GEMINI PROJECT

Site-Specific EA Application

MAGNETIC SOUTH PTY LTD

December 2020

VOLUME 2:

- Appendix C: Groundwater Impact Assessment
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Appendix C Groundwater Impact Assessment

MAGNETIC SOUTH PTY LTD

GROUNDWATER IMPACT ASSESSMENT
GEMINI COAL PROJECT

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1.0 INTRODUCTION

Magnetic South Pty Ltd is the project proponent and the applicant for the Mining Lease (ML) and Environmental authority (EA) to develop the Gemini Project, a greenfield open cut mine to produce Pulverised Coal Injection (PCI) coal and Coking Coal products for export for steel production. The Project term is anticipated to be 25 years from grant of the ML with this term including initial construction, mine operation and rehabilitation activities. Mining at the Gemini Project is projected to occur over approximately 20 years as a truck and shovel operation at an average of 1.8 million tonnes per annum (Mtpa) ROM coal.

The Project is located approximately 150 km to the east of Rockhampton and 8 km west of the town of Dingo and is accessed by the Capricorn Highway, which transects the northern part of the tenement (Figure 1-1).

This report provides a comprehensive assessment of:

- The regional and mine-scale geology and hydrogeology;
- The installation of a groundwater monitoring bore network that has been designed to provide water level and water quality data from all groundwater units at site;
- A program of hydraulic testing that has been carried out on the groundwater monitoring bores at site in order to provide site-specific hydraulic conductivity data for groundwater modelling;
- Water level and water quality data obtained to date from the site groundwater monitoring bores;
- Regional groundwater occurrence and use;
- A conceptual groundwater model for the site; and,
- Groundwater modelling that has been undertaken to provide predictions of:
    - the rate of groundwater inflow to the mined voids; and
    - the extent of groundwater level impacts from mining, which are used to provide prediction of the potential for impact on sensitive environmental receptors such as landholder bores and groundwater dependent ecosystems (GDEs).

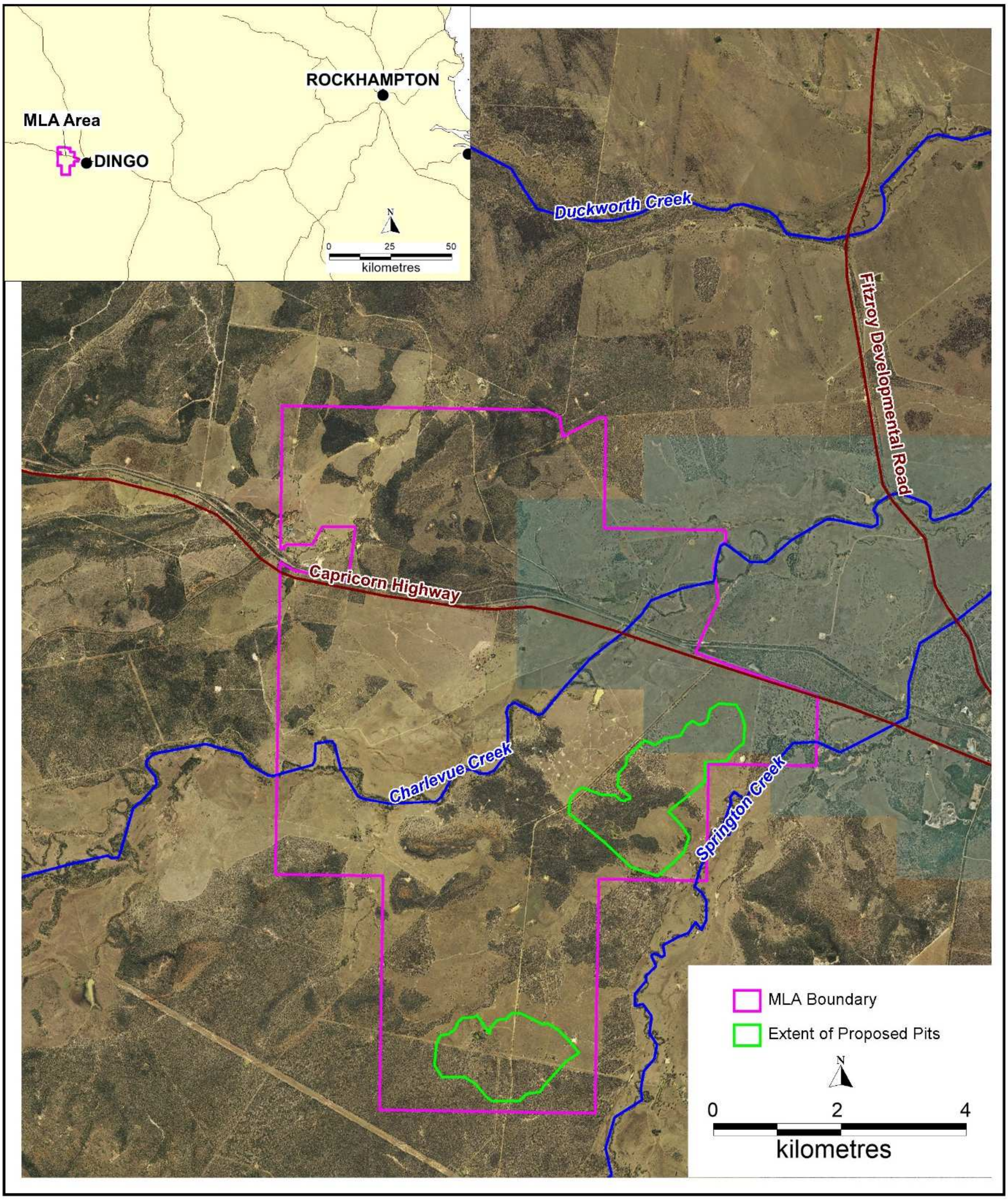


Figure 1-1: Project Location

2.0 CLIMATIC DATA

The climatic description of the region in which the project site is located has been compiled using data from the DNRM SILO Data Drill. The Data Drill accesses grids of climate data available from surrounding Bureau of Meteorology (BoM) point observations and then creates interpolated climate values for the requested location. The SILO climate data was obtained for coordinates that correspond to the approximate centre of the Gemini Project site.

Summary data for rainfall and evaporation is shown in Table 2-1 and indicates that:

- Mean annual rainfall for the site is approximately 678 mm; and,
- Mean annual evaporation is approximately 2024 mm and exceeds rainfall for every month of the year.

The data has been utilised to produce a climatograph for the Gemini Project site (Figure 2-1), which shows that:

- rainfall is highly seasonal, with the dry season from April to September-October, and a wet season from November through to March;
- The coldest month of the year is July, with a mean minimum temperature of 7.7 ºC and a mean maximum temperature of 23.2 ºC; and,
- The hottest month of the year is January, with a mean minimum temperature of 21.6 ºC and a mean maximum temperature of 33.8 ºC.

Figure 2-2 shows the total monthly rainfall for the period 2000 to July 2019 and also presents a rainfall residual mass (RRM) curve for the data. The RRM is calculated by subtracting the long-term average monthly rainfall from the actual monthly rainfall, to provide a monthly “departure” from average conditions. If the monthly rainfall is above average, the resulting rainfall departure number is positive, whereas if the rainfall is below average, the number is negative. A number of below-average rainfall months will result in a falling RRM curve, while a number of above average rainfall months will result in a rising RRM curve. The RRM curve is used extensively in groundwater investigations due to the strong correlation in many locations between the RRM and groundwater level trends. The RRM curve shows a downward trend from 2000 to 2007, an upward trend from 2008 to 2013 and a relatively stable trend from 2013 to present. The downward trend from 2013 to present indicates a potential for falling groundwater levels over that period for shallow aquifers where rainfall recharge is the dominant factor that affects water level rise and water levels tend to fall during periods of below-average rainfall.

Table 2-1: Average Monthly Rainfall and Evaporation (SILO Data)

Month	Average Rainfall (mm)	Average Evaporation (mm)
January	109.9	229.5
February	105.7	186.5
March	76.0	184.2
April	35.8	151.3
May	33.5	117.9
June	34.7	94.2
July	27.5	101.9
August	21.4	129.6
September	23.9	164.1
October	45.7	206.9
November	63.0	220.0
December	101.1	238.1
Total	**678.2**	**2024.2**

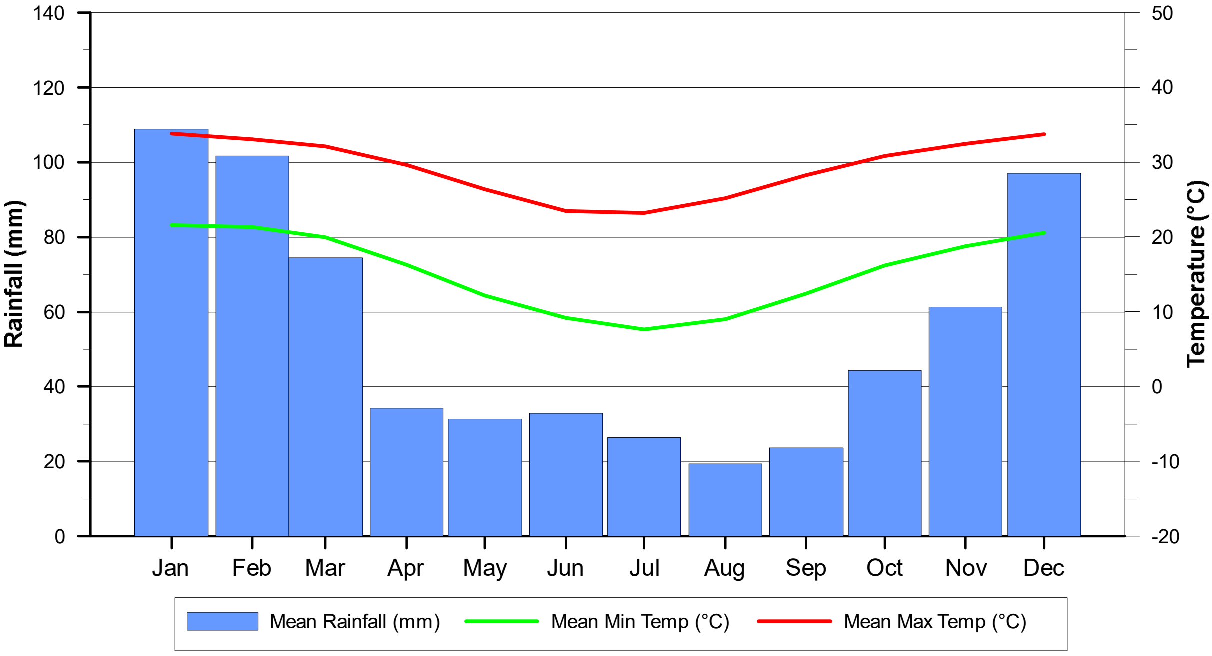


Figure 2-1: Climatograph for the Gemini Project Site

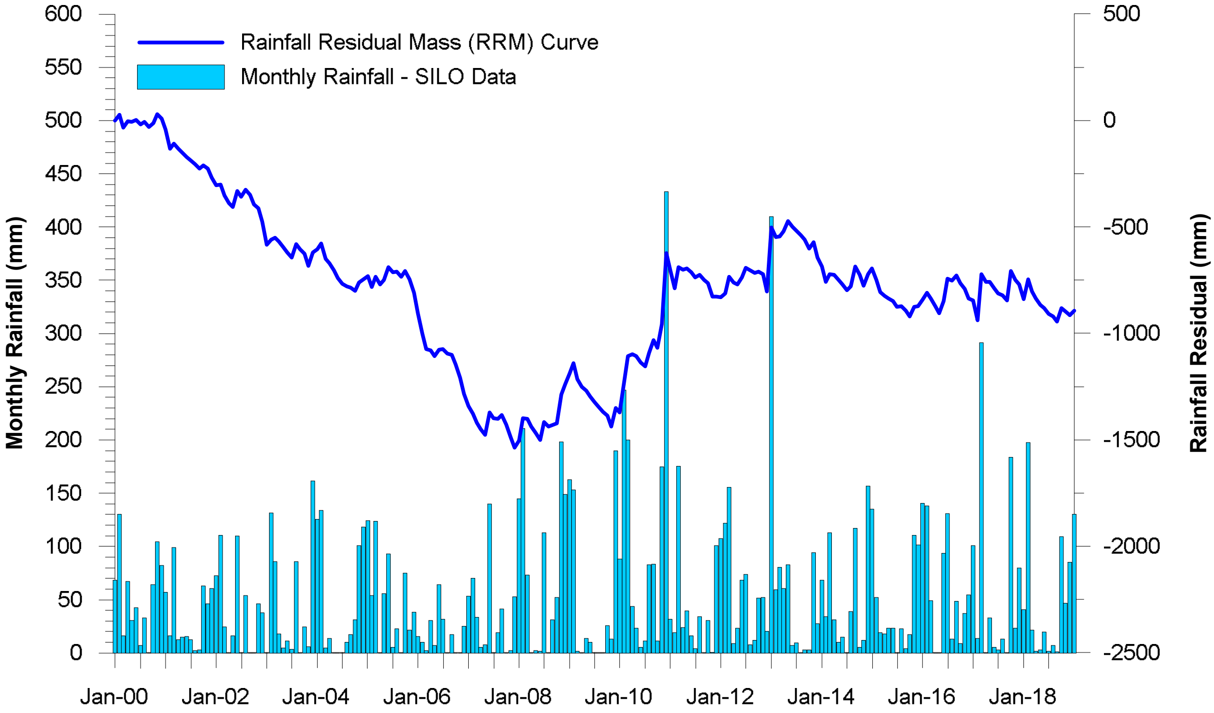


Figure 2-2: Monthly Rainfall and Rainfall Residual Mass Curve

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 Stratigraphy

The Gemini coal deposit is hosted within the Permian Rangal Coal Measures and within the Yarrabee Structural Zone. Seven seams or seam groups have been identified at the Gemini Project site, which belong to either the Rangal Coal Measures or the underlying Burngrove Formation (Boyd 2019). In descending stratigraphic order the seams include the Aries, Castor, Pollux, Orion, Pisces, Virgo and Leo seams. The seams contain a number of individual plies that have identified for mining at site; the main coal seams that are encountered at site and their typical thickness are shown below in Table 3-1.

The surface geology at site is shown in Figure 3-1. It predominantly comprises sediments of the Tertiary Duaringa Formation and Quaternary alluvium associated with ephemeral creeks including Charlevue Creek and Springton Creek. At one location north of Pit C a small area of remnant basalt has been identified from drilling, measuring approximately 600 m long and 200 m wide with a thickness of approximately 20 m (JTB 2019). Bore DW7105W1 (Section 4.1) is located within the basalt and is dry.

Figure 2-2 shows the project location in relation to the underlying Bowen Basin solid geology (i.e. the surficial unconsolidated Quaternary and Tertiary units have been removed, revealing the relationship between the underlying Triassic and Permian sediments as well as the prevalence of regional-scale faults). The two mining areas (A-B Pit and C Pit) are located in areas where folding has brought the coal seams close to surface at depths that can be economically mined. Figures 3-1 and 3-2 also show the locations of east-west cross sections through each mining area and a long section through both mining areas. Data from these sections has been utilised to create cross sectional groundwater models, which are discussed below in Section 6.0.

Table 3-1: Summary of Regional and Site Stratigraphy

Geological Age	Unit	Coal Seams	Description	Typical Thickness at Site (m)
Quaternary	Alluvium		Unconsolidated soil, silt clay, sand and gravel associated with current surface drainage systems, e.g. Charlevue Creek and Springton Creek	1.5
Tertiary	Duaringa Formation		Mudstone, sandstone, conglomerate, siltstone	15 - 30
	Basalt		Minor basalt at one location north of Pit C.	20
Triassic	Rewan Group		Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate at base	0 - 50
Permian	Rangal Coal Measures	Aries Upper	Feldspathic and lithic sandstone, carbonaceous mudstone, siltstone, tuff and coal seams. Includes the Aries, Castor and Pollux Coal Seam, which are the target coal seam for mining at the Gemini Project	2.1
		Aries Lower		4
		Castor Upper		1.6
		Castor Lower		2
		Pollux Upper		1.9
		Pollux Lower Upper		2.9
		Pollux Lower Lower		3.5
		Orion		6.1
		Pisces Upper		1.7
		Yarrabee Tuff		0.9
		Pisces Lower		0.7
	Burngrove Formation	Virgo	Mudstone, siltstone, sandstone, coal, tuff	2.8
		Leo		4.4
	Gyranda Formation		Siltstone and shale with minor tuff and volcanilithic sandstone and rare coal	0 to 100 m+

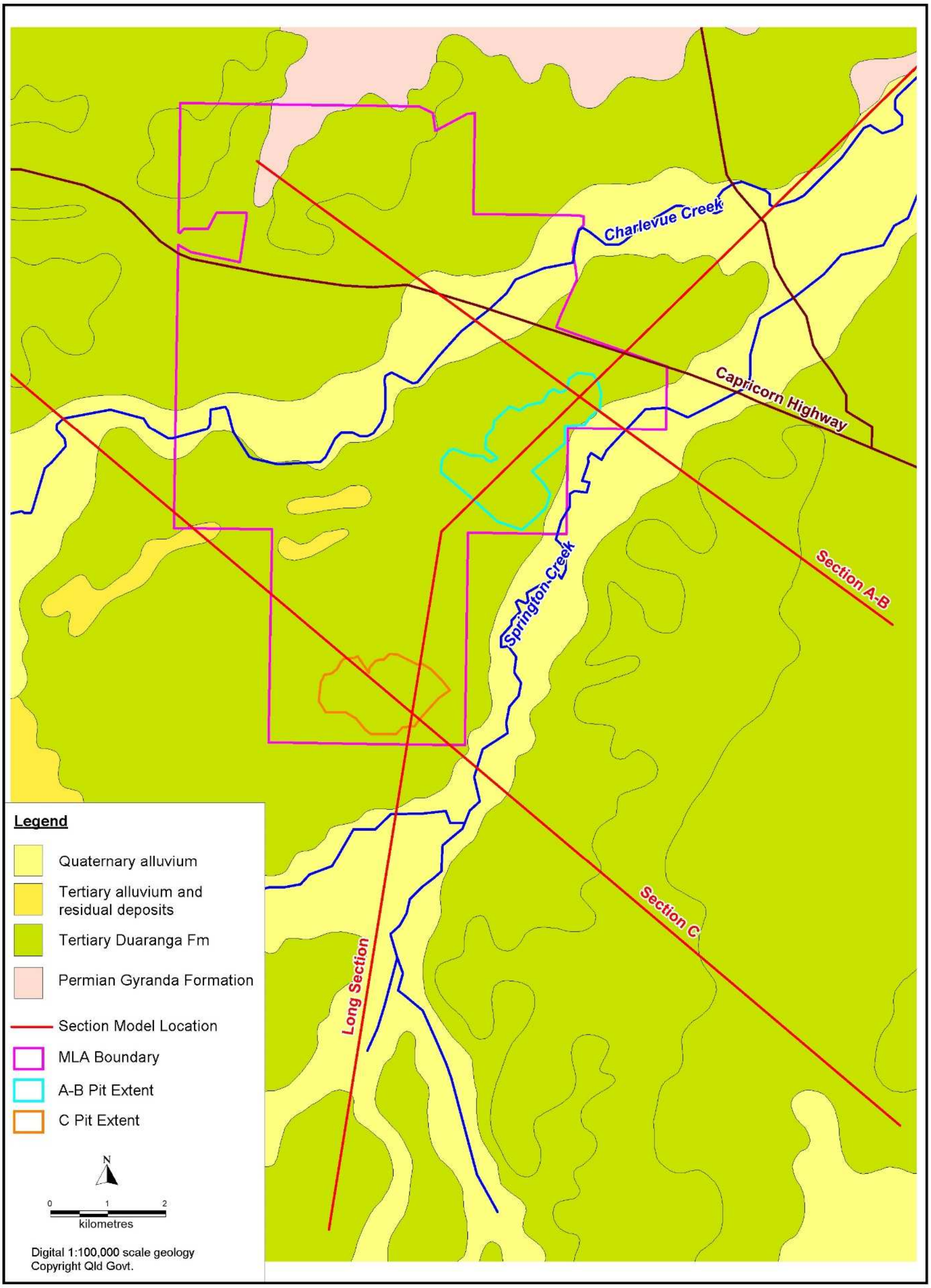
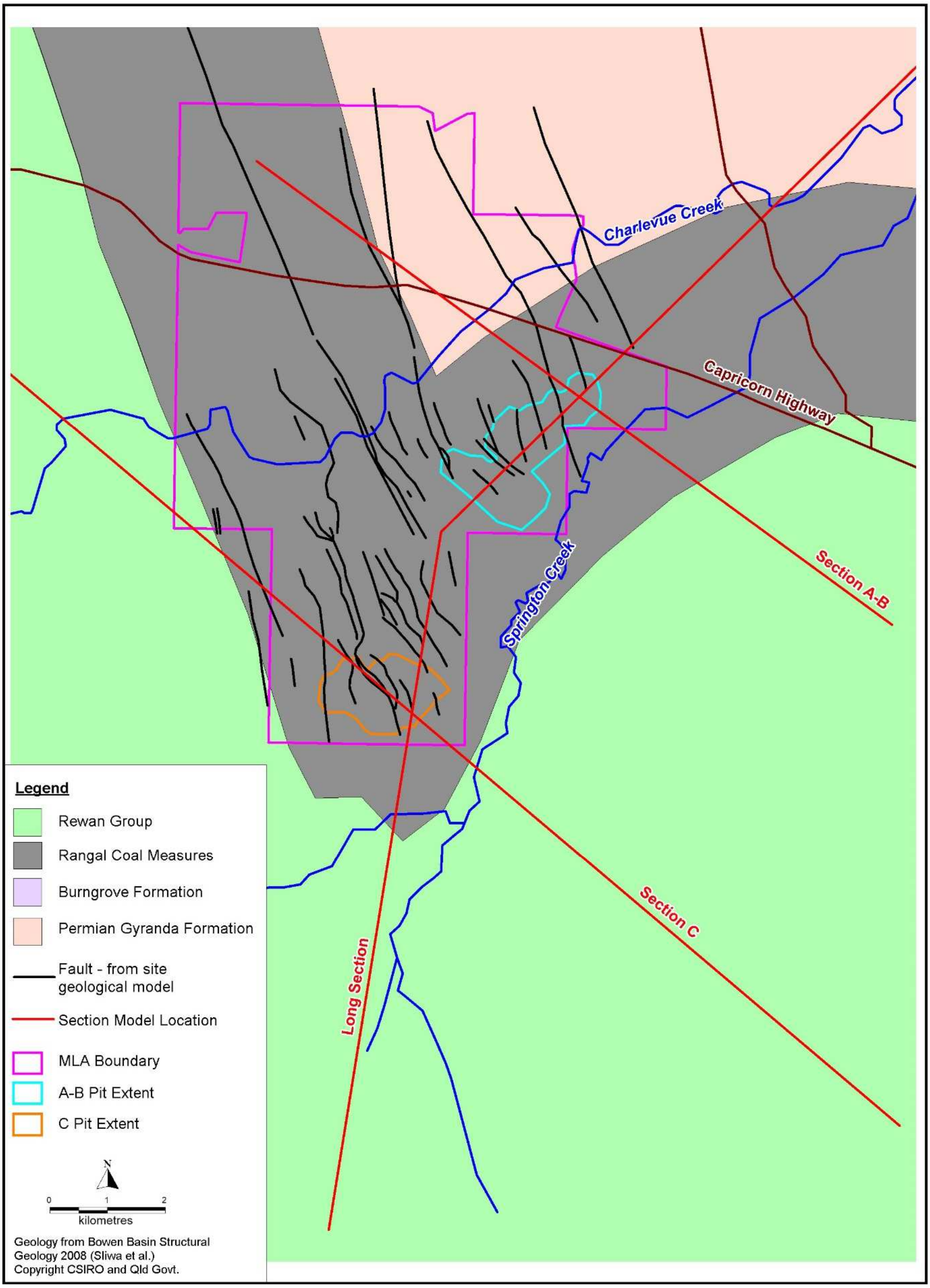


Figure 3-1: Project Location and Surface Geology (1:100,000 Scale Digital Geology)



Geology from Bowen Basin Structural Geology 2008 (Sliwa et al.)
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Figure 3-2: Project Location and Bowen Basin Solid Geology

3.2 Igneous Rocks and Intrusions

A minor occurrence of Tertiary basalt has been identified from geological drilling to the north of Pit C. The area of basalt is approximately 600 m long, 200 m wide and 20 m thick and has been interpreted as a localised basalt paleochannel (JTB 2019). One groundwater monitoring bore has been located within the basalt (bore DW7105W1, Section 4.1, Figures 4-1 and 4-2); the bore is 23 m deep and the basalt is dry at the bore location. The basalt flow is interpreted to be dry (as it is above the regional groundwater level) and of limited extent and is therefore not an important groundwater feature within the project area.

Extensive geological drilling across the project area has shown no other evidence of basaltic flows or intrusions (JTB 2019).

3.3 Structure

The Permian coal measures have undergone intense structural deformation, resulting in folding and faulting of the unit. Multiple reverse angle faults are present within the deposit, with displacements on some faults estimated to be in excess of 100 m (Boyd 2019). The location of mapped faults that are included in the site geological model are shown in Figure 3-2. With respect to the potential for impacts on groundwater occurrence and movement, the potential impacts are assessed to be:

- The fault zones may provide localilsed increases in hydraulic conductivity and storage that is associated with the shear zones of each fault; and,
- The faults may act as barriers to groundwater flow at locations where the faults disrupt individual coal seams, which are the main conduits for groundwater flow, especially at locations where the entire thickness of coal is displaced so that the coal seam terminates against lower-permeability interburden (the impacts of faults on groundwater are discussed further in Sections 4.6, 6.0 and 6.4).

4.0 GROUNDWATER INVESTIGATIONS AND DATA

4.1 Groundwater Monitoring Bores

The groundwater monitoring bore network at the Project site comprises 38 monitoring bores at 17 sites; bore locations are shown below in Figure 4-2, with summary details for the bores provided in Table 4-1. The monitoring bore network was designed to allow hydraulic testing as well as water level and water quality monitoring of all groundwater units encountered at site and includes:

- Two (2) bores within Quaternary alluvium;
- Ten (10) bores within Tertiary deposits (9 bores within Tertiary sediments and 1 bore (DW7105W1) in Tertiary basalt;
- Twenty-three (23) bores within Permian coal seams; and,
- Three (3) bores within the Permian overburden/interburden sediments that occur above/between the coal seams.

Bore construction logs for the monitoring bores are provided in Appendix A.

The development and utilisation of the monitoring bore network is summarised as follows:

- The network has been developed in two stages, comprising:
  - Stage 1 – installation of 11 bores at 5 sites (Sites 1 to 5 – refer Figure 4-2 and Table 4-1), with the bores installed in April 2018; and,
  - Stage 2 – Installation of a further 27 bores at 12 sites (Sites 6 to 17), with the bores drilled from May to June 2019.
- The bores at sites 1 to 5 have been monitored for water level and water quality on approximately a monthly basis since December 2018, with data available for this report from 8 sampling events between December 2018 and August 2019. Water level and water quality data is summarised below in Sections 4.2 and 4.3 respectively.
- Bores at Sites 6 to 17 were utilised for hydraulic testing (falling-head slug tests). Hydraulic tests were performed on a total of 25 bores, which provided data for all groundwater units present at site. Results from the hydraulic testing program are presented and discussed in Section 4.4.

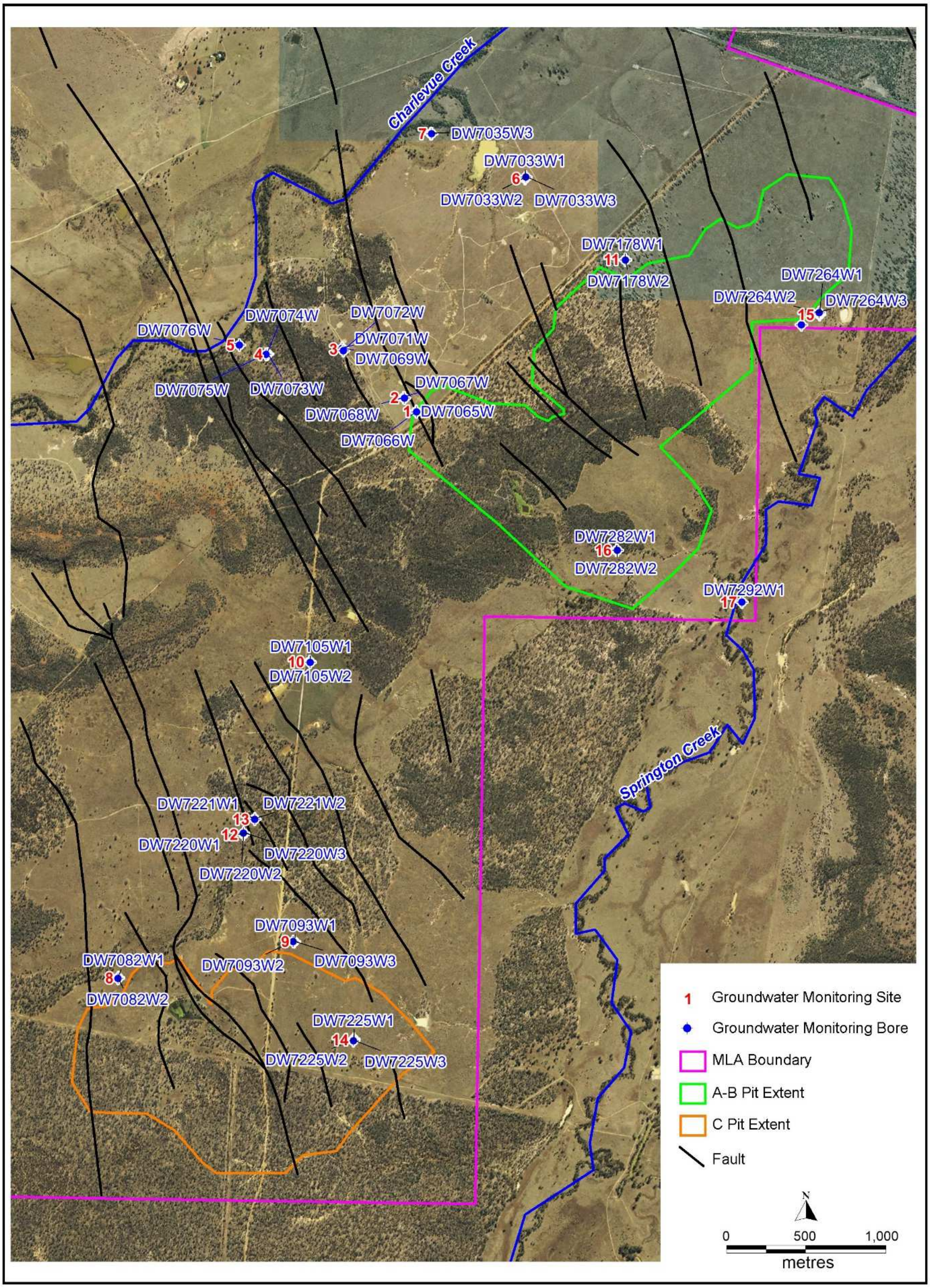


Figure 4-1: Groundwater Monitoring Bore Locations

Table 4-1: Summary Details of Groundwater Monitoring Bores

Site	Bore ID	Unit Monitored	Easting (GDA94)	Northing (GDA94)	RL (mTOC)*	Bore Depth (m)	Gravel Pack		Slotted Interval		Water Level	
							From*	To*	From*	To*	mbgl*	mAHD
1	DW7065W	Aries 3 Seam	730860	7382307	136.65	77.27	70.3	77.3	47.3	77.3	46.62	89.35
	DW7066W	Tertiary sediments	730863	7382304	137.19	17.35	10.35	17.35	Dry	17.35	Dry	-
2	DW7067W	Aries 3 Seam	730781	7382394	134.81	100.14	96.1	100.1	45.05	100.1	44.16	89.76
	DW7068W	Tertiary sediments	730785	7382391	134.94	47.5	42	47.5	45.68	47.5	44.74	89.26
3	DW7069W	Pollux Upper Seam	730397	7382699	133.46	71.38	64.4	71.4	42.73	71.4	41.84	90.73
	DW7071W	Aries 3 Seam	730394	7382703	133.22	31.59	27.6	31.6	Dry	31.6	Dry	-
	DW7072W	Tertiary sediments	730403	7382687	133.14	14.01	10	14	Dry	14	Dry	-
4	DW7073W	Castor/ Pollux Seams	729926	7382666	123.04	82.1	78.1	82.1	32.71	82.1	31.76	90.33
	DW7074W	Castor Upper Seams	729922	7382666	122.94	55.78	53.3	55.8	32.72	55.8	31.82	90.22
	DW7075W	Tertiary sediments	729918	7382666	122.83	14.03	10	14	Dry	14	Dry	
5	DW7076W	Quaternary Alluvium	729750	7382723	120.82	12	8	12	9.78	12	8.77	111.04
6	DW7033W1	Tertiary	731543	7383768	125.44	45.23	38	44.99	30.98	44.99	29.94	94.46
	DW7033W2	Orion 5 Seam	731546	7383773	125.46	74.77	72	74.5	30.02	74.5	29.01	95.44
	DW7033W3	Interburden	731548	7383777	125.47	81	78.5	81	29.97	81	28.93	95.50
7	DW7035W3	Orion 1 Seam	730957	7384050	117.73	48.47	45.9	48.44	22.81	48.44	21.75	94.92
8	DW7082W1	Castor Lower Seam	728989	7378746	136.34	40.58	38.1	40.64	17.99	40.64	16.91	118.35
	DW7082W2	Pollux Upper Seam	728986	7378742	136.32	59.17	57.6	59.17	18.03	59.17	17.04	118.29
9	DW7093W1	Pollux Lower Upper Seam	730096	7378974	140.14	87.3	84.5	87.3	29.58	87.3	28.44	110.56
	DW7093W2	Interburden	730092	7378973	140.14	99.2	97.5	99.2	29.54	99.2	28.45	110.60
	DW7093W3	Pollux Lower Lower Seam	730088	7378974	140.17	123.25	120.7	123.25	29.51	123.25	28.46	110.66
10	DW7105W1	Tertiary Basalt	730192	7380733	129.62	23.04	19	23.04	Dry	23.04	Dry	-
	DW7105W2	Pollux Lower Upper Seam	730193	7380729	129.72	69.25	61.7	64.2	32.2	64.2	31.18	97.52
11	DW7178W1	Tertiary	732174	7383260	129.62	51.15	43	48.5	38.68	48.5	37.71	90.94
	DW7178W2	Pollux Lower Upper Seam	732174	7383256	129.66	58.69	54.4	58.4	39.47	58.4	38.45	90.19
12	DW7220W1	Tertiary	729775	7379648	129.72	26.5	22.5	26.5	16.42	26.5	15.38	113.30
	DW7220W2	Castor Seam	729775	7379651	129.62	38.4	34.4	38.4	20.23	38.4	19.25	109.39
	DW7220W3	Pollux Lower Upper Seam	729774	7379655	129.67	75.08	72.5	75.04	20.03	75.04	19.04	109.64
13	DW7221W1	Aries 3 Seam	729846	7379745	130.34	50.43	46.4	50.43	21.52	50.43	20.50	108.82
	DW7221W2	Castor Seam	729845	7379742	130.32	72.36	69.8	72.36	21.57	72.36	20.50	108.75
14	DW7225W1	Tertiary	730467	7378359	141.70	37	30	37	33.43	37	32.37	108.27
	DW7225W2	Aries 3 Seam	730466	7378355	141.76	78.9	74.2	78.9	33.17	78.9	32.10	108.59
	DW7225W3	Castor Seam	730465	7378351	141.74	112.8	107	112.8	32.64	112.8	31.60	109.10
15	DW7264W1	Tertiary	733392	7382915	113.16	14	11.5	14	Dry	14	Dry	-
	DW7264W2	Aries 1 Seam	733391	7382921	113.22	104.21	101.7	104.21	22.57	104.21	21.59	90.65
	DW7264W3	Aries 3 Seam	733391	7382925	113.24	136.7	134.2	136.7	22.58	136.7	21.58	90.66
16	DW7282W1	Overburden	732119	7381433	116.84	43.03	36	43	27.25	43	26.25	89.59
	DW7282W2	Aries 3 Seam	732123	7381433	116.82	89.91	87.4	89.91	27.31	89.91	26.32	89.51
17	DW7292W1	Quaternary Alluvium	732905	7381108	114.41	15	11	15	12.02	15	11.19	102.39

* RL (mTOC) = elevation in mAHD of the top of bore casing; mbgl = metres below ground level; gravel pack and slotted interval from/to = from/to mbgl

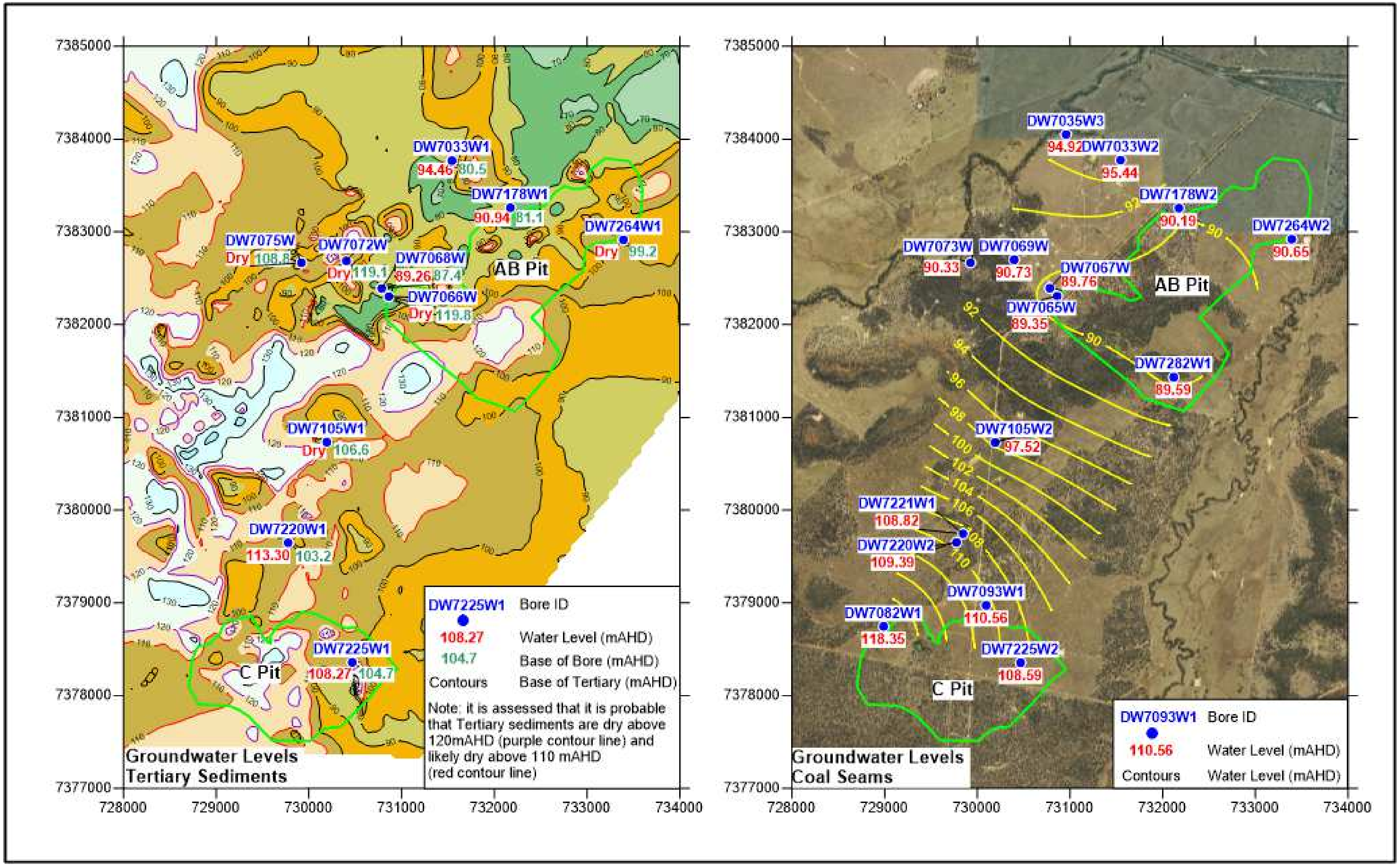
4.2 Groundwater Levels

Available groundwater level data from the site groundwater monitoring bores is summarised as follows:

- For bores at sites 1 to 5 (refer Table 4-1), data is available to date for 9 sampling events between December 2018 and August 2019;
- For bore DW7076W, which is constructed within Quaternary alluvium adjacent to Charlevue Creek (Figure 4-2), a data logger has been fitted to the bore that records data at 3-hourly intervals. A barometric logger is also installed at the site to allow barometric correction of the data;
- For bores at sites 6 to 17, which were drilled in May/June 2019, water level data is available from field testing that was undertaken in July/August 2019.

Table 4-1 provides the most recent water level data (July/August 2019) for all monitoring sites and is summarised as follows:

- Six of the monitoring bores are dry; five of these bores are constructed within Tertiary units at depths of between 14 and 23 m and one bore is constructed with the Aries seam at a depth of 31.6 m;
- Available data for bores within the Tertiary sediments are shown below in Figure 4-2, which is summarised as follows:
  - Data shown in Figure 4-2 includes contours for RL base of Tertiary (mAHD), bore ID, water level (mAHD) and base of bore (mAHD);
  - At a number of sites where the bore is dry, the bore has not been constructed to the full depth of Tertiary sediments. These sites include DW7075W, DW7072W, DW7066W;
  - Two sites that are dry (DW7105W1 and DW7264W1) have been drilled to base of Tertiary, indicating that the Tertiary is dry at these locations. Bore DW7105W1 is constructed within the small area of remnant basalt north of C Pit that has been identified from geological drilling (section 3.1); the bore is 23 m deep and is dry;
  - There is a significant reduction in the level of the base of Tertiary to the west and north-west of AB Pit, where the level of base of Tertiary reduces from approximately 100 mAHD to 70-80 mAHD. The bores within the lower elevation area of base of Tertiary tend to record water levels in the order of 90 to 95 mAHD, whereas the bores in the range of 105 to 113 mAHD; and,
  - The presence of dry bores within the Tertiary, as well as the variation in water level between the topographically elevated base of Tertiary and topographically lower base of Tertiary, suggest that a continuous water surface does not exist in the Tertiary sediments and that the elevation of the base of Tertiary will be a control on the presence of groundwater within the sediments. From review of available data it is assessed that it is probable that the Tertiary sediments are dry above 120 mAHD and likely dry above 110 mAHD (refer Figure 4-2).
- Available data for bores within the coal seams is also shown below in Figure 4-2. In summary:
  - From the data shown in Table 4-1 it is evident that, where multiple coal seam bores exist at the one location, the water level (as mAHD) is almost identical. This suggests that there is no significant trend for upward or downward movement of groundwater between the coal seams at this location;
  - Figure 4-2 also shows groundwater level contours for the coal measures; these indicate a trend for groundwater movement within the coal seams from the southwest to the northeast, and also from the northwest to the southeast, towards a depression that is centred on the area where the AB Pit is proposed to be developed.



Note: it is assessed that it is probable that Tertiary sediments are dry above 120mAHD (purple contour line) and likely dry above 110 mAHD (red contour line)

Figure 4-2: Water Level Data for Coal Seam and Tertiary Groundwater Units

For bores at Sites 1 to 5, where water level data is available from December 2018 to August 2019, the data is plotted on bore hydrographs. These are presented below and are summarised as follows:

- The bores shown on the plots below are located to the west of the AB Pit (Figure 4-2);
- When presented as water elevation data (i.e. as water level in mAHD) the data plots within a relatively tight range between approximately 88 to 90 mAHD;
- When presented as depth to water (m below ground level - mbgl), the range is from approximately 33 to 47 mbgl. This serves to highlight that the variability in the depth to groundwater is mainly related to the variation in surface topography, with the groundwater elevation in a particular area being relatively consistent; and,
- Figure 4-2 shows the location of bore DW7073W to the west of the AB Pit. This site also includes bore DW7074W, which is not shown in Figure 4-2. This is because only one coal seam bore was selected for generation of the water level contours shown in Figure 4-2, due to the similarity between the water levels within different coal seams at each site (refer water level data in Table 4-1). This relationship is highlighted in the water level data for bores DW7073W and DW7074W in the depth to water plot below; for these bores it can be seen that the water level is the same (within 0.1 m) for each monitoring event.

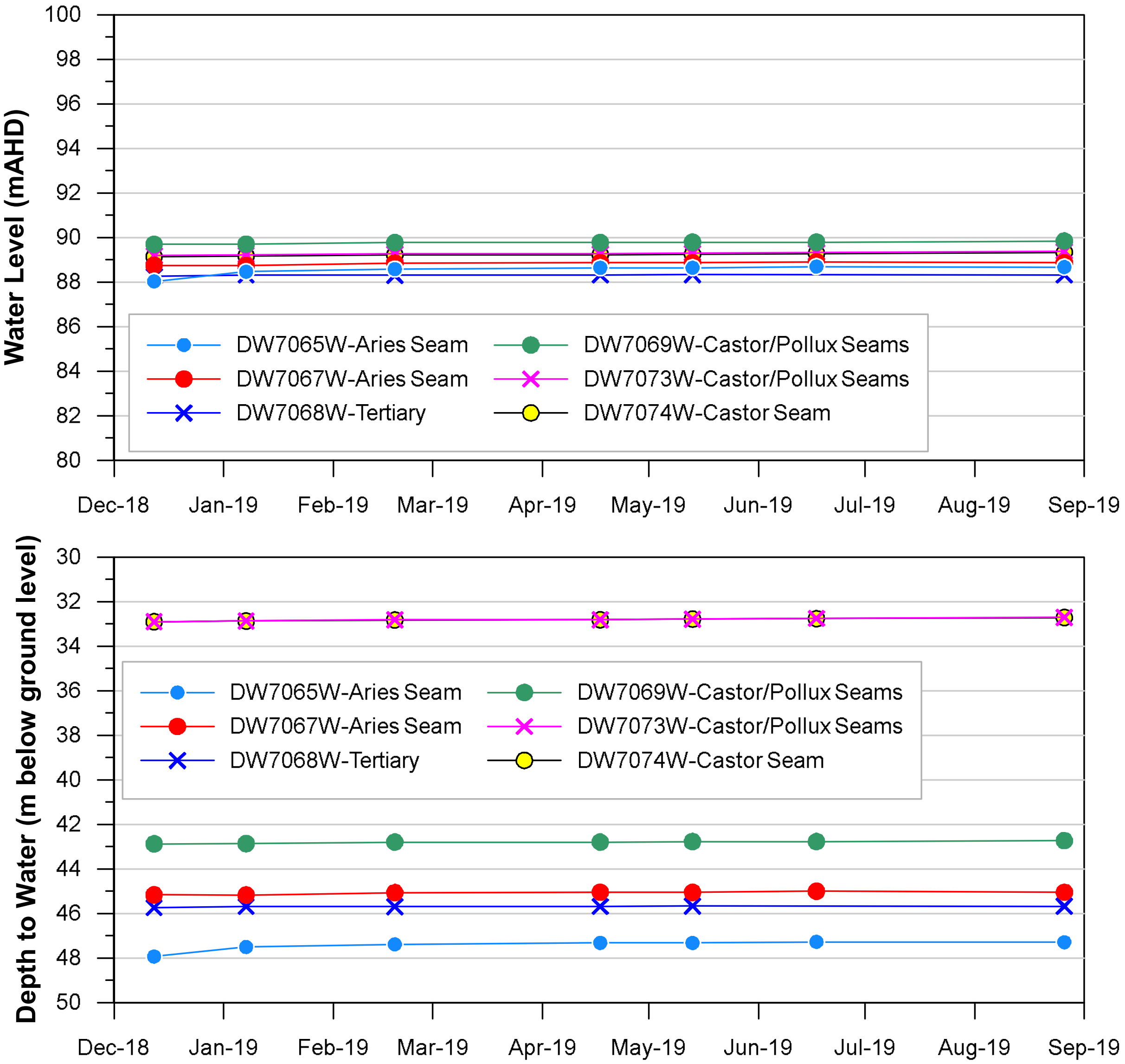


Figure 4-3: Water Level as Elevation (mAHD-top plot) and Depth to Water (mbgl-bottom plot)

Bore DW7076W (refer Figure 4-1 for bore location) is screened within Quaternary alluvium adjacent to Charlevue Creek. The bore has been fitted with a data logger that records water level at 3-hourly intervals, to allow the relationship between creek flow and water level to be established over time. To date the water level has been relatively stable, displaying a slightly downward water level tend between 9 and 10 mbgl. It is uncertain at this stage whether the reduction in water level is related to the ongoing removal of groundwater from the bore during sampling events (with the reduction in water level following sampling being evident in the bore hydrograph. Further data will be required at this site to establish the long-term water level trend.

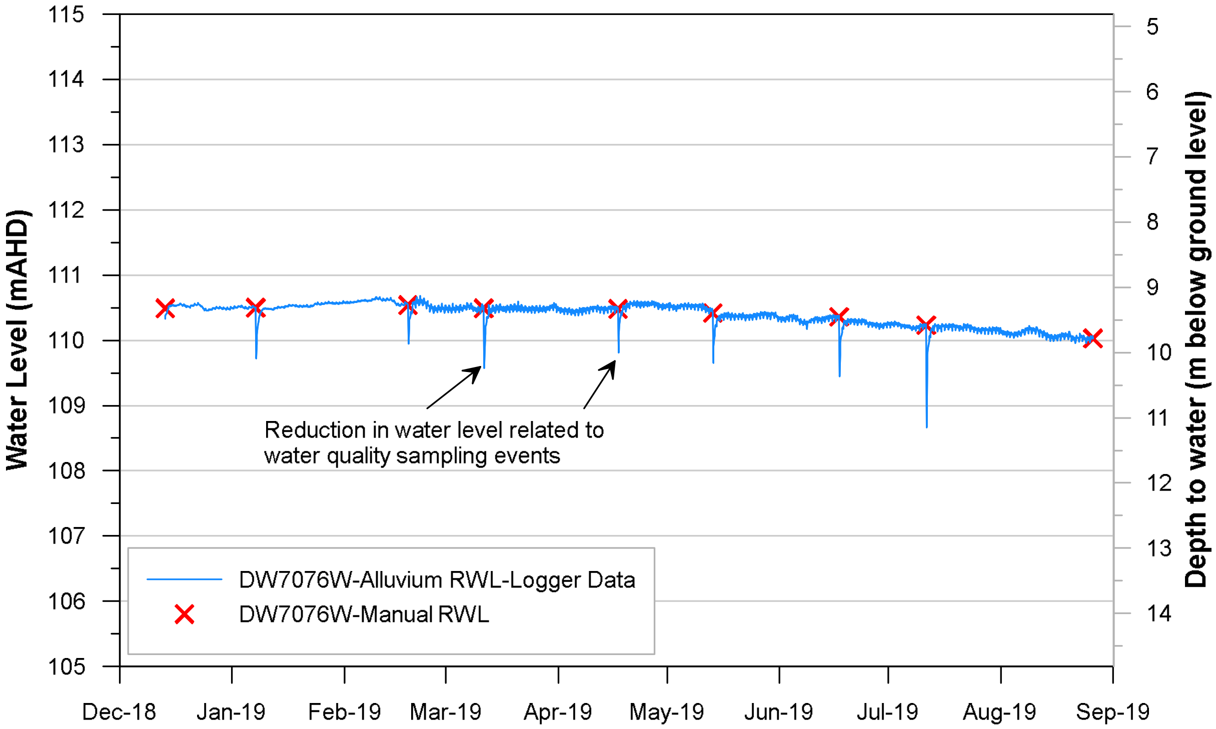


Figure 4-4: Water Level Data for Quaternary Alluvium Bore DW7076W

4.3 Groundwater Quality

Groundwater quality data is available for 8 sampling events that have occurred at approximately monthly intervals between December 2018 and August 2019. Available data includes:

- pH (field and laboratory data);
- Electrical Conductivity (EC – field and laboratory data);
- Total Dissolved Solids (TDS);
- Major ions (sodium, calcium, magnesium, potassium, chloride, sulphate, alkalinity); and,
- Total and dissolved metals/metalloids (aluminium, arsenic, barium, beryllium, boron, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, uranium, vanadium, zinc).

Available data is included as summary tables in Appendix B. Observations from review of the data area summarised as follows:

- pH (Field)
  - Quaternary alluvium - the pH ranges from 7.05 to 7.49, with a mean of 7.30 and median of 7.33;

  - Tertiary sediments - the pH ranges from 6.78 to 7.06, with a mean of 6.93 and median of 6.94; and,
  - Coal seams - the pH ranges from 6.21 to 6.84, with a mean of 6.44 and median of 6.42.
- Electrical Conductivity (EC – lab)
  - Quaternary alluvium - the EC at bore DW7076W (Charlevue Creek alluvium) ranges from 15,200 µS/cm to 16,600 µS/cm, with a mean of 15,788 µS/cm and median of 15,700 µS/cm (8 samples). A single field value from bore DW7292W1 (Springton Creek alluvium) recorded an EC of 5,948 µS/cm;
  - Tertiary sediments - the EC ranges from 20,200 µS/cm to 21,900 µS/cm, with a mean of 20,843 µS/cm and median of 20,800 µS/cm; and,
  - Coal seams - the EC ranges from 22,100 µS/cm to 28,500 µS/cm, with a mean of 25,693 µS/cm and median of 25,600 µS/cm.
- Sulphate (SO_4). Due to the high salinity of the groundwater, samples are also relatively high in sulphate, especially for the coal seams, with data summarised as:
  - Quaternary alluvium - the sulphate concentration ranges from 204 mg/L to 249 mg/L, with a mean of 217 mg/L and median of 212 mg/L;
  - Tertiary sediments - the sulphate concentration ranges from 291 mg/L to 635 mg/L, with a mean of 367 mg/L and median of 334 mg/L; and,
  - Coal seams - the sulphate concentration ranges from 341 mg/L to 841 mg/L, with a mean of 622 mg/L and median of 642 mg/L.
- Dissolved metal/metalloid data has been analysed with reference to the ANZECC 2000 95% freshwater ecosystem protection trigger values for parameters where guideline values exist; these include aluminium, arsenic, boron, cadmium, copper, lead, mercury, nickel, selenium, silver and zinc. Observations of note include:
  - All groundwater samples are above the guideline limit for boron of 0.37 mg/L, with data summarised as:
    - Quaternary alluvium – the boron concentration ranges from 0.56 to 4.56 mg/L, with mean of 3.50 mg/L and median of 3.81 mg/L;
    - Tertiary sediments – the boron concentration ranges from 1.14 to 1.52 mg/L, with mean of 1.28 mg/L and median of 1.26 mg/L; and,
    - Coal seams - the boron concentration ranges from 0.88 to 1.49 mg/L, with mean of 1.23 mg/L and median of 1.25 mg/L.
  - The majority of groundwater samples are above the guideline limit for copper of 0.0014 mg/L, with data summarised as:
    - Quaternary alluvium – the copper concentration ranges from 0.002 to 0.023 mg/L, with mean of 0.013 mg/L and median of 0.011 mg/L (9 samples, all samples >LOR);
    - Tertiary sediments – the copper concentration ranges from 0.001 to 0.014 mg/L, with mean of 0.004 mg/L and median of 0.003 mg/L (7 samples, 4 samples >LOR); and,
    - Coal seams - the copper concentration ranges from 0.001 to 0.081 mg/L, with mean of 0.011 mg/L and median of 0.003 mg/L (45 samples, 25 samples >LOR).
  - The majority of groundwater samples are above the guideline limit for zinc of 0.008 mg/L, with data summarised as:

    - Quaternary alluvium – the zinc concentration ranges from 0.007 to 0.028 mg/L, with mean of 0.014 mg/L and median of 0.011 mg/L (9 samples, 7 samples >LOR);
    - Tertiary sediments – the zinc concentration ranges from 0.017 to 0.096 mg/L, with mean of 0.049 mg/L and median of 0.035 mg/L (7 samples, all >LOR); and,
    - Coal seams - the zinc concentration ranges from 0.025 to 0.21 mg/L, with mean of 0.086 mg/L and median of 0.075 mg/L (45 samples, all >LOR).
  - A number of samples exceed the guideline values for aluminium, arsenic, lead and nickel.

The samples collected to date represent background water quality for the site. It can therefore be summarised that:

- Groundwater at site records very high EC for all groundwater units (Quaternary alluvium, Tertiary sediments and Permian coal measures). It is noted that the ANZECC 2000 livestock limit for beef cattle is 4,000 mg/L; this corresponds to an EC of approximately 6,000 µS/cm at a conversion factor of EC (µS/cm) x 0.67 = TDS (mg/L) (ANZECC 2000). It is therefore concluded, based on EC data, that groundwater at site is unsuited to stock watering; and,
- Groundwater at site is above the ANZECC 2000 freshwater ecosystem protection trigger value (95% species protection) for boron (all samples), copper and zinc (majority of samples) as well as aluminium, arsenic, lead and nickel (a number of samples for each analyte).

4.4 Hydraulic Conductivity data from Monitoring Bores

Falling head (slug) tests were undertaken on 25 monitoring bores in order to obtain site-specific hydraulic conductivity (K) data from all groundwater units that are encountered at site. The results for each bore are shown below in Table 4-2. Summary data for each groundwater unit are discussed further below and are provided in Table 4-3 and the slug test analysis sheets are included in Appendix C.

Table 4-2: Hydraulic Conductivity and Air Lift Yield Data for Monitoring Bores

Hole	Groundwater Unit	Centre of Screened Interval (mbgl)	SWL (mBTOC)	Hydraulic Conductivity (K) (m/day)	Air Lift Yield (L/s)*
DW7292W1	Alluvium	13.5	12.02	0.097	
DW7220W1	Tertiary	25.0	16.42	0.045	0.010
DW7225W1	Tertiary	34.0	33.43	0.444	0.010
DW7282W1	Tertiary	40.0	27.25	0.027	0.010
DW7033W1	Tertiary	42.0	30.98	0.703	2.250
DW7178W1	Tertiary	46.3	38.68	3.805	0.460
DW7220W2	Castor	35.4	20.23	0.012	0.010
DW7082W1	Castor Lower	39.8	17.99	5.387	2.180
DW7035W3	Orion 1	47.7	22.81	1.593	0.010
DW7221W1	AR3	48.9	21.52	0.286	0.010
DW7178W2	PLU2	56.9	39.47	0.532	0.330
DW7082W2	Pollux Upper	58.4	18.03	1.855	1.840
DW7105W2	PLU1	63.5	32.20	0.066	0.010
DW7221W2	Castor	71.6	21.57	0.243	1.530
DW7033W2	Orion 5	73.8	30.02	0.061	2.180
DW7220W3	PLU1	74.3	20.03	0.293	1.530
DW7225W2	AR3	77.4	33.17	2.141	7.730
DW7093W1	Pollux Upper 2	86.6	29.58	0.022	0.610
DW7282W2	AR3	89.2	27.31	0.245	0.220
DW7264W2	AR1	103.5	22.57	0.009	0.220
DW7225W3	Castor	111.3	32.64	0.002	
DW7093W3	PLL2	122.5	29.51	0.039	0.330
DW7264W3	AR3	136.0	22.58	0.011	0.220
DW7033W3	Interburden	80.3	29.97	0.002	2.250
DW7093W2	Interburden	98.5	29.54	0.001**	

* Air Lift Yield data was obtained from the base of bore prior to bore construction and therefore represents the yield of the entire open interval

** Data could not be analysed due to lack of recovery over test period – K set at low value of 0.001 m/day

The data was also reviewed in association with data from air-lift yield testing of the groundwater monitoring bores, which was undertaken at the completion of drilling (i.e. at the base of the hole) and prior to bore construction. From review of the combined dataset of hydraulic conductivity data and air-lift yield data, and with reference to information contained in Table 4-2, Table 4-3 and Figure 4-2, the following observations are made:

- A total of 17 slug tests were performed on bores that are screened within the coal seams. From review of the data it is evident that the K decreases with depth and that the difference becomes apparent when comparing data for coal seam bores that are screened at a depth of less than 80 metres below ground level (mbgl) to data for bores that are screened at a depth greater than 80 mbgl;

- Table 4-3 contains summary statistics (minimum value, maximum value and geometric mean) for the K of the coal seams, which is summarised as follows:
  - For data for all coal seams (17 data points), the K range is from 0.002 to 5.4 m/day, with a geometric mean of 0.13 m/day
  - For coal seam bores that are screened above 80 mbgl (11 data points) the K range is from 0.012 to 5.4 m/day, with a geometric mean of 0.37 m/day
  - For coal seam bores that are screened below 80 mbgl (6 data points) the K range is from 0.002 to 0.24 m/day, with a geometric mean of 0.02 m/day;
- The relationship between hydraulic conductivity and depth is shown graphically in Figure 4-2. Of particular interest is the data for the coal seam bores, where the trend for the lower K with depth is shown via the trend line and the 95% confidence interval that has been applied to the data (curves have been automatically fit within the software program Grapher).

Table 4-3: Summary of Hydraulic Conductivity and Air-Lift Yield Data per Groundwater Unit

Groundwater Unit	No. of Tests	Hydraulic Conductivity (m/day)			Average Air-Lift Yield (L/s)
		Min	Max	Geometric Mean	
Quaternary Alluvium	1	0.097		-	-
Tertiary	5	0.027	3.805	0.27	0.548
Permian Coal Seams	17	0.002	5.387	0.13	1.185
Coal Seams <80 mbgl	11	0.012	5.387	0.37	1.578
Coal Seams >80 mbgl	6	0.002	0.245	0.02	0.320
Permian Interburden	2	0.001	0.002	-	-

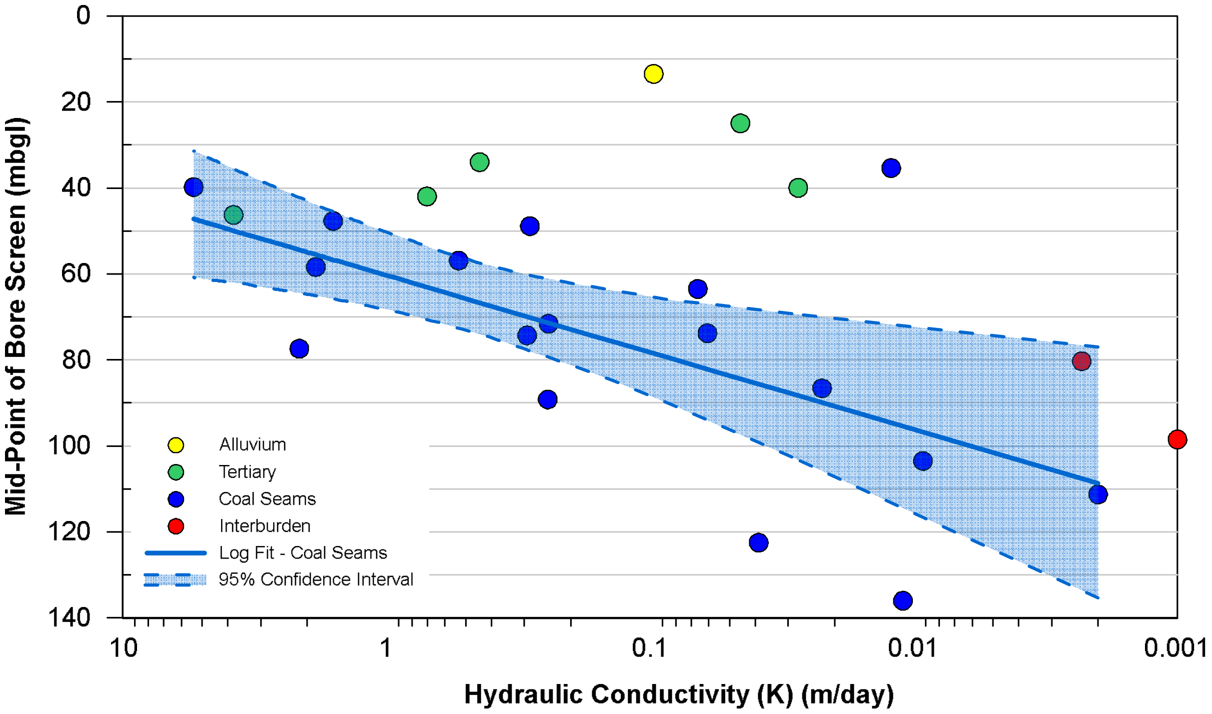


Figure 4-5: Relationship between Hydraulic Conductivity and Depth

4.5 Use of Groundwater Quality Data for Estimating Groundwater Recharge

Groundwater data from site has been utilised to provide an estimate of groundwater recharge based on the chloride mass balance (CMB) method, which utilises the concentration of chloride in rainfall and the concentration of chloride in groundwater to provide an estimate of the net recharge rate to groundwater. The CMB equation is given as:

$$R = \frac{PCp}{Cg}$$

Where:

R = Recharge (mm/year).

P = Rainfall (mm/year).

Cp = Chloride concentration in rainfall (mg/L).

Cg = Chloride concentration in groundwater (mg/L).

Utilising the above formula, the recharge rates for each groundwater unit were calculated using the following input data:

- Mean annual rainfall for the Gemini project site of 678 mm (from SILO data).
- Mean chloride concentration in rainfall for the Gemini project site of 4.9 mg/L (CSIRO 2014[1]).
- Mean chloride concentration of groundwater (refer Appendix B) of:
    - 4,088 mg/L for the alluvium;
    - 7,440 mg/L for Tertiary sediments; and,
    - 9,081 mg/L for the Permian coal seams.

The calculated recharge rates to groundwater are very low, being less than 1 mm of rainfall recharge for each groundwater unit at site and corresponds to approximately 0.05 to 0.12% of average annual rainfall reporting as recharge to the groundwater units.

While the calculated recharge rates are assessed to be low, the low recharge rates are consistent with the high salinity of the groundwater, which is observed for even the shallow alluvial units at site.

Table 4-4: Calculated Recharge via CMB Method

Parameter	Description	Groundwater Unit		
		Alluvium	Tertiary	Coal Seams
Cg	Chloride concentration in groundwater (mg/L)	4088	7440	9081
Cp	mg/L chloride in rainfall	4.9	4.9	4.9
P	Annual average rainfall (mm)	678	678	678
R	Annual average recharge (mm)	0.78	0.43	0.35
	Recharge as % of average annual rainfall	0.12	0.07	0.05

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[1] CSIRO 2014 - Australian Chloride Deposition Rate https://doi.org/10.4225/08/545BEE54CD4FC

4.6 Summary of Observations from Site Data

The main observations from review of site data are as follows:

- Groundwater occurs within three main groundwater units at site, including:
    - Quaternary alluvium associated with Charlevue Creek and Springton Creek;
    - Tertiary sediments of the Duaringa Formation; and,
    - The Permian coal measures, where groundwater occurs preferentially within the coal seams.
- The site is heavily faulted and the faults may act to influence groundwater occurrence and movement as follows:
    - Shear zones associated with faulting may act as a store of water and as locally higher hydraulic conductivity zones. As discussed below, recharge to the groundwater system is assessed to be low; therefore the faults may provide initial relatively high inflow rates to the workings (in the order of several L/s), but the total storage within the faults is anticipated to be relatively low, with the initial rates of inflow not able to be sustained in the long-term; and,
    - Where the faults completely disrupt the coal seams, especially for cases where the coal seam terminates against lower-hydraulic conductivity interburden, the faults will act to disrupt groundwater flow.
- Available hydraulic conductivity and air-lift yield data indicates that there is notable reduction in hydraulic conductivity and bore yield for bores that are deeper than 80 mbgl compared to bores that are shallower than 80 mbgl.
- Groundwater level data at site are summarised as:
    - The water level within the alluvium ranges from 8.77 m to 11.19 m below ground level for bores adjacent to the creek channels;
    - The water level with the Tertiary sediments ranges from dry (5 bores, ranging in depth from 14 to 23 m) to 15.38-44.74 mbgl (where water is present). The presence of water within the Tertiary sediments is related to the RL of the base of Tertiary and from review of available data it is assessed that it is probable that the Tertiary sediments are dry above 120 mAHD and likely dry above 110 mAHD; and,
    - The water level in the coal measures ranges from 16.91 to 46.62 mbgl for bore depths of between 38.4 and 136.7 m, with one bore dry at a depth of 31.59 m.
- Groundwater quality data is summarised as:
    - All groundwater units at site record high EC groundwater, as follows:
        - Quaternary alluvium – bore DWDW7076W (Charlevue Creek alluvium) records an EC range from 15,200 µS/cm to 16,600 µS/cm (8 samples). A single field value for bore DW7292W (Springton Creek alluvium) records an EC of 5,948 µS/cm;
        - Tertiary sediments - the EC ranges from 20,200 µS/cm to 21,200 µS/cm; and,
        - Coal seams - the EC ranges from 22,100 µS/cm to 28,500 µS/cm.
    - Groundwater at site is above the ANZECC 2000 freshwater ecosystem protection trigger value (95% species protection) for boron (all samples), copper and zinc (majority of samples) as well as aluminium, arsenic, lead and nickel (a number of samples for each analyte).
    - All groundwater samples collected to date are assessed to represent the background water quality for the site.

  - The recharge rate to the groundwater units at site, which has been calculated via the chloride mass balance method, indicates an extremely low recharge rate of less than 1 mm/year for each groundwater unit. The low rate of calculated recharge is consistent with the observation of highly saline groundwater at site, which is present for even the shallow alluvial units.
  - The observation of a low recharge rate for groundwater suggests that, even though relatively high rates of groundwater inflow may be observed from faults/shear zones as mining progresses, the inflow rates are likely to be of short duration due to the relatively low volume that can be stored within fractures/faults and the very low rates of recharge observed at site (i.e. once the fault storage is depleted the faults are unlikely to be recharged).
  - Because the faults may act as conduits for groundwater movement, the control of surface water around the site will be of particular importance (i.e. water that ponds at surface may recharge the underlying sediments and report as seepage to the pits via movement along faults/fractures. This type of flow would represent infiltrated surface water rather than groundwater.

4.7 Regional Groundwater Use

Data from DNRM groundwater database within a distance of 10 km from the EPC boundary is shown below in Figure 4-6 and summary data is provided in Table 4-4. With reference to the information in Table 4-4 and Figure 4-6 the following observations are made:

- There are 48 registered bores within 10km of EPC881 that are listed as being either existing or abandoned by useable.
- The majority of bores are screened within Tertiary units (26 bores) or Permian coal measures (15 bores).
- The right-hand plot in Figure 4-6 shows the available data classed according to EC range, being:
  - Bores that record an EC <1000 µS/cm. This includes four bores in Tertiary sediments to the east or south of the project area;
  - Bores that record an EC between 1,000 and 6,000 µS/cm. A limit of 6,000 µS/cm was assessed as this EC equates to 4,000 mg/L[2], which is the ANZECC 2000 livestock drinking limit for beef cattle (assessed to the most likely stock use for the area); and,
  - Bores that record an EC >6,000 µS/cm (assessed to be of limited or no use for stock watering).
- The majority of Tertiary bores outside the tenement area record an EC of < 6,000 µS/cm, whereas the majority of bores within or close to the tenement area record and EC in excess of 6,000 µS/cm (from Table 4-4 it is noted that the EC of groundwater within the Tertiary Duaringa Formation is often in excess of 10,000 µS/cm and at some sites in excess of 20,000 µS/cm; this observation is consistent with water quality data from site).

Data from private groundwater bores is discussed further in Sections 7.1 and 7.2.1.

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[2]

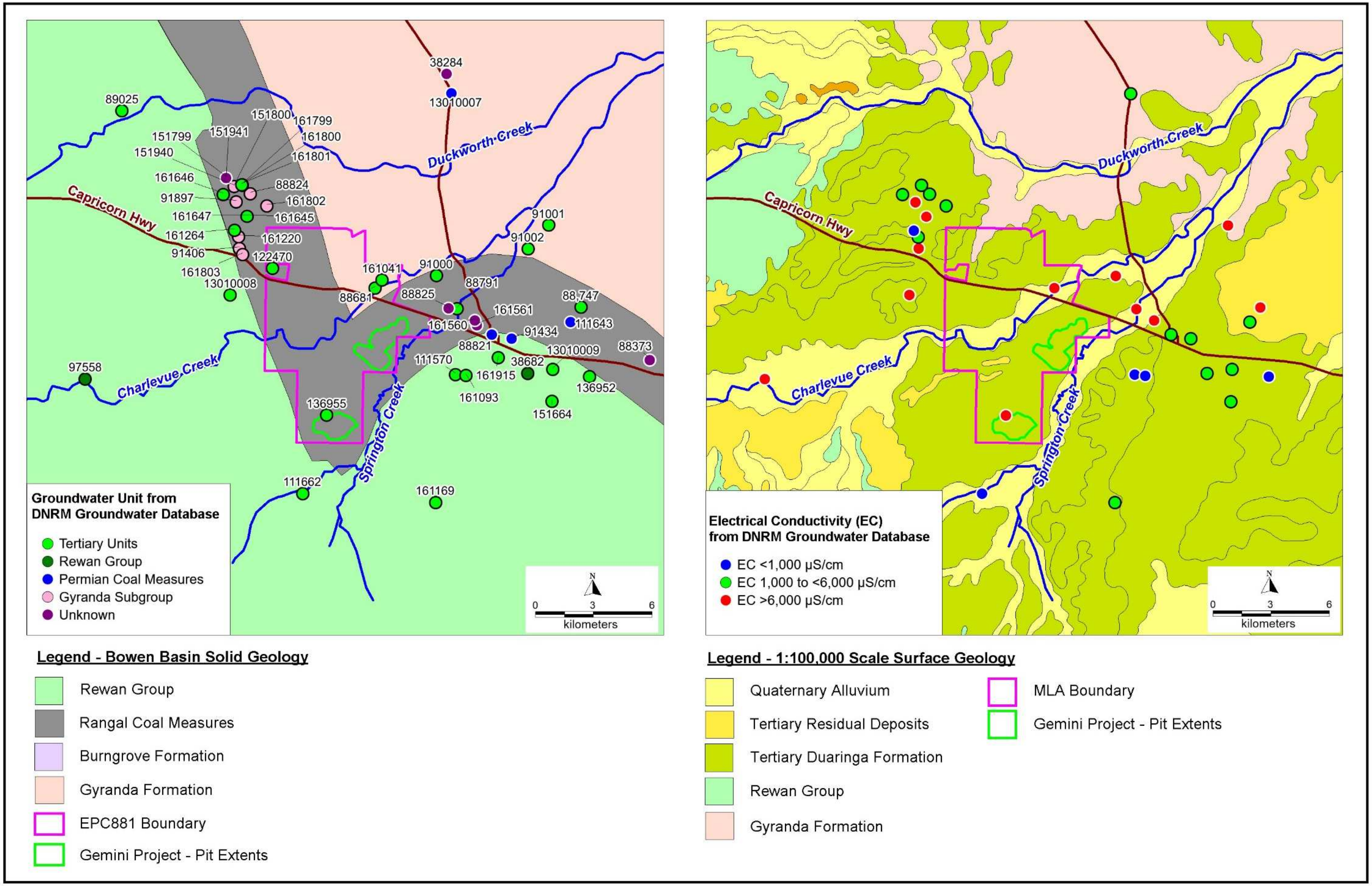

Figure 4-6: Aquifer Data and Groundwater EC Data from DNRM Groundwater Database

Table 4-5: Summary Data from DNRM Groundwater Database for Bores within 10km of EPC Boundary

RN	EASTING GD94	NORTHING GDA94	FACILITY_STATUS	Aquifer	DRILLED_DATE	EC (µS/cm)	Water Quality Description	YIELD (L/s)	SWL (mbgl)	Original Bore Name
38284	735584	7396485	Existing	Unknown						SANDY CREEK BORE
38682	739791	7381024	Existing	DUARINGA FORMATION	31-Oct-72	2370		0.19	-5.3	
88373	746081	7381702	Existing	Unknown	01-Jan-15					GOOWARRA WELL
88681	731897	7385429	Existing	DUARINGA FORMATION	28-Nov-92	10000		2.5		
88747	742541	7384432	Existing	DUARINGA FORMATION	15-Feb-93	10360		1.1		
88791	736137	7384353	Existing	DUARINGA FORMATION	06-Apr-93	19200		0.78	-20	NEW BORE
88821	737932	7383029	Existing	RANGAL COAL MEASURES	03-Apr-93	4510		0.63	-8	FITZGERALDS PLACE
88824	725449	7390299	Existing	GYRANDA SUBGROUP	05-Apr-93	3800		0.78	-15	BORE 3
88825	735685	7384385	Existing	Unknown						WINDMILL
89025	718817	7394577	Existing	BASALT	01-Jan-64			0.4		
91000	735078	7386067	Abandoned but Usable	DUARINGA FORMATION	07-Apr-93	14660		0.75	-20	MACKENZIE OLO
91001	740865	7388678	Abandoned but Usable	DUARINGA FORMATION	18-Apr-93	42000		1.5	-24	MACKENZIE OLO
91002	739796	7387438	Abandoned but Usable	DUARINGA FORMATION	19-Apr-93		SALTY	2.1		MACKENZIE OLO
91406	724894	7387470	Existing	GYRANDA SUBGROUP	04-Aug-94	9240		0.32	-30.5	
91434	738947	7382824	Existing	RANGAL COAL MEASURES	16-Aug-94	1080		2.14		DINGO RACECOURSE
91897	724724	7389881	Existing	GYRANDA SUBGROUP	31-Dec-99	15330		0.65		NAUGHTON (OLO)
97558	716925	7380734	Existing	REWAN GROUP	09-Jul-96	7600		0.36	-27.4	SIMON CATTLE CO
111570	736059	7380966	Existing	TERTIARY - UNDEFINED	02-Nov-01	240		1.2	-16	WARD
111643	741998	7383678	Existing	BLACKWATER GROUP - UNDIFF.	03-Oct-01	4120		4.4	-27.4	G SMITH
111662	728169	7374811	Existing	TERTIARY - UNDEFINED	29-Dec-01	750		2.5	-17	SMITH
122470	726594	7386438	Existing	TERTIARY - UNDEFINED						
136131	707571	7381259	Existing	DUARINGA FORMATION	27-Mar-06	900		1.3	-18	
136952	742978	7380858	Existing	TERTIARY - UNDEFINED	27-Jan-07	848		0.1	-17.37	
136955	729388	7378869	Existing	TERTIARY - UNDEFINED	30-Sep-08	10300		2.2	-21	
151664	741024	7379579	Existing	DUARINGA FORMATION	14-Feb-10	1250	POTABLE	0.25	-26	
151799	724194	7391110	Existing	GYRANDA SUBGROUP	22-Jan-13		POTABLE	2.1	-71	
151800	724628	7390671	Existing	BLACKWATER GROUP	23-Jan-13		POTABLE	0.31	-20	
151940	724627	7390671	Existing	GYRANDA SUBGROUP	28-Sep-13		POTABLE	0.31	-20	
151941	724194	7391113	Existing	Unknown	28-Sep-13		POTABLE	2.1	-71	
161041	732247	7385838	Existing	DUARINGA FORMATION	28-Apr-14		BRACKISH	1	-29	
161093	736592	7380908	Existing	TERTIARY MAFIC VOLCANICS	31-Aug-14	710	FRESH	0.61	-19.5	
161169	735022	7374342	Existing	TERTIARY - UNDEFINED	12-Oct-13	3300		0.25	-15	
161220	724858	7388061	Existing	BANANA FORMATION	21-Dec-14	2400		1.2	-32	
161264	724639	7388396	Existing	DUARINGA FORMATION	30-Mar-15	960		1.5	-54	
161560	737046	7383758	Existing	Unknown	28-Nov-16	28102				DINGO LANDFILL MW2
161561	737159	7383502	Existing	Unknown	29-Nov-16					DINGO LANDFILL MW1
161645	725283	7389134	Existing	DUARINGA FORMATION	06-Jul-17		BRACKISH	1	-27.64	MB01
161646	724053	7390267	Existing	DUARINGA FORMATION	07-Jul-17	2942				MB02
161647	725283	7389134	Existing	DUARINGA FORMATION	09-Jul-17	29000	BRACKISH		-36.87	MB03
161799	725034	7390748	Existing	GYRANDA SUBGROUP	16-Apr-18	4420	BRACKISH	0.4		MB04C (AQ090A)
161800	725026	7390758	Existing	GYRANDA SUBGROUP	16-Apr-18	5459	SALTY	0.6		MB04B (AQ090B)
161801	725020	7390764	Existing	DUARINGA FORMATION	16-Apr-18					AQ090C
161802	726308	7389681	Existing	GYRANDA SUBGROUP	16-Apr-18	1380	SALTY	7.5		MB06 (AQ091)
161803	725061	7387160	Existing	GYRANDA SUBGROUP	16-Apr-18		SALTY-BRACKISH	0.4		QQ092
161915	738258	7381843	Existing	DUARINGA FORMATION	10-Sep-18			1.62	-4.5	
13010007	735835	7395478	Abandoned but Usable	BLACKWATER GROUP	28-Oct-04	1534				
13010008	724410	7385071	Existing	DUARINGA FORMATION	31-Oct-04	16100				
13010009	741076	7381232	Abandoned but Usable	DUARINGA FORMATION	02-Nov-04	3690				

5.0 CONCEPTUAL GROUNDWATER MODEL

Essential elements of the conceptual model that have informed numerical modelling include:

- Quaternary alluvium is present within ephemeral water courses to the east and west of the mining area (Springton Creek and Charlevue Creek respectively);
- Tertiary deposits are present across the project area that comprise mainly sediments of the Duaringa Formation. The Tertiary sediments are variably saturated the elevation of the base of Tertiary being a control on the occurrence of water within the sediments; it is assessed that Tertiary sediment above approximately 110 mAHD are likely to be unsaturated;
- A minor area of Tertiary basalt is present to the north of Pit C; the basalt is interpreted to be dry and of limited extent and is therefore not considered as a groundwater unit at site;
- Recharge to alluvium and Tertiary sediments is via direct rainfall recharge. The rate of recharge to the alluvium and Tertiary sediments is calculated by the chloride mass balance method (Section 4.5) to be in the order of 0.4 to 0.8 mm/year (0.07 to 0.12 % of annual average recharge respectively). The low rate of recharge is consistent with the observation of elevated salinity in the shallow sediments, with an EC range for alluvial sediments from 15,200 µS/cm to 16,600 µS/cm and for Tertiary sediments from 20,200 µS/cm to 21,200 µS/cm. The high EC that is recorded for the shallow sediments (alluvium and Tertiary) is interpreted to be reflective of a low rate of groundwater recharge as well as high residence times for groundwater;
- The coal measures are heavily faulted and folded and mining occurs where folding and faulting has brought the coal seams close to surface, as shown below in Figures 6-2 to 6-6;
- The coal seams are recharged in subcrop areas where the coal seams directly underlay Tertiary and/or Quaternary sediments. The rate of recharge to the coal seams has been calculated by the CMB method (Section 4.5) to be in the order of 0.05% of average annual rainfall. The extremely high salinity of groundwater within the coal measures (range from 22,100 µS/cm to 28,500 µS/cm) supports an interpretation of a low rate of recharge and high groundwater residence times for these units;
- Within the Permian coal measures the coal seams are the primary conduits for groundwater flow. This interpretation is supported by hydraulic conductivity data from site testing, which indicates a much lower hydraulic conductivity of interburden/ overburden units relative to the hydraulic conductivity of the coal seams;
- Hydraulic conductivity data (from testing of completed monitoring bores) and air-lift yield data (from air-lift testing undertaken at the base of the bore on completion of drilling and prior to bore construction) indicates that the shallow coal seams (shallower than approximately 80 mbgl) have a higher hydraulic conductivity and are higher yielding than the coal seams below 80 mbgl;
- The relatively high rates of groundwater flow (from air-lift yield testing) for bores shallower than 80 m may be related in some cases to proximity to faults, as the hydraulic conductivity calculated for some of the coal seams (in excess of 1.5 m/day at four sites) is assessed to be greater (by approximately an order of magnitude) than the geometric mean of the coal seam data;
- However, taken together with the interpreted low rate of recharge and high groundwater salinity it is interpreted that, while the faults may locally increase hydraulic conductivity and storage within the secondary porosity of the shear zones, the faults also act to compartmentalise the groundwater system (for example by truncating the coal seams so that they terminate against lower hydraulic

conductivity interburden); this leads to high residence times for groundwater that contributes to the elevated groundwater salinity;

- The direction of groundwater flow within the coal seams is generally from southwest to northeast; and,
- It is interpreted that a continuous water surface does not exist in the Tertiary sediments and that the elevation of the base of Tertiary will be a control on the presence of groundwater within the sediments. From review of available data it is assessed that it is probable that the Tertiary sediments are dry above 120 mAHD and likely dry above 110 mAHD.

6.0 GROUNDWATER MODELLING

6.1 Choice of Numerical Model

To estimate the extent of water level impact from the proposed project, 2-dimensional seepage modelling has been undertaken using the program Seep/W. The choice of model code has been based on an assessment of the model platform that would be appropriate to the study requirements.

A number of factors are assessed when choosing the appropriate modelling platform for a particular groundwater modelling study. Factors that are relevant to the Gemini Project include:

- The ability of the model to represent the essential elements of the conceptual groundwater model. At the Gemini Project this includes the ability of the model to accurately represent the complexity of the geology including faulting of strata, which acts to compartmentalise the geological and hydrogeological units, as faulting has the potential to significantly impact groundwater occurrence and flow; and,
- The ability of the model to adequately address the requirements of the scope of work. At the Gemini Project this includes assessment of the extent of groundwater level impact from mining, assessment of the potential impact of groundwater level changes on any groundwater dependant ecosystems, and assessment of the rate of groundwater inflow to the active mining area and final voids.

Based on assessment of the model requirements, including representation of the essential elements of the conceptual groundwater model, it was concluded that 2-dimensional cross-section modelling would be appropriate for the Gemini project and on that basis the model Seep/W was selected. The use of a 2-dimensional Seep/W cross-section model was assessed to be appropriate to this investigation for the following reasons:

- The geology of the mining area is complex, and includes a number of local-scale and regional-scale faults which significantly disrupt the strata (refer Figure 2-2 for solid geology). It is possible within a 2-dimensional model to reproduce complex cross-sectional geology, whereas such detail could not be included practically within a 3-dimensional model;
- Seep/W is designed to simulate flow in both the saturated zone and the unsaturated zone. When mining occurs below the phreatic surface[1] an unsaturated zone is induced in the pit walls as seepage to the excavation occurs. Seep/W is well suited to investigation of groundwater level impacts resulting from seepage to open pits, particularly for projects such as Gemini where mine dewatering via bores does not occur, and seepage to the excavation is the only means via which the mine removes water from the groundwater system;
- In open cut mines groundwater storage conditions transition from confined to unconfined in the zone adjacent to the pit walls. Seep/W models the rate of drainage to an excavation via a property called the volumetric water content (refer Section 6.3.2), which is able to accurately account for the rate of groundwater flow and the rate of change of the phreatic surface as groundwater conditions transition from confined to unconfined and gravity drainage of groundwater occurs to the excavation;
- One of the main purposes of the model is to investigate the rate and extent of groundwater level drawdown in response to mining, especially in areas of potentially connected surface water and

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[1] The phreatic surface is a line of zero pore water pressure below which all pore spaces are saturated with water, and is analogous to the water table. The term phreatic surface is used throughout this report for consistency with Seep/W modelling terminology.

groundwater systems. This can be readily (and potentially more accurately) achieved through the use of a 2-dimensional cross-section models that are able to accurately represent faulting, relatively thin coal seams and seepage conditions within the mined void;

- The use of 2-dimensional models is valid in cases where the section can be oriented along a groundwater flow line so that all groundwater flow is along the section rather than across it. In open-cut mines where mining occurs below the water table, groundwater flow towards the excavation tends to dominate over the previous regional flow patterns, making it possible to orient a section along a groundwater flow line. Therefore the use of 2-dimensional cross-section models is assessed to be valid for the purposes of this investigation.

The selected modelling platform (Seep/W) is an industry-standard finite-element model capable of modelling groundwater movement and pressure distribution within the saturated/unsaturated zone of porous materials such as soil and rock. Seep/W has been used in this study to predict the rate and extent of change to the phreatic surface in response to the ongoing mining of the already approved Central North Mine, as well as the proposed extension of the operation into the extension area.

Three models were prepared for this study including west-east cross-sectional models through each of the AB and C Pits as well as a long section model that is orientated approximately north-south and represents mining at both pits; the models are described below in Section 6.2. Other details of the models (e.g. hydraulic parameters, boundary conditions, representation of faulting etc.) are discussed in subsequent sections.

6.2 Model Locations and Scenarios

Three models were generated for the study, including:

- A west-east cross section through the C Pit;
- A west-east cross section through the AB Pit; and,
- A long section that runs through the final void of both the C Pit and the AB Pit.

The locations of the sections are shown on Figures 3-1 and 3-2 as well as in Figure 6-1 below.

The models include representation of the mining schedule, including progressive backfilling of the mined areas with spoil, development of the final voids, partial backfilling of the final voids with spoil, and development of the pit void lakes to a level as modelled by WRM (2019). Selected stages in mining are shown below in Figure 6-1 and include:

- Year 1 – Mining commences in the AB Pit in the southwest region of the mining area, with mining progressing to approximately RL-45 in the deepest area, representing a depth of mining of approximately 165 m;
- Year 5 – Mining of the AB Pit has progressed from west to east, to a deepest mined level of approximately -65 mAHD, representing a depth of mining of approximately 185 m. Progressive backfilling of the mined area with spoil has occurred, in conjunction with the development of an out of pit dump;
- Year 9 – Mining of the AB Pit has progressed to the north, with the southern area of mining backfilled with spoil and progressively rehabilitated. The deepest mined area is approximately -65 mAHD, representing a depth of mining of approximately 185 m;
- Year 12 - Mining of the AB Pit has reached the full extent to the north and the floor of the pit is at a level of approximately -45 mAHD, representing a depth of mining in that area of approximately 165 m. Mining of the C Pit has commenced in the west of the mining area;

- Year 16 – Mining of the AB Pit is complete and the final landform has been developed. The final landform includes the partial backfilling of the final void area to a level of approximately 42 mAHD, representing a depth below original ground level of approximately 75 m. Development of the C Pit has progressed to the east and north and the floor is at approximately -50 mAHD, representing a depth below original ground surface of approximately 190 m at that location. Backfilling of the mined area with spoil and development of an out of pit dump has been progressively occurring; and,
- Final Landform (Years 18-20). The final voids are developed for each pit area. The final void levels for the AB Pit are as described above. The final void for C Pit has been partially backfilled with spoil to approximately 65 mAHD, representing a depth below original ground level of approximately 65 m.

The representation of mining in the Seep/W section models is shown on figures from the models and includes:

- Figure 6-2 shows detail of the long section model in the location of the AB Pit, from start of mining to Year 7. Detail from Figure 6-2, which is common to each section model, includes:
    - The coal seams are represented as distinct material types in the model, with the average thickness of each seam represented;
    - Faults are included in the model as they are shown in the sections from the geological model. As discussed in Sections 4.6 and 6.4, the main impact of the faults on groundwater flow occurs when the faults completely truncate the coal seams so that they terminate against lower hydraulic conductivity interburden;
    - The coal measures and overburden are progressively removed from the models in accordance with the mining schedule; and,
    - The mined voids are backfilled with spoil at the rate defined by the mining schedule.
- Figure 6-3 shows detail of the long section model in the location of the AB Pit, from mining Year 8 to end of mining and the final landform. Detail from Figure 6-3, which is common to all model stages that that simulate the final void and final landform, include:
    - The final void is partially backfilled with spoil as a means of reducing groundwater inflow to the final void and reducing the long-term impact on regional groundwater levels (as the water level adjacent to the final void will be to the groundwater level within the spoil and/or final void lake, rather than long-term groundwater drawdown to the base of the final void); and,
    - The average modelled water level within the AB final void of 53.7 mAHD (WRM 2019) has been included as a boundary condition for the post-mining period.
- Figure 6-4 shows detail of the long section model in the location of the C Pit, from commencement of mining in Mining Year 12 to end of mining and the final landform. Detail shown in the model is as described above, with the exception that the final void water level for the C Pit is represented at the average modelled water level of 70.3 mAHD (WRM 2019).
- Figure 6-5 shows the modelled mining sequence at the location of the west-east cross section model through Pit AB, with model detail as described above.
- Figure 6-6 shows the modelled mining sequence at the location of the west-east cross section model through Pit C, with model detail as described above.

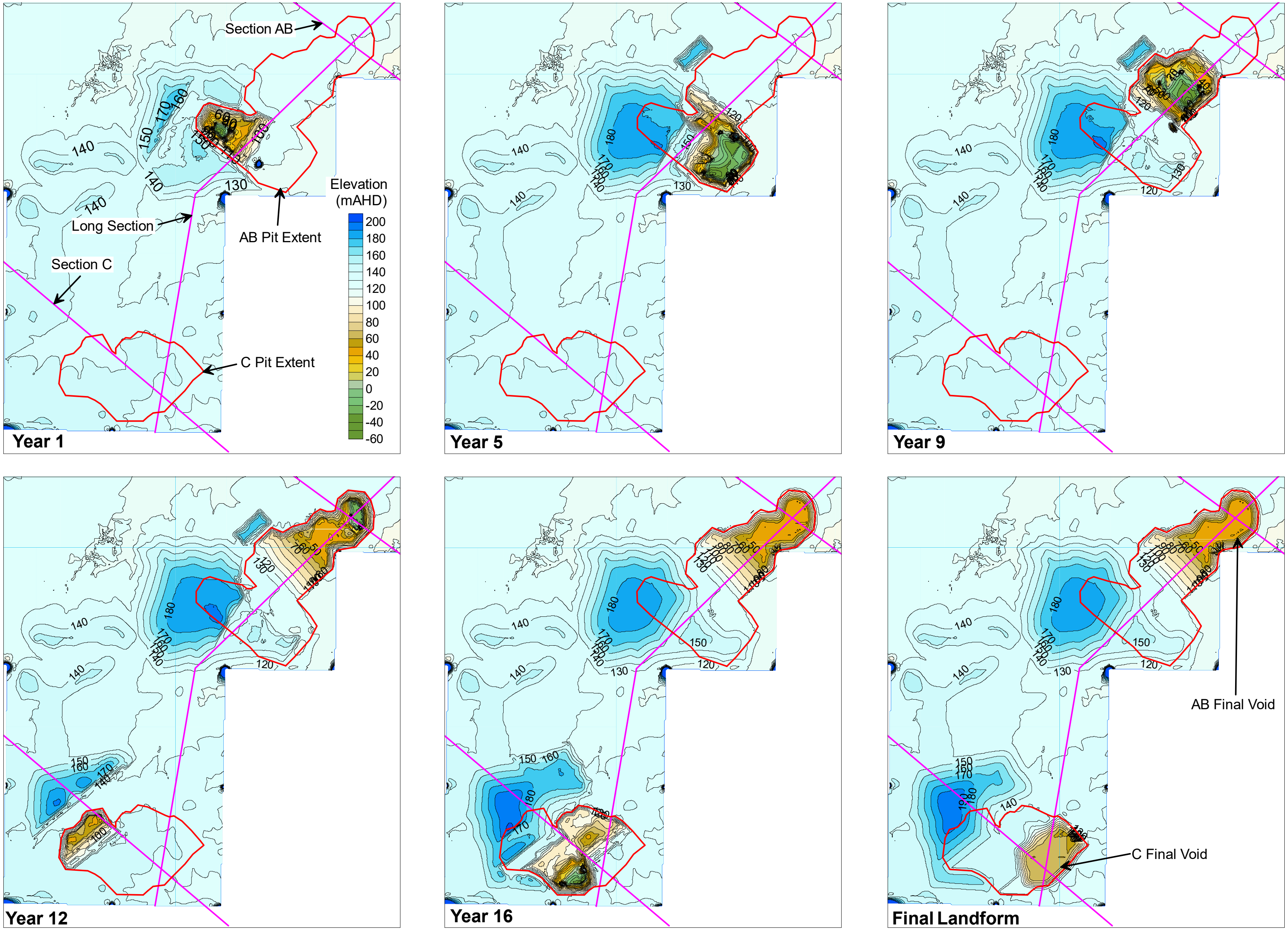

Figure 6-1: Representation of Mining Schedule for Selected Years

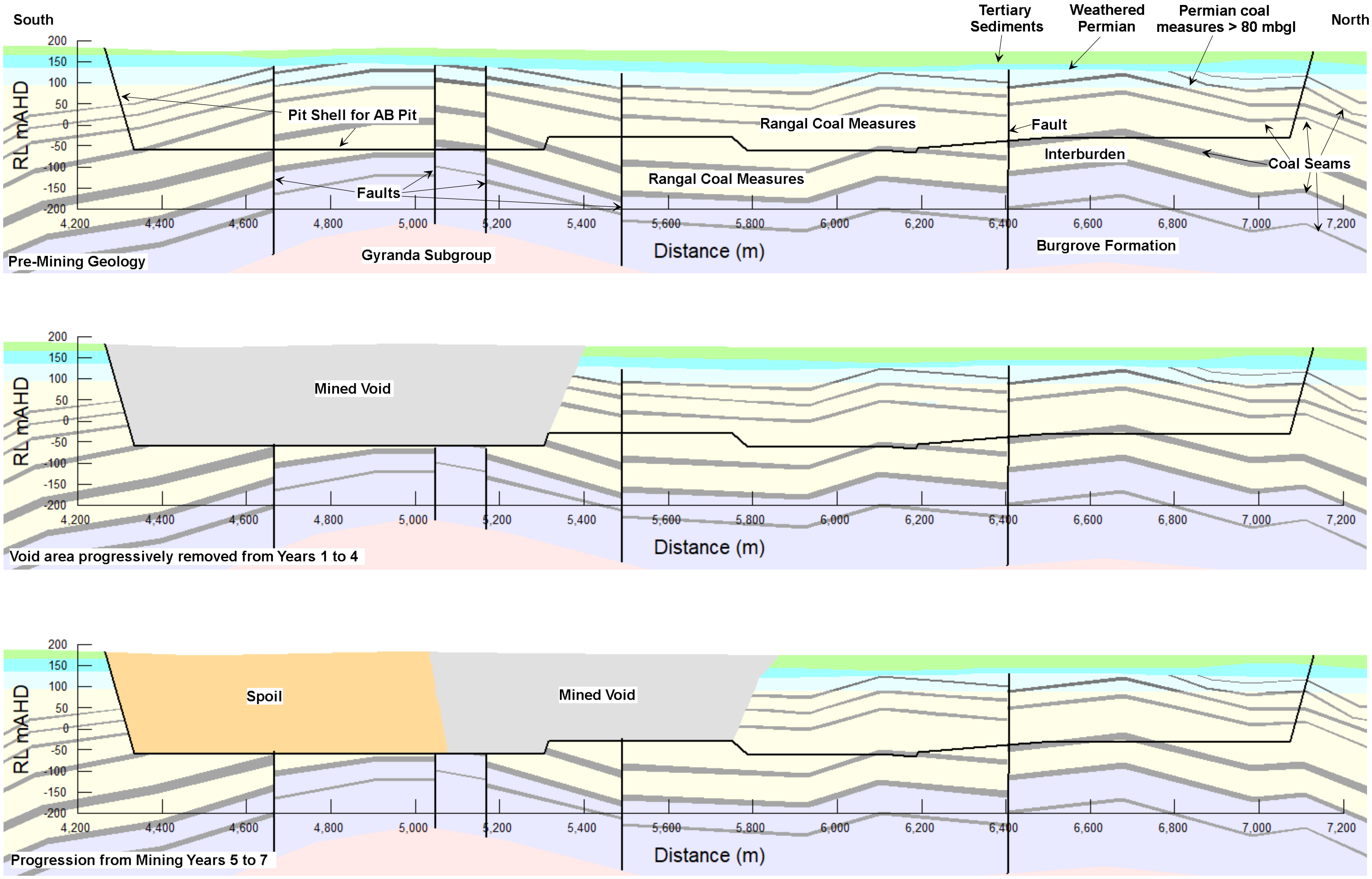

Figure 6-2: Representation of Mining, Long-Section Model, A-B Pit – Start of Mining to Year 7

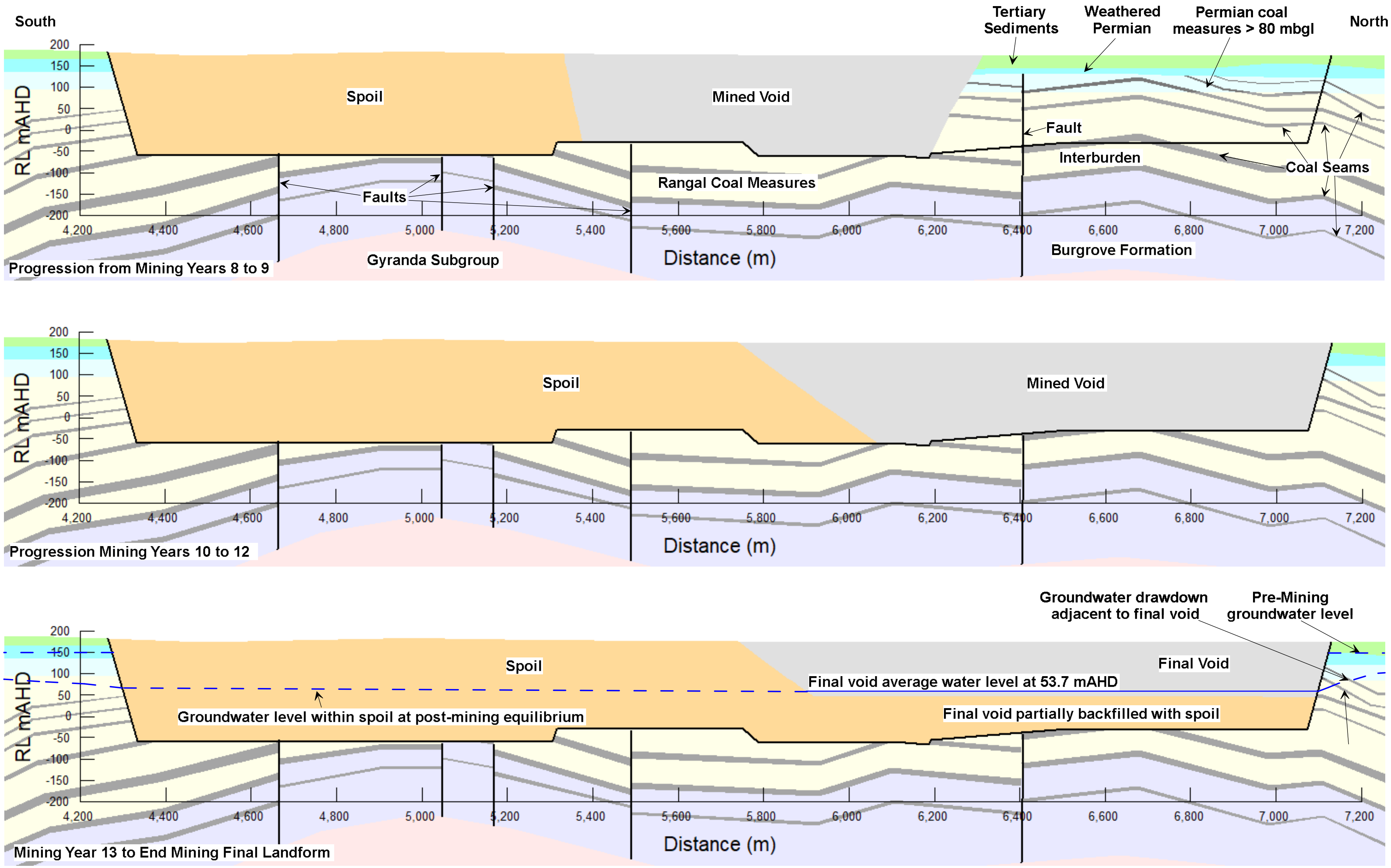

Figure 6-3: Representation of Mining, Long-Section Model, AB Pit – Mining Year 8 to Final Landform

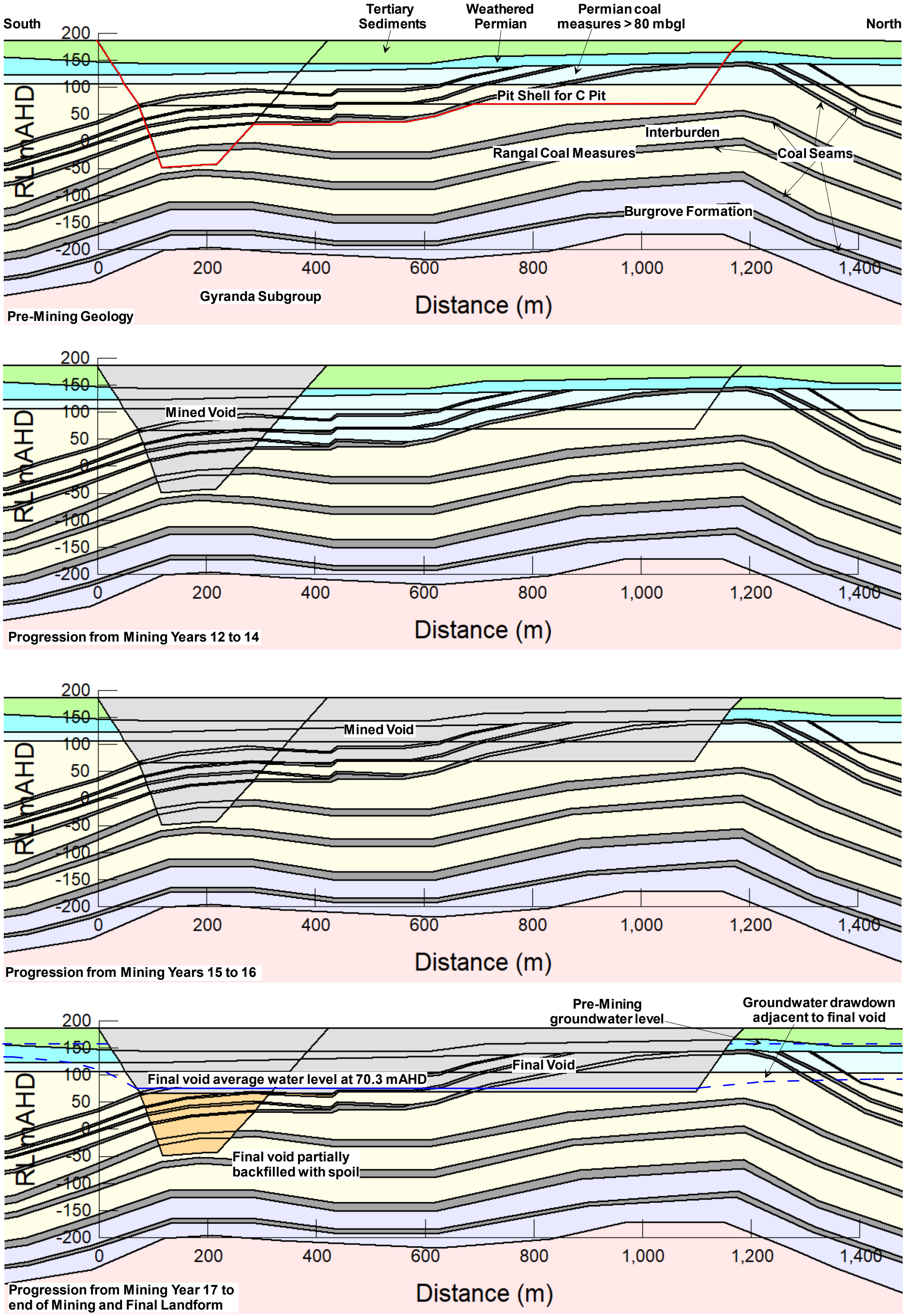

Figure 6-4: Representation of Mining in Long-Section Model – Pit C

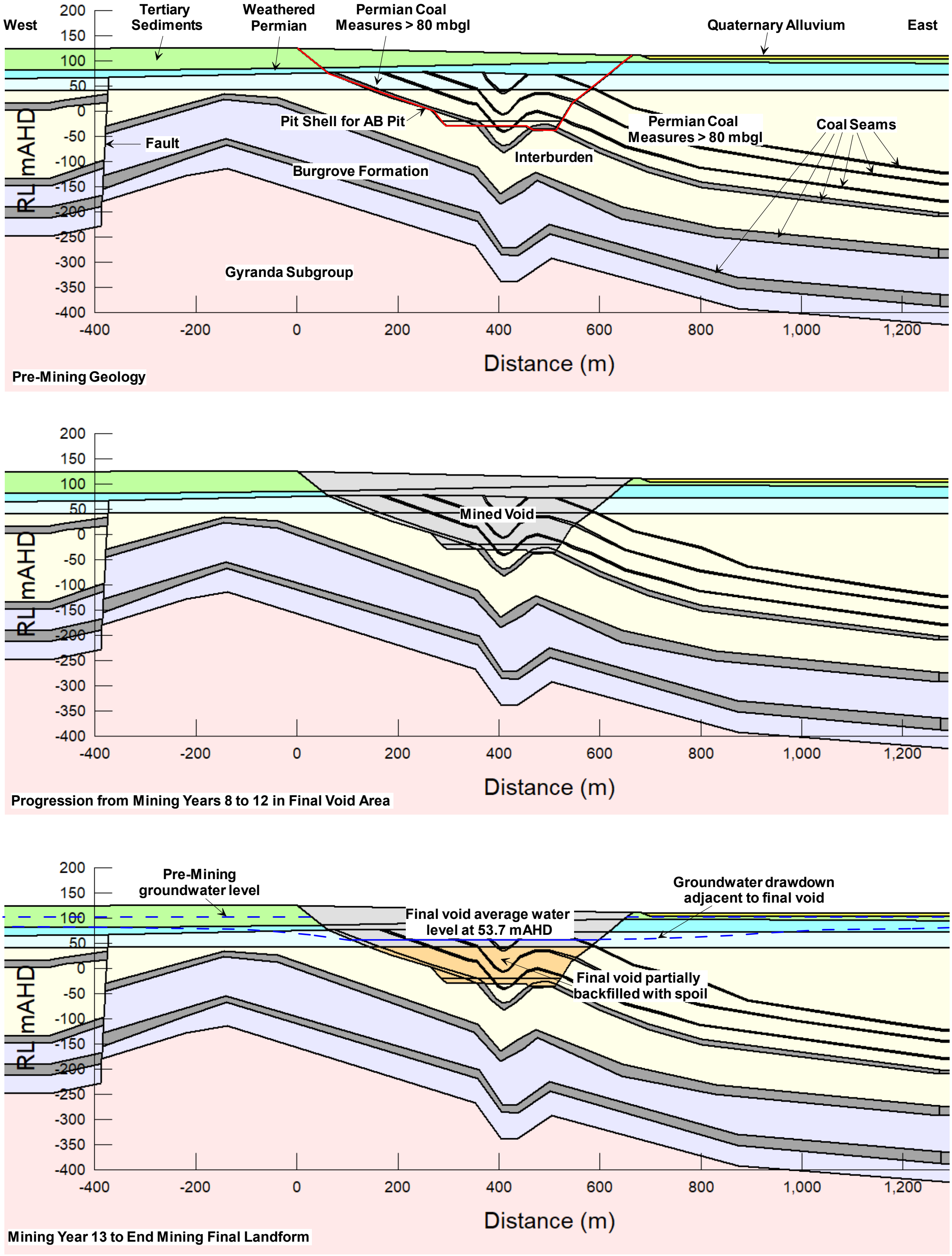

Figure 6-5: Representation of Mining in Cross Section Model through Final Void for AB Pit

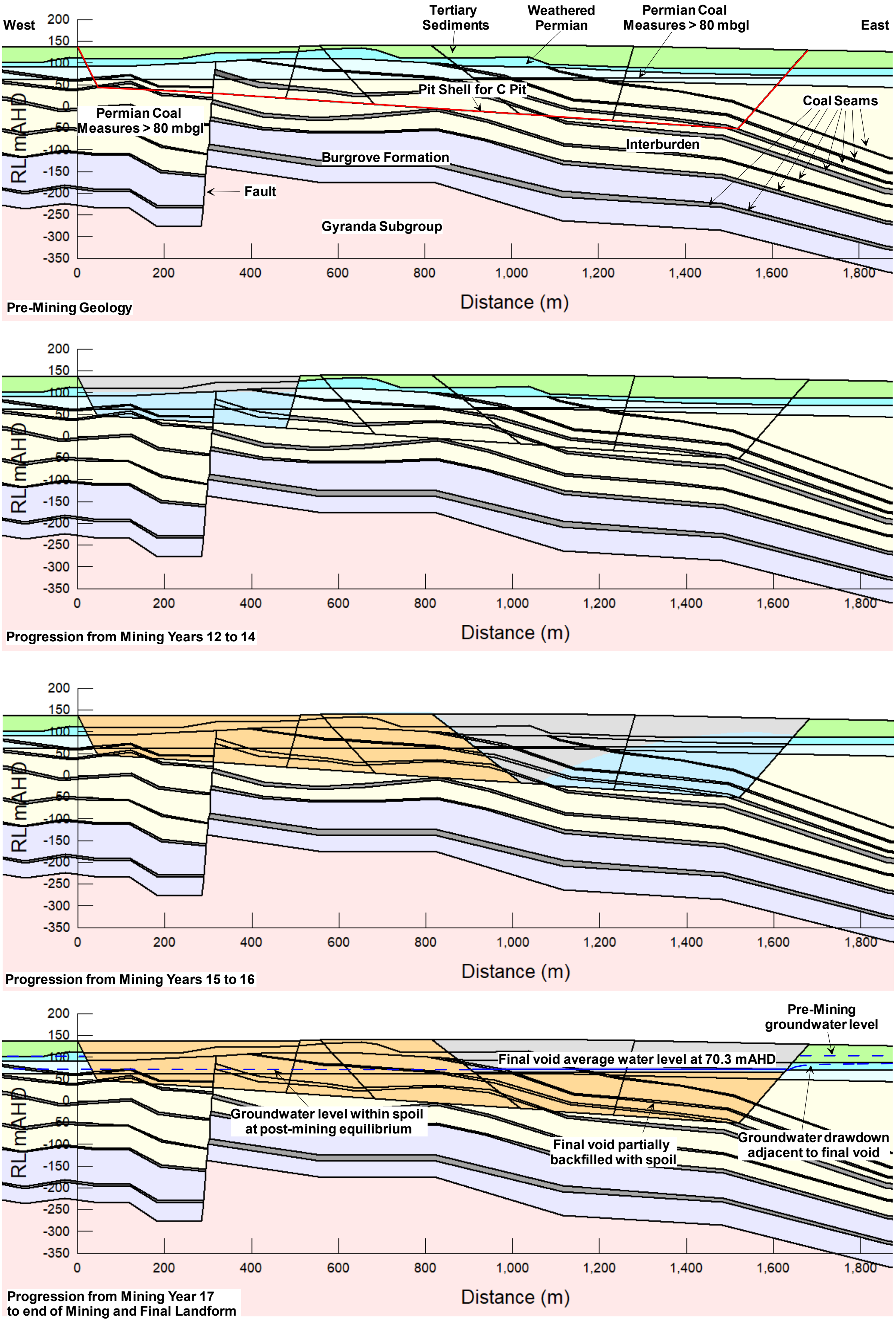

Figure 6-6: Representation of Mining in Cross Section Model for C Pit

6.3 Hydraulic Properties

6.3.1 Hydraulic Conductivity

Based on review and analysis of data discussed in Section 4-4, hydraulic conductivity values have been applied to the base-case model as shown below in Table 6-1.

Table 6-1: Hydraulic Properties Used in Model

Groundwater Unit	K (m/day)	Comment
Quaternary Alluvium	0.1	Value from slug test of bore DW7292W1.
Tertiary	0.27	Geometric mean of data from slug tests (Section 4.4)
Rewan Group	0.002	Estimated K value from other Bowen Basin projects. The Rewan Group is not present in over most of the tenement area but is present in the model area
Coal Seams <80 mbgl	0.37	Geometric mean of slug test data from bores with screened intervals less than 80mbgl
Coal Seams >80 mbgl	0.02	Geometric mean of slug test data from bores with screened intervals greater than 80mbgl
Permian Interburden <80 mbgl	0.01	Value set an order of magnitude higher than the value for interburden below 80 mbgl
Permian Interburden >80 mbgl	0.001	Estimate based on values from slug testing of DW7033W3 (0.002 m/day) and DW7093W2 (recovery rate so slow that the test data could not be analysed)
Mined Spoil	1	Estimate based on professional experience

6.3.2 Volumetric Water Content

6.3.2.1 Specific Yield

Seep/W represents the water content and drainage properties modelled units via a property called volumetric water content, which describes the transition from fully saturated porosity to fully drained porosity. Total porosity comprises specific yield (the volume that will drain from a material under gravity) and specific retention (the volume that will remain within the material following gravity drainage). The specific yield applied to each model unit is shown below in Table 6-2; the specific yield component of the volumetric water content curve is significant for areas close to the open cut void, as previously confined aquifers (such as the Permian coal measures) become unconfined as they drain to the mined void.

Table 6-2: Specific Yield Values used in Model

Lithology	Specific Yield (Sy)
Quaternary Alluvium	0.08 (8%)
Duaringa Formation	0.01 (1%)
Rewan Group	0.01 (1%)
Permian Overburden (weathered)	0.01 (1%)
Permian Overburden (unweathered)	0.01 (1%)
Coal Seams	0.02 (2%)
Permian Interburden	0.01 (1%)
Burngrove Formation and Gyranda Subgroup	0.01 (1%)
Mined Spoil	0.08 (8%)

6.3.2.2 Specific Storage

In Seep/W the specific storage (*Ss*) of the aquifer is accounted for via a related property called the coefficient of volume compressibility (*mv*). In areas where groundwater is draining to the pit void, the model utilises the specific yield (*Sy*) portion of the volumetric water content curve (as discussed above). With increasing distance from the pit wall the groundwater storage conditions become increasingly confined, Seep/W automatically transitions from unconfined to confined conditions (i.e. from the portion of the volumetric water content curve where pore pressures are at or below atmospheric pressure (and draining to the pit void) to the portion of the curve where pore pressures are positive) using the properties of the Coefficient of Volumetric Compressibility (*mv*). The relationship between the coefficient of volume compressibility (*mv*) and specific storage (*Ss*), can be established from the following equation (Geoslope 2012):

$$S_S = \rho_w g(\alpha + n\beta) = \rho_w g(mv)$$

Where:

Ss = Specific Storage
mv = Coefficient of volume compressibility
ρw = The density of water
g = Acceleration due to gravity
α = Compressibility of the aquifer skeleton
n = The porosity of the aquifer
β = Compressibility of water

The value for *mv* generally ranges from 1 x 10^{-6}/ kPa to 1 x 10^{-3}/kPa and for confined aquifers a value of 1 x 10^{-5}/kPa is generally appropriate (Geoslope 2012). An *mv* of 1 x 10^{-5}/kPa has therefore been applied to all groundwater units in the model.

6.4 Representation of Faulting

Faults are represented in the models as follows:

- The site geological model conforms to the solid geology as shown in Figure 2-2. For areas of the model that are beyond the boundaries of the site geological model the solid geology, including fault locations, is consistent with the geology shown on the solid geology map (Figure 2-2).
- Where faults are shown on the sections produced from the site geological model or regional geological data, the location of the faults has been accurately reproduced in the Seep/W models;
- The faults have not been assigned any hydraulic properties, as no quantitative data exists to indicate whether individual faults act as groundwater conduits or as barriers to groundwater flow. Rather, the faults will act as described above, i.e. to allow transmission of groundwater across the fault if more permeable units are connected (such as coal seam to coal seam), and will tend to act as barriers to flow if a conductive unit such as a coal seam is terminated against lower permeability interburden material.

6.5 Boundary Conditions

6.5.1 Recharge

The recharge rate that was applied to the model was based on the recharge calculated via the chloride mass balance (CMB) method, as described above in Section 4.5. The recharge value used was equivalent to 0.1% of average annual rainfall, as an average of the CMB-calculated values for Quaternary sediments of 0.12% of average annual rainfall and the Tertiary sediments of 0.07% of average annual rainfall.

Recharge was applied to transient models as a flux boundary condition applied to the upper layer of the model (representing the ground surface). Rainfall was applied uniformly to the surface formation (alluvium and Tertiary). Rainfall was not applied to the steady-state model as the starting phreatic surface was generated based on fixed head boundary conditions at the edges of the model.

Rainfall was applied at a rate of 0.678 mm/year, which corresponds to 0.1% of average annual rainfall of 678 mm/year, so that the flux was assigned as:

- 678 mm/year x 0.1% = 0.678 mm/year of recharge = 1.86 x 10^{-6} m/day

6.5.2 Starting Phreatic Surface

The initial phreatic surface was generated in the steady state model by applying fixed heads at the boundaries of the model. The boundaries were set at a distance of approximately 10 km from the edge of mining in order that the boundary conditions did not interfere with the groundwater response to mining, with the boundary conditions set to place the water level within the Tertiary sediments at levels observed from the groundwater monitoring bores for each mining area.

6.5.3 Groundwater Seepage to Voids

Seep/W requires the setting of seepage face review boundary conditions to allow water to leave the model and flow to the mine void. The seepage face boundary a flux boundary with total flux (Q) set at 0 m/day. The area of the mined void is set as a material type with no hydraulic properties; in practice the void is modelled as a zone into which groundwater flow can occur unimpeded through the seepage face boundaries.

6.6 Model Results

6.6.1 Groundwater Level Impacts

The modelled drawdown at the end of mining is shown in Figure 6-7, with the extent of drawdown at post-mining equilibrium (i.e. steady-state post-mining drawdown) shown in Figure 6-8. The contours are shown as the extent of 5 m and 2 m drawdown, based on extrapolation of data points from each of the cross section models (with the location of the data points also shown on Figures 6-7 and 6-8).

These contours have been utilised (refer Section 7.1) to estimate the potential impact on existing groundwater users, based on the definition of bore trigger thresholds for the Queensland *Water Act 2000*. The *Water Act* defines a “bore trigger threshold” (section 362) as *a decline in the water level in the aquifer that is-*

(a) If a regulation prescribes the bore trigger threshold for an area in which the aquifer is situated – the prescribed threshold for the area; or

(b) Otherwise-

  i. For a consolidated aquifer – 5 m; or

  ii. For an unconsolidated aquifer – 2 m.

The potential for impact on existing groundwater users is discussed in Section 7.1.

The potential for water level impact on environmental values (e.g. groundwater dependent ecosystems) is discussed in Section 7.2.

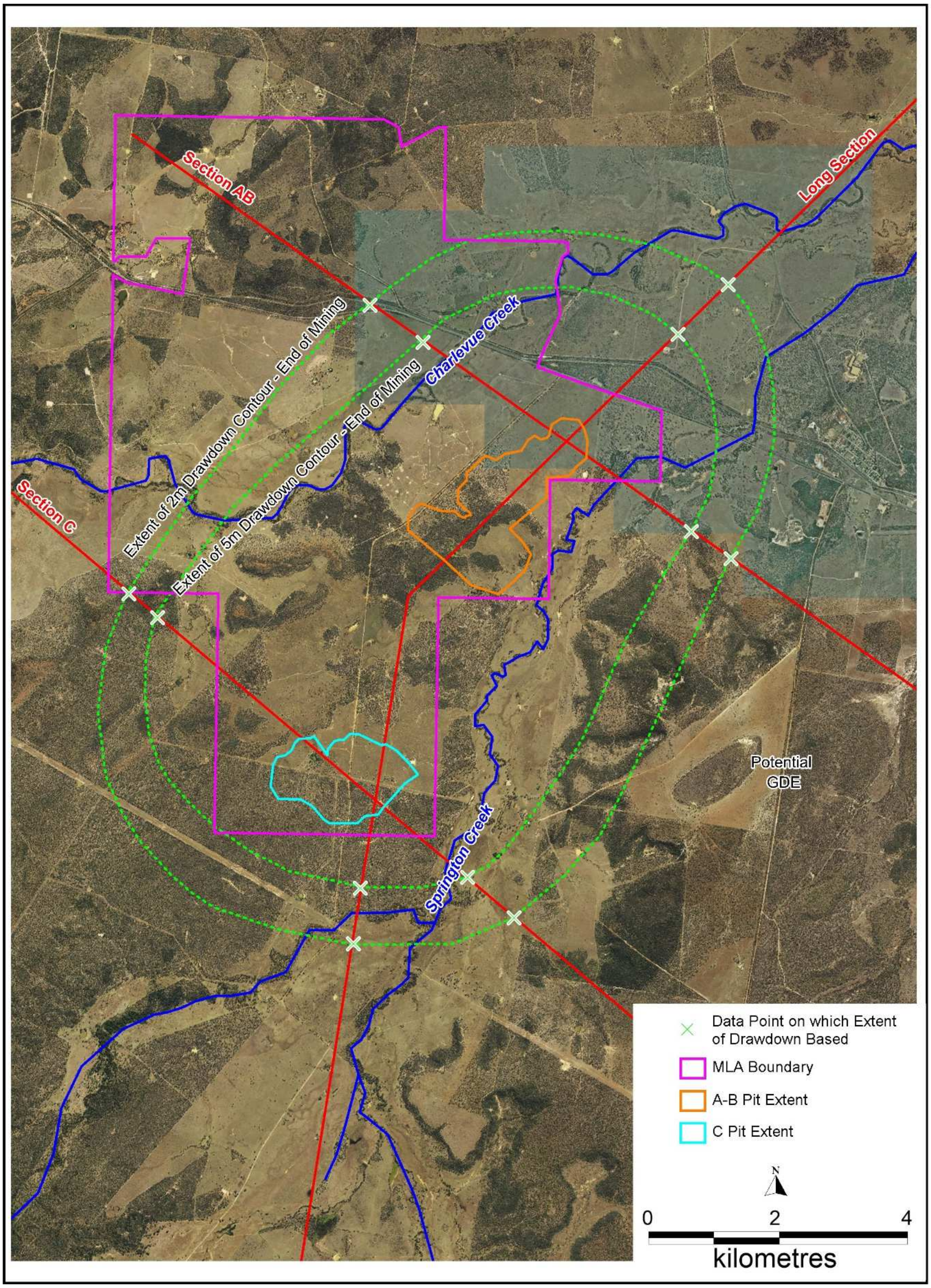

Figure 6-7: Extent of 2 m and 5 m Water Level Drawdown – End of Mining

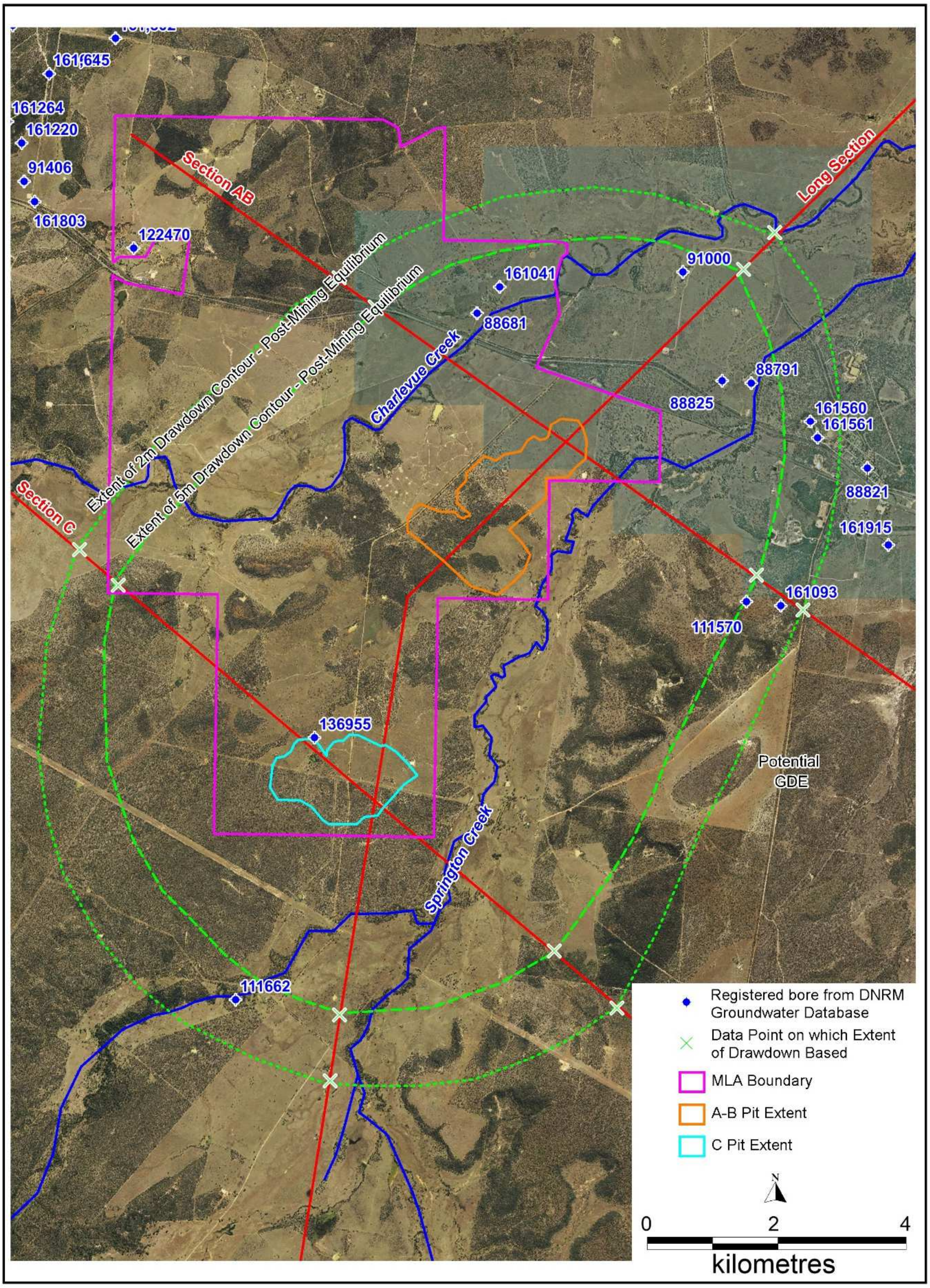

Figure 6-8: Extent of 2 m and 5 m Water Level Drawdown – Post-Mining Equilibrium

6.6.2 Groundwater inflow to the Mined Voids

The rate of groundwater inflow to the mined voids during the operational period of mining has been calculated via the following methodology:

- The seepage rate through the pit walls and floor was calculated within the Seep/W models from the two cross section models (AB Pit Section and C Pit Section) and the long section model for both the AB Pit and C Pit.
- The seepage rate was calculated as the mine development progressed and included the rate of seepage to the mining operation from the backfilled spoil
- The seepage rate, which was calculated on a per-metre basis in the models, was multiplied over the length of pit, using data from the model that was appropriate to each area;
- The modelled inflow rates for each mining year and for each pit are shown below in Table 7-1, in units of both litres per second (L/s) and cubic metres pe day (m^3/day);
- For the purpose of water balance modelling, the effects of evaporation on pit inflows was calculated to provide a value for inflow rates less evaporation (Table 7-1). The evaporation rate was applied using "Morton's estimate of wet environment areal evaporation over land" that was obtained for the project area from the SILO datadrill. This evaporation dataset was used for calculating evaporation from the pit walls and floor, based on advice from the project hydrologist WRM (M Batchelor pers. comm.). Evaporation was applied to the modelled inflow using a pan factor of 0.8 for the surface of the pit, decreasing linearly to a pan factor of 0.5 at the base of the pit (with the lower evaporation at the base of the pit due to shading etc.). The net inflow rate to each pit (modelled inflow less evaporation) is shown in Table 7-1.

Other observations/ notes with respect to the calculated inflow rates are as follows:

- The increase in the modelled and net inflow rate in years 11 and 12 of the AB pit is due to groundwater from the spoil reporting to the final void area. The spoil was modelled as being placed dry (fully-drained but with a residual water content); the groundwater level in the spoil increased over time due to inflow from the floor and walls of the mined area, as this inflow rate was not subject to evaporation. In addition, the rate of recharge to the spoil occurs at a rate that is higher than the natural ground, allowing a water table to develop within the spoil. By mining years 11 and 12 the water level within the spoil had developed to a level that allowed relatively significant rates of inflow to occur.
- For the purpose of future associated water reporting it is concluded that it would be more reasonable to assume the rate of inflow prior to development of the spoil aquifer (i.e. ~5.7 L/s or ~500 m^3/day) as the water that is developed from the spoil is derived mainly from rainfall recharge to the spoil and does not represent water from the natural formation.
- The modelled inflow rate and net inflow rate (less evaporation) reduces significantly in mining years 17 and 18 for the AB Pit and at mining year 18 for the C Pit. This is due to the partial backfilling of the final void area with spoil.
- For the post-mining years the net groundwater inflow rate is zero, as the rate of inflow from the pit walls above the backfilled area of spoil and the final void lake occurs at such a low rate that the rate of evaporation is significantly greater than the modelled rate of inflow.

Table 6-3: Calculated Rates of Inflow to the AB Pit and C Pit

Year	AB Pit				C Pit			
	Modelled Inflow Rate		Less Evaporation		Modelled Inflow Rate		Less Evaporation	
	L/s	m3/day	L/s	m3/day	L/s	m3/day	L/s	m3/day
1	7.2	626	1	86				
2	7.2	626	1	86				
3	5.0	433	1	86				
4	5.0	433	1	86				
5	5.9	508	1	86				
6	5.9	508	1	86				
7	11.0	946	1	86				
8	11.0	946	1	86				
9	5.7	493	1	86				
10	5.7	493	1	86				
11	18.0	1554	7	605				
12	18.0	1554	7	605	1.4	121	0	0
13	13.7	1181	6	518	1.4	121	0	0
14	13.7	1181	6	518	2.8	241	0.5	43
15	5.2	453	0.5	43	2.8	241	0.5	43
16	5.2	453	0.5	43	2.8	239	0.5	43
17	2.9	248	0.5	43	2.8	239	0.5	43
18	2.9	248	0.5	43	1.9	163	1	86

6.7 Uncertainty Analysis

6.7.1 Introduction

A sensitivity analysis of the groundwater model developed for the Gemini Project has been undertaken with reference to the following documents:

- Barnett et al. (2012) *Australian Groundwater Modelling Guidelines*. Sinclair Knight Merz and National Centre for Groundwater Research and Training, Waterline Report Series No. 82, June 2012; and,
- Middlemis, H. & Peeters, L.J.M. (2018) *Explanatory Note, Uncertainty Analysis in Groundwater Modelling*. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy (Draft).
- Reilly, T.E. & Harbaugh, A.W. (2004) *Guidelines for Evaluation of Groundwater Flow Models.* United States Geological Survey, Scientific Investigations Report 2004-5038.

A groundwater model sensitivity analysis involves the evaluation of model input parameters to see how much they affect model outputs, which are heads and flows (Reilly & Harbaugh 2004). The process of sensitivity analysis can be conducted manually or automatically; in the manual approach, multiple model simulations are made in which ideally a single parameter is adjusted by an arbitrary amount (Reilly & Harbaugh 2004). The emphasis of sensitivity modelling is on determining how sensitive the model is to each parameter tested, using a non-technical interpretation of “sensitive” (Barnett et al. 2012).

The explanatory notes for uncertainty analysis that were prepared for the IESC (Middlemis & Peeters 2018) outline three general approaches to uncertainty analysis; these are, in order of increasing complexity:

1. Scenario analysis with subjective probability;
2. Deterministic modelling with linear probability quantification; and,
3. Stochastic modelling with Bayesian probability.

The first method (scenario analysis with subjective probability) has been applied to this modelling study. This methodology is judged to be appropriate to the analysis of a Seep/W model, which utilises a single set of parameters for each material type. A sensitivity analysis of the Gemini Project model was undertaken as follows:

- The base-case models were used to establish the extent of 5 m drawdown from the edge of the final voids to the north, south, east and west of the mining area. The location of the section models, as well as detail from the models pre and post-mining, are shown in Figures 3-1 and 3-2. The sections highlight the relationship between the various groundwater units, including the degree to which faulting and folding compartmentalises the units (as shown from Figures 6-1 to 6-6, which show detail of the cross section models in the area of mining);
- The base-case model was altered to make changes to specific parameters (discussed below) and to assess the impact that the change in parameters had on the location of the extent of the 5 m drawdown contour at the post-mining equilibrium.
- The parameters that were selected for the sensitivity analysis are summarised below in Table 6-4 and include:
    - Horizontal hydraulic conductivity (Kh;
    - Vertical hydraulic conductivity (Kz);
    - Specific yield (Sy) and coefficient of volume compressibility (*mv*) (which is related to the aquifer specific storage (Ss), as described in Section 6.3.2.2); and,
    - Recharge.

6.7.2 Results

The results of the sensitivity analysis are discussed below and are presented in Table 6-4 and on Figure 6-8, which shows the extent of the 5 m post-mining equilibrium drawdown contour for each uncertainty analysis parameter. Results are summarised as follows:

- The model is assessed to be most sensitive to changes in horizontal hydraulic conductivity (Kh) and recharge, with results as follows;
    - An increase in the Kh of the Permian coal measures (coal seams and interburden) by a factor of 10 results in an increase in the extent of the 5 m drawdown contour at post-mining equilibrium years post-mining of between 800 m (to the east of C Pit) and 2,000 m (to the south of C Pit), as shown on Figure 6-8. The variability in the extent of the 5 m drawdown contour is related to dominant rock type in each direction and the variability in faulting, folding and dip direction of the coal measures. The drawdown contours also extend further to the north/south than to the east/west. This is interpreted to be related to:
        - The more continuous extension of coal seams along geological strike, as the coal seams have a higher permeability than the interburden and are the main conduits for groundwater flow within the coal measures; and,

        - The steep dip of the coal seams to the east and west, as a component of the drawdown will be acting in a direction that includes a combination of the Kh and the lower hydraulic conductivity Kz of the unit.
    - An increase in the recharge by a factor of 10, from 0.1% of average annual rainfall to 1% of average annual rainfall, results in a reduction in the extent of drawdown of between -550 m (to the west of Pit C) and -1,300 m (to the east of Pit C). The variability in the impact of the change in recharge is interpreted to be related to factors such as the thickness of Tertiary sediments and the weathered Permian sediments, in conjunction with the factors such as folding and faulting that also impact the other parameters tested.
- The model is relatively sensitive to changes in vertical hydraulic conductivity (Kz); an increase in the Kz of the Permian coal measures (interburden and coal seams) by a factor of 10 results in an increase in the extent of 5 m drawdown of between approximately 100 m (to the west of C Pit) to 670 m (to the south of C Pit);
- An increase in the storage properties (specific yield (Sy) by a factor of 2 and coefficient of volume compressibility (*mv*) by a factor of 10) results in a decrease in the extent of the 5 m drawdown contour relative to the base case of between -330 m (to the north of AB Pit) and -1,200 m (to the east of C Pit).

  Because the specific yield component of storage only acts locally (i.e. close to the walls of the open cut), the main impact on drawdown is related to the change in the coefficient of volume compressibility (*mv*). A lower value for *mv* (and hence *Ss*) indicates a geotechnically stiffer (less compressible) aquifer; by contrast an increase in the aquifer *mv* (and hence *Ss*), as undertaken in the uncertainty analysis, will result in a more compressible aquifer, which in turn will act to decrease the extent of drawdown.

Table 6-4: Results of Uncertainty Analysis

Scenario	Description	Base Case	Sensitivity Model	Change (m) in extent of 5 m drawdown contour*	
Long Section Model through AB Pit and C Pits				**North of AB Pit**	**South of C Pit**
1	Increase Kh of Permian Interburden <80 mbgl x 10	0.01 m/day	0.1 m/day	1,800	2,000
	Increase Kh of Coal Seams < 80 mbgl x 10	0.37 m/day	3.7 m/day		
	Increase Kh of Permian Interburden >80 mbgl x 10	0.001 m/day	0.01 m/day		
	Increase Kh of Coal Seams >80 mbgl x 10	0.02 m/day	0.2 m/day		
2	Increase Kz of Permian Interburden <80 mbgl x 10	0.001 m/day	0.01 m/day	450	670
	Increase Kz of Coal Seams < 80 mbgl x 10	0.037 m/day	0.37 m/day		
	Increase Kz of Permian Interburden >80 mbgl x 10	0.0001 m/day	0.001 m/day		
	Increase Kz of Coal Seams >80 mbgl x 10	0.002 m/day	0.02 m/day		
3	Increase specific yield (*Sy*) of Permian Interburden x 2	0.02 (2%)	0.04 (4%)	-330	-430
	Increase specific yield (*Sy*) of coal seams x 2	0.01 (1%)	0.02 (2%)		
	Increase storage coefficient (*Ss*) of Permian coal seams and Interburden x 10	1 x 10^{-5}	1 x 10^{-4}		
4	Increase Recharge x 10	0.1% of rainfall	1% of rainfall	-650	-1200
AB Pit Cross Section Model				**West of AB Pit**	**East of AB Pit**
1	Increase Kh as described above	As above	As above	1,000	1,200
2	Increase Kz as described above	As above	As above	350	440
3	Increase Sy and Ss as described above	As above	As above	-930	-700
4	Increase recharge as described above	As above	As above	-1,400	-1,200
C Pit Cross Section Model				**West of C Pit**	**East of C Pit**
1	Increase Kh as described above	As above	As above	900	800
2	Increase Kz as described above	As above	As above	100	210
3	Increase Sy and Ss as described above	As above	As above	-800	-1200
4	Increase recharge as described above	As above	As above	-550	-1,300

* A positive value indicates an increase in the extent of drawdown, a negative value indicates a decrease in the extent of drawdown

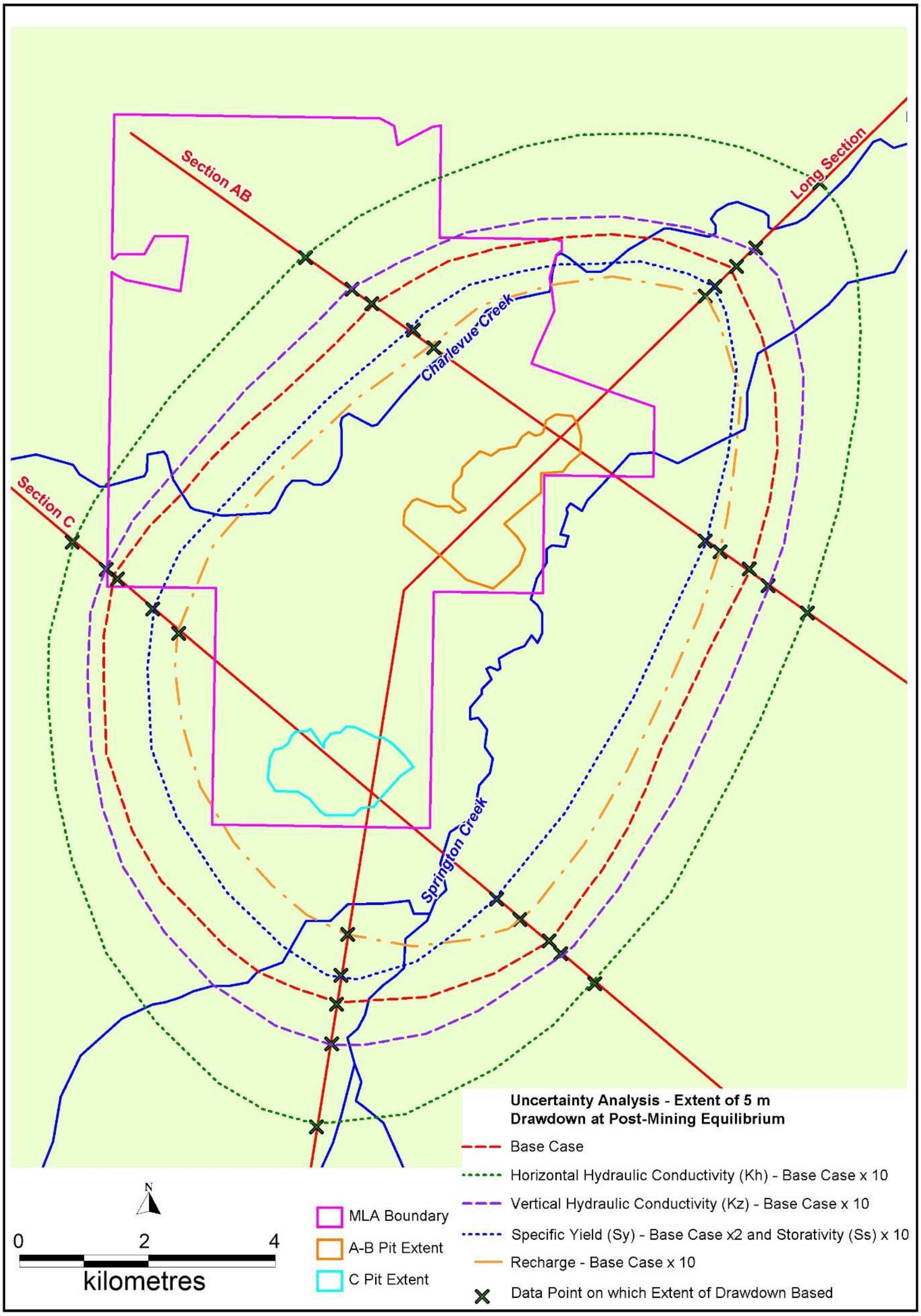

Figure 6-9: Uncertainty Analysis

7.0 GROUNDWATER IMPACTS FROM MINING

7.1 Impacts on Existing Groundwater Users

Figures 6-7 and 6-8 show the location of eleven (11) registered groundwater bores (bores from the DNRM groundwater database that are listed as being either existing or abandoned but useable) within the 2 m drawdown zone at end of mining (Figure 6-7) and/or at post-mining equilibrium (Figure 6-8). Summary data for the bores within this zone are shown below in Table 7-1. In summary:

- Bores 136955 and 11662 are located on land that is owned by Magnetic South (the proponent for the Gemini project);
- Two bores (161560 and 161561) appear to be monitoring bores for the Dingo Landfill;
- A number of bores record groundwater that is highly saline and assessed to be of no beneficial use (as discussed in Section 4.3, an EC of 6,000 µS/cm is assessed to be the upper limit of salinity tolerance for beef cattle, sheep, horses and pigs with no loss of production (ANZECC 2000), with a decline in animal health at progressively higher salinity values. Bores 88681, 88791 and 91000 record EC values of 10,000 µS/cm, 19,200 µS/cm and 14,660 µS/cm respectively, and on this basis are assessed to have little to no beneficial use);
- Bores that remain in the area of potential impact (i.e. that are not discussed in the above dot points) include:
    - Bores 88825 and 161041, which are sites with relatively little available data, but which are located within the zone of potential impact to the northeast and west-northwest of AB Pit respectively;
    - Bores 111570 and 161093 also record relatively fresh groundwater (<1,000 µS/cm) at shallow depth. While these bores are located within the extent of 2 m drawdown, these bores are also assessed to be isolated from the regional groundwater system (refer discussion in Section 7.2.1 below)

At sites including 111570 and 161093 it is noted that the sites are not located within the zone of potential impact at end of mining, but are within the zone of potential impact at post-mining equilibrium.

Notwithstanding the time that it may take for drawdown impacts to be observed at the private groundwater bores listed in Table 7-1, it is recommended that a bore survey be undertaken on the potentially impacted properties (as defined by the extent of 2 m drawdown contour on Figure 6-8).

It is further noted that make-good agreements may be required for groundwater bores within the zone of potential impact in the event that groundwater level drawdown affects the utility of the bores.

Table 7-1: Bores from DNRM Groundwater Database within 2m Drawdown Zone

RN	Aquifer	EC (µS/cm)	SWL (mbgl)	Original Bore Name	Comment
88681	Duaringa Formation	10000			Located within MLA - land owned by Magnetic South
88791	Duaringa Formation	19200	-20	New Bore	Extremely saline - no beneficial use based on water quality
88825	Unknown			Windmill	
91000	Duaringa Formation	14660	-20	Mackenzie OLO	Extremely saline - no beneficial use based on water quality
111570	Tertiary-Undefined	240	-16	Ward	Refer Section 7.2.1 for discussion
111662	Tertiary-Undefined	750	-17	Smith	Located within land owned by Magnetic South
136955	Tertiary-Undefined	10300	-21		Located within MLA - land owned by Magnetic South
161041	Duaringa Formation		-29		
161093	Tertiary Mafic Volcanics	710	-19.5		Refer Section 7.2.1 for discussion
161560	Unknown	28102		Dingo Landfill MW2	Assumed to be monitoring bore at Dingo Landfill
161561	Unknown			Dingo Landfill MW1	Assumed to be monitoring bore at Dingo Landfill

7.2 Groundwater Dependant Ecosystems

7.2.1 Area of Mapped Potential GDE to East of MLA

A potential groundwater dependant ecosystem (GDE) has been mapped to the east of the MLA and is shown below in Figure 7-1. The following observations and comments are made with respect to the potential GDE:

- The top plot on Figure 7-1 shows the potential GDE from an aerial photograph as an ovaloid feature with an area of approximately 82 ha that is located approximately 4 km east of the MLA boundary.
- The bottom plot on Figure 7-1 shows the potential GDE underlain by contours of surface topography and includes water level data from available groundwater bores. From this plot it is noted that:
  - The surface elevation of the eastern area of the MLA is in the range 125 to 135 mAHD, with the elevation of the Springton Creek floodplain dropping below 120 mAHD in the area between the MLA boundary and the potential GDE;
  - The potential GDE is located on an elevated ridgeline; the feature is located within a shallow depression on the ridgeline that is surrounded to the south, west and east by elevation contours at 170 mAHD, with the central of the depression falling below 165 mAHD. This area drains to the northeast via a narrow zone that is at a surface elevation of approximately 167 mAHD.
- The potential GDE is therefore located within a shallow depression on the ridgeline that is likely to be internally draining under average rainfall conditions and that only discharges to the northeast under high rainfall conditions. It is interpreted that, under average rainfall conditions and at the tail end of high rainfall conditions, surface runoff within the relatively small catchment that reports to this area will pond in the area of the shallow depression and provide localised recharge to an

underlying groundwater lens that is likely to be disconnected from the regional groundwater system (discussed further below).

- The bottom plot on Figure shows available groundwater level data from site monitoring bores (water levels from July/August 2019 – refer Table 4-1) as well as from two registered groundwater bores from the DNRM groundwater database). The date of the groundwater measurement for the two registered bores is likely to be from the time of drilling/construction; bore 111570 was constructed in November 2001 and bore 161093 was constructed in August 2014 (refer Table 4-5 of this report). From the water level data shown on Figure 7-1 it is observed that:
    - The depth to water for bores constructed within Tertiary sediments and Permian coal measures ranges from 26.25 to 32.37 mbgl in this area (Figure 7-1 shows data for the shallowest bore in this area; the Tertiary bore at the location of DW7105W2 is dry). Based on the elevation at these sites, this equates to a groundwater elevation of 108-110 mAHD for bores in topographically elevated areas (DW7093W1 and DW7225W1) to 89.59 mAHD at bore DW7282W1 (located in a topographically lower area of the MLA adjacent to Springton Creek).
    - The water level in alluvium bore DW7292W1 is 11.19 mbgl, which equates to an elevation of 102.39 mAHD;
    - The water level in the site monitoring bores, which are assessed to be representative of the regional groundwater level, are therefore considerably lower than the elevation of the base of the potential GDE, which is at an elevation approximately 165 mAHD;
- The water level in the two private bores to the north of the potential GDE (16 mbgl at 111570 and 19.5 mbgl at 161093) equates to a groundwater elevation of 132 to 144 mAHD at these sites.
- Based on the observations discussed above, it is concluded that:
    - The potential GDE is located on an elevated ridgeline, but within a shallow depression that is likely to drain internally under average rainfall conditions but drains to the northeast under high rainfall conditions;
    - The drainage of surface runoff to the shallow depression is likely to result in localised recharge to a perched lens of groundwater that is disconnected from the regional groundwater system;
    - It is probable that this perched groundwater lens provides water to vegetation within the depression during the dry season, but that the groundwater lens is an extremely localised system that relies on replenishment by seasonal rainfall rather than being maintained by the regional groundwater system
- It is noted the EC of site groundwater monitoring bores, which are interpreted to be within the regional groundwater system, is high (15,000 µS/cm to 29,000 µS/cm – refer Section 4.3). However it is also noted that the EC of the registered bores to the north of the potential GDE is very low, with bore 111570 recording an EC of 240 µS/cm and bore 161093 recording an EC of 710 µS/cm. This is interpreted to provide further evidence that the groundwater system in this area is perched above the regional groundwater system, with the flowline from the area of the potential GDE (where recharge is interpreted to occur) to the area where these bores are located being very short.
- From the groundwater modelling data presented in Section 6.7.2 and Figure 6-8, it is noted that the 2 m drawdown contour at post-mining equilibrium extends under the area where the potential GDE is located. It is interpreted that the risk posed by drawdown from the mining operation to the potential GDE is very low, as:
    - It is interpreted that the potential GDE exists in an area where the groundwater system is very localised and is perched above the regional groundwater system; and,

  - The groundwater lens that is interpreted to be located beneath the potential GDE is likely to be maintained by seasonal surface water runoff rather than the regional groundwater system.
- It is noted that, based on the evidence available to date, it cannot be conclusively stated that the groundwater system is not continuously saturated from the area below the potential GDE (at RL165 mAHD to the regional groundwater system (at an elevation of 110 to 89 mAHD). However, based on professional experience and judgement, it is considered that:
  - It is most probable that the ridgeline and the potential GDE is underlain by a perched groundwater system and,
- In any case it is interpreted that the potential GDE is maintained by localised runoff and shallow recharge and that a reduction in the regional groundwater level of approximately 2 m, at a vertical distance of approximately 50 to 60 m below the base of the potential GDE, has a very low risk of impacting groundwater levels beneath the potential GDE.

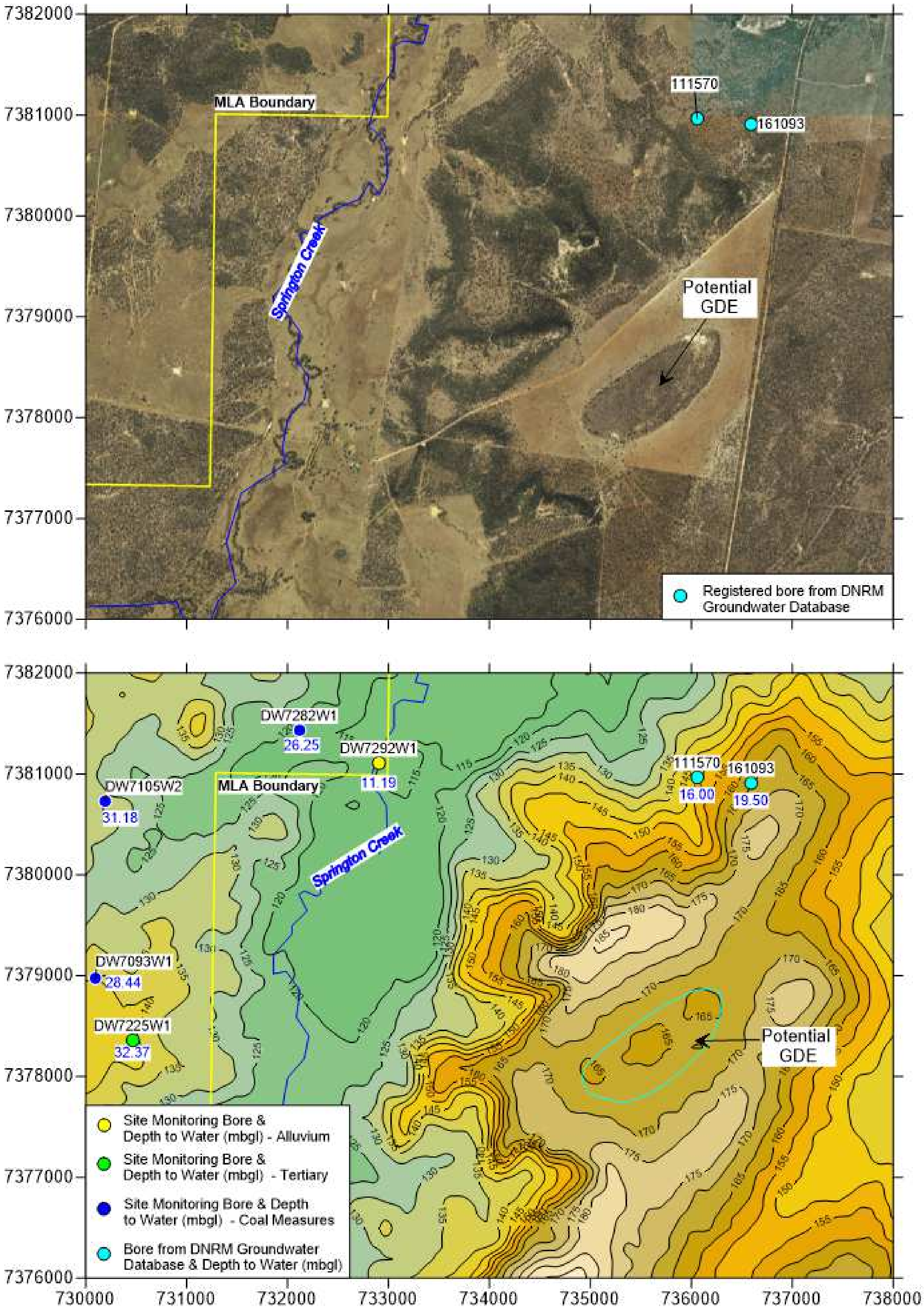

Figure 7-1: Assessment of Potential GDE to East of the Gemini Project MLA

7.2.2 GDE's Associated with Watercourses and Floodplains

A number of potential GDE's in the Project area are riverine-type wetlands that include riparian vegetation on watercourses and floodplains. It is understood from the ecological assessment (reference) that the riverine vegetation includes tree species such as blue gum (*Eucalyptus tereticornis*) and River oak (*Casuarina cunninghamiana*). With respect to the potential for the mining operation to impact this type of potential GDE the following observations are made:

- The water level drawdown associated with mining is predicted to be in excess of 5 m at some locations below both Charlevue Creek and Springton Creek (Section 6.6.1, Figures 6-7 and 6-8). It cannot be ruled out that drawdown from mining may affect water levels in the alluvium at some locations.
- This section therefore considers the potential for vegetation within the Project area to be currently dependent on groundwater, either totally or partially, which will then inform the risk to vegetation in the event that groundwater level drawdown from mining does impact groundwater levels within the alluvium.
- The assessment of current dependence of vegetation on groundwater considers both groundwater level and groundwater quality; these considerations are summarised as follows:
  - Groundwater level considerations:
    - It is understood from the ecological assessment (reference) that blue gum has a rooting depth of up to 10 m.
    - The measured depth to groundwater in the alluvium bores close to the creeks is between 8.77 m (DW7076W, adjacent to Charlevue Creek) and 11.19 m (bore DW7292W1, adjacent to Springton Creek). It is noted that the groundwater level is likely to be somewhat closer to ground surface at the invert (i.e. central line) of the creeks than in the bores, which are constructed outside the main creek channel.
    - Therefore, while the groundwater level is assessed as being close to the maximum depth that could be accessible by vegetation, it cannot be conclusively ruled out that the groundwater level is beyond the depth that is accessible to the root zone of some plants.
    - In addition, the seasonal range of water level within the alluvium is currently unknown. However, it is noted that bore DW7076W (adjacent to Charlevue Creek) is currently fitted with a datalogger (refer Section 4.2 and Figure 4-4) and that bore DW7292W1 (adjacent to Springton Creek) is programmed to be fitted with a datalogger; this data will allow assessment of the range of water level within the alluvium and the response of groundwater levels within the alluvium to rainfall recharge and stream flow events.
  - Groundwater quality considerations
    - As noted above, the riverine vegetation includes tree species such as blue gum (*Eucalyptus tereticornis*) and River oak (*Casuarina cunninghamiana*). With reference to available online information[1] it is noted that the species listed above are described as being tolerant of moderately saline conditions, which are defined[1] as being in the range of 4,000 to 8,000 µS/cm;
    - The measured EC of groundwater within the alluvium is relatively high, with a range from 15,200 µS/cm to 16,600 µS/cm for bore DW7076W (adjacent to Charlevue Creek) and a single field value for bore DW7292W1 of 5,948 µS/cm (adjacent to Springton Creek).

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[1] http://www.plantstress.com/articles/salinity_m/salinity_m_files/salt%20tol%20australia.htm

- It is therefore assessed that, based on available EC data, the groundwater within the Charlevue Creek alluvium is too saline to be useable by the vegetation that occurs along the creek.
- The EC at bore DW7292W1 is within the range that is potentially useable by moderately salt-tolerant plants, but it is also noted that the depth to groundwater in that area (11.19 mbgl) is potentially beyond the depth that is accessible by vegetation.

Figure 7-2 (below) shows two photos that were taken at the time of airlift development of bore DW7076W, which is constructed within alluvium adjacent to Charlevue Creek. With reference to the photos in Figure 7-2 and the information outlined above, it is observed that:

- The photo on the left of Figure 7-2 shows bore DW7076W, with the trees in the background located within the or adjacent to the channel of Charlevue Creek;
- The photo on the right of Figure 7-2 shows vegetation within the channel of Charlevue Creek;
- Noting that the EC of groundwater in the Charlevue Creek alluvium at bore DW7076W is within the range of 15,200 µS/cm to 16,600 µS/cm, it is concluded that the groundwater at this site is too saline for use by the vegetation within the creek;
- However, the vegetation within and adjacent to Charlevue Creek appears healthy; on this basis it could be concluded that the vegetation is likely to subsist on water that becomes available following wet-season flow events in Charlevue Creek, and the soil moisture and/or perched groundwater that may exist for some time after flow events in the creek, rather than on the water table that exists at greater depth where the water is highly saline.

Figure 7-2: Alluvium Bore DW7076W and Charlevue Creek adjacent to Bore

On the basis of the above assessment, it is concluded that:

- Groundwater level drawdown from the proposed mining operation will extend beneath Charlevue Creek and Springton Creek and it cannot be ruled out that drawdown from mining may affect water levels in the alluvium at some locations.

- The riparian vegetation at site (within both Charlevue Creek and Springton Creek) is likely to subsist on water that becomes available following wet-season flow events in the creeks, and on the soil moisture and/or perched groundwater that may exist for some time after flow events in the creek, rather than on the water table that exists at greater depth (in the range of 9 to 11 m, based on available data) where the water is moderately to highly saline (and in the case of data for the Charlevue Creek alluvium, too saline to be tolerated by the vegetation species that line the creek);
- Therefore, even if mining does impact on groundwater levels within the alluvium, the risk of impacts to existing riparian vegetation is assessed to be very low, as it is assessed that it is unlikely that the vegetation is dependent on groundwater for survival.

Notwithstanding the above assessment, ongoing monitoring of groundwater levels is recommended, with a recommendation that bores within the alluvium are monitored via water level dataloggers to allow assessment of the range of seasonal water level variation at these sites. It is noted that a data logger is already fitted to bore DW7076W and that it is planned to install a logger in bore DW7292W1

7.3 Cumulative Impacts

There are no mining operations within the zone of predicted drawdown from mining at the Gemini Project site; it is therefore concluded that there are no cumulative impacts to assess.

7.4 Impacts on Groundwater Quality

Groundwater modelling (Section 6.0) predicts that a permanent cone of depression will develop that will direct groundwater flow towards the final voids; therefore, the risk of the project impacting on water quality (via outflow to the groundwater system) is assessed to be low.

It is, however, assessed that the Project could impact groundwater quality if the water within the final void were able to exit the void via unconsolidated sediments (i.e. the base of Tertiary) and flow via the groundwater system towards sensitive environmental receptors such as Springton Creek. For this reason, an assessment of the potential for water within the final voids to exit the void via the base of Tertiary sediments has been undertaken as follows:

- Contours for the base of Tertiary sediments was obtained for the area of the AB Pit and C Pit from the site geological model;
- The final void water level was obtained for each of the final voids from the WRM surface water assessment report (WRM 2019) and was assessed for:
  - The maximum final void water level for the Base Case; and,
  - The maximum final void water level for the High Inflow Case.
- The data for each mining area was assessed to establish whether any pathways existed for water to exit the final void via the base of Tertiary sediments, for the maximum Base Case and maximum High Inflow Case final void water levels.

The results of the assessment are summarised as follows:

- Assessment of the AB Pit:
  - Figure 7-3 shows the base of Tertiary contours for the area around the AB Pit and includes:
    - The limit of mining within the AB Pit;
    - The location of the final void;
    - The area of the final void that is within the area of inundation at the maximum water level for the High Inflow Case of 64.7 mAHD;

    - The location of the closest environmental receptor (Springton Creek), which occurs to the east of the AB Pit.
  - From the assessment it is concluded that:
    - The lowest level for the base of Tertiary adjacent to the AB Pit mining area and final void area is approximately 70.5 mAHD (as shown on Figure 7-3);
    - The base of Tertiary is therefore approximately 6 m higher than the maximum water level for the High Inflow Case;
    - There is no outlet for water within the final void of the AB Pit via the base of Tertiary sediments

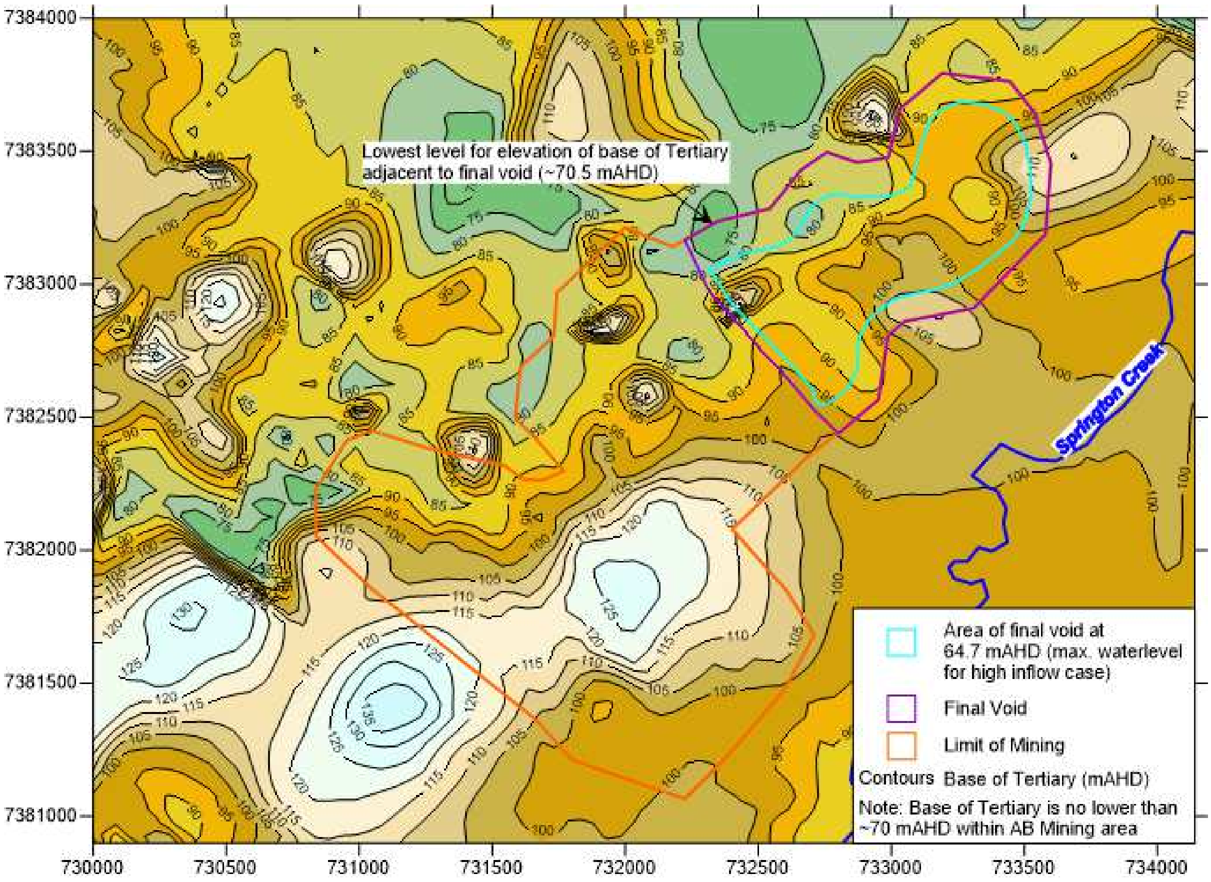

Figure 7-3: Base of Tertiary Contours and AB Pit Final Void Water Levels

- Assessment of the C Pit:
  - Figure 7-4 shows the base of Tertiary contours for the area around the C Pit and includes:
    - The limit of mining within the C Pit;
    - The location of the final void;
    - The area of the final void that is within the area of inundation at the maximum water level for the High Inflow Case of 80.0 mAHD;
    - The contour line for the base of Tertiary at the Base Case maximum water level of 73.6 mAHD;
    - The contour line for the base of Tertiary at the High Inflow Case maximum water level of 80.0 mAHD

    - The location of the closest environmental receptor (Springton Creek), which occurs to the east of the C Pit.
- From the assessment it is concluded that:
    - The areas where the base of Tertiary is at or below the Base Case or High Inflow Case water levels in within the final void area, i.e. an area that will be removed by mining;
    - The lowest level for the base of Tertiary adjacent to the C Pit mining area and final void area is approximately 82.5 mAHD (as shown on Figure 7-4), which is approximately 2.5 m above the maximum water level for the High Inflow Case;
    - The elevation of the base of Tertiary increases away from the area described above to an elevation of approximately 88.5 mAHD, before the elevation of base of Tertiary reduces again towards Springton Creek
    - Therefore, there is no outlet for water within the final void of the C Pit via the base of Tertiary sediments

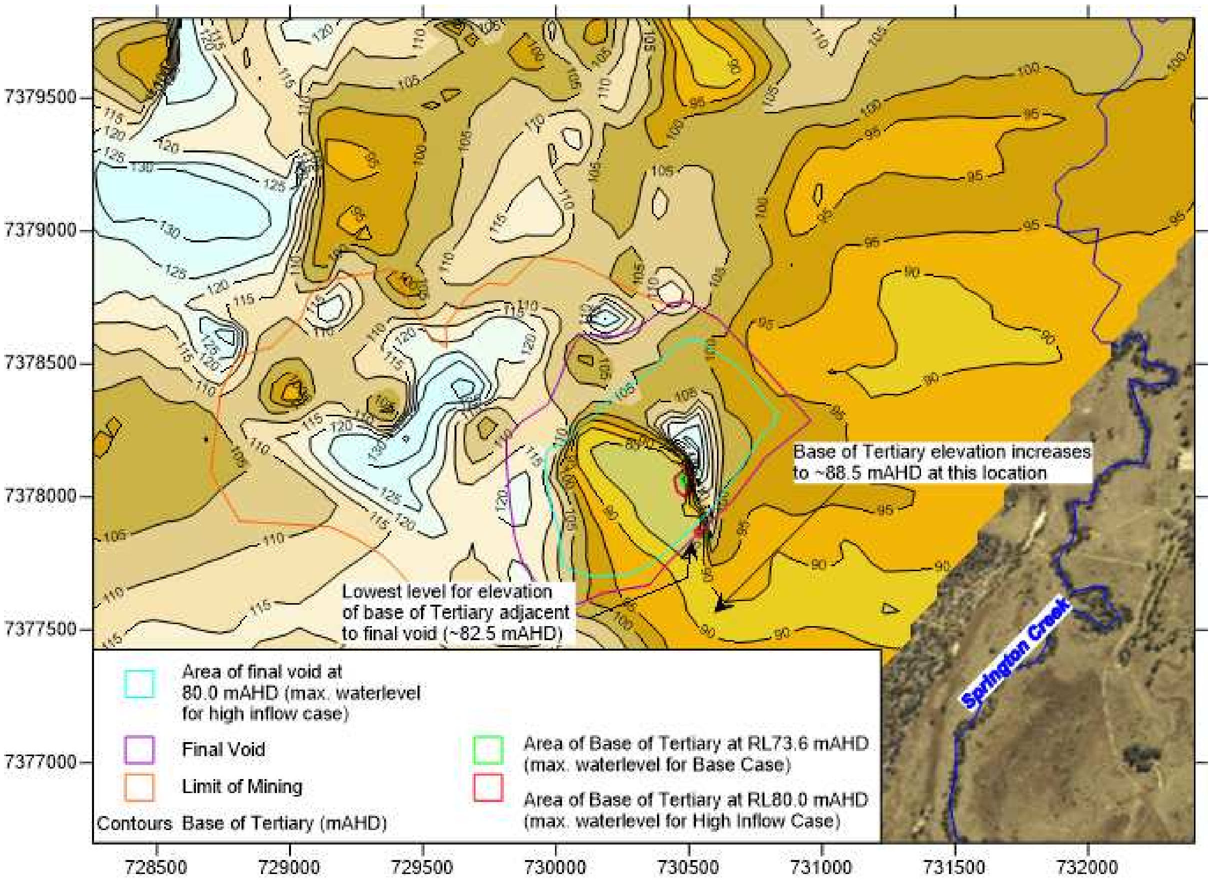

Figure 7-4: Base of Tertiary Contours and C Pit Final Void Water Levels

Based on the assessment undertaken above it is concluded that there is a very low risk of water within the final voids of the AB and C Pits impacting the surrounding groundwater system

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8.0 SUMMARY AND CONCUSIONS

8.1 Review of Project and Site Data

- The Gemini Project proposes to mine coal from the Aries, Castor and Pollux coal seams of the Rangal Coal Measures, at depths of up to 185 mbgl;
- The mined voids will be progressively backfilled with waste rock (spoil) and the final voids will be backfilled with spoil to approximately 80 mbgl; this backfilling is being undertaken to reduce groundwater seepage to the final void and to limit the impact of mining on groundwater levels;
- Groundwater occurs within three main groundwater units at site, including:
  - Quaternary alluvium associated with Charlevue Creek and Springton Creek
  - Tertiary sediments of the Duaringa Formation; and,
  - The Permian Rangal Coal Measures, where groundwater occurs preferentially within the coal seams
- The site is heavily faulted and the faults may act to influence groundwater occurrence and movement as follows:
  - Shear zones associated with faulting may act as a store of water and as locally higher hydraulic conductivity zones. As discussed below, recharge to the groundwater system is assessed to be low; therefore the faults may provide initial relatively high inflow rates to the workings (in the order of several L/s), but the total storage within the faults is anticipated to be relatively low, with the initial rates of inflow not able to be sustained in the long-term; and,
  - Where the faults completely disrupt the coal seams, especially for cases where the coal seam terminates against lower-hydraulic conductivity interburden, the faults will act to disrupt groundwater flow.
- Available hydraulic conductivity and air-lift yield data indicates that there is notable reduction in hydraulic conductivity and bore yield for bores that are deeper than 80 mbgl compared to bores that are shallower than 80 mbgl.
- Groundwater level data at site are summarised as:
  - The water level within the alluvium ranges from 8.77 to 11.19 m below ground level for bores adjacent to the creek channels;
  - The water level with the Tertiary sediments ranges from dry (5 bores, ranging in depth from 14 to 23 m) to 15.38-44.74 mbgl (where water is present). The presence of water within the Tertiary sediments is related to the RL of the base of Tertiary and from review of available data it is assessed that it is probable that the Tertiary sediments are dry above 120 mAHD and likely dry above 110 mAHD; and,
  - The water level in the coal measures ranges from 16.91 to 46.62 mbgl for bore depths of between 38.4 and 136.7 m, with one bore dry at a depth of 31.59 m. The groundwater flow direction for groundwater within the coal measures is from southwest to northeast and from northwest to southeast, towards a depression that is centred on the area where the AB Pit is proposed to be developed.
- Groundwater quality data is summarised as:
  - All groundwater units at site record high EC groundwater, as follows:
    - Alluvial sediments – EC data is available from:

      - A bore adjacent to Charlevue Creek (DW7076W), where the recorded EC range is from 15,200 µS/cm to 16,600 µS/cm; and,
      - A bore adjacent to Springton Creek (DW7292W1) has recorded an EC value of 5,948 µS/cm from a single field value (sampling of the recently-drilled monitoring bores commenced in September 2019 with no laboratory data available to date);
    - Tertiary sediments - the EC ranges from 20,200 µS/cm to 21,900 µS/cm;
    - Coal seams - the EC ranges from 22,100 µS/cm to 28,500 µS/cm.
  - Groundwater at site is above the ANZECC 2000 freshwater ecosystem protection trigger value (95% species protection) for boron (all samples), zinc (majority of samples) as well as aluminium, arsenic, copper, lead and nickel (a number of samples for each analyte).
  - All groundwater samples collected to data are assessed to represent the background water quality for the site.
  - The recharge rate to the groundwater units at site, which has been calculated via the chloride mass balance method, indicates an extremely low recharge rate of less than 1 mm/year for each groundwater unit. The low rate of calculated recharge is consistent with the observation of highly saline groundwater at site, which is present for even the shallow alluvial units.
  - The observation of a low recharge rate for groundwater suggests that, even though relatively high rates of groundwater inflow may be observed from faults/shear zones as mining progresses, especially for the zone above 80 mbgl, the inflow rates are likely to be of short duration due to the relatively low volume that can be stored within fractures/faults and the very low rates of recharge observed at site (i.e. once the fault storage is depleted the faults are unlikely to be recharged).
  - Because the faults may act as conduits for groundwater movement, the control of surface water around the site will be of particular importance (i.e. water that ponds at surface may recharge the underlying sediments and report as seepage to the pits via movement along faults/fractures). This mode of inflow would represent infiltrated surface water rather than groundwater from the formations.

8.2 Groundwater Modelling

- 2-dimensional groundwater models have been developed within the program Seep/W for three locations, including
  - A west-east cross section through the C Pit;
  - A west-east cross section through the AB Pit; and,
  - A long section that runs through the final void of both the C Pit and the AB Pit.
- The models take into account:
  - the mining schedule (progression of mining, depth of mining);
  - the progressive backfilling of the pits with waste rock (spoil); and,
  - The backfilling of the final voids to a dept that corresponds to approximately 80 mbgl.
- The models have been utilised to provide the following output:
  - Inflow rates over time to the mine throughout the mining period and to the final void, including inflow rates from the natural groundwater units (Permian coal measures, Tertiary sediments) as well as the spoil aquifer. Groundwater inflow rates to the final voids took into account the partial backfilling of the voids with spoil and the average level of the final void lakes.

  - The predicted extent of drawdown (2 m and 5 m drawdown contours) at end of mining and post-mining equilibrium (i.e. steady-state)
- Observations with respect to the calculated inflow rates are as follows:
  - The highest inflow rates to the AB Pit occur in mining years 11 and 12 and are due to groundwater from the spoil reporting to the final void area;
  - For the purpose of future associated water licence reporting it is concluded that it would be more reasonable to assume the rate of inflow prior to development of the spoil aquifer (i.e. ~5.7 L/s or ~500 m^3/day) as the water that is developed from the spoil is derived mainly from rainfall recharge to the spoil and does not represent water from the natural formation;
  - The modelled inflow rates and net inflow rates (i.e. modelled inflow less evaporation) reduces significantly in mining years 17 and 18 for the AB Pit and at mining year 18 for the C Pit. This is due to the partial backfilling of the final void area with spoil; and,
  - For the post-mining years the net groundwater inflow rate is zero, as the rate of inflow from the pit walls above the backfilled area of spoil and the final void lake occurs at such a low rate that the rate of evaporation is significantly greater than the modelled rate of inflow.

8.3 Groundwater Impacts from Mining

Observations with respect to potential groundwater impacts from mining include:

- Impacts on existing groundwater users:
  - There are a total of eleven registered groundwater bores (listed from the DNRM groundwater database as either existing or abandoned but useable) within the zone of 2 m drawdown at post-mining equilibrium.
  - A number of sites are either located within land that is owned by Magnetic South (the project proponent) or record an EC >10,000 µS/cm, making the groundwater quality of little or no beneficial use.
  - Two bores that record an EC <1,000 µS/cm are assessed to be in an elevated area that is potentially disconnected from the regional groundwater system that the mining project is developed within. At these sites it is also noted that the sites are not located within the zone of potential impact at end of mining, but are within the zone of potential impact at post-mining equilibrium.
  - Notwithstanding the time that it may take for drawdown impacts to be observed at the private groundwater bores, it is recommended that a bore survey be undertaken on the potentially impacted properties (as defined by the extent of 2 m drawdown contour on Figure 6-8).
  - It is further noted that make-good agreements may be required for groundwater bores within the zone of potential impact, in the event that groundwater level drawdown affects the utility of the bores.
- Impacts on groundwater dependent ecosystems:
  - A potential groundwater dependant ecosystem (GDE) has been mapped to the east of the MLA and is discussed in Section 7.2.1. The potential GDE is located on an elevated ridgeline but in an area where surface water drainage is internal towards the potential GDE. It is therefore interpreted that the vegetation at this location may be groundwater dependent, but that the site is perched above the regional groundwater system and may be maintained in the dry season by a shallow groundwater lens that is seasonally replenished by surface flow and localised recharge. It is therefore interpreted that, although the site is located within the 2 m zone of

drawdown impacts from mining, there is a low risk of impact due to the perched nature of the system and the assessment that the site is likely to be disconnected from the regional groundwater system.

  - A number of potential GDE's in the Project area are riverine-type wetlands that include riparian vegetation on watercourses and floodplains. With respect to the potential for the mining operation to impact this type of potential GDE, it is concluded that:
    - Groundwater level drawdown from the proposed mining operation will extend beneath Charlevue Creek and Springton Creek and it cannot be ruled out that drawdown from mining may affect water levels in the alluvium at some locations;
    - The riparian vegetation at site (within both Charlevue Creek and Springton Creek) is likely to subsist on water that becomes available following wet-season flow events in the creeks, and on the soil moisture and/or perched groundwater that may exist for some time after flow events in the creek, rather than on the water table that exists at greater depth (in the range of 9 to 11 m, based on available data) where the water is moderately to highly saline (and in the case of data for the Charlevue Creek alluvium, too saline to be tolerated by the vegetation species that line the creek); and,
    - Therefore, even if mining does impact on groundwater levels within the alluvium, the risk of impacts to existing riparian vegetation is assessed to be very low, as it is assessed that it is unlikely that the vegetation is dependent on groundwater for survival.
  - Notwithstanding the above assessment, ongoing monitoring of groundwater levels is recommended, with a recommendation that bores within the alluvium are monitored via water level dataloggers to allow assessment of the range of seasonal water level variation at these sites. It is noted that a data logger is already fitted to bore DW7076W and that it is planned to install a logger in bore DW7292W1.
- Cumulative Impacts
  - There are no mining operations within the zone of predicted drawdown from mining at the Gemini Project site; it is therefore concluded that there are no cumulative impacts to assess.
- Impacts on Groundwater Quality
  - Groundwater modelling undertaken for this report predicts that a permanent cone of depression will develop that will direct groundwater flow towards the final voids; therefore, the risk of the project impacting on water quality (via outflow to the groundwater system) is assessed to be low.
  - It is, however, assessed that the Project could impact groundwater quality if the water within the final void were able to exit the void via unconsolidated sediments (i.e. the base of Tertiary) and flow via the groundwater system towards sensitive environmental receptors such as Springton Creek. For this reason, an assessment of the potential for water within the final voids to exit the void via the base of Tertiary sediments has been undertaken as follows:
    - Contours for the base of Tertiary sediments was obtained for the area of the AB Pit and C Pit from the site geological model;
    - The final void water level was obtained for each of the final voids from the WRM surface water assessment report (WRM 2019) and was assessed for:
      - The maximum final void water level for the Base Case; and,
      - The maximum final void water level for the High Inflow Case.

    - The data for each mining area was assessed to establish whether any pathways existed for water to exit the final void via the base of Tertiary sediments, for the maximum Base Case and maximum High Inflow Case final void water levels.
  - Based on the assessment described above it is concluded that there is no outlet via the base of Tertiary for water within the final void of either the AB Pit or the C Pit, for either the maximum Base Case water level or the maximum High Inflow Case water level.
  - It is therefore concluded that there is a low risk of the Project impacting on groundwater quality.

9.0 REFERENCES

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Reilly, T.E. & Harbaugh, A.W. (2004) *Guidelines for Evaluation Groundwater Flow Models*. United States Geological Survey, Scientific Investigations Report 2004-5038.

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APPENDIX A

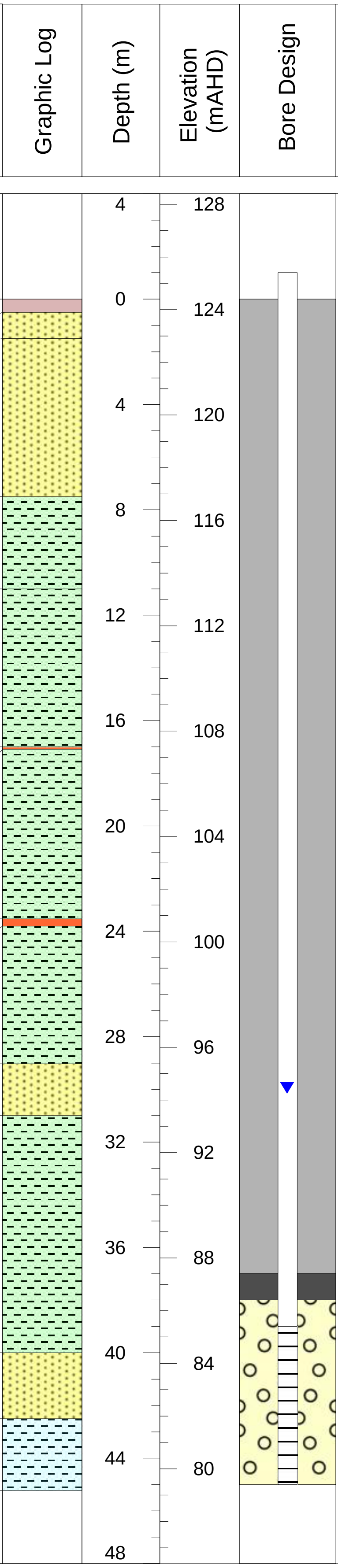
BORE CONSTRUCTION LOGS

Project: Gemini Project

Bore ID: DW7033W1

Drilled Date: 30-May-2019

Lithological Description
SOIL, light to medium greyish brown, sandy
SAND, light creamy white, clayey with limonitic traces
SAND, light creamy white, clayey
CLAY, silty, light greyish-white, sandy
CLAY, silty, light to medium brownish-white, with ferruginous traces near base of unit
FERRICRETE, dark reddish-brown
CLAY, silty, lightish-white
FERRICRETE, dark reddish-brown
CLAY, silty, light white, ferruginous lenses near top of unit
SAND, clayey, light creamy-white, coarse
CLAY, light to medium greyish-white, ferruginous lenses near middle of unit
SAND, light to medium orangey grey, limonitic traces, base of Tertiary at 42.5 mbgl
SILTSTONE, light to medium orangey brown



Bore Construction/ General Drilling Notes

Stickup to Lip of Steel Monument - 1.04 m

Grout from surface to 37 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 29.94 mbgl - 17/7/2019

Bentonite Seal - 37 to 38 mbgl

Gravel Pack - 38 to 45 mbgl

Screen - machine-slotted 50 mm PVC - 39 to 45 mbgl

Easting: 731543.2

Northing: 7383768

Collar RL (mAHD): 124.4

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 45.23

Project: Gemini Project

Bore ID: DW7033W2

Drilled Date: 29-May-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, light to medium greyish-brown, sandy

Sand, light greyish-white, clayey

Clay, silty, light to medium brownish white, ferruginous traces near base of unit

FERRICRETE, dark reddish-brown

Clay, silty, lightish white

FERRICRETE, dark reddish-brown

CLAY, silty, lightish-white, ferruginous lenses near top of unit

SAND, clayey, light creamy white

CLAY, lightish white

SAND, light to medium greyish-white, clayey

CLAY, light to medium greyish-white, limonitic traces, base of Tertiary at 42.5 mbgl

SILTSTONE, medium to dark orangey-brown

SANDSTONE, fine to medium, light to medium grey

COAL, Orion 4 Seam, fresh

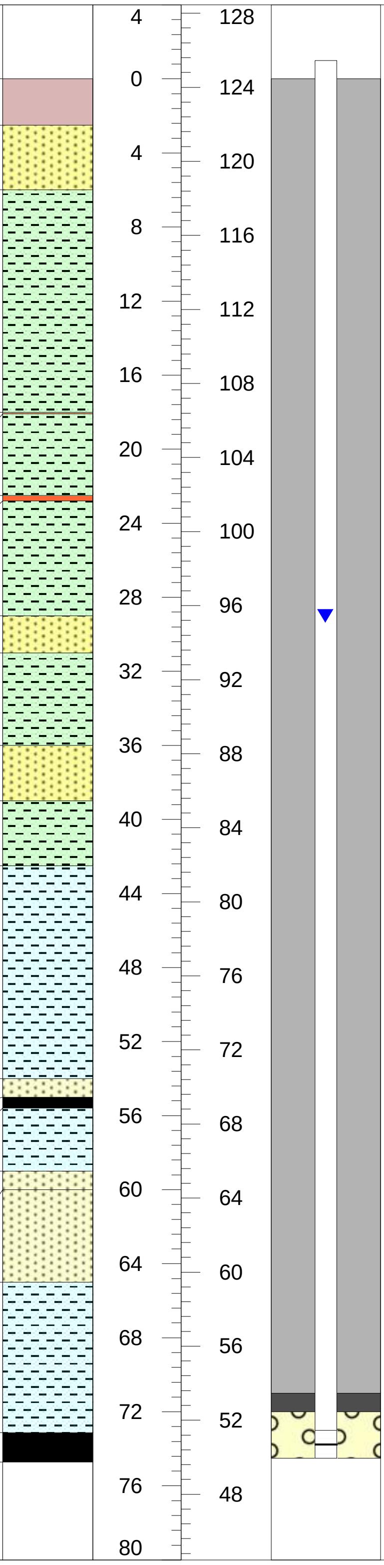
SILTSTONE, medium grey, minor sandstone

SANDSTONE, fine to medium, light to medium grey, common siltstone fragments

SANDSTONE, fine to coarse, light to medium grey

SILTSTONE, dark grey

COAL, Orion 5 Seam, fresh



Stickup to Lip of Steel Monument - 1.01 m

Grout from surface to 71 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 29.01 mbgl - 17/7/2019

Bentonite Seal - 71 to 72 mbgl

Gravel Pack - 72 to 74.5 mbgl

Screen - machine-slotted 50 mm PVC - 73 to 74.5 mbgl

Easting: 731546.2

Northing: 7383773.1

Collar RL (mAHD): 124.45

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 74.77

Project: Gemini Project

Bore ID: DW7033W3

Drilled Date: 28-May-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, light to medium greyish-brown, sandy

SAND, light greyish-white, clayey

CLAY, silty, light to medium brownish white, ferruginous traces near base of unit

FERRICRETE, dark reddish-brown

CLAY, silty, lightish white

FERRICRETE, dark reddish-brown

CLAY, silty, lightish-white, ferruginous lenses near top of unit

SAND, clayey, light creamy white

CLAY, lightish white

SAND, light to medium greyish-white, clayey

CLAY, light to medium greyish-white, limonitic traces, base of Tertiary at 42.5 mbgl

SILTSTONE, medium to dark orangey-brown

SANDSTONE, fine to medium, light to medium grey

COAL, Orion 4 Seam, fresh

SILTSTONE, medium grey, minor sandstone

SANDSTONE, fine to medium, light to medium grey, common siltstone fragments

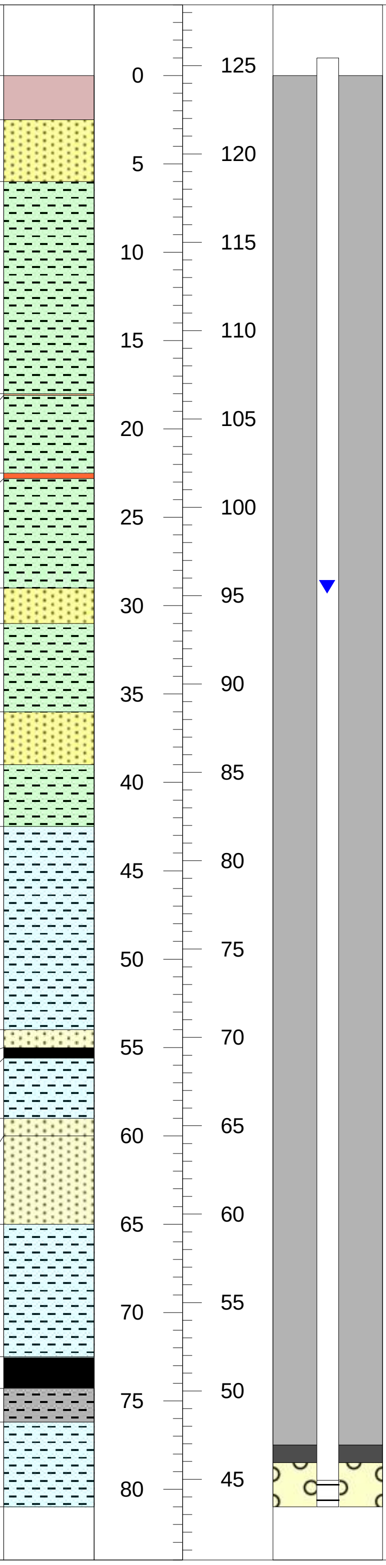
SANDSTONE, fine to coarse, light to medium grey

SILTSTONE, dark grey

COAL, Orion 5 Seam, fresh

CARBONACEOUS SILTSTONE, black

SILTSTONE, medium grey, abundant sandstone near base of unit



Stickup to Lip of Steel Monument - 1.04 m

Grout from surface to 77.5 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 28.93 mbgl - 17/7/2019

Bentonite Seal - 77.5 to 78.5 mbgl

Gravel Pack - 78.5 to 81.0 mbgl

Screen - machine-slotted 50 mm PVC - 79.5 to 81.0 mbgl

Easting: 731548.4

Northing: 7383777.5

Collar RL (mAHD): 124.43

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 81

Project: Gemini Project

Bore ID: DW7035W3

Drilled Date: 31-May-2019

Lithological Description

SOIL, dark brown, clayey and silty

CLAY, dark reddish-brown, silty, sandy near base of unit

SAND, medium to dark reddish-brown

SAND, medium brownish-red

IRONSTONE, medium to dark reddish-brown

SAND, medium brownish-red

FERRICRETE, dark reddish-brown

GRAVEL, medium to dark brownish grey, sandy with ferruginous grains

SAND, medium brownish-red

CLAY, light to medium brownish-white, sandy near base of unit

SAND, silty, light greyish-white

CLAY, sandy, light yellowish-brown, base of Tertiary at 33 mbgl

SILTSTONE, medium to dark orangey-brown, clayey

LIMONITE, medium to dark reddish-brown, ferruginous

SILTSTONE, light to medium brownish-grey

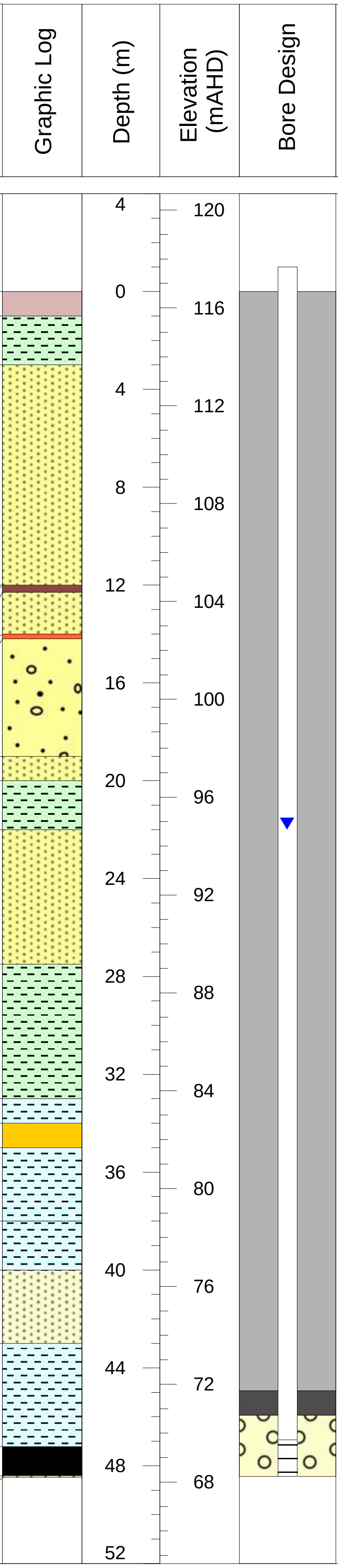
SILTSTONE, medium to dark greyish0brown

SANDSTONE, light to medium brownish-grey

SILTSTONE, medium grey, sandstone near base of unit

COAL, Orion 1 seam, black, fresh

SANDSTONE, fine-grained, medium grey



Bore Construction/ General Drilling Notes

Stickup to Lip of Steel Monument - 1.06 m

Grout from surface to 44.9 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 21.75 mbgl - 16/7/2019

Bentonite Seal - 44.9 to 45.9mbgl

Gravel Pack - 45.9 to 48.4 mbgl

Screen - machine-slotted 50 mm PVC - 46.9 to 48.4 mbgl

Easting: 730957.4
Northing: 7384050
Collar RL (mAHD): 116.67
Co-ord System: GDA94

Drilling Company: Hodge Drilling
Drill Rig:
Hole Diameter (mm): 120
Total Depth (m): 48.47

Project: Gemini Project

Bore ID: DW7065W

Drilled Date: 05-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL: medium to dark grey, loose, earthy

CLAY: light brownish-white, firm, chalky.

CLAY, sandy : light orangey-white, with ferruginous traces, firm, chalky, haematitic.

SAND: light yellowish-white, loose.

CLAY: light white, sandy ferruginous bands near middle of unit, stiff, chalky, haematitic

SAND, clayey: light greyish-white, very clayey, medium dense.

GRAVEL, clayey: medium to dark reddish-brown, very clayey, dense.

CLAY: light brown, sandy, stiff.

CLAY, silty : medium to dark orangey-brown, stiff, chalky, haematitic.
Base of Tertiary at 54 mbgl.

SILTSTONE : medium to dark reddish-brown, clayey, weathered.
Base of Weathering at 61.5 mbgl

SILTSTONE : medium to dark grey.

SILTSTONE : black, fresh.

COAL: black, fresh, Aries 3 Upper Seam

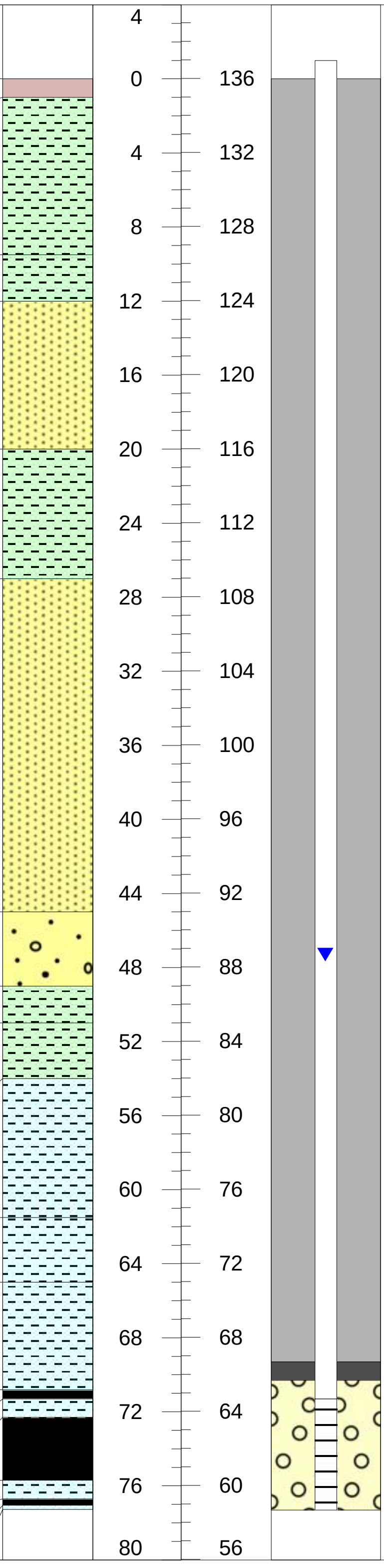
SILTSTONE : medium to dark grey, fresh.

COAL: black, fresh, Aries 3 Seam.

SILTSTONE : medium to dark grey.

COAL: black, Aries 3 Lower Seam.

SILTSTONE : medium to dark grey.



Stickup to Lip of Steel Monument - 1.0 m

Grout from surface to 69.3 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 47.30 mbgl - 26/8/2019

Bentonite Seal - 69.3 to 70.3 mbgl

Gravel Pack - 70.3 to 77.3 mbgl

Screen - machine-slotted 50 mm PVC - 71.3 to 77.3 mbgl

Easting: 730860.4
Northing: 7382307.1
Collar RL (mAHD): 135.97
Co-ord System: GDA94

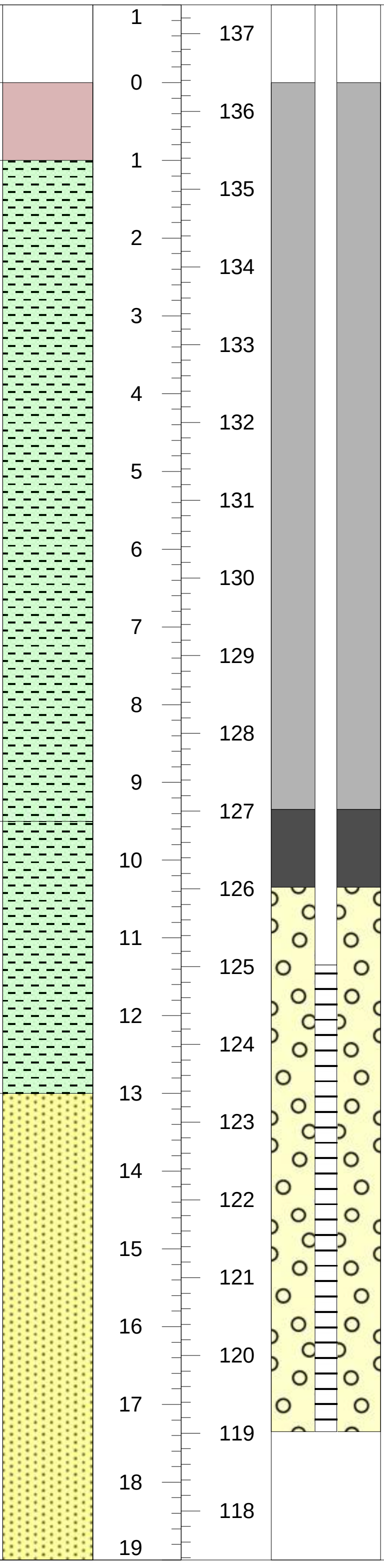
Drilling Company: Hodge Drilling
Drill Rig: Gardner Denver 1400
Hole Diameter (mm): 120
Total Depth (m): 77.27

Project: Gemini Project

Bore ID: DW7066W

Drilled Date: 05-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



SOIL: medium to dark grey, loose, earthy.

CLAY : light brownish-white, firm, chalky.

CLAY, sandy : light yellowish-white, with limonitic traces, firm, chalky, haematitic.

SAND: light white, loose.

Stickup to Lip of Steel Monument - 0.94 m

Grout from surface to 9.35 mbgl

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 9.35 to 10.35 mbgl

Gravel Pack - 10.35 to 17.35 mbgl

Screen - machine-slotted 50 mm PVC - 11.35 to 17.35 mbgl

Bore Dry - 26/8/2019

JBT consulting

Easting:	730863.1	Drilling Company:	Hodge Drilling
Northing:	7382304.1	Drill Rig:	Gardner Denver 1400
Collar RL (mAHD):	136.37	Hole Diameter (mm):	120
Co-ord System:	GDA94	Total Depth (m):	17.35

Project: Gemini Project

Bore ID: DW7067W

Drilled Date: 06-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL: light to dark brown, sandy, loose.

CLAY: medium to dark brown, lateritic, clayey near top of unit, firm.

CLAY: light white, sandy, soil.

CLAY, silty: medium to dark brownish-grey, with ferruginous traces, firm.

CLAY, sandy: light to medium greyish-white, ferruginous near base of unit, stiff.

CLAY : light to medium orangey-brown, sandy, stiff. Base of Tertiary at 50 mbgl

SILTSTONE : light to medium orangey-brown and dark brown, extremely weathered, becoming slightly weathered towards base.

COAL: black, slightly weathered. Aries 2 Seam

CARBONACEOUS SILTSTONE : light to dark greyish-black, with thin sandstone bands, slightly weathered. Base of weathering at 60.5 mbgl

SILTSTONE : medium to dark grey, sandstone laminae (2-20mm), fresh.

SANDSTONE, fine to medium : medium grey, fresh.

SILTSTONE : medium to dark grey, fresh.

SANDSTONE, fine : medium to dark grey, minor (1-15%) siltstone laminae (2-20mm) throughout, fresh.

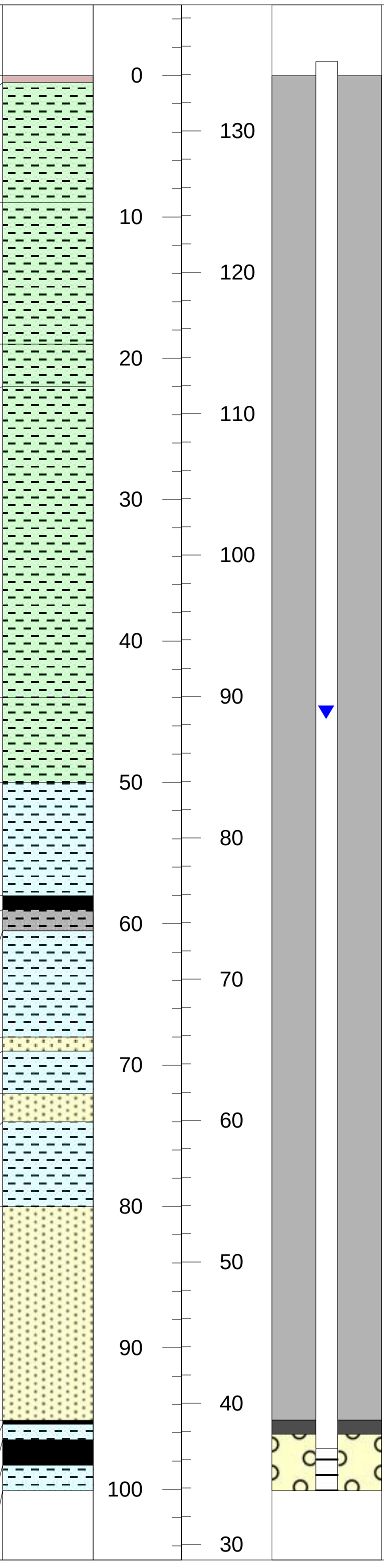
SILTSTONE : medium to dark grey, sandstone bands near middle of unit, fresh.

SANDSTONE, fine to medium : medium grey, coarser near base of unit, siltstone bands.

COAL: dark greyish-black, dominant (>60%), carbonaceous, siltstone throughout. