (Eds), 1988: *Chapter 8 – Tertiary* by C. Abele et al, in *Geology of Victoria*, Victorian Division Geological Society of Australia Incorporated, Melbourne, pp 265-272.

Rankin, L.R., Clough, B.J. and Gatehouse, C.G., 1991. *Mafic Suites in Nasegment Beneath the Murray Basin: New Data for the Early Palaeozoic History of the Tasman Orogenic Province*. PIRSA report book no 91/44 (DME 281/89)





ILUKA RESOURCES LTD  
ABN 34 008 675 018

EL5265 Mannum

GDA94 MGA 54

**S01 (Holes)**

- [ABSENT]
- [G]
- [M]
- [P]
- [VG]
- [VP]

**HM**

- 0.0-0.5
- 0.5-1.5
- 1.5-3.0
- 3.0-4.5
- 4.5-6.0
- 6.0-8.0
- 8.0-10.0
- 10.0-15.0
- 15.0-25.0
- 25.0-40.0

**Drillhole: OS**

- 0.0-0.5
- 0.5-1.5
- 1.5-3.0
- 3.0-4.5
- 4.5-6.0
- 6.0-8.0
- 8.0-10.0
- 10.0-15.0
- 15.0-25.0
- 25.0-40.0
- >40

**Legend**

Lithology: Far left

Dominant grain size: Left

Sorting: Left

Slimes: Right

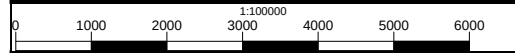
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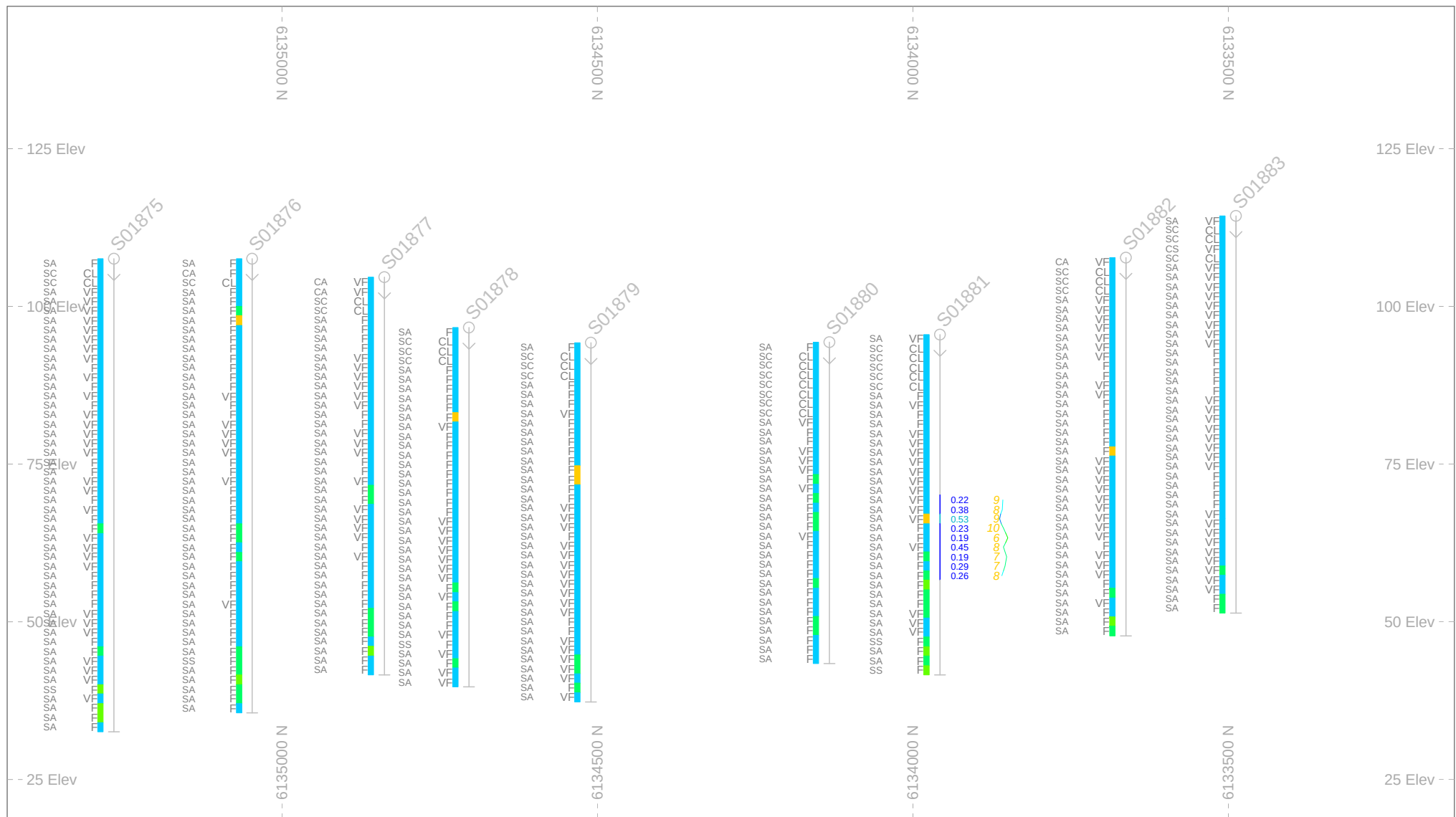
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Section 1 of 9

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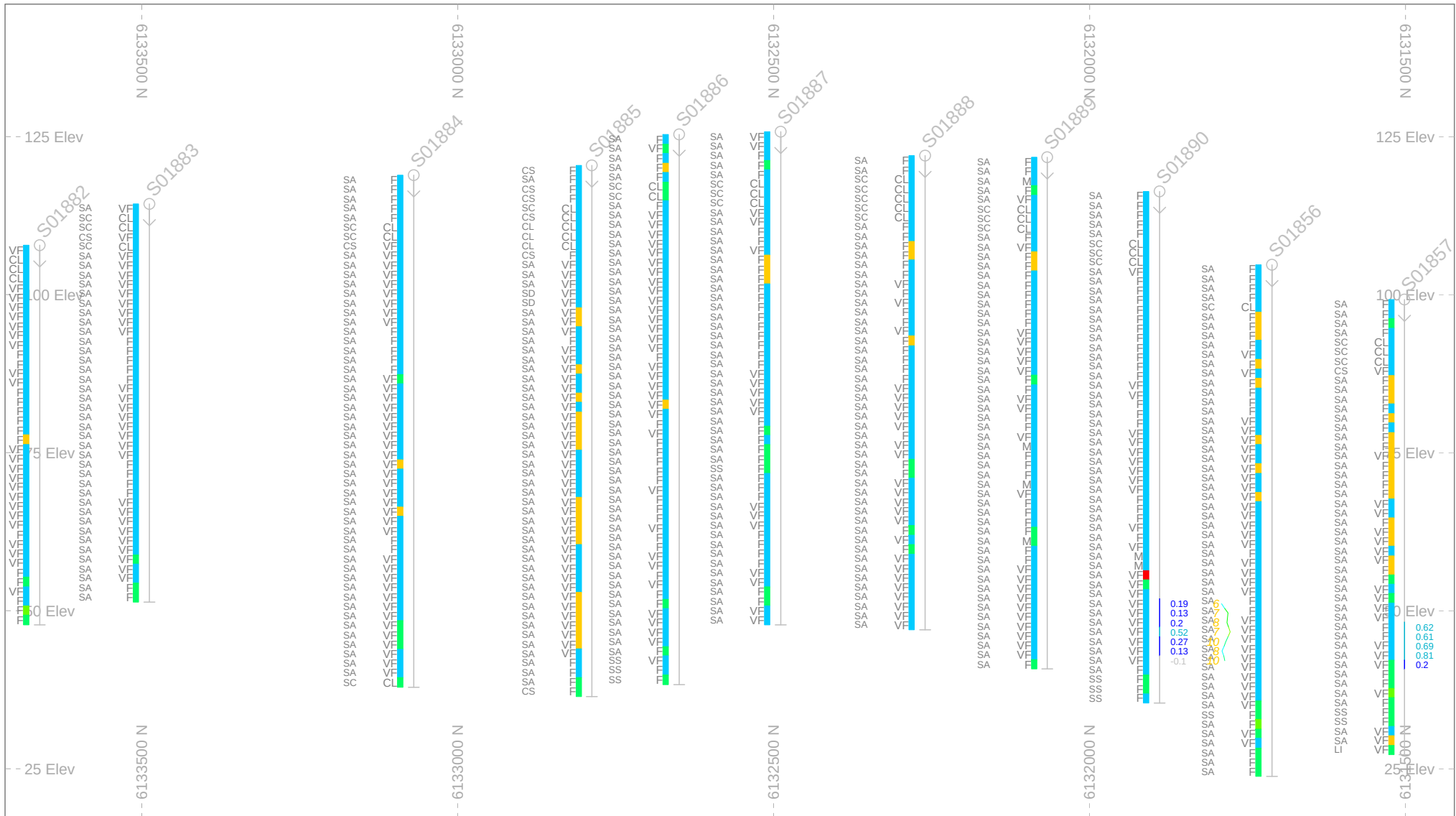


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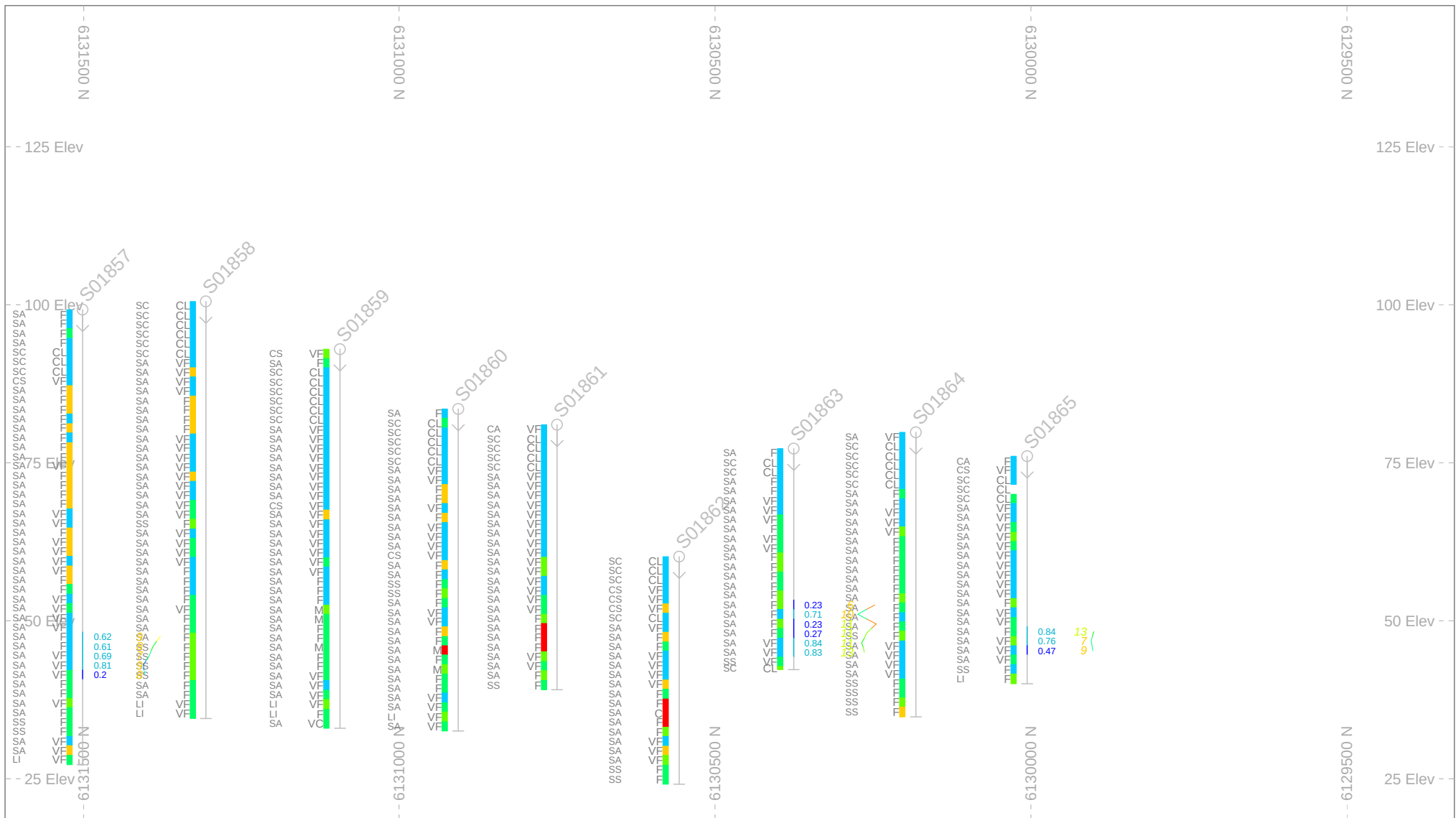
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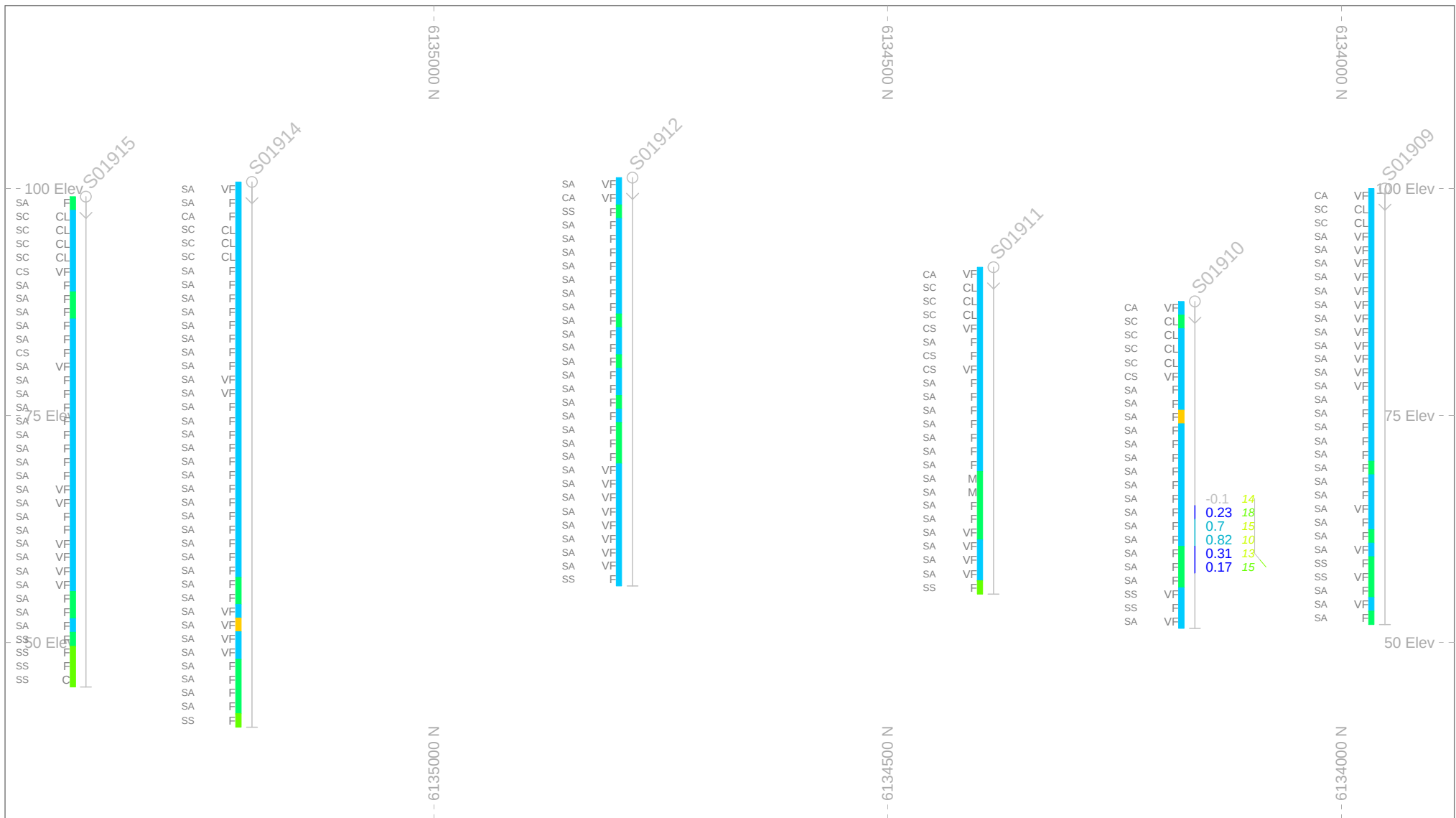
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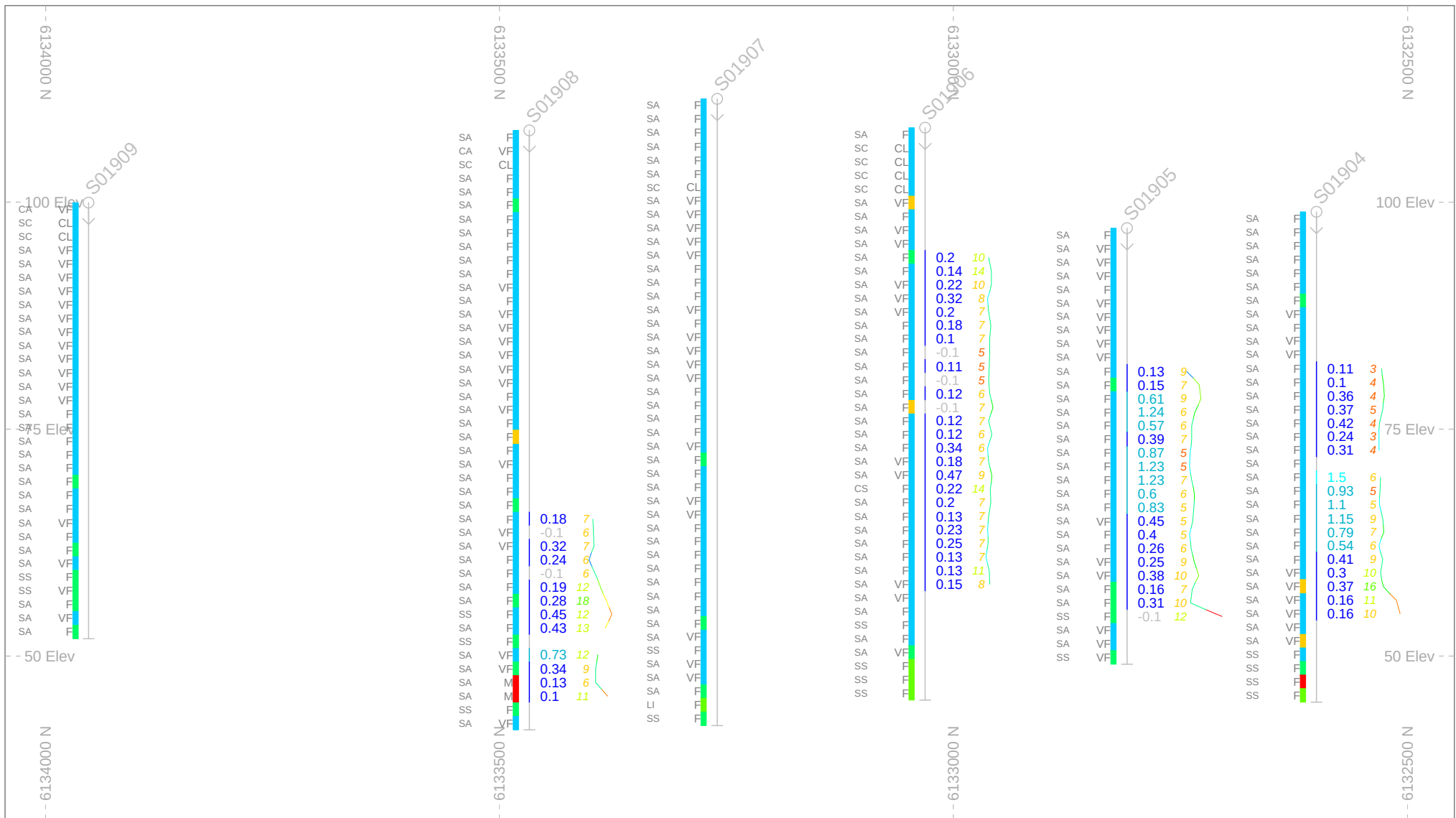


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EL5265 Mannum

GDA94 MGA 54

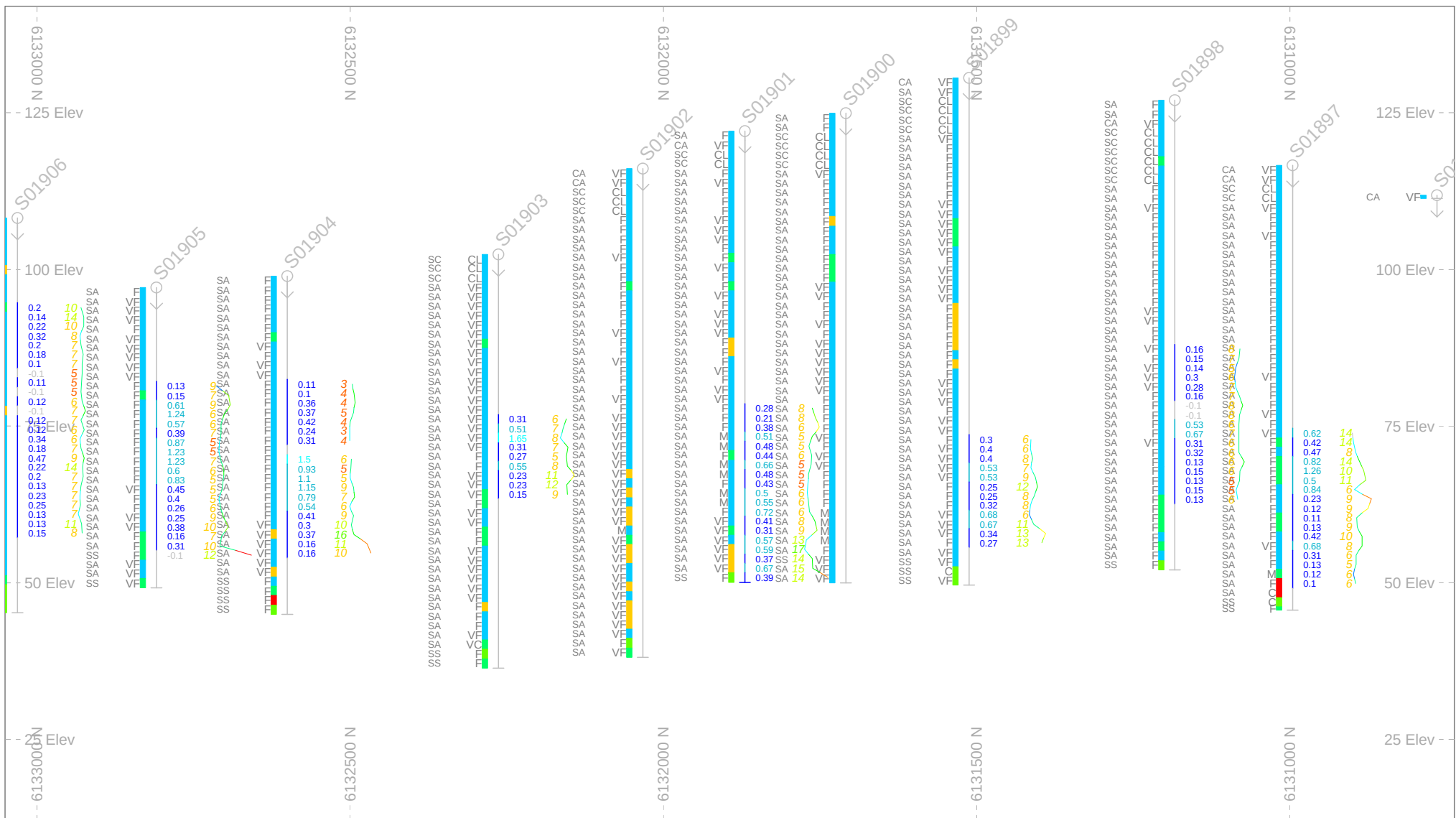
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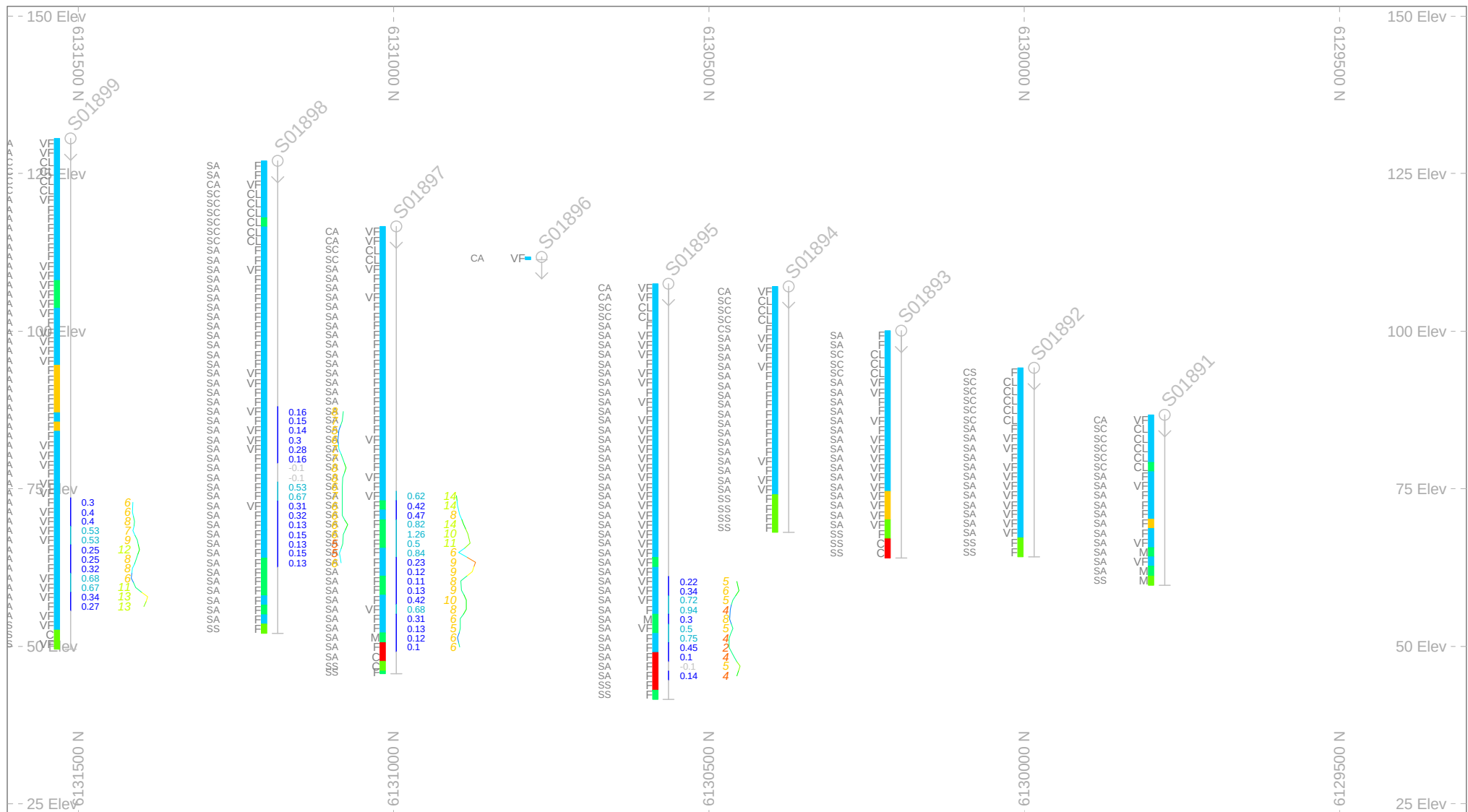
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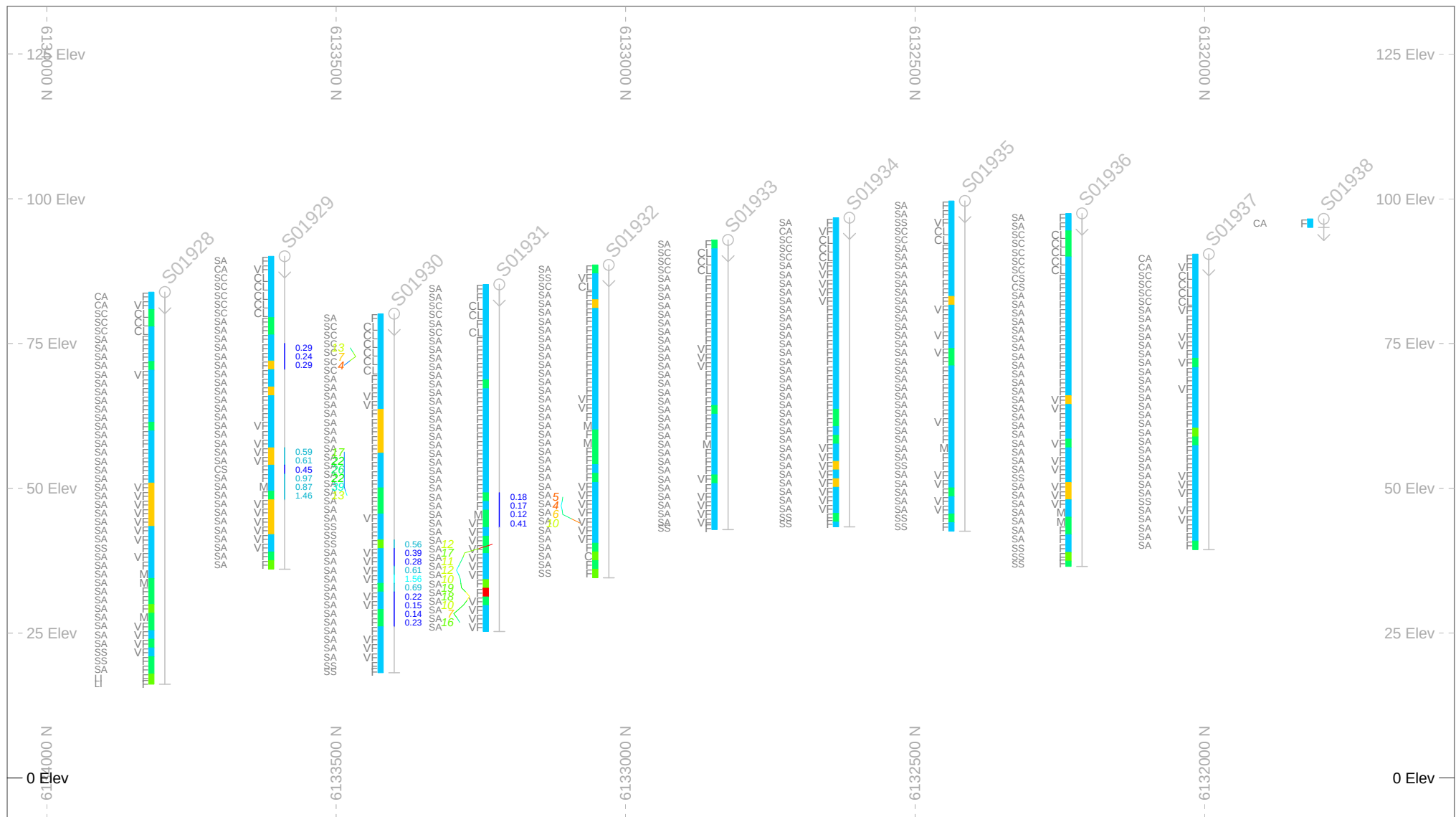


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|                                                  |  |  |  |                                                                     |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |                |                |             |
|--------------------------------------------------|--|--|--|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------|----------------|-------------|
| <b>ILUKA RESOURCES LTD</b><br>ABN 34 008 675 018 |  |  |  | <b>S01 (Holes)</b><br>[ABSENT]<br>[G]<br>[M]<br>[P]<br>[VG]<br>[VP] | <b>HM</b><br>[ABSENT/NEGATIVE]<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Drillhole: OS</b><br>[ABSENT/NEGATIVE]<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Legend</b><br>Lithology: Far left<br>Dominant grain size: Left<br>Sorting: Left<br>Slimes: Right<br>Oversize: Far right | <b>ST067 D</b> |                |             |
| EL5265 Mannum                                    |  |  |  |                                                                     |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |                | Section 8 of 9 |             |
| GDA94 MGA 54                                     |  |  |  |                                                                     |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |                | Date: 15/08/14 | Time: 08:17 |





|                                                                                           |  |                                                                     |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |              |                |             |
|-------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------|----------------|-------------|
| <b>ILUKA RESOURCES LTD</b><br>ABN 34 008 675 018<br><br>EL5265 Mannum<br><br>GDA94 MGA 54 |  | <b>S01 (Holes)</b><br>[ABSENT]<br>[G]<br>[M]<br>[P]<br>[VG]<br>[VP] | <b>HM</b><br>[ABSENT/NEGATIVE]<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Drillhole: OS</b><br>[ABSENT/NEGATIVE]<br>0.0-0.5<br>0.5-1.5<br>1.5-3.0<br>3.0-4.5<br>4.5-6.0<br>6.0-8.0<br>8.0-10.0<br>10.0-15.0<br>15.0-25.0<br>25.0-40.0 | <b>Legend</b><br>Lithology: Far left<br>Dominant grain size: Left<br>Sorting: Left<br>Slimes: Right<br>Oversize: Far right | <b>ST068</b> |                |             |
|                                                                                           |  | Section 9 of 9                                                      |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |              | Date: 15/08/14 | Time: 08:17 |
|                                                                                           |  |                                                                     |                                                                                                                                                     |                                                                                                                                                                |                                                                                                                            |              |                |             |

### Metadata used in Iluka Resources Ltd Surface Location Files

| Name       | Type* | Size | Decimals | Description                             |
|------------|-------|------|----------|-----------------------------------------|
| HOLE_ID    | C     | 10   | 0        | Hole Name                               |
| LATITUDE   | N     | 12   | 6        | Latitude                                |
| LONGITUDE  | N     | 12   | 6        | Longitude                               |
| RL         | N     | 7    | 2        | AHDRL Elevation                         |
| DATUM      | C     | 5    | 0        | Datum Name                              |
| SURV_METH  | C     | 10   | 0        | Survey Method                           |
| SURV_COMP  | C     | 10   | 0        | Survey Company                          |
| SURV_NAM   | C     | 10   | 0        | Surveyor Name                           |
| PEG_VAR    | C     | 1    | 0        | Variation from Peg                      |
| UTM_NORTH  | N     | 12   | 2        | Northing MGA (GDA94) datum              |
| UTM_EAST   | N     | 12   | 2        | Easting MGA (GDA94) datum               |
| UTM_GRIDID | C     | 10   | 0        | Universal Transverse Mercator Grid Name |
| LOCAL_E    | N     | 12   | 2        | Local Grid Easting                      |
| LOCAL_N    | N     | 12   | 2        | Local Grid Northing                     |
| LOCAL_GRID | C     | 20   | 0        | Local Grid Name                         |
| DRILL_TYPE | C     | 5    | 0        | Drilling Method                         |
| HOLE_SIZE  | C     | 3    | 0        | Hole Diameter                           |
| AZIMUTH    | N     | 1    | 0        | Azimuth of Drill String                 |
| DIP        | N     | 3    | 0        | Dip of Drill String                     |
| SAMP_SPLIT | C     | 5    | 0        | Percentage of Sample Taken              |
| TWIN       | C     | 1    | 0        | Twin Hole                               |
| TWIN OF    | C     | 10   | 0        | Twin Hole Original                      |
| TD         | N     | 6    | 1        | Depth of Hole                           |
| TENURE_REF | C     | 10   | 0        | Exploration Licence                     |
| STATE      | C     | 5    | 0        | State                                   |
| COMPANY    | C     | 10   | 0        | Exploration Company                     |
| PROJECT    | C     | 30   | 0        | Regional Project Area                   |
| DEPOSIT    | C     | 30   | 0        | Deposit                                 |
| GRID_LINE  | C     | 12   | 0        | Grid Line Name                          |
| TRAVERSE   | C     | 20   | 0        | Traverse Name                           |
| ANOMALY    | C     | 20   | 0        | Anomaly Name                            |
| PEG_ID     | C     | 12   | 0        | Peg Name                                |
| PAN        | C     | 1    | 0        | Confirmation of Panning                 |
| LOGGER     | C     | 15   | 0        | Logger Name                             |
| DRILL_CO   | C     | 10   | 0        | Drilling Company                        |
| DRILL_RIG  | C     | 10   | 0        | Drilling Rig                            |
| DATE       | C     | 10   | 0        | Date                                    |
| COMMENTS   | C     | 30   | 0        | Comments                                |
| VIS_VAL    | C     | 1    | 0        | Visual Validation of Data               |

\* C = Character  
N=Numeric

### Metadata used in Iluka Resources Ltd Lithological Logging Files

| Name      | Type | Size | Decimals | Description                        |
|-----------|------|------|----------|------------------------------------|
| HOLE_ID   | C    | 10   | 0        | Hole Name                          |
| PROJECT   | C    | 30   | 0        | Regional Project Area              |
| FROM      | N    | 5    | 1        | Depth From                         |
| TO        | N    | 5    | 1        | Depth To                           |
| SAMPLE_ID | C    | 10   | 0        | Sample Name                        |
| AS        | C    | 3    | 0        | Assay                              |
| SAMP_QUAL | C    | 1    | 0        | Quality of Sample                  |
| WATER     | C    | 1    | 0        | Sample Moisture                    |
| E_SL      | N    | 3    | 0        | Estimated Slimes Percentage        |
| WA        | C    | 2    | 0        | Washability of Sample              |
| CO1       | C    | 3    | 0        | Primary Sample Colour              |
| LI1       | C    | 3    | 0        | Primary Lithology                  |
| DGS1      | C    | 2    | 0        | Primary Dominant Grain Size        |
| CGS1      | C    | 2    | 0        | Primary Maximum Grain Size         |
| SO1       | C    | 2    | 0        | Primary Sorting                    |
| LINK      | C    | 2    | 0        | Link to Second Lithology           |
| CO2       | C    | 3    | 0        | Secondary Colour                   |
| LI2       | C    | 3    | 0        | Secondary Lithology                |
| E_LI2     | N    | 3    | 0        | Percentage of Secondary Lithology  |
| DGS2      | C    | 2    | 0        | Secondary Dominant Grain Size      |
| CGS2      | C    | 2    | 0        | Secondary Maximum Grain Size       |
| SO2       | C    | 2    | 0        | Secondary Sorting                  |
| IND       | C    | 4    | 0        | Induration                         |
| E_IND     | N    | 3    | 0        | Percentage of Induration in Sample |
| H         | N    | 1    | 0        | Hardness of Induration             |
| E_HM      | N    | 5    | 1        | Estimated HM percentage            |
| HMGS      | C    | 2    | 0        | HM Grain Size                      |
| QU        | C    | 3    | 0        | Qualifiers                         |
| COMMENTS  | C    | 30   | 0        | Comments                           |
| FM        | C    | 3    | 0        | Formation                          |

### Metadata used in Iluka Resources Ltd Assay Files

| Name      | Type | Size | Decimals | Description            |
|-----------|------|------|----------|------------------------|
| HOLE_ID   | C    | 10   | 0        | Hole Name              |
| FROM      | N    | 5    | 1        | Depth From             |
| TO        | N    | 5    | 1        | Depth To               |
| SAMPLE_ID | C    | 10   | 0        | Sample Name            |
| OS        | N    | 5    | 2        | Oversize Percentage    |
| SANDC     | N    | 5    | 2        | Coarse Sand Percentage |
| SAND      | N    | 5    | 2        | Sand Percentage        |
| SLIMES    | N    | 5    | 2        | Slimes Percentage      |
| HM        | N    | 5    | 2        | HM Percentage          |

## CODES

| CODE | ASSAY          |
|------|----------------|
| Y    | YES - HM ASSAY |
| N    | NO - HM ASSAY  |
| M    | MULTI ELEMENT  |
| D    | DUPLICATE      |
| 3P   | STANDARD       |
| E3   | STANDARD       |
| HG1  | STANDARD       |
| HG2  | STANDARD       |
| HG3  | STANDARD       |
| HG4  | STANDARD       |

| CODE | GRAINSIZE   |
|------|-------------|
| CL   | CLAY        |
| GR   | GRIT        |
| PB   | PEBBLE      |
| SI   | SILT        |
| VF   | VERY FINE   |
| F    | FINE        |
| M    | MEDIUM      |
| C    | COARSE      |
| VC   | VERY COARSE |

| CODE  | SURVEY COMPANY |
|-------|----------------|
| PDS   | Peter Danson   |
| ILUKA | Iluka          |

| CODE     | SURVEY METHOD |
|----------|---------------|
| GPS      | GPS           |
| DGPS RTK | DGPS RTK      |
| OTHER    | OTHER         |

| CODE | WATER    |
|------|----------|
| D    | DRY      |
| M    | MOIST    |
| W    | WET      |
| I    | INJECTED |

| CODE | COMPANY             |
|------|---------------------|
| ILU  | ILUKA RESOURCES LTD |

| CODE   | DRILLING COMPANY    |
|--------|---------------------|
| WALLIS | WALLIS DRILLING LTD |
| ILUKA  | ILUKA RESOURCES LTD |

| CODE       | DRILL RIG |
|------------|-----------|
| CUSTOM     | CUSTOM    |
| MANTIS1    | MANTIS1   |
| MANTIS2    | MANTIS2   |
| MANTIS3    | MANTIS3   |
| DELTA15    | DELTA15   |
| DELTA28    | DELTA28   |
| WALLD29    | DELTA29   |
| WALLIS D30 | DELTA30   |
| DELTA32    | DELTA32   |
| DELTA5     | DELTA5    |
| DELTA7     | DELTA7    |
| WARMAN     | WARMAN    |

| CODE    | DRILL TYPE                      |
|---------|---------------------------------|
| RCAC    | REVERSE CIRCULATION<br>AIR CORE |
| AU      | AUGER                           |
| RAB     | ROTARY AIR BLAST                |
| DIAMOND | DIAMOND                         |
| RC      | REVERSE CIRCULATION             |

| CODE | FORMATION          |
|------|--------------------|
| TFS  | TOP OF FORESHORE   |
| TLS  | TOP OF LOWERSHORE  |
| TSZ  | TOP OF SURFZONE    |
| TLI  | TOP OF LIMESTONE   |
| DU   | DUNAL              |
| WT   | TOP OF WATER TABLE |

---

| <b>CODE</b> | <b>INDURATION<br/>HARDNESS</b> |
|-------------|--------------------------------|
| 1           | VERY SOFT                      |
| 2           | SOFT                           |
| 3           | MEDIUM                         |
| 4           | HARD                           |
| 5           | VERY HARD                      |

| <b>CODE</b> | <b>HM GRAINSIZE</b> |
|-------------|---------------------|
| F           | FINE                |
| VF          | VERY FINE           |
| FM          | FINE-MEDIUM         |
| M           | MEDIUM              |
| MC          | MEDIUM-COARSE       |
| C           | COARSE              |
| VC          | VERY COARSE         |

| <b>CODE</b> | <b>HOLE SIZE</b> |
|-------------|------------------|
| BQ          | 60mm             |
| NQ          | 75.8mm           |

| <b>CODE</b> | <b>INDURATION</b>                                |
|-------------|--------------------------------------------------|
| FE          | FERRUGINOUS<br>INDURATION                        |
| SI          | SILICEOUS INDURATION<br>CALCAREOUS<br>INDURATION |
| CC          | INDURATION                                       |
| PY          | PYRITIC INDURATION                               |

| <b>CODE</b> | <b>LITHOLOGY</b> |
|-------------|------------------|
| BA          | BASALT           |
| CA          | CALCRETE         |
| CL          | CLAY             |
| CT          | CLAY STONE       |
| YS          | CLAY-SILT        |
| CS          | CLAYEY SAND      |
| CO          | COAL             |
| CG          | CONGLOMERATE     |
| DO          | DOLOMITE         |
| GA          | GRANITE          |
| GR          | GRAVEL           |
| GY          | GYPSUM           |

|     |                  |
|-----|------------------|
| HM  | HEAVY MINERAL    |
| IC  | INDURATED CLAY   |
| IR  | IRONSTONE        |
| LA  | LATERITE         |
| LI  | LIMESTONE        |
| LS  | LOMESAND         |
| LC  | LOST CORE        |
| MU  | MUDSTONE         |
| PY  | PYRITE           |
| QU  | QUARTZ           |
| RK  | ROCK UNKNOWN     |
| SA  | SAND             |
| SS  | SANDSTONE        |
| SC  | SANDY CLAY       |
| SAP | SAPROLITE        |
| ST  | SCHIST           |
| SH  | SHALE            |
| SE  | SILCRETE         |
| SI  | SILT             |
| SIS | SILTSTONE        |
| SD  | SILTY-SAND       |
| SY  | SILTY-CLAY       |
| SYS | SILTY-CLAY-SAND  |
| SDY | SILTY-SANDY-CLAY |
| SL  | SLATE            |
| SLM | SLIME            |
| SO  | SOIL             |

| <b>CODE</b> | <b>LINK</b> |
|-------------|-------------|
| TO          | TO          |
| AN          | AND         |

| <b>CODE</b> | <b>PEG VARIATION</b> |
|-------------|----------------------|
| Y           | YES                  |
| N           | NO                   |
| P           | PICK-UP              |

| <b>CODE</b> | <b>QUALIFIER</b>        |
|-------------|-------------------------|
| AT          | ABUNDANT BLACK<br>TRASH |
| CB          | CARBONACEOUS            |
| CT          | COMMON BLACK TRASH      |
| FE          | FERRUGINOUS             |

|     |                             |
|-----|-----------------------------|
| LA  | LATERITIC                   |
| MI  | MICACEOUS                   |
| MO  | MOTTLED                     |
| MT  | MINOR BLACK TRASH           |
| OX  | OXIDISED                    |
| PY  | PYRITIC                     |
| WE  | WEATHERED                   |
| SI  | SILICEOUS                   |
| CC  | CALCAREOUS                  |
| CE  | CARBONATE                   |
| GY  | GYPSUM                      |
| OR  | ORGANIC                     |
| ALF | ABUNDANT LATERITIC<br>FINES |
| CLF | COMMON LATERITIC<br>FINES   |
| MLF | MINOR LATERITIC FINES       |
| BM  | BASEMENT                    |
| TL  | TAILINGS                    |
| SL  | SLIMES                      |
| CV  | CAVEN                       |

| CODE | SAMPLE QUALITY |
|------|----------------|
| G    | GOOD           |
| M    | MODERATE       |
| P    | POOR           |

| CODE  | SAMPLE SPLIT      |
|-------|-------------------|
| 25_75 | 25% SAMPLE SPLIT  |
| 50_50 | 50% SAMPLE SPLIT  |
| 100   | 100% SAMPLE SPLIT |

| CODE | SORTING   |
|------|-----------|
| G    | GOOD      |
| M    | MODERATE  |
| P    | POOR      |
| VG   | VERY GOOD |
| VP   | VERY POOR |

| CODE | WASHABILITY |
|------|-------------|
| IM   | IMPOSSIBLE  |
| M    | MODERATE    |

|    |                      |
|----|----------------------|
| MD | MODERATELY DIFFICULT |
| ME | MODERATELY EASY      |
| VD | VERY DIFFICULT       |
| VE | VERY EASY            |

| CODE | COLOUR            |
|------|-------------------|
| BK   | BLACK             |
| BL   | BLUE              |
| BR   | BROWN             |
| BB   | BROWN-BLACK       |
| BC   | BROWN-CREAM       |
| BO   | BROWN-ORANGE      |
| BW   | BROWN-WHITE       |
| BY   | BROWN-YELLOW      |
| BU   | BUFF              |
| CR   | CREAM             |
| CO   | CREAM-ORANGE      |
| RC   | CREAM-RED         |
| DBK  | DARK BLACK        |
| DBL  | DARK BLUE         |
| DBR  | DARK BROWN        |
| DBB  | DARK BROWN-BLACK  |
| DBC  | DARK BROWN-CREAM  |
| DBO  | DARK BROWN-ORANGE |
| DBW  | DARK BROWN-WHITE  |
| DBY  | DARK BROWN-YELLOW |
| DBU  | DARK BUFF         |
| DCR  | DARK CREAM        |
| DCO  | DARK CREAM-ORANGE |
| DRC  | DARK CREAM-RED    |
| DGN  | DARK GREEN        |
| DNB  | DARK GREEN-BROWN  |
| DNY  | DARK GREEN-YELLOW |
| DGR  | DARK GREY         |
| DGK  | DARK GREY-BLACK   |
| DGB  | DARK GREY-BROWN   |
| DGC  | DARK GREY-CREAM   |
| DGG  | DARK GREY-GREEN   |
| DGO  | DARK GREY-ORANGE  |
| DGP  | DARK GREY-PINK    |
| DGD  | DARK GREY-RED     |
| DGW  | DARK GREY-WHITE   |
| DGY  | DARK GREY-YELLOW  |
| DMU  | DARK MUSTARD      |
| DOR  | DARK ORANGE       |

|     |                    |     |                     |
|-----|--------------------|-----|---------------------|
| DOB | DARK ORANGE-BROWN  | LCO | LIGHT CREAM-ORANGE  |
| DOW | DARK ORANGE-WHITE  | LRC | LIGHT CREAM-RED     |
| DOY | DARK ORANGE-YELLOW | LGN | LIGHT GREEN         |
| DPI | DARK PINK          | LNB | LIGHT GREEN-BROWN   |
| DPB | DARK PINK BROWN    | LNJ | LIGHT GREEN-YELLOW  |
| DPC | DARK PINK-CREAM    | LGR | LIGHT GREY          |
| DPO | DARK PINK-ORANGE   | LGK | LIGHT GREY-BLACK    |
| DPW | DARK PINK-WHITE    | LGB | LIGHT GREY-BROWN    |
| DPU | DARK PURPLE        | LGC | LIGHT GREY-CREAM    |
| DRE | DARK RED           | LGG | LIGHT GREY-GREEN    |
| DRK | DARK RED-BLACK     | LGO | LIGHT GREY-ORANGE   |
| DRB | DARK RED-BROWN     | LGP | LIGHT GREY-PINK     |
| DRO | DARK RED-ORANGE    | LGD | LIGHT GREY-RED      |
| DRP | DARK RED-PINK      | LGW | LIGHT GREY-WHITE    |
| DRW | DARK RED-WHITE     | LGY | LIGHT GREY-YELLOW   |
| DRY | DARK RED-YELLOW    | LMU | LIGHT MUSTARD       |
| DWH | DARK WHITE         | LOR | LIGHT ORANGE        |
| DWC | DARK WHITE-CREAM   | LOB | LIGHT ORANGE-BROWN  |
| DYE | DARK YELLOW        | LOW | LIGHT ORANGE-WHITE  |
| DYB | DARK YELLOW-BROWN  | LOY | LIGHT ORANGE-YELLOW |
| DYG | DARK YELLOW-GREEN  | LPI | LIGHT PINK          |
| DYW | DARK YELLOW-WHITE  | LPB | LIGHT PINK BROWN    |
| GN  | GREEN              | LPC | LIGHT PINK-CREAM    |
| NB  | GREEN-BROWN        | LPO | LIGHT PINK-ORANGE   |
| NY  | GREEN-YELLOW       | LPW | LIGHT PINK-WHITE    |
| GR  | GREY               | LPU | LIGHT PURPLE        |
| GK  | GREY-BLACK         | LRE | LIGHT RED           |
| GB  | GREY-BROWN         | LRK | LIGHT RED-BLACK     |
| GC  | GREY-CREAM         | LRB | LIGHT RED-BROWN     |
| GG  | GREY-GREEN         | LRO | LIGHT RED-ORANGE    |
| GO  | GREY-ORANGE        | LRP | LIGHT RED-PINK      |
| GP  | GREY-PINK          | LRW | LIGHT RED-WHITE     |
| GD  | GREY-RED           | LRJ | LIGHT RED-YELLOW    |
| GW  | GREY-WHITE         | LWH | LIGHT WHITE         |
| GY  | GREY-YELLOW        | LWC | LIGHT WHITE-CREAM   |
| KH  | KHARKI             | LYE | LIGHT YELLOW        |
| LBK | LIGHT BLACK        | LYB | LIGHT YELLOW-BROWN  |
| LBL | LIGHT BLUE         | LYG | LIGHT YELLOW-GREEN  |
| LBR | LIGHT BROWN        | LYW | LIGHT YELLOW-WHITE  |
| LBB | LIGHT BROWN-BLACK  | MU  | MUSTARD             |
| LBC | LIGHT BROWN-CREAM  | OR  | ORANGE              |
| LBO | LIGHT BROWN-ORANGE | OB  | ORANGE-BROWN        |
| LBW | LIGHT BROWN-WHITE  | OW  | ORANGE-WHITE        |
| LBY | LIGHT BROWN-YELLOW | OY  | ORANGE-YELLOW       |
| LBU | LIGHT BUFF         | PI  | PINK                |
| LCR | LIGHT CREAM        | PB  | PINK BROWN          |

|    |             |
|----|-------------|
| PC | PINK-CREAM  |
| PO | PINK-ORANGE |
| PW | PINK-WHITE  |
| PU | PURPLE      |
| RE | RED         |
| RK | RED-BLACK   |
| RB | RED-BROWN   |
| RO | RED-ORANGE  |
| RP | RED-PINK    |
| RW | RED-WHITE   |

|    |               |
|----|---------------|
| RY | RED-YELLOW    |
| WH | WHITE         |
| WC | WHITE-CREAM   |
| YE | YELLOW        |
| YB | YELLOW-BROWN  |
| YG | YELLOW-GREEN  |
| YO | YELLOW-ORANGE |
| YR | YELLOW-RED    |
| YW | YELLOW-WHITE  |