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Avonbank Heavy Mineral Sands Project
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2019 Hydrogeology Summary Report

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Client: WIM Resource Pty Ltd

ABN: 59159389929

Prepared by

AECOM Australia Pty Ltd
Level 10, Tower Two, 727 Collins Street, Melbourne VIC 3008, Australia
T +61 3 9653 1234 F +61 3 9654 7117 www.aecom.com
ABN 20 093 846 925

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Executive Summary

WIM Resource Pty Ltd (WIM) is currently progressing mining feasibility investigations at their Avonbank Heavy Mineral Sands Mine which is within Retention Licence 2014 (RL2014), located near Horsham in Western Victoria.

The key objective of this report is to provide an updated understanding of the baseline hydrogeology, specifically focused on the potential for and risks to Groundwater Dependant Ecosystems (GDE) in proximity to the Project.

WIM engaged AECOM Australia Pty Ltd (AECOM) to undertake a critical review of hydrogeological studies conducted to date and identify any potential data gaps in the conceptual hydrogeological understanding. Outcomes of the critical review highlighted:

- The need to further understand surface water – groundwater interactions in nearby ephemeral surface water features (Dooen Swamp, Darlot Swamp, Yarriambiack Creek and Two Mile Creek); and
- The need to further understand hydraulic connectivity between the Upper Tertiary (marine) Aquifer (UTAM), present within the Loxton Parilla Sands, and the Lower Tertiary Aquifer (LTA), which is present within the Renmark Group.

To address these data gaps works a program of air core drilling and groundwater bore drilling and additional groundwater monitoring bore installations were completed in early 2019.

The factual conclusions of 2019 site investigations were as follows:

- The upper aquifer (UTAM) beneath the Mine is brackish (salinity generally 6,000 to 13,000 mg/L TDS) with limited users in the vicinity of the mine plan area (only two registered stock and domestic bores within a 5 km radius).
- Groundwater within the upper aquifer shows a general increase in salinity down flow path (northwards), away from the surface drainage features present south of the proposed Mine.
- There is little change in hydro-geochemistry between up-gradient bores (south), bores adjacent to surface drainage features, bores screened within the mineralised zone and down gradient outside of the mineralised zone (north).
- Geera Clay is found to consist of a high plasticity clay unit beneath entire Mine site, with an observed head difference between the overlying (UTAM) and underlying (LTA) aquifers where monitored.
- The depth to groundwater beneath the lowest points of Darlot and Dooen Swamps is greater than 5 metres (measured in March 2019 at 5.9 and 6.2m respectively).
- Downward vertical gradient immediately adjacent to swamps.

The implications of this updated factual information on the groundwater risks from the Project are as follows:

- The ephemeral swamps (Dooen and Darlot) are losing systems, whereby they recharge the underlying aquifer whenever they fill with surface water flows.
- The depth to groundwater, vertical hydraulic gradient and groundwater salinity profile indicates that within Dooen Swamp and Darlot Swamp there is:
  - no potential for aquatic GDEs;
  - potential for terrestrial GDEs, but only if there exists deep rooted (phreatophyte) type vegetation that requires more than periodic flooding and is tolerant to brackish water.
- The mining of the mineral sands within the project area will require dewatering the upper aquifer (UTAM) by less than 10 metres. The extent of the resultant cone of depression will be limited by the relatively low permeability and temporal period of dewatering.

- Any tailings disposal into the mining voids will result in seepage of water entering the upper aquifer system, and will result in some level of mounding and changes to groundwater quality. The brackish nature and limited users of the upper aquifer (UTAM) across the Mine footprint mean the consequences are likely to be minor.
- Limited risks to the underlying Renmark Group aquifer (LTA) from either dewatering or mounding in the upper aquifer (UTAM) given the nature and occurrence of the mapped Geera Clay aquitard.

1.0 Introduction

1.1 Project Background

WIM Resource Pty Ltd (WIM) is progressing mining feasibility investigations at their Avonbank Heavy Mineral Sands Project ('Mine'). The proposed Mine is within, and covers less 40 percent of Retention Licence 2014 (RL2014), which is located near Horsham in Western Victoria (shown in

Figure 1**, Appendix A**).

The key objective of this report is to provide an updated understanding of the hydrogeology, specifically focused on the potential for Groundwater Dependant Ecosystems (GDE) in proximity to the Mine, based on field works undertaken in early 2019.

1.2 Scope of work

1.2.1 Hydrogeological Critical Review

In December 2018, WIM engaged AECOM Australia Pty Ltd (AECOM) to undertake a critical review of hydrogeological studies conducted to date. Outcomes of the review identified a number of data gaps in the conceptual hydrogeological understanding. To address these gaps, further drilling investigations and additional groundwater monitoring bore installations were proposed.

The critical review collated all available information, including previous investigations, with the intention to identify key data gaps that need to be addressed in preparation of the bulk test pit program and any EES submissions. The reports included in the review were:

1. Avonbank HMS Project Desktop Hydrogeological Assessment, prepared by GHD, August 2018.
2. Avonbank HMS project Groundwater monitoring bore and aquifer testing completion report, prepared by GHD, August 2018.
3. Groundwater Modelling Results, prepared by GHD, October 2018.
4. Report on Geotechnical Drilling Program, Preliminary Assessment of Pit Slopes, Trafficability and Excavabaility. Report no: 115138.01, prepared by ATC Williams, June 2017.
5. Warracknabeal and Brim Flood Investigation – Hydrology and Hydraulics. Prepared for Wimmera Catchment Management Authority by Water Technology, 2015.

1.2.2 Field Investigations

In February 2019, field groundwater based investigations were undertaken as recommended in the hydrogeological review. This work included:

1. Installation of six additional groundwater monitoring bores (GW18, GW19, GW20, GW21 and GW22) (locations shown on

2.

3. Figure 1**, Appendix A** construction detail provided in **Table 1, Appendix B**); and
4. Groundwater monitoring event of key bores (GW05, GW14, GW18, GW19, GW21 and GW22);
    - Sampling of groundwater bores was completed using low flow techniques in accordance with the groundwater sampling guidelines- EPA publication 669 (EPA, 2000);
    - Groundwater bores standing water level and total bore depths were measured prior to any sampling or installation of sampling equipment;
    - Measurement of field parameters- Electrical Conductivity, pH, temperature and redox during sampling was recorded to ensure collection of a representative groundwater sample;
    - Field Quality Assurance and Quality Control (QA/QC) samples were collected to ensure sampling and lab analysis techniques are adequate;
    - Water quality samples were sent to a NATA accredited laboratory and tested for the following laboratory analytical suite;
        - Salinity (as EC, as TDS);
        - Alkalinity (Total, OH, HCO_3, CO_3, Hardness);
        - Major Ions (Na, Ca, K, Mg, Cl, SO_4);
        - Metals (Al, As, Ba, Be, Br, B, Cd, Ce, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sr, Tl, Sn, Ti, V, Y, Zn);
        - Radionuclides (including gross alpha and beta) (bores GW05, GW20 and GW21 only), and
        - Uranium and Thorium (bores GW05, GW20 and GW21 only).
5. Deployment of electronic groundwater level data loggers in key bores recording on a daily interval.

2.0 Site Setting

A detailed regional outline of the hydrogeological setting of the Mine is provided in the Avonbank Hydrogeological Assessment (GHD, 2018). The following is a summary of the key aspects updated based on the information and data collected from the field investigations outlined in Section 1.2.2 (above):

2.1 Hydro-stratigraphy

The Mine is located on the southern boundary of the Murray Basin, which has been filled with Tertiary aged marine and non-marine sediments. These are overlain in many locations by Quaternary aged aeolian, fluvial and lacustrine sediments.

A description of the geological stratigraphy and their associated hydrogeological units are provided Table 1. Detailed description of the stratigraphic units is provided below.

2.1.1 Quaternary Aquifer (QA)

The recent and Quaternary aged unconsolidated deposits (QA) associated with drainage lines are generally less than 10 m thick, and may be periodically saturated closer to drainages.

The QA may exist adjacent to drainages such as the Wimmera River to the south where the Loxton Parilla Sands (LPS) have been eroded allowing for channel infill of more recent sediments. Recent drilling results at GW22 to the south west of the Mine and GW18 to the south east of the mine indicated the LPS was absent and that recent fluvio-deltaic sediments directly overlie the Geera Clay and form the upper aquifer.

Recharge to the QA is anticipated via river systems (such as the Wimmera River) and other surface water bodies. Recharge is expected to largely occur during episodic flooding events which allow for recharge to the bank storage and adjacent sediments, eventually feeding seeping down into the underlying aquifer system.

2.1.2 Upper Tertiary Aquifer (fluvial) (UTAF)

The Tertiary aged Shepparton Formation sediments (UTAF) are not saturated within the Mine and its immediate surrounds, and thus do not form an aquifer unit to be considered.

2.1.3 Upper Tertiary Aquifer (marine) (UTAM)

The Loxton Parilla Sands, which host the Upper Tertiary aged aquifer (UTAM), is comprised of dune, foreshore or surf zone sands overlying the mineralised offshore sands. The LPS thickness has been found to range from 20 to 30 m across the Project site. The UTAM is associated with the lower portion of the Loxton Parilla Sands (LPS) and has been found to be less than 10 m in saturated thickness across the Mine.

Individual bore yields from the UTAM are expected to be less than 0.5 L/second as the sediments are typically dominated by clays and silts in this region and have a relatively low permeability in comparison to other areas further west of the Wimmera River. Hydraulic conductivity is reportedly to range from 0.01 to 5.3 m/day but is known to be higher in places outside the Project area (URS, 2010). Aquifer (slug) tests were completed in 2018 on the Avonbank project bores (GHD, 2018b), with results reported hydraulic conductivity ranging from 0.1 to 2.3 m/day.

Groundwater recharge is expected to occur on the floodplains via direct rainfall infiltration and through seasonal deep drainage. Low rainfall and high evaporation rates are expected to result in low recharge rates to the water table aquifer. Localised recharge may also occur in areas where the UTAM has a relatively high permeability.

From a groundwater flow system viewpoint, the UTAM and the adjacent QA are considered to be fully connected and essentially form a continuous aquifer unit and are referenced as the UTAM/QA throughout the remainder of this report.

2.1.4 Upper Tertiary Aquitard (UTD)

The Geera Clay forms the Upper Tertiary Aquitard (UTD) within the Murray Basin. It is a hydraulically confining unit separating the UTAM/QA from the deeper Renmark Group (Lower Tertiary Aquifer - LTA).

Resource drilling has confirmed the Geera Clay is beneath the entire Mine footprint and immediate surrounds.

Regionally, the Geera Clay is described as comprising silty sandy clays, sometimes pyritic and carbonaceous and often containing fossils. At the Mine, drilling results indicate the Geera Clays to be dominantly a high plasticity, silty-sandy, clay.

Across the broader region the Geera Clay is intercepted immediately below the LPS and is reported to be 20 to 40 m thick (GHD, 2018a). Project specific mapping of the Geera Clay suggests actual thickness increases from south east to north west (URS, 2010), with 2019 (air-core) drilling results completed by WIM confirming the Geera Clay thickness to be 13 m at GW18, adjacent to Darlot Swamp, and >40 m beneath the mineralised portions of the LPS (WIM, 2019).

2.1.5 Lower Tertiary Aquifer (LTA)

The Renmark Group sediments form the basal depositional sequence of the Murray Basin and comprise fluvio-lacustrine sediments which make up the Lower Tertiary Aquifer (LTA).

The Renmark Group is noted to be present at a depth of around 70 to 80 m where investigated within RL2014.

The thickness of the LTA is varying and is largely controlled by the undulating nature of the top of basement bedrock. Previous work done in the region has shown thickness between 34 and 75 m beneath the Mine (URS, 2010). The aquifer is noted to be thicker towards the north-west, and possibly absent to the east of the Mine.

Inspection of registered bore lithology (Bores ID 68429 and 68430 shown on

Figure 1**, Appendix A**) indicate the LTA thickness is >50 m in the south west corner of RL2014 at bore 68429 and possibly absent registered bore 68430, east of the site and adjacent to Yarriambiack Creek, which is consistent with the literature.

Aquifer yields can be highly variable and are generally expected to range from <5 to 5 L/sec (URS, 2010). Yields are expected to generally improve to the north-west where the aquifer system is deeper and thicker.

Overall, the nature and extent of the overlying Geera Clay (UTD) suggests that the LTA will be hydraulically isolated from impacts within the upper aquifer(s).

2.1.6 Mesozoic and Palaeozoic Bedrock (BSE)

The Murray Basin Bedrock Aquifer (BSE) consists of predominantly of Grampians Group marine and fluvial sandstone, siltstone and minor conglomerate, Moralana Supergroup marine sandstone and siltstone and unnamed Cambrain ‘greenstone’.

Bedrock outcrops to the south (24 km) of the Mine in the Grampians Ranges and acts as primary recharge areas to the fractured bedrock aquifer and LTA. However, typically the BSE is highly weathered and clay dominant across is upper profile beneath the Murray Basin sediments (URS, 2010).

The significance of the BSE with respect to the Mine is considered negligible given its depth, upper weathering profile and the occurrence of the overlying Geera Clay aquitard. As such, the BSE is not discussed further.

Table 1 Stratigraphy

Period	Geological Unit	Geological Description	Location and Extent	Aquifer Unit[1]	Salinity (as TDS) range (mg/L)
Quaternary	Alluvial and Colluvial Deposits	Undifferentiated deposits of silty clays, sands and gravels	Outcropping along drainage lines (Yarriambiack Creek, Two Mile Creek and Wimmera River). Expected to be <10 m thick.	Quaternary Aquifer (**QA**)	Unknown
Quaternary/Tertiary (upper)	Shepparton Formation	Unconsolidated fluvial and lacustrine sediments consisting of sands, gravels and clays	Main surface outcrop formation across the Project area. Generally <10 m thick across Project area.	Quaternary / Upper Tertiary Aquifer (fluvial) (**UTAF**) *Not present*	Unknown
Tertiary (upper)	Loxton Parilla Sands	Sands, sandstones and silt. Shallow marine deposit.	Regionally extensive unit. In the order of 20-30 m thick across Project site. Host unit to HMS orebody.	Upper Tertiary Aquifer (marine) (**UTAM**)	3,501 – 13,000
Tertiary	Geera Clay	Clay, dark grey-black rare silt, sometime glauconitic	Regionally extensive unit, thinning towards the south western region of the Project site	Upper tertiary Aquitard (**UTD**)	Unknown
Tertiary	Renmark Group	Sands, gravels, clays	Regionally extensive but absent in local areas to the north east of the site	Lower Tertiary Aquifer (**LTA**)	3,501 – 13,000
Silurian	Grampians Group	Sandstones / siltstones / minor mudstones	Basement rock	Mesozoic and Palaeozoic Bedrock (**BSE**)	1,001 – 3,501

[1] Aquifer nomenclature based on the Victorian Aquifer Framework (DSE, 2012)

2.2 Groundwater Levels and Flow Direction

Groundwater levels have been measured monthly at all bores across the site since November 2018. Groundwater monitoring and elevation data is presented in **Table 3 and Table 4, Appendix B**.

2.2.1 UTAM/QA

The groundwater levels observed in the UTAM and QA (where present) ranged from 6.4 mbgl (GW19) to 37.9 mbgl (GW20) over the monitored period (November 2018 to May 2019).

The general pattern beneath the Mine is of an increasing depth to water from south to north. The saturated thickness of the UTAM is variable and appears to decrease along the observed flow path, to the northwest.

Depth to water plotted vs time (**Figure 4**, **Appendix A**) shows very little variation over the 7 month period and does not appear to be strongly influenced by seasonal variation. It is expected that water levels would be at annual maximums in November at the end of winter / spring season, then declining over the summer and autumn months.

It should be noted that measurements over the winter / spring higher rainfall months is absent from the dataset. In January 2019 the water level record at GW04 appears to be an outlier.

Interpolated groundwater flow contours (based on March 2019 data) in the UTAM/QA are presented in **Figure 3, Appendix A**. Groundwater elevations (plotted in **Figure 6, Appendix A**) range from 103 mAHD (GW20) to 126 mAHD (GW19) from southeast to northwest. The groundwater flow direction reflects topographic fall, in a north-north westerly direction. Measured groundwater elevation and flow direction at the project site are consistent with the regional publically available groundwater data as presented in the Desktop Hydrogeological Assessment (GHD, 2018a).

2.2.2 LTA

Groundwater in the LTA is confined, with groundwater levels in bores screened beneath the Geera Clay ranging between 5.8 mbgl (INV01) to 38.9 mbgl (GW10) (plotted in **Figure 5, Appendix A**). Similar to the UTAM there appears to be a general increasing depth to groundwater trend from south to north across the project site.

Groundwater elevations range from 107.2 mAHD (GW10) to 126.9 mAHD (INV01) (plotted in **Figure 7, Appendix A)**. Similarly to the water table aquifer, groundwater flow direction in the LTA is northwards. Measured site data is consistent with the regional publically available groundwater data as presented in the Desktop Hydrogeological Assessment (GHD, 2018a).

2.2.3 Vertical Gradients

An indication of the vertical hydraulic gradient beneath the Darlot Swamp (located approximately 1.9 km from the Mine) can be estimated within the UTAM/QA and also compared with the underlying LTA. In this area three bores are screened at different intervals:

- GW18 is screened at the water table;
- GW14 is screened at the base of the UTAM/QA; and
- INV02 is screened in the confined LTA. A generalised schematic of the groundwater heads at various depths is presented in **Figure 9, Appendix A**.

Comparison of the levels in these three bores (based on November 2018 to May 2019 gauge results) shows the following:

- UTAM/QA - A downward hydraulic gradient within the UTAM/QA of 0.015 m/m. This provides evidence that the ephemeral water body of the swamp is a losing system (discharges to groundwater). The time series data (see **Figure 6, Appendix A**) also shows the relative water level at GW18 consistently greater than GW14 (vertical hydraulic gradient downwards) over the monitored period.
- LTA – The groundwater level in the LTA bore is consistently 0.3 m higher than the deeper UTAM/QA bore. Thus although there is an apparent driving head in the underlying LTA, this does not appear to have been transmitted into the UTAM/QA, given the head difference and observed

downward hydraulic gradient seen within the aquifer. This provides clear evidence that the Geera Clay, in this location at least, is acting as effective hydraulic barrier.

2.2.4 Connectivity between LTA and UTAM/QA

The potential for any hydraulic connectivity between the LTA (Renmark Group Aquifer) and the UTAM/QA (upper aquifer within the LPS) is the controlled by the permeability of the Geera Clay and hydraulic gradient between the overlying and underlying aquifers.

WIM's resource drilling, and the additional drilling undertaken during various groundwater investigations, show the Geera Clay is present across the entire Mine footprint and also the wider RL2014. It has been logged to be predominantly a high plasticity, silty-sandy, clay with a thickness typically greater than 40 m beneath the Mine, where it has been fully intersected.

It is noted that outside RL2014 (adjacent to Darlot Swamp) the Geera Clay thickness has been interpreted to be approximately 13 m. However, it is at this location that the head different between the two aquifers above and below is recorded to be in the order of +0.3m, with no evidence of the pressure head being transmitted across the unit.

Thus, where the Geera Clay is found to be the thinnest, there is strong evidence to show there is no material hydraulic connection between the LTA and UTAM/QA, and gives confidence that beneath the Mine footprint, where it is observed to be thicker sequence, a similar lack of hydraulic connection can be assumed.

2.3 Groundwater quality

The February 2019 groundwater bore installation development records are presented in **Table 2**, **Appendix B**, with laboratory results from a number of groundwater samples collected in March 2019 presented in **Appendix D**.

The groundwater sample results provide the following information on baseline conditions beneath the proposed Mine:

2.3.1 Salinity

UTAM / QA

Six (6) monitoring bores screen in the UTAM/QA were sampled:

- Bores GW14, GW18 and GW22, are located adjacent to Darlot and Dooen swamps, with salinity reported at 13,000 mg/L 7,280 mg/L and 6,890 mg/L respectively.
- Bores adjacent to Darlot Swamp (GW14 and GW18) are constructed as a shallow and deep pair within the water table UTAM /QA aquifer. The shallow screened bore GW18 indicates a fresher water quality (7,280 mg/L) as compared with GW14 which is screened at the base of the aquifer, where salinity is 13,000 mg/L. These results are consistent with the calculated downward vertical hydraulic gradients (refer Section 2.2.3) adjacent to Darlot swamp, suggesting that fresher water captured in the swamp infiltrates downward and outwards to the underlying aquifer.
- Bore GW22, adjacent to Dooen Swamp and screened at the base of the UTAM/QA, suggests a similar (relatively fresher) environment as GW18 and some level of dilution due to recharge from the adjacent swamp, as compared to background (field parameters in GW19).

Although not sampled for water quality in March 2019, post development of groundwater bore GW19, adjacent to Two Mile Creek (data presented in **Appendix C**), recorded an EC of 14,910 µS/cm, equivalent to 9,691 mg/L TDS using the same conversion factor as the laboratory[2], noting that the bore is screened at the base of the UTAM/QA.

Samples from bores across the wider Mine footprint (GW05, GW21 and GW20) reported salinity ranging from 6,360 mg/L to 13,000 mg/L indicating that salinity is variable across the UTAM/QA and can be higher than anticipated. This compares with the publically available regional salinity mapping (as presented in GHD, 2018a) which indicates groundwater salinity (as TDS) within the UTAM/QA is in the order of 3,000 to 7,000 mg/L.

The variability in groundwater salinity observed in the UTAM/QA is likely a reflection of its heterogeneous nature, the proximity to recharge features (such as swamps/creeks) and the connectivity of higher permeability zones, such as the 'stringer' channels associated with higher energy depositions, to these recharge features.

LTA

No bores were sampled as part of the March 2019 groundwater monitoring event, however publically available regional salinity mapping (as presented in GHD, 2018a) indicates salinity in the LTA is in the order of 3,000 mg/L to 7,000 mg/L at the southern end of the Project area, increasing to 7,000 mg/L to 14,000 mg/L at the northern end of the Project area.

Bores screened in the LTA within and outside RL2014 (GW10, INV02 and INV03) were developed in April 2018 (GHD, 2018b) and field measurements taken. The field measurements show salinities of between 4,056 mg/L and 14,612 mg/L, which are consistent with regional mapping.

2.3.2 Major Ions

Major ions were analysed for from samples collected during the March 2019 groundwater monitoring event. **Figure 10, Appendix A** compares the ionic composition of the water samples collected from each bore. All bores samples show a Sodium (Na) + Potassium (K) – Chloride (Cl) dominant water type. Sample GW20 has a slightly higher Sulfate (SO_4) concentration, whilst GW22 exhibits a slightly higher Na concentration.

[2] Salinity as mg/L TDS = Electrical Conductivity (µS/cm) x 0.65

All waters plot along the central right portion of the hydro-chemical facies diamond indicating the alkalies exceed alkalkine earth metals, which is common for recharge water originating from rainfall infiltration.

There does not appear to be any major differences between the hydro-chemical facies of bores GW14 and GW18 screened at the upper and lower portions of the UTAM/QA or between bores positioned adjacent to swamps and the bores positioned within the ore body.

3.0 Discussion

3.1 Surface Water – Groundwater Interaction

3.1.1 Water Courses and Water Bodies

The surface topography, registered water courses and water bodies are presented in **Figure 2, Appendix A**, and include a number of artificial waterways within RL2014's boundary. This includes the Dooen Main Channel, Dooen East Channel, College Channel and the Jung West Channel. It is noted that the majority of these have been decommissioned, no longer in operation and/or are disconnected from the catchment since the commissioning of the Wimmera Mallee Pipeline (completed between 2006 and 2010).

The remaining key water bodies are discussed below:

3.1.2 Dooen Swamp

The Dooen Swamp has been reported to be a deep freshwater marsh (GHD, 2018) located adjacent and south west of RL2014, and approximately 2.0km from the Mine. In general, there is anecdotal evidence to suggest this swamp and Darlot Swamp have been modified through drainage and levelling since land development for agriculture during the 19th and 20th centuries.

The swamp is situated within 500 m (north) of the Wimmera River and is mapped as overlying Quaternary (Holocene) aged Unnamed Alluvium, consisting gravel, sand and silt. The swamp appears to have formed on the lithological boundary between the Quaternary Unnamed Alluvium and the adjacent Quaternary/Tertiary Shepparton Formation (fluvial and lacustrine sediments consisting of sands, gravels and clays).

Potential Groundwater Dependant Ecosystem (GDE) mapping undertaken by the Bureau of Meteorology (BoM) identify the swamp as having a low aquatic GDE potential. GHD (2018a) made comment that the wetland is ephemeral and is expected to be a losing surface water feature. The swamp is also classified by the BoM as having a high potential for supporting terrestrial GDEs.

Investigation works undertaken in 2019 have focused on assessing the potential groundwater connectivity to the swamp:

- Topographic survey:
  - Recent 1 m Lidar estimates the low point within Dooen Swamp is between 125 and 126 mAHD.
- Groundwater levels:
  - GW22 is installed approximately 250 m from the lowest surface point in the Dooen Swamp.
  - The LPS appears to have been eroded at GW22 and replaced with more recent Quaternary sediments associated with the surface drainage features.
  - Groundwater elevation at GW22 is reported at between 119.04 and 119.11 mAHD (March to May 2019), indicating that the water table is at least 5.9m below the swamp.

Overall the 2019 information shows the following in regards groundwater – surface water connectivity at Dooen Swamp:

- forms part of a historical river course feature that is likely to be (hydraulically) connected to the Wimmera River;
- not an aquatic GDE based on the observed depth to groundwater and the interpreted flow direction northwards, away from the swamp;
- groundwater salinity is marginally fresher beneath the swamp as compared to down flow path adding to the conceptual understanding that the swamp is likely a periodic recharge area for groundwater (i.e. limited to major flood events), and can be classified as a losing system;

GHD (2018a) noted that there is a high potential for terrestrial GDEs to be dependent on groundwater beneath or around the swamp. However, the measured depth to groundwater of 5.9m suggests

although there is potential for terrestrial GDEs, this would only be the case if there exists deep rooted (phreatophyte) type vegetation that requires more than the periodic flooding, and is tolerant of brackish water.

3.1.3 Darlot Swamp

The Darlot Swamp is located to the east and adjacent to RL2014 and approximately 1.9km from the Mine footprint. The swamp is located in the Yarriambiack Creek and Two Mile Creek floodplain.

The surface geology underlying the swamp is mapped largely as Quaternary (Holocene) aged fluvial gravel, sand and silt, and to the north bounds Quaternary (Pleistocene) aged Shepparton Formation consisting fluvial silt, sand and minor gravels (Geology is shown on **Figure 1, Appendix A**).

The swamp appears to be hydraulically connected to the Yarriambiack Creek and therefore likely receives flows when distributed from the Wimmera River.

Flows reaching Darlot Swamp appear to then return, via Two Mile Creek (southward), back into the Wimmera River (Water Technology, 2015). GHD (2018a) noted that Darlot Swamp is an ephemeral, freshwater marsh, expected to be a losing surface water feature, with a low potential to be an aquatic GDE. The assumption is supported by evidence that Yarriambiack Creek is largely dry for most periods, with exceptions after prolonged rainfall or after receiving flows from the Wimmera River (Water Technology, 2015).

Investigation works undertaken in 2019 have focused on assessing the potential groundwater connectivity to the swamp:

- Topographic survey:
  - Recent 1 m Lidar estimates the low point within Darlot Swamp is between 132 and 133 mAHD.
- Groundwater levels:
  - GW18 drilled adjacent to swamp indicate that the entire thickness of Loxton Parilla Sands has been removed and replaced with more recent Quaternary (Alluvium) sediments adjacent at this location; and
  - GW14 and GW18 are located approximately 330 m of the swamp, where the water table is observed within the Quaternary Alluvium at 125.8 mAHD (based on March to May 2019 observations).

Overall the 2019 information shows the following in regards groundwater – surface water connectivity at Darlot Swamp:

- lithology beneath the swamp is of the QA aquifer;
- not an aquatic GDE based on the observed depth to groundwater of 6.2m below the lowest point of swamp's surface;
- groundwater flow is northwards, away from the swamp and downwards within the shallow and deep portions of UTAM/QA bores (GW18 and GW14 respectively); and
- groundwater salinity measurements beneath the swamp in the UTAM/QA bores increases from 7,280 mg/L to 13,000 mg/L, which suggest the swamp is a recharge feature.

GHD (2018a) noted that Darlot Swamp is unlikely to support terrestrial GDEs, as per the national GDE assessment. The 2019 information suggests a potential for terrestrial GDEs, but as with Dooen Swamp, this would only be the case if there exists deep rooted (phreatophyte) type vegetation that requires more than the periodic flooding, and is tolerant of brackish water.

3.1.4 Yarriambiack Creek and Two Mile Creek

Yarriambiack Creek is approximately 2.4 km from the eastern boundary of RL2014, flows generally north and drains into Lake Coorong, northeast of Hopetown. The creek is a distributary of the Wimmera River and leaves the Wimmera near Drung Drung, approximately 20 km east of Horsham.

Creek flow is intermittent and only significant rainfall events occurring within the catchment will generate flows. However, it is also noted that creek flow depends almost entirely on the level of the Wimmera River which distributes flow into the creek during certain periods. There are a number of weirs built along the creek to hold water.

During high flows, the majority of flow distribution to Yarriambiack Creek (from the Wimmera River) returns to the Wimmera River via Two Mile Creek (and subsequently through Darlot Swamp). Approximately 30% of flow distributed from the Wimmera River continues northwards along Yarriambiack Creek (Water Technologies, 2015).

The creek is subject to flooding, notable flood events are recorded for 1909, 1981, 1983 and most recently in September 2010 and January 2011 after not flowing for most of 1995 – 2010.

Lidar data provided by WIM is presented in **Figure 2, Appendix A**. Lidar along Yarriambiack Creek indicates a very subtle fall along each of the drainage lines:

- At Wimmera Highway, 1,500 m North of Darlot Swamp The lowest observed LIDAR point is 131 mAHD;
- East of Jung Tip Road, 2,700 m North of Darlot Swamp, the lowest observed LIDAR point is 129 mAHD; and
- At Green Hills Road, ~5,000 m North of Darlot Swamp, the lowest observed LIDAR point is 128 mAHD.

Mapped groundwater table elevation contours within RL2014, west of these points infer the water table is between 125 and 115 mAHD, groundwater contours show a north – northwest flow direction, away from Yarriambiack Creek.

Similarly to Yarriambiack Creek, the topography fall along Two Mile Creek appears to be subtle:

- South (300 m) of GW19, the lowest observed LIDAR point is 131 mAHD; and
- Where Two Mile Creek reaches the Wimmera River, the lowest observed LIDAR point is 128 mAHD.

Adjacent to Two Mile Creek at GW19, depth to groundwater is less than 7 m below ground level, the groundwater elevation is around 126.3 mAHD (observed March to May 2019), Groundwater gradients infer flow direction is north, away from Two Mile Creek (and subsequently away from the Wimmera River). Depth to groundwater may become shallower in closer proximity to the creek, becoming readily accessible to terrestrial GDEs. Salinity estimates (from post development EC measurements) do not appear to suggest any freshening of the aquifer at GW19.

4.0 Conclusions

The factual outcomes from the 2019 field investigations are as follows:

- The upper aquifer (referred to as the UTAM/QA) beneath the Mine is brackish (salinity generally 6,000 to 13,000 mg/L TDS) with limited users in the vicinity of the mine plan area (only two registered stock and domestic bores within a 5 km radius).
- Groundwater within the upper aquifer shows a general increase in salinity down flow path (northwards), away from the surface drainage features present south of the proposed Mine.
- There is little change in hydro-geochemistry between up-gradient bores (south), those adjacent to surface drainage features, bores screened within the mineralised zone and down gradient outside of the mineralised zone (north).
- Geera Clay is found to consist of a high plasticity clay unit beneath entire Mine site, with an observed head difference between the overlying (UTAM) and underlying (LTA) aquifers where monitored.
- The depth to groundwater beneath the lowest points of Darlot and Dooen Swamps is greater than 5 metres (measured in March 2019 at 5.9 and 6.2m respectively).
- Downward vertical gradient immediately adjacent to swamps.

The implications of this updated factual information on the potential groundwater risks are as follows:

- The ephemeral swamps (Dooen and Darlot) are losing systems, whereby they recharge the underlying aquifer whenever they fill with surface water flows.
- The depth to groundwater, vertical hydraulic gradient and groundwater salinity profile indicates that within Dooen Swamp and Darlot Swamp there is:
  - no potential for aquatic GDEs;
  - potential for terrestrial GDEs, but only if there exists deep rooted (phreatophyte) type vegetation that requires more than the periodic flooding, and is tolerant to brackish water.
- The mining of the mineral sands within the project area will require dewatering the upper aquifer (UTAM/QA) by less than 10 metres. The extent of the resultant cone of depression will be limited by the relatively low permeability and temporal period of dewatering.
- Any tailings disposal into the mining voids will result in seepage of water entering the upper aquifer system, and will result in some level of mounding and changes to groundwater quality. The brackish nature and limited users of the upper aquifer in the Project area mean the consequences are likely to be minor.
- Limited risks to the underlying Renmark Group aquifer (LTA) from either dewatering or mounding in the upper aquifer (UTAM) given the nature and occurrence of the mapped Geera Clay aquitard.

5.0 Limitations

AECOM Australia Pty Limited (AECOM) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of WIM Resource Pty Limited and only those third parties who have been authorised in writing by AECOM to rely on this Report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Report.

It is prepared in accordance with the scope of work and for the purpose outlined in the variation (email) request dated 20 May 2019, under the Hydrology – Critical Review contract dated 18 December 2018

Where this Report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information except as expressly stated in the Report. AECOM assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between 20 May 2019 and 28 May 2019 and is based on the information reviewed at the time of preparation. AECOM disclaims responsibility for any changes that may have occurred after this time.

This Report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This Report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

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It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

6.0 References

AECOM 2019, Hydrogeological Gap Analysis – Avonbank Heavy Mineral Sands Project. Letter report no# 60595006-ENV-LTR-001, prepared for WIM Resource Pty Ltd, Melbourne Victoria, May 2019

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GHD 2018b. "*Avonbank HMS project Groundwater monitoring bore and aquifer testing completion report*." prepared by GHD, August 2018.

GHD 2018c. "*Groundwater Modelling Results.*" prepared by GHD, October 2018

Water Technology 2015. "*Warracknabeal and Brim Flood Investigation – Hydrology and Hydraulics*." Report R01 (reference 3532-01) prepared for Wimmera CMA, Notting Hill, Victoria.

URS, 2010 "*Grampians West Groundwater Resource Appraisal*." Report 43325977/1/4 prepared for Grampians Wimmera Mallee Water, June 2019

Appendix A

Figures

Appendix A Figures

INSERT 1

GW09 GW10 GW09R GW17

GW20

SLE CH

KALKEE CHANNEL

JUNG NORTH CHANNEL

JUNG WEST EXT CHANNEL

MAIN WESTERN CHANNEL

JUNG WEST CHANNEL

JUNG WEST CHANNEL

GW08

HENTY HIGHWAY

DOOEN EAST CHANNEL

BH05

68430

GW09 GW10 GW09R GW17

GW05 BH04

JUNG

GW04

YARRIAMBIACK CREEK

Dooen Landfill

DOOEN MAIN CHANNEL BH06

GW11

GW03

DOOEN MAIN CHANNEL

WIMMERA HIGHWAY

PATTERSONS SWAMP CHANNEL

DOOEN CENTRAL CHANNEL

YARRIAMBIACK CREEK

MAIN WESTERN CHANNEL

DARLOT CHANNEL

DARLOT SWAMP

GW21

BH01 BH03

GW13

BH02

INV02

GW18

GW14

DARLOT SWAMP

GW02

WALMER NORTH CHANNEL

GW01

68429

GW19

TWO MILE CREEK

WALMER NORTH CHANNEL

DOOEN

GW22

GW15

COLLEGE CHANNEL

DOOEN SWAMP

GW16

INV03

TWO MILE CREEK

LONGERENONG NORTH CHANNEL

COLLEGE

LONGERENONG NORTH

WIMMERA RIVER

TWO MILE CREEK

INV01

LONGERENONG

INSERT 2

GW14

INV02

GW18

NO 3 CHANNEL

WIMMERA RIVER

RIVERSIDE

TWO MILE CREEK

Data sources:
VicMap data:

PROJECT ID 60595006
CREATED BY TSMITH
LAST MODIFIED TSMITH 30 MAY 2019

AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 500 1,000 2,000

metres

1:50,000 (when printed at A3)

LEGEND

Select Registered Bores

Aquifer

UTAM / QA

LTA

Resource Block CB1
Resource Block CB2
Resource Block EB
Resource Block WB
30_year_mine_pit_shell Extent

RL2014
Freeway/Highway
Major Roads
Minor Roads
Watercourse
Waterbody

Surface Geology (1:250000)

Unnamed alluvium
Unnamed swamp and lake deposits
Shepparton Formation
Lowan Sand
Parilla Sand
Grampians Group
Dooen Landfill

Site Features

WIM Resource Pty Ltd

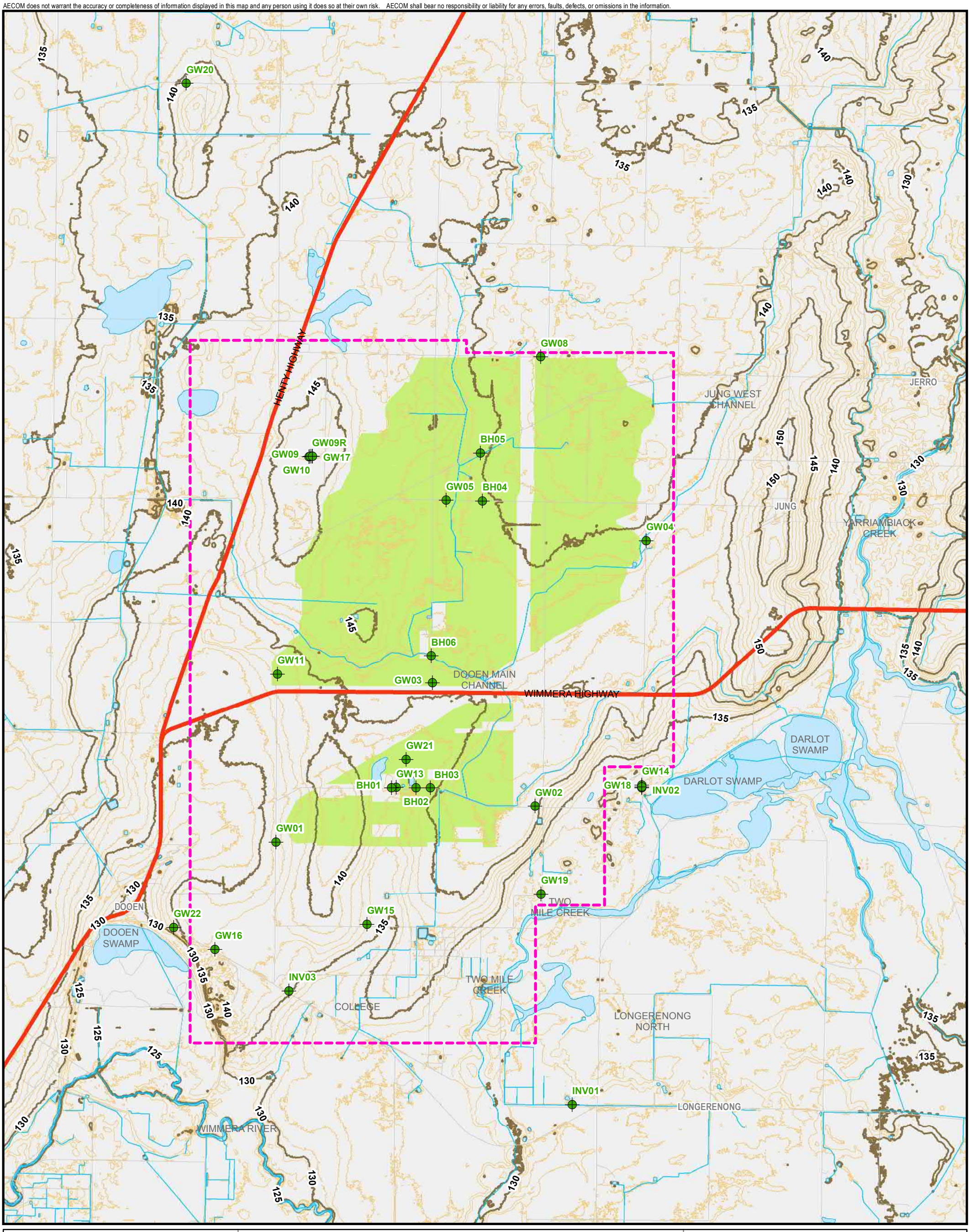
Avonbank Project Hydrogeological Summary Report

Dooen, VIC

Figure 1

Map Document: (\\aumel1fp001\projects\605X\60595006\900_CAD_GIS\920_GIS\MXD\03 Hydro Summary Report\60595006_F1_SiteFeatures.mxd)

A3 size



PROJECT ID 60595006
CREATED BY TSMITH
LAST MODIFIED TSMITH 06 JUN 2019

AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION MGA ZONE 55

0 500 1,000 2,000
metres

1:50,000 (when printed at A3)

LEGEND

- Groundwater_Bore_Locations
- RL2014
- 30_year_mine_pit_shell Extent
- Freeway/Highway
- Major Roads
- Minor Roads
- Watercourse
- Waterbody
- 5 m Surface Contour
- 1 m Surface Contour

Notes:
A significant number of the registered water courses / channels identified as drainage features accross the site are believed to have been decommissioned, no longer in operation and/or disconnected from the local catchment.

Data sources:
VicMap data:

Surface Topography and Drainage Features

WIM Resource Pty Ltd

Avonbank Project Hydrogeological Summary Report

Dooen, VIC

Figure 2

Map Document: (\\aumel1fp001\projects\605X\60595006\900_CAD_GIS\920_GIS\MXD\03 Hydro Summary Report\60595006_F2_Topography and Drainage.mxd)

A3 size

GW20 103.32
GW08 112.35
GW09
GW09R
GW17 112.37
BH05
GW05 114.64
BH04
GW04 118.00
GW11 118.66
BH06
GW03 118.94
GW21 120.60
GW13 121.48
BH02
BH01
BH03
GW02 124.70
INV02
GW14 125.70
GW18 125.84
GW01 121.17
GW19 126.37
GW22 119.11
GW15 123.93
GW16 121.72
INV03
INV01

105
110
115
120
125

HENTY HIGHWAY
WIMMERA HIGHWAY
KALKEE CHANNEL
JUNG NORTH CHANNEL
JUNG WEST EXT CHANNEL
MAIN WESTERN CHANNEL
YARRIAMBIACK CREEK
DOOEN EAST CHANNEL
DOOEN MAIN CHANNEL
DOOEN CENTRAL CHANNEL
WALMER NORTH CHANNEL
KEWELL EAST CHANNEL
DARLOT CHANNEL
COLLEGE CHANNEL
WIMMERA RIVER
NO 3 CHANNEL
TWO MILE CREEK
LONGERENONG NORTH CHANNEL

JERRO
JUNG
DOOEN
LONGERENONG

DARLOT SWAMP
Surface RL 132

DOOEN SWAMP
Surface RL: 125

PROJECT ID 60595006
CREATED BY TSMITH
LAST MODIFIED TSMITH 06 JUN 2019

AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION MGA ZONE 55
0 500 1,000 2,000
metres
1:50,000 (when printed at A3)

LEGEND
- Sections
- Groundwater Elevation Contour (mAHD)
- GAUGED March 2019 (mAHD)
- EXISTING BORES (Not Included in Contours)
- RL2014
- 30_year_mine_pit_shell Extent
- Freeway/Highway
- Major Roads
- Minor Roads
- 5 m Surface Contour
- 1 m Surface Contour
- Watercourse
- Waterbody

Bore ID
GW RWL (mAHD)

Data sources:
VicMap data: Background Mapping Data Copyright The State of Victoria 2015. The State of Victoria does not warrant the accuracy or completeness of information in this publicaiton and any peron using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the inofrmation.

Groundwater Elevations and Water Table Contours - 24 March 2019

WIM Resource Pty Ltd

Avonbank Project Hydrogeological Summary Report

Dooen, VIC

Figure 3

Map Document: (\\aumel1fp001\projects\605X\60595006\900_CAD_GIS\920_GIS\MXD\03 Hydro Summary Report\60595006_F3_GWContours.mxd)

A3 size

Figure 4 Depth to water in UTAM / QA

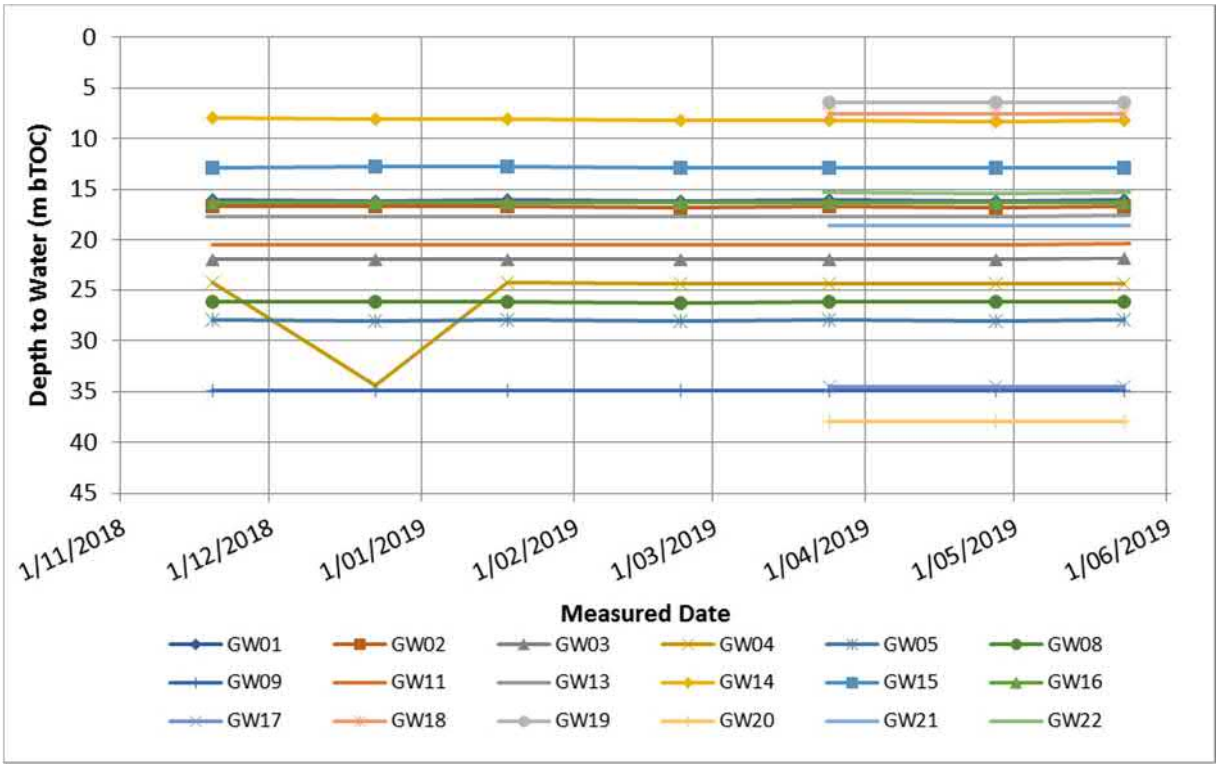


Figure 5 Depth to Water LTA

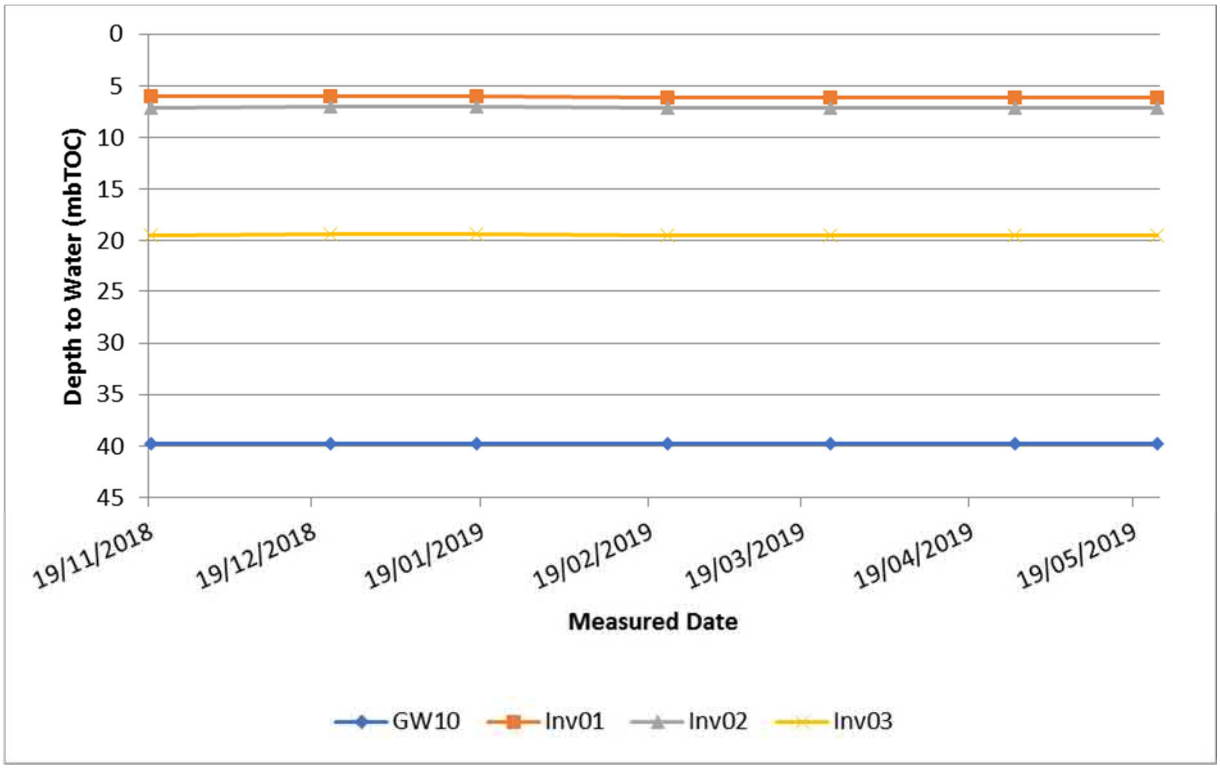


Figure 6 Groundwater elevations in UTAM / QA

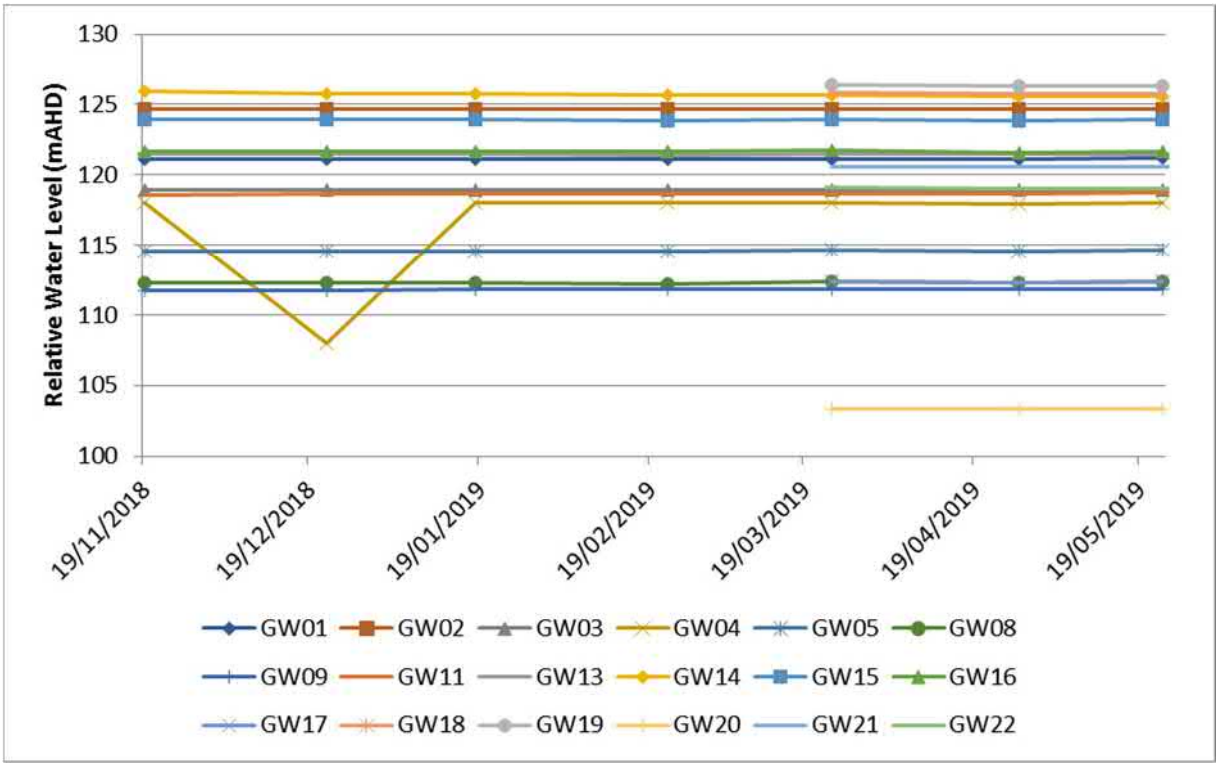


Figure 7 Groundwater elevations in LTA

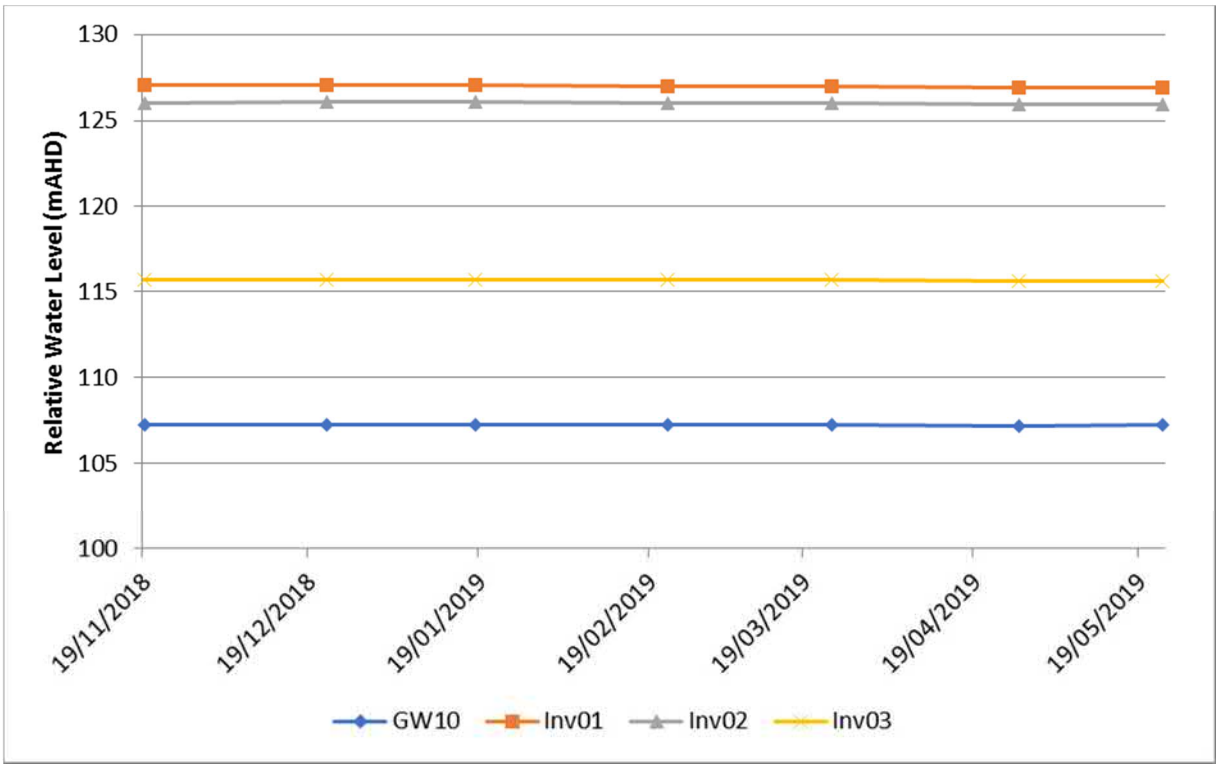


Figure 8 Cross Section Schematics of surface topography and water table elevations at Dooen Swamp and Darlot Swamp interpolating depth to water below ground surface

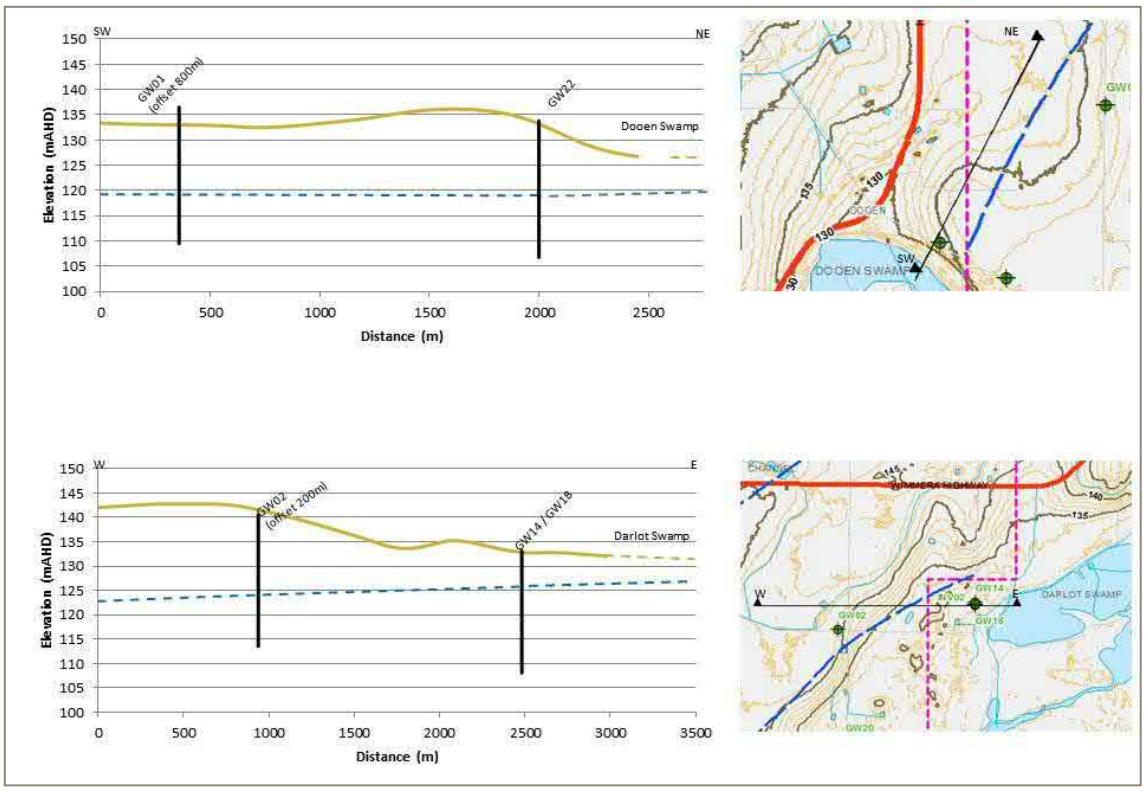


Figure 9 Indicatives schematic of water levels and differences in hydraulic heads between UTAM/QA and LTA, adjacent to Darlot Swamp

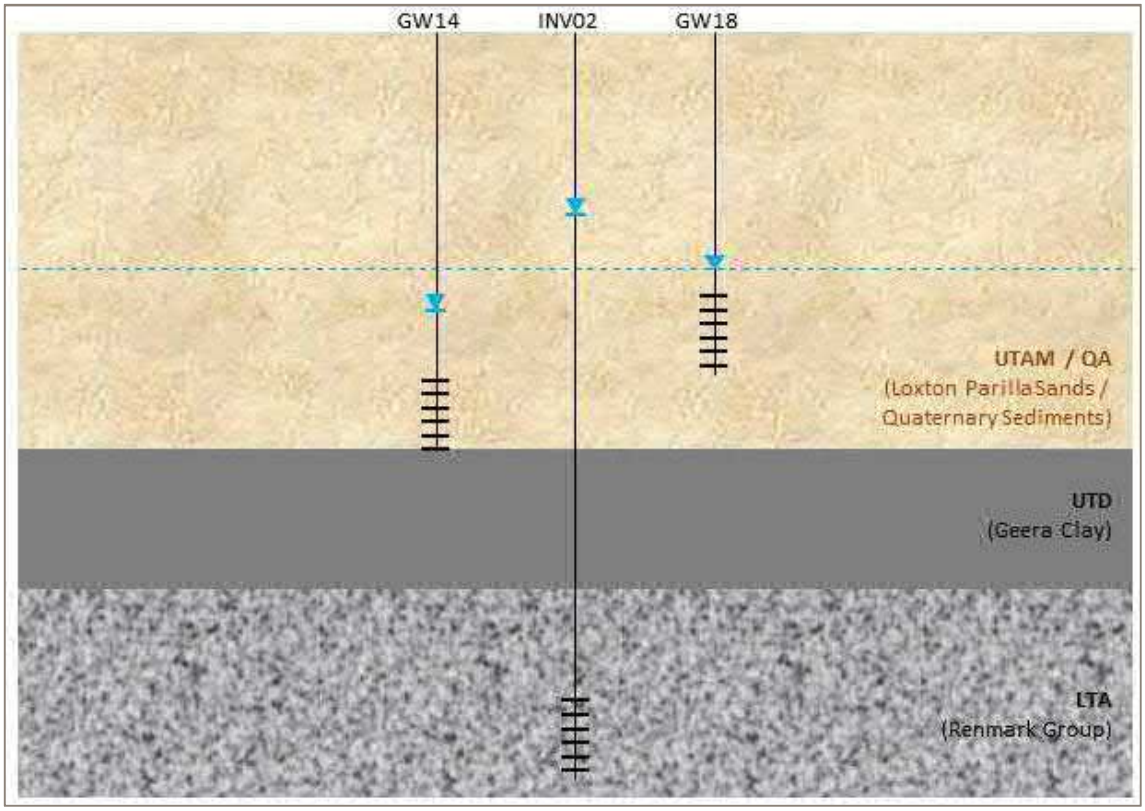
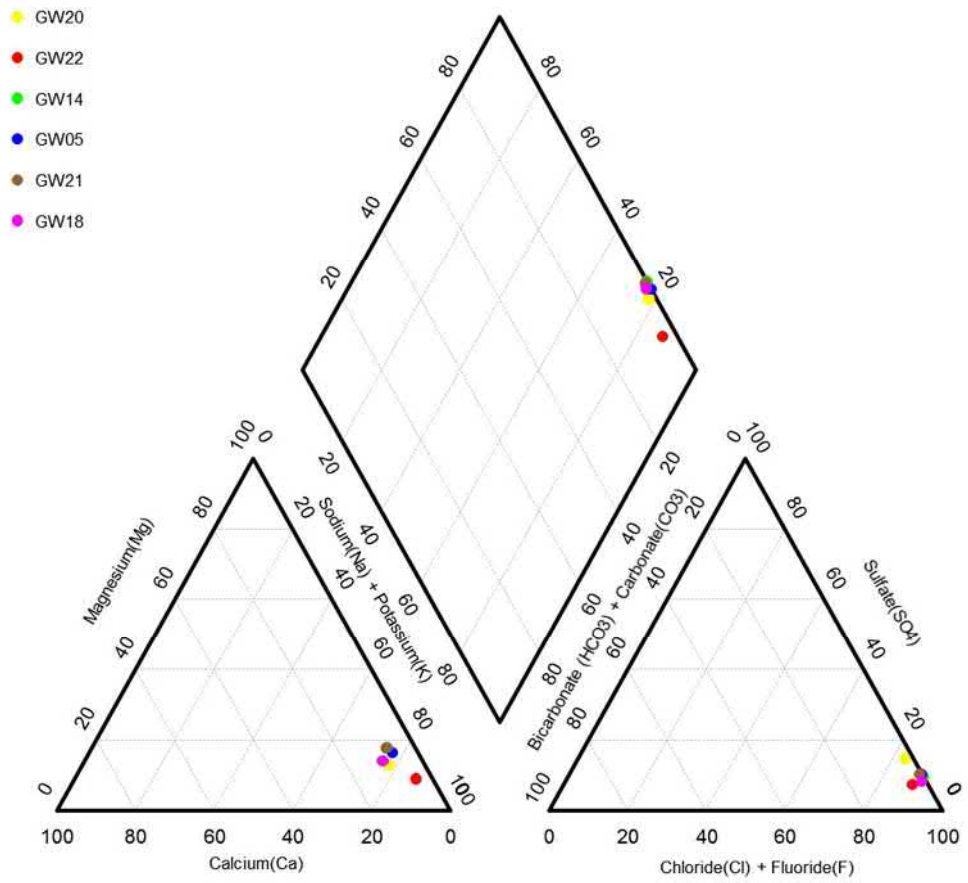


Figure 10 Piper plot of March 2019 major ion analysis



Appendix B

Tables

Appendix B Tables

Table 1 - 2019 Groundawter Bore Monitoring Locations

Location	Location ID	Installation Date	Easting (m)	Northing (m)	Surface Elevation (m AHD)	PVC Reference Elevation (m AHD)	PVC Reference Point (TOC) Height (m agl)	Steel Casing Height (m agl)	Casing Diameter (mm)	Drilled Depth (m bgl)	Screened From (m bgl)	Screened To (m bgl)
Drovers Rd	GW17	22/02/2019	614727.05	5948496.53	146.19	146.85	0.66	0.73	50	45	36.0	42.0
Drung-Jung Rd	GW18	20/02/2019	619541.33	5943688.30	132.82	133.40	0.59	0.69	50	18	8.0	14.0
Tuckers Rd	GW19	23/02/2019	618076.95	5942154.74	132.05	132.78	0.73	0.85	50	36	23.0	29.0
Banyena Rd	GW20	21/02/2019	612941.10	5953898.25	140.73	141.24	0.51	0.62	50	46	35.0	41.0
Test Pit Crest	GW21	26/02/2019	616136.46	5944104.59	138.60	139.16	0.56	0.68	50	31	21.0	27.0
Longerong Rd	GW22	18/02/2019	612768.48	5941667.44	133.74	134.41	0.67	0.78	50	30	22.0	28.0

Surveyed 26 March 2019

Table 2 - 2019 Groundwater Bore Development Results

Location ID	Development Date(s)	Pre Develop SWL (m btoc)	Post Develop SWL (m btoc)	Volume Removed (L)	pH (pH units)		Electrical Conductivity (µS/cm)		Post DevelopmentComment
					Pre	Post	Pre	Post	
GW17	24 & 26/02/2019	34.06	33.85	60	10.54	8.37	1,954	12,555	Dark Brown, fines in sample
GW18	24/02/2019	7.56	8.66	330	12	8.6	2,333	10,850	Clear, non turbid
GW19	24/02/2019	6.30	6.53	500	7.79	12.75	2,953	14,910	Clear, non turbid
GW20	25 & 26/02/2019	37.85	37.89	80	9.31	8.3	5,275	8,145	Brown-grey, distinctly fresher than other bores.
GW21	26/02/2019	17.60	17.8	300	10.67	8.57	2,127	12,580	Slightly cloudy
GW22	24 & 26/02/2019	4.92	14.54	95	11.44	8.19	32,775	10,164	Brown-yellow, turbid

mbtoc metres below top of casing

Table 3 - 2018/2019 Manual Groundwater Level Gauging Data

Bore ID	Depth To Water (m below Top of Casing)						
	19/11/2018	22/12/2018	18/01/2019	22/02/2019	24/03/2019	27/04/2019	23/05/2019
Upper Tertiary Aqifer (Marine) / Quaternary Aquifer - Loxton Parilla Sands							
GW01	16.12	16.14	16.12	16.16	16.11	16.17	16.1
GW02	16.72	16.74	16.73	16.78	16.74	16.79	16.74
GW03	22.01	22.02	21.97	22	21.98	21.99	21.94
GW04	24.32	34.35	24.32	24.39	24.38	24.41	24.37
GW05	27.99	28.04	27.99	28.06	27.94	28.02	27.95
GW08	26.2	26.24	26.23	26.25	26.13	26.21	26.14
GW09	34.91	34.91	34.9	34.9	34.87	34.89	34.89
GW11	20.54	20.52	20.51	20.52	20.49	20.49	20.41
GW13	17.68	17.68	17.67	17.7	17.66	17.68	17.64
GW14	7.92	8.14	8.13	8.19	8.19	8.29	8.26
GW15	12.85	12.8	12.81	12.88	12.85	12.91	12.87
GW16	16.28	16.3	16.28	16.33	16.26	16.36	16.31
GW17	-	-	-	-	34.48	34.53	34.47
GW18	-	-	-	-	7.56	7.59	7.6
GW19	-	-	-	-	6.41	6.48	6.44
GW20	-	-	-	-	37.92	37.92	37.91
GW21	-	-	-	-	18.56	18.6	18.56
GW22	-	-	-	-	15.3	15.37	15.35
Lower Tertiary Aquifer - Renmark Group							
GW10	39.79	39.79	39.77	39.8	39.77	39.82	39.78
Inv01	6.02	6.02	6.04	6.11	6.14	6.18	6.15
Inv02	7.09	7.04	7.08	7.13	7.15	7.19	7.2
Inv03	19.42	19.41	19.4	19.43	19.43	19.47	19.46

Table 4 - 2018/2019 Relative Water Levels

Bore ID	Relative Water Levels (m Australian Height Datum)						
	19/11/2018	22/12/2018	18/01/2019	22/02/2019	24/03/2019	27/04/2019	23/05/2019
Upper Tertiary Aqifer (Marine) / Quaternary Aquifer - Loxton Parilla Sands							
GW01	121.16	121.14	121.16	121.12	121.17	121.11	121.18
GW02	124.72	124.7	124.71	124.66	124.7	124.65	124.7
GW03	118.91	118.9	118.95	118.92	118.94	118.93	118.98
GW04	118.06	108.03	118.06	117.99	118	117.97	118.01
GW05	114.59	114.54	114.59	114.52	114.64	114.56	114.63
GW08	112.28	112.24	112.25	112.23	112.35	112.27	112.34
GW09	111.78	111.78	111.79	111.79	111.82	111.8	111.8
GW11	118.61	118.63	118.64	118.63	118.66	118.66	118.74
GW13	121.46	121.46	121.47	121.44	121.48	121.46	121.5
GW14	125.97	125.75	125.76	125.7	125.7	125.6	125.63
GW15	123.93	123.98	123.97	123.9	123.93	123.87	123.91
GW16	121.7	121.68	121.7	121.65	121.72	121.62	121.67
GW17	-	-	-	-	112.368	112.318	112.378
GW18	-	-	-	-	125.844	125.814	125.804
GW19	-	-	-	-	126.369	126.299	126.339
GW20	-	-	-	-	103.322	103.322	103.332
GW21	-	-	-	-	120.596	120.556	120.596
GW22	-	-	-	-	119.113	119.043	119.063
Lower Tertiary Aquifer - Renmark Group							
GW10	107.24	107.24	107.26	107.23	107.26	107.21	107.25
Inv01	127.07	127.07	127.05	126.98	126.95	126.91	126.94
Inv02	126.04	126.09	126.05	126	125.98	125.94	125.93
Inv03	115.69	115.7	115.71	115.68	115.68	115.64	115.65

Appendix C

Bore Logs

Appendix C 2019Bore Completion Report

AECOM

Final

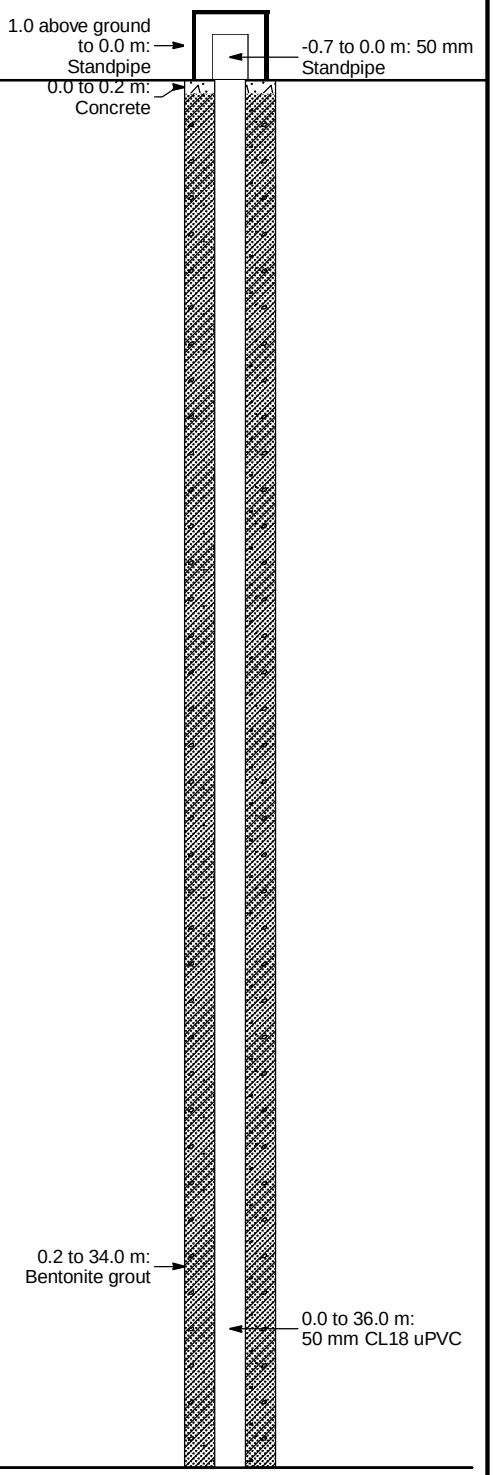
MONITORING WELL GW17

Sheet: 1 of 3

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	21/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	22/02/2019
Location:	Drovers Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	614727.050 m	**Top of Casing:**	146.850 mRL
Drill Type:	Mud Rotary	**Northing:**	5948496.530 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:**	45.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H
Drill Fluid:	Water / Liquipol	**Bore Dia.:**	150 mm	**Pipe Dia.:**	50 mm
				Surface:	Topsoil
				Permit No.:	WLE073514

Drill Method	Sample Interval	PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)
Mud Rotary	○		NA			CI-MH	silty CLAY :Brown, medium plasticity, soft, with fine to medium grained sand (~20%): medium to high plasticity at 1.00 m: brown-grey; trace sand (~10%)			0	146
						CH	CLAY :Light grey, high plasticity, firm to stiff, trace fine grained sand (5%): high plasticity			1	145
						SP	SAND :Mottled orange and brown, fine to medium grained, subrount to subangular sand; poorly sorted			2	144
						SM	silty SAND :Orange-brown, fine to medium grained, subround to subangular sand; poorly sorted.			3	143
						SP	SAND :Orange-brown and light brown, fine to medium grained, subround to subangular; poorly sorted			4	142
						SM	silty SAND :Orange-brown, fine to medium grained, subround (quartz) from 15.00 m, becoming fine to coarse grained from 17.00 m, becoming yellow-brown and light-brown at 19.00 m: with red, fine to medium, subround (oxidised sandstone and quartz) gravel (10-20%)			5	141
										6	140
										7	139
										8	138
										9	137
										10	136
										11	135
										12	134
										13	133
										14	132
										15	131
										16	130
										17	129
										18	128
										19	127

WELL CONSTRUCTION DETAILS



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MONITORING WELL GW17

Sheet: 2 of 3

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	21/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	22/02/2019
Location:	Drovers Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	614727.050 m	**Top of Casing:**	146.850 mRL
Drill Type:	Mud Rotary	**Northing:**	5948496.530 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:** 45.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H	**Surface:** Topsoil
Drill Fluid:	Water / Liquipol	**Bore Dia.:** 150 mm	**Pipe Dia.:**	50 mm	**Permit No.:** WLE073514

Drill Method	Sample Interval	PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)	WELL CONSTRUCTION DETAILS
Mud Rotary			NA			SM	silty SAND :Orange-brown, fine to medium grained, subround (quartz) at 21.00 m: absence of gravel from 22.00 m, becoming fine to coarse			20	126	
						SP-SC	clayey SAND :Pale grey, fine to coarse grained, subround with clay (~10%) at 25.00 m: clay matrix grades to orange and pale grey at 27.00 m: abesnce of clay, trace subround (quartz) gravel (<5%) at 29.00 m: with orange, low plasticity clay (<10%) at 30.00 m: absence of clay			21 22 23 24 25 26 27 28 29 30	125 124 123 122 121 120 119 118 117 116	
						CL	sandy CLAY :Pale grey and red, low plasticity; with fine to medium grained, subround to subangular sand.: low plasticity from 34.00 m, becoming light-brown from 35.00 m, becoming red, trace fine to coarse, angular sand			31 32 33 34 35	115 114 113 112 111	Standing water level at 33.85 m 26/02/2019 34.0 to 35.0 m: Bentonite pellet seal
						CL	sandy CLAY :Dark grey, medium to high plasticity, firm to stiff ; with fine to medium grained (quartz) sand: low plasticity			36	110	
						SW	SAND :Mottled pale brown, grey, red, yellow, medium to coarse graiend, well sorted (quartz)			37	109	
						SM	silty SAND :Pale brown, fine to medium grained, subround (quartz)			38	108	35.0 to 42.0 m: 8/16" Filter sand
						CH	CLAY :Dark grey, medium to hgh plasticity, firm to stiff; with fine to medium grained sand (quartz): high			39	107	36.0 to 42.0 m: 50 mm CL18 uPVC, 0.4mm machine slotted screen

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Final

MONITORING WELL GW17

Sheet: 3 of 3

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	21/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	22/02/2019
Location:	Drovers Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	614727.050 m	**Top of Casing:**	146.850 mRL
Drill Type:	Mud Rotary	**Northing:**	5948496.530 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:**	45.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H
Drill Fluid:	Water / Liquipol	**Bore Dia.:**	150 mm	**Pipe Dia.:**	50 mm
				Surface:	Topsoil
				Permit No.:	WLE073514

Drill Method	Sample Interval	PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)	WELL CONSTRUCTION DETAILS
Mud Rotary			NA			GM	plasticity			40	106	
						CL	:Dark grey, highly indurated band: fine to medium grained sandy CLAY :Dark grey to black, medium to high plasticity, sand is fine to medium grained: low plasticity			41	105	
						CH	CLAY :Dark grey, medium to high plasticity, stiff; with fine to medium grained sand (~20%) (fragments of organic white shells): high plasticity			42	104	42.0 to 43.0 m: Bentonite pellet seal
										43	103	
										44	102	43.0 to 45.0 m: Filter sand backfill
										45	101	
										46	100	
										47	99	
										48	98	
										49	97	
										50	96	
										51	95	
										52	94	
										53	93	
										54	92	
										55	91	
										56	90	
										57	89	
										58	88	
										59	87	

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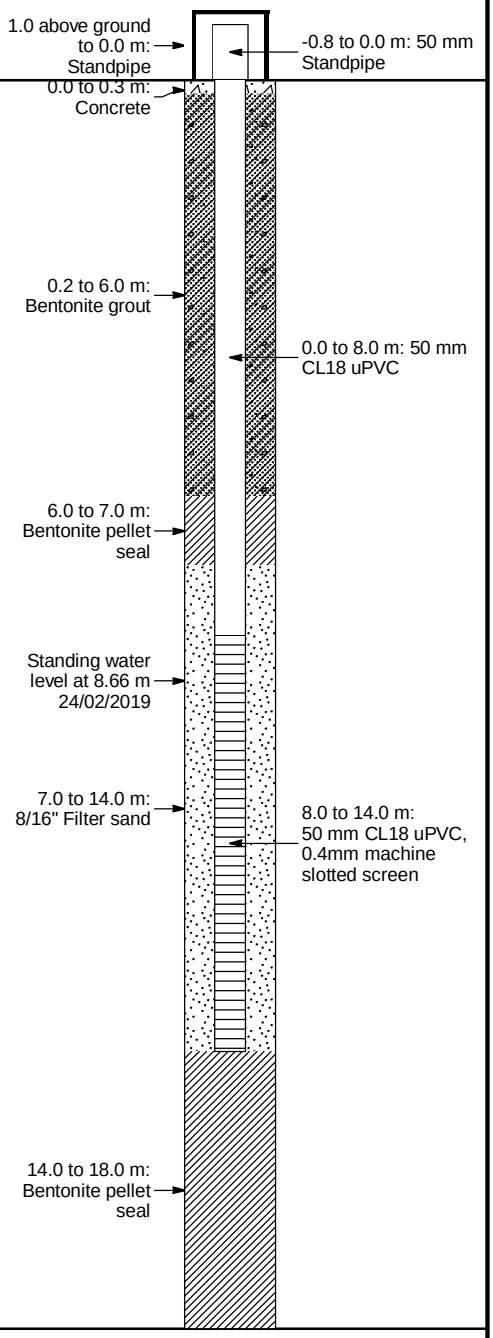
MONITORING WELL GW18

Sheet: 1 of 1

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	19/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	20/02/2019
Location:	Drung-Jung Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	619541.330 m	**Top of Casing:**	9999.000 mRL
Drill Type:	Mud Rotary	**Northing:**	5943688.300 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:** 18.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H	**Surface:** Topsoil
Drill Fluid:	Water / Liquipol	**Bore Dia.:** 150 mm	**Pipe Dia.:**	50 mm	**Permit No.:** WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)
Mud Rotary					CI	silty CLAY :Dark grey, medium to high plasticity, firm; trace fine to coarse grained subround sand (<5%): medium plasticity from 1.00 m, becoming brown-grey from 2.00 m, becoming orange-brown			0	
									1	132
									2	131
									3	130
									4	129
									5	128
					SC	sandy CLAY :Light brown, low to medium plasticity, firm; fine to medium grained sand (30%)			6	127
					CL	silty CLAY :Pale brown, medium to high plasticity; trace fine grained sand (<10%): low plasticity			7	126
					SW	SAND :Pale grey mottled brown, fine to coarse grained, well graded subround sand (quartz)			8	125
					SC	clayey SAND :Pale grey mottled brown, fine to coarse grained, well graded subround sand, clays are medium to high plasticity (~20%) at 11.00 m: Grey and orange-brown			9	124
					SW	SAND :Orange-brown and pale grey, fine to coarse grained, well sorted and subround (quartz)			10	123
									11	122
									12	121
									13	120
									14	119
									15	118
									16	117
						at 16.00 m: with grey, high plasticity clay fines (15-20%)				
						CLAY :Grey, high plasticity, firm to stiff, trace fine to caorse, soubtround sand (10%) (quartz) at 17.00 m: becomes brown-grey			17	116
									18	115
									19	114
										113

WELL CONSTRUCTION DETAILS



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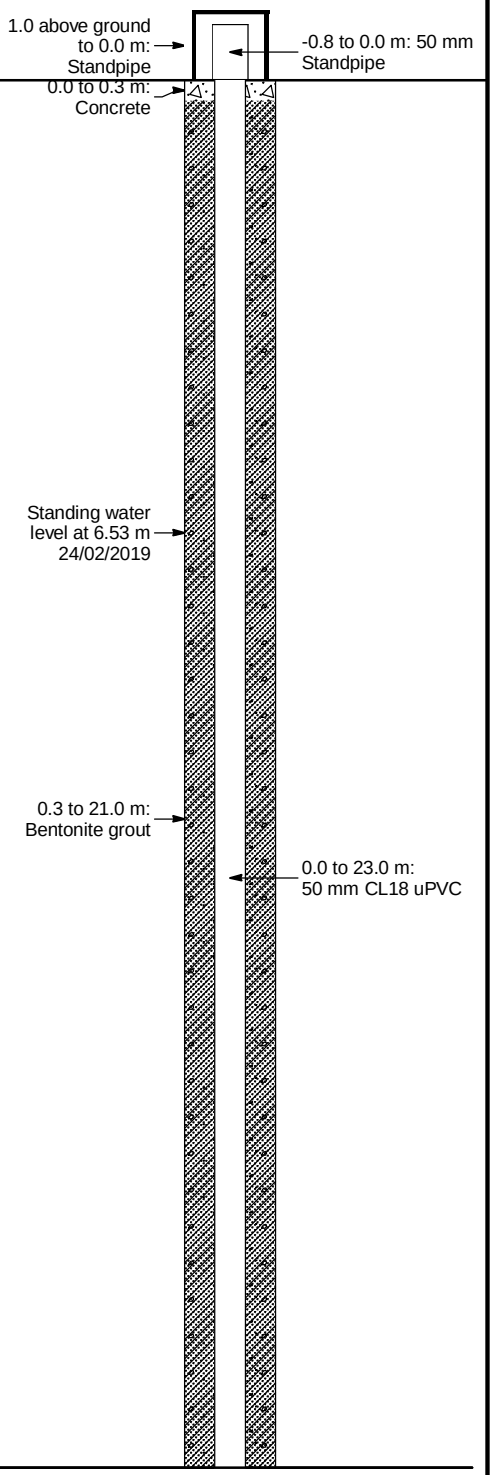
MONITORING WELL GW19

Sheet: 1 of 2

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	22/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	23/02/2019
Location:	Tuckers Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	618076.950 m	**Top of Casing:**	8888.000 mRL
Drill Type:	Mud Rotary	**Northing:**	5942154.740 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:** 36.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H	**Surface:** Topsoil
Drill Fluid:	Water / Liquipol	**Bore Dia.:** 150 mm	**Pipe Dia.:**	50 mm	**Permit No.:** WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)
Mud Rotary					CL	silty CLAY :Grey, low to medium plasticity, soft to firm; trace fine sand (5%): low plasticity			0	132
					CH	CLAY :Brown-grey, high plasticity, stiff: high plasticity			1	131
					CL	silty CLAY :Yellow-brown and brown-grey, medium plasticity, firm, with fine grained sand (10%): low plasticity			2	130
						from 4.00 m, becoming orange-brown and grey-brown (streaky)			3	129
						from 5.00 m, becoming mottled yellow-brown and grey, with fine to coarse subangular sand (10-20%) (quartz)			4	128
					SP	SAND :Orange-brown, fine to coarse grained, subround (quartz)			5	127
						at 7.00 m: grey-brown			6	126
					CH	CLAY :Brown-grey, medium to high plasticity, firm to stiff; with fine to coarse grained subround sand (20%): high plasticity			7	125
					CL	sandy CLAY :Brown-grey, low to medium plasticity, firm; fine to coarse grained subround sand: low plasticity			8	124
					SC	clayey SAND :Brown-red, fine to coarse grained, subround to subangular sand; trace fine subangular to subround gravel (<5%) (quartz, oxidised sandstone)			9	123
					CL	sandy CLAY :Brown, low to medium plasticity, firm to stiff; fine to medium grained, subround to subangular sand (quartz and sandstone); trace fine gravel (<5%): low plasticity			10	122
					SM	silty SAND :Light-brown and orange-brown, fine to medium grained, subround to subangular (quartz); trace fine gravel (<5%) (quartz)			11	121
						at 14.00 m: red-orange, sand content is increasing			12	120
									13	119
									14	118
									15	117
									16	116
									17	115
									18	114
					CH	CLAY :Grey, high plasticity, very stiff; trace fine grained sand (10%): high plasticity			19	113

WELL CONSTRUCTION DETAILS



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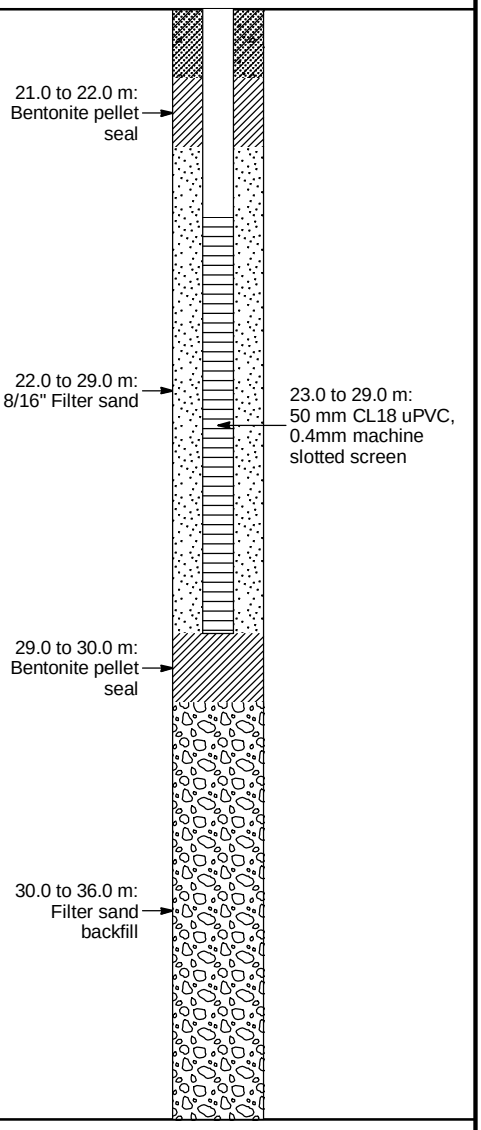
MONITORING WELL GW19

Sheet: 2 of 2

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	22/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	23/02/2019
Location:	Tuckers Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	618076.950 m	**Top of Casing:**	8888.000 mRL
Drill Type:	Mud Rotary	**Northing:**	5942154.740 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:** 36.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H	**Surface:** Topsoil
Drill Fluid:	Water / Liquipol	**Bore Dia.:** 150 mm	**Pipe Dia.:**	50 mm	**Permit No.:** WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)
Mud Rotary					SM	silty SAND :Light-brown and orange-brown, fine to medium grained, subround to subangular (quartz and oxidised sandstone)			20	112
					SP-SM	gravelly SAND :Light-brown and orange-brown, fine to coarse grained sand with fine to medium subround to subangular (quartz) gravel (up to 8mm); with silth (10-20%)			21	111
					SM	silty SAND :Light-brown and orange-brown, fine to medium grained, subround to subangular; trace fine subangular (quartz) gravel (5%)			22	110
					SP-SM	gravelly SAND :Light-brown and orange-brown, fine to coarse grained sand; fine to medium grained, subround to subangular (quartz) gravel (up to 8mm); with fines (10-20%)			23	109
					SM	silty SAND :Light-brown and orange-brown, fine to medium grained, subround to subangular from 28.00 m, becoming with grey and red high plasticity clay (20%)			24	108
					CH	CLAY :Dark-grey (trace red), high plasticity, stiff; trace fine to medium grained sand (10%): high plasticity at 30.00 m: Dark-grey			25	107
						at 33.00 m: Dark-grey (trace red)			26	106
									27	105
									28	104
									29	103
									30	102
									31	101
									32	100
									33	99
									34	98
									35	97
									36	96
									37	95
									38	94
									39	93

WELL CONSTRUCTION DETAILS



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MONITORING WELL GW20

Sheet: 1 of 3

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	20/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	21/02/2019
Location:	Banyena Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	612941.100 m	**Top of Casing:**	
Drill Type:	Mud Rotary	**Northing:**	5953898.250 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:** 46.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H	**Surface:** Topsoil
Drill Fluid:	Water / Liquipol	**Bore Dia.:** 150 mm	**Pipe Dia.:**	50 mm	**Permit No.:** WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)
Mud Rotary					CL	silty CLAY :Brown, low plasticity, soft to firm: low plasticity			0	
					CL	CLAY :Orange-brown and brown, medium to high plasticity, stiff: low plasticity			1	140
					SM	silty SAND :Orange-brown, fine to coarses grained subround, well sorted sand (quartz), partially (weakly) cemented			2	139
					SW	SAND :Orange brown and brown, fine to coarses subround, well graded sand; trace silt (<10%)			3	138
					SM	silty SAND :Orange-brown, fine to medium grained, subround sand.			4	137
					SW	gravelly SAND :Orange-brown, fine to coarse, well graded sand, fine subround quarz gravel (oxidised, dark brown), pale grey clay fines (~15%)			5	136
					SP	SAND :Orange-brown, fine to medium grained, subround (quartz)			6	135
						from 11.00 m, becoming fine grained			7	134
						from 12.00 m, becoming light yellow-brown mottled orange-brown and grey, fine to medium grained			8	133
									9	132
									10	131
									11	130
									12	129
									13	128
									14	127
									15	126
									16	125
									17	124
						from 17.00 m, becoming orange-brown, fine to coarse, poorly graded			18	123
									19	122
										121

WELL CONSTRUCTION DETAILS

1.0 above ground to 0.0 m: Standpipe

-0.8 to 0.0 m: 50 mm Standpipe

0.0 to 0.3 m: Concrete

0.3 to 33.0 m: Bentonite grout

0.0 to 35.0 m: 50 mm CL18 uPVC

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MONITORING WELL GW20

Sheet: 2 of 3

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	20/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	21/02/2019
Location:	Banyena Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	612941.100 m	**Top of Casing:**	
Drill Type:	Mud Rotary	**Northing:**	5953898.250 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:**	46.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H
Drill Fluid:	Water / Liquipol	**Bore Dia.:**	150 mm	**Pipe Dia.:**	50 mm
				Surface:	Topsoil
				Permit No.:	WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)	WELL CONSTRUCTION DETAILS
Mud Rotary					SW	SAND :Light yellow-brown and red, fine to coarses grained, well graded, subround to ubangular			20		
						at 22.00 m: trace dark grey coarse sand			21	120	
						at 23.00 m: trace dark grey clay fines			22	119	
					SW-SM	gravelly SAND :Light yellow-brown, fine to coarse grained, well graded; fine subangular (quartz and ferruginous sandstone) gravel, with silt (10%)			23	118	
									24	117	
									25	116	
									26	115	
									27	114	
									28	113	
									29	112	
					SM	sandy SILT :Light yellow-brown, non plastic, fine to medium grained sand, trace (10%) fine gravel			30	111	
					SM	silty SAND :Light yellow-brown, fine to coarse grained sand and dark grey silt fines, trace fine grained subround gravel			31	110	
						from 33.50 m, becoming gravel content increasing			32	109	
					GM	silty GRAVEL :Red and grey, fine to medium grained, subround gravel, grey silt/clay fines, trace fine to coarse grained sand			33	108	33.0 to 34.0 m: Bentonite pellet seal
									34	107	
									35	106	
									36	105	
					SC	sandy CLAY :Grey, high plasticity; fine to medium grained sand, trace fine grained subround gravel (<5%)			37	104	34.0 to 41.0 m: 8/16" Filter sand
									38	103	35.0 to 41.0 m: 50 mm CL18 uPVC, 0.4mm machine slotted screen
					CH	CLAY :Mottled grey, red and orange-brown, high plasticity, firm to stiff: high plasticity			39	102	
										101	

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MONITORING WELL GW20

Sheet: 3 of 3

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	20/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	21/02/2019
Location:	Banyena Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	612941.100 m	**Top of Casing:**	
Drill Type:	Mud Rotary	**Northing:**	5953898.250 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:**	46.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H
Drill Fluid:	Water / Liquipol	**Bore Dia.:**	150 mm	**Pipe Dia.:**	50 mm
				Surface:	Topsoil
				Permit No.:	WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)	WELL CONSTRUCTION DETAILS
Mud Rotary					SM	silty SAND :Yellow-brown, fine to medium grained, rounded, indurated			40		
					CH	CLAY :Dark grey to black, high plasticity, stiff; with fine to medium grained sand (~20%): high plasticity			41	100	41.0 to 42.0 m: Bentonite pellet seal
					CH	SANDSTONE :Dark grey, fine to medium grained, ferruginous (coffee rock)			42	99	
						CLAY :Dark grey to black, high plasticity, stiff: high plasticity			43	98	
						at 44.00 m: with sand (~20%) (shells and shell fragments)			44	97	42.0 to 46.0 m: Filter sand backfill
									45	96	
									46	95	
									47	94	
									48	93	
									49	92	
									50	91	
									51	90	
									52	89	
									53	88	
									54	87	
									55	86	
									56	85	
									57	84	
									58	83	
									59	82	
										81	

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MONITORING WELL GW21

Sheet: 1 of 2

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	25/02/2019
Project:	AVONBANK	**Logged by:**	Tim Smith	**End Date:**	26/02/2019
Location:	Test Pit Crest	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	616136.460 m	**Top of Casing:**	8888.000 mRL
Drill Type:	Mud Rotary	**Northing:**	5944104.590 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:** 31.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H	**Surface:** Topsoil
Drill Fluid:	Water / Liquipol	**Bore Dia.:** 150 mm	**Pipe Dia.:**	50 mm	**Permit No.:** WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)
Mud Rotary					CL	silty CLAY :Dark grey, no to low plasticity, soft; trace medium to coarse angular (quartz) sand: low plasticity			0	138
					SC	sandy CLAY :Brown-grey, low plasticity, soft; medium grained, subround to subangular (quartz) sand (20-30%), gap graded			1	137
					CI	CLAY :Light yellow-brown, soft to firm; with fine to medium grained subangular to angular sand (10-20%), poorly graded: medium plasticity			2	136
									3	135
									4	134
					CH	CLAY :Light grey and Light brown mottled, high plasticity, stiff to very stiff; trace fine angualr (partially feruginious) sand (5-10%): high plasticity at 7.00 m: silty CLAY: brown grey, medium plasticity, soft; trace fine sand (<5%)			5	133
									6	132
									7	131
					SM	silty SAND :Light yellow-brown, fine to coarse subround to angular (quartz) sand, well graded, some slight induration and trace ferruginised			8	130
					SP	SAND :Light grey, fine to coarse grained, subangular, poorly graded (mostly coarse) (quartz) sand, trace silt			9	129
					SM	silty SAND :Light grey, fine to coarse, subangular to angular (quartz) sand, well graded; silt (20-30%), traces of very weakly indurated zones			10	128
									11	127
					SP-SM	SAND :Light yellow-brown, fine to medium grained, very weakly indurated; trace silts/clays at 13.00 m: increasing clay content			12	126
									13	125
					SC	clayey SAND :Light brown, fine to coarse, subangular to angular, well graded, slightly ferruginous at 15.00 m: yellow-brown			14	124
									15	123
									16	122
									17	121
									18	120
						at 19.00 m: dark-brown			19	119

WELL CONSTRUCTION DETAILS

- 1.0 above ground to 0.0 m: Standpipe
- -0.8 to 0.0 m: 50 mm Standpipe
- 0.0 to 0.3 m: Concrete
- 0.3 to 18.5 m: Bentonite grout
- 0.0 to 21.0 m: 50 mm CL18 uPVC
- Standing water level at 18.10 m 26/02/2019
- 18.5 to 19.8 m: Bentonite pellet seal

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MONITORING WELL GW21

Sheet: 2 of 2

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	25/02/2019
Project:	AVONBANK	**Logged by:**	Tim Smith	**End Date:**	26/02/2019
Location:	Test Pit Crest	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	616136.460 m	**Top of Casing:**	8888.000 mRL
Drill Type:	Mud Rotary	**Northing:**	5944104.590 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:** 31.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H	**Surface:** Topsoil
Drill Fluid:	Water / Liquipol	**Bore Dia.:** 150 mm	**Pipe Dia.:**	50 mm	**Permit No.:** WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)	WELL CONSTRUCTION DETAILS
Mud Rotary					SW	silty SAND :Yellow-brown, fine to coarse grained, subround to angular, well graded, trace weakly indurated dark-grey fines (mineralised?) and ferruginous			20	118	19.8 to 27.0 m: 8/16" Filter sand; 21.0 to 27.0 m: 50 mm CL18 uPVC, bell end, 0.4mm
						at 23.00 m: increasing percentave of black indurated flecks/bands			21	117	
						at 25.00 m: dark-brown			22	116	
					CL	CLAY :Light yellow-brown, low to medium plasticity, with fine grained sand (<5%). Significant contamination from 20m-25m in sample: low plasticity			23	115	
					CI	CLAY :Light yellow-brown, low to medium plasticity; trace fine sand: medium plasticity			24	114	
						at 28.50 m: hard indurated sandy CLAY lens ~100mm			25	113	
					CH	CLAY :Dark brown, medium to high plasticity, firm; trace fine sand (<5%): high plasticity			26	112	27.0 to 27.5 m: Bentonite pellet seal; 27.5 to 29.0 m: Filter sand backfill
						at 30.90 m: Dark grey			27	111	
									28	110	
									29	109	29.0 to 31.0 m: Collapse
									30	108	
									31	107	
									32	106	
									33	105	
									34	104	
									35	103	
									36	102	
									37	101	
									38	100	
									39	99	

AECOM

Final

MONITORING WELL GW22

Sheet: 1 of 2

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	18/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	18/02/2019
Location:	Longerong Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	612768.480 m	**Top of Casing:**	8888.000 mRL
Drill Type:	Mud Rotary	**Northing:**	5941667.440 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:** 30.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H	**Surface:** Topsoil
Drill Fluid:	Water / Liquipol	**Bore Dia.:** 150 mm	**Pipe Dia.:**	50 mm	**Permit No.:** WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)
Mud Rotary					CH	CLAY :Brown, high plasticity, firm to stiff: high plasticity from 1.00 m, becoming light brown with dark-brown streaks from 2.00 m, becoming light yellow-brown, stiff; trace fine grained sand (<5%)			0	133
					GC	gravelly CLAY :Red, light brown and brown, high plasticity, stiff; gravels are fine grained, subangular (~20%)			1	132
					SP	SAND :Light yellow-brown to pale grey, fine to coarse grained, well graded; with fine grained subangular gravel (!15%) at 9.00 m: red-brown, with silt			2	131
					SM	silty SAND :Pale grey, fine to coarse grained sand; trace fine subangular (quartz) gravel (<10%) from 12.00 m, becoming fine to medium grained sand at 15.00 m: fine to coarse grained, subround sand from 16.00 m, becoming pale grey sand with yellow-brown silt matrix			3	130
					SP	clayey SAND :Yellow-brown, fine to medium grained; with fine subroun to subangular (quartz) gravel (~10%) from 19.00 m, becoming fine grained sand			4	129
									5	128
									6	127
									7	126
									8	125
									9	124
									10	123
									11	122
									12	121
									13	120
									14	119
									15	118
									16	117
									17	116
									18	115
									19	114

WELL CONSTRUCTION DETAILS

1.0 above ground to 0.0 m: Standpipe

-0.8 to 0.0 m: 50 mm Standpipe

0.3 to 20.0 m: Bentonite grout

0.0 to 22.0 m: 50 mm CL18 uPVC

Standing water level at 14.54 m 26/02/2019

AECOM

Final

MONITORING WELL GW22

Sheet: 2 of 2

Client:	WIM Resource Pty Ltd	**Project No:**	60595006	**Start Date:**	18/02/2019
Project:	AVONBANK	**Logged by:**	Will Dillon	**End Date:**	18/02/2019
Location:	Longerong Rd	**Checked by:**	Tim Smith	**Location Meth.:**	dGPS0.001
Driller:	McLeish Drilling	**Easting:**	612768.480 m	**Top of Casing:**	8888.000 mRL
Drill Type:	Mud Rotary	**Northing:**	5941667.440 m	**Ver. Datum:**	AHD
Drill Model:	Edson 6000 Truck Mounted	**Total Depth:**	30.00 m	**Hor. Proj/Dat:**	MGA94/GDA94-54H
Drill Fluid:	Water / Liquipol	**Bore Dia.:**	150 mm	**Pipe Dia.:**	50 mm
				Surface:	Topsoil
				Permit No.:	WLE073514

Drill Method	Sample Interval PID (ppm)	Sample ID	Analysed	Graphic Log	Classification	LITHOLOGICAL DESCRIPTION	Moisture	Consistency/ Relative Density	Depth (m)	Reduced Level (m)	WELL CONSTRUCTION DETAILS
Mud Rotary					SP-SM	silty SAND :Yellow-brown, fine grained, poorly graded			20		20.0 to 21.0 m: Bentonite pellet seal
						at 22.00 m: fine to coaarse grained, moderately graded, with fine to coarse grained subangular gravel			21	113	
									22	112	
									23	111	
						from 24.50 m, becoming yellow-brown, fine to medium grained sand (~20% ferruginous)			24	110	21.0 to 28.0 m: 8/16" Filter sand
									25	109	22.0 to 28.0 m: 50 mm CL18 uPVC, 0.4mm machine slotted screen
					CI-MH	CLAY :Grey, medium to high plasticity; trace fine to coarse sand (ferruginous): medium to high plasticity			26	108	
									27	107	
					CH	CLAY :Grey and dark grey, high plasticity, stiff; trace fine to medium grained sand (<10%): high plasticity			28	106	28.0 to 28.5 m: Bentonite pellet seal
									29	105	28.5 to 30.0 m: Filter sand backfill
									30	104	
									31	103	
									32	102	
									33	101	
									34	100	
									35	99	
									36	98	
									37	97	
									38	96	
									39	95	
										94	

Appendix D

Groundwater Laboratory Analysis Reports

Appendix D Groundwater Laboratory Analysis Reports

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1904454**	Page	: 1 of 8
Client	: **WIM Resource Pty Ltd**	Laboratory	: Environmental Division Melbourne
Contact	: MICHAEL WINTERNITZ	Contact	: Customer Services EM
Address	: 201 Elizabeth Street Sydney	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: 0467 515 100	Telephone	: +61-3-8549 9600
Project	: 60595006	Date Samples Received	: 27-Mar-2019 15:00
Order number	: 60595006/2	Date Analysis Commenced	: 27-Mar-2019
C-O-C number	: ----	Issue Date	: 08-May-2019 09:54
Sampler	: BREANA MCCARTNEY		
Site	: Avonbank		
Quote number	: ----		
No. of samples received	: 9		
No. of samples analysed	: 9		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane External Subcontracting, Stafford, QLD
Titus Vimalasiri	Metals Teamleader	Radionuclides, Fyshwick, ACT

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Radiological work undertaken by ALS Laboratory Group (Ceska Lipa) under CAI accreditation No. L1163. Report No. PR1935438. NATA and CAI accreditations' are both recognised under ILAC.
- EA010-P: Electrical Conductivity @ 25°C was analysed by manual method (EA010).
- Gross Alpha and Beta Activity analyses are performed by ALS Fyshwick (NATA Accreditation number 992).
- Ionic balances were calculated using: major anions - chloride, alkalinity and sulfate; and major cations - calcium, magnesium, potassium and sodium.
- ED045G: The presence of thiocyanate can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW20_25/3/19	GW22_25/3/19	QC01_25/3/19	QC02_26/3/19	QC04_26/3/19
				Client sampling date / time	25-Mar-2019 00:00	25-Mar-2019 00:00	25-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00
Compound	CAS Number	LOR	Unit		EM1904454-001	EM1904454-002	EM1904454-003	EM1904454-004	EM1904454-005
					Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		9780	10600	<1	16500	1
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	----	1	mg/L		6360	6890	<1	10700	<1
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		936	623	<1	1840	<1
EA250: Gross Alpha and Beta Activity									
Gross alpha	----	0.05	Bq/L		0.36	----	----	----	----
Gross beta activity - 40K	----	0.10	Bq/L		0.44	----	----	----	----
EA251: Radium 226 and Radium 228 Activity									
Radium 226	13982-63-3	0.05	Bq/L		0.05	----	----	----	----
Radium 228	7440-14-4	0.08	Bq/L		0.09	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		206	414	<1	102	<1
Total Alkalinity as CaCO3	----	1	mg/L		206	414	<1	102	<1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		690	381	<1	758	<1
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		2880	3360	<1	5060	<1
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		154	78	<1	211	<1
Magnesium	7439-95-4	1	mg/L		134	104	<1	319	<1
Sodium	7440-23-5	1	mg/L		1500	1880	<1	2530	<1
Potassium	7440-09-7	1	mg/L		28	16	<1	36	<1
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		0.01	0.01	<0.01	<0.01	0.01
Arsenic	7440-38-2	0.001	mg/L		0.006	0.007	<0.001	0.003	<0.001
Boron	7440-42-8	0.05	mg/L		1.25	2.20	<0.05	1.61	<0.05
Barium	7440-39-3	0.001	mg/L		0.120	0.079	<0.001	0.114	<0.001
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L		0.010	0.003	<0.001	0.027	<0.001
Chromium	7440-47-3	0.001	mg/L		<0.001	0.017	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW20_25/3/19	GW22_25/3/19	QC01_25/3/19	QC02_26/3/19	QC04_26/3/19
				Client sampling date / time	25-Mar-2019 00:00	25-Mar-2019 00:00	25-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00
Compound	CAS Number	LOR	Unit		EM1904454-001	EM1904454-002	EM1904454-003	EM1904454-004	EM1904454-005
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued									
Cerium	7440-45-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L		**0.003**	**0.007**	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L		**0.424**	**0.052**	<0.001	**0.717**	<0.001
Nickel	7440-02-0	0.001	mg/L		**0.015**	**0.014**	<0.001	**0.044**	<0.001
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L		**0.01**	**0.06**	<0.01	<0.01	<0.01
Vanadium	7440-62-2	0.01	mg/L		<0.01	**0.02**	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L		**0.049**	**0.020**	<0.005	**0.023**	<0.005
Molybdenum	7439-98-7	0.001	mg/L		**0.003**	**0.005**	<0.001	<0.001	<0.001
Silver	7440-22-4	0.001	mg/L		**0.002**	**0.002**	<0.001	**0.002**	<0.001
Strontium	7440-24-6	0.001	mg/L		**2.42**	**1.81**	<0.001	**3.92**	<0.001
Thallium	7440-28-0	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Yttrium	7440-65-5	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L		**0.11**	<0.05	<0.05	<0.05	<0.05
Bromine	7726-95-6	0.1	mg/L		**9.2**	**5.3**	<0.1	**17.0**	<0.1
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.10**	**0.79**	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.13**	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.02**	**0.10**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.15**	**0.10**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.73**	**0.37**	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**99.7**	**111**	<0.01	**160**	<0.01
Total Cations	----	0.01	meq/L		**84.7**	**94.6**	<0.01	**148**	<0.01
Ionic Balance	----	0.01	%		----	----	<0.01	----	<0.01
Ionic Balance	----	0.01	%		**8.16**	**7.95**	----	**4.15**	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	GW20_25/3/19	GW22_25/3/19	QC01_25/3/19	QC02_26/3/19	QC04_26/3/19
				Client sampling date / time	25-Mar-2019 00:00	25-Mar-2019 00:00	25-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00
Compound	CAS Number	LOR	Unit		EM1904454-001	EM1904454-002	EM1904454-003	EM1904454-004	EM1904454-005
					Result	Result	Result	Result	Result
Radionuclides / Activity									
Uranium 238	7440-61-1	0.001	Bq/L		**0.107**	----	----	----	----
Uranium 235	15117-96-1	0.001	Bq/L		**0.005**	----	----	----	----
Uranium 234	13966-29-5	0.004	Bq/L		**0.126**	----	----	----	----
Thorium 232	----	0.001	Bq/L		**0.119**	----	----	----	----
Thorium 230	----	0.004	Bq/L		**0.024**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	GW14_26/3/19	GW05_26/3/19	GW21_26/3/19	GW18_26/3/19	----
			Client sampling date / time	26-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00	----
Compound	CAS Number	LOR	Unit	EM1904454-006	EM1904454-007	EM1904454-008	EM1904454-009	--------
				Result	Result	Result	Result	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	20000	18200	15700	11200	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	13000	11800	10200	7280	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	2150	2040	1840	1310	----
EA250: Gross Alpha and Beta Activity								
Gross alpha	----	0.05	Bq/L	----	<0.30	0.33	----	----
Gross beta activity - 40K	----	0.10	Bq/L	----	0.99	0.62	----	----
EA251: Radium 226 and Radium 228 Activity								
Radium 226	13982-63-3	0.05	Bq/L	----	<0.05	0.08	----	----
Radium 228	7440-14-4	0.08	Bq/L	----	<0.08	0.10	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	24	35	99	150	----
Total Alkalinity as CaCO3	----	1	mg/L	24	35	99	150	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	949	983	800	489	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	6610	6400	5140	3970	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	260	232	212	220	----
Magnesium	7439-95-4	1	mg/L	365	355	318	185	----
Sodium	7440-23-5	1	mg/L	2930	3110	2510	1880	----
Potassium	7440-09-7	1	mg/L	34	45	35	16	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.06	<0.01	<0.01	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	0.003	0.024	0.003	0.002	----
Boron	7440-42-8	0.05	mg/L	1.54	1.98	1.68	0.80	----
Barium	7440-39-3	0.001	mg/L	0.061	0.061	0.111	0.388	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L	0.012	0.004	0.027	0.001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	0.001	<0.001	<0.001	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW14_26/3/19	GW05_26/3/19	GW21_26/3/19	GW18_26/3/19	----
				Client sampling date / time	26-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00	----
Compound	CAS Number	LOR	Unit		EM1904454-006	EM1904454-007	EM1904454-008	EM1904454-009	--------
					Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Cerium	7440-45-1	0.001	mg/L		**0.021**	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L		<0.001	**0.001**	<0.001	**0.003**	----
Manganese	7439-96-5	0.001	mg/L		**0.237**	**0.434**	**0.706**	**0.044**	----
Nickel	7440-02-0	0.001	mg/L		**0.020**	**0.036**	**0.044**	**0.003**	----
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	**0.02**	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L		**0.063**	**0.010**	**0.022**	**0.010**	----
Molybdenum	7439-98-7	0.001	mg/L		<0.001	<0.001	<0.001	**0.002**	----
Silver	7440-22-4	0.001	mg/L		**0.002**	**0.001**	<0.001	<0.001	----
Strontium	7440-24-6	0.001	mg/L		**4.86**	**4.72**	**3.79**	**2.92**	----
Thallium	7440-28-0	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Tin	7440-31-5	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Titanium	7440-32-6	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Yttrium	7440-65-5	0.001	mg/L		**0.003**	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L		**3.68**	**4.56**	<0.05	<0.05	----
Bromine	7726-95-6	0.1	mg/L		**22.5**	**22.5**	**16.8**	**12.7**	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.10**	**0.05**	**0.04**	**0.15**	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	**0.02**	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	**0.02**	**0.01**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	**0.02**	**0.03**	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.15**	**0.19**	**0.65**	**0.08**	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**207**	**202**	**164**	**125**	----
Total Cations	----	0.01	meq/L		**171**	**177**	**147**	**108**	----
Ionic Balance	----	0.01	%		**9.36**	**6.46**	**5.41**	**7.18**	----
Radionuclides / Activity									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW14_26/3/19	GW05_26/3/19	GW21_26/3/19	GW18_26/3/19	----
				Client sampling date / time	26-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00	26-Mar-2019 00:00	----
Compound	CAS Number	LOR	Unit		EM1904454-006	EM1904454-007	EM1904454-008	EM1904454-009	--------
					Result	Result	Result	Result	----
Radionuclides / Activity - Continued									
Uranium 238	7440-61-1	0.001	Bq/L		----	<0.001	**0.033**	----	----
Uranium 235	15117-96-1	0.001	Bq/L		----	<0.001	**0.002**	----	----
Uranium 234	13966-29-5	0.004	Bq/L		----	<0.004	**0.044**	----	----
Thorium 232	----	0.001	Bq/L		----	<0.001	**0.058**	----	----
Thorium 230	----	0.004	Bq/L		----	<0.004	**0.019**	----	----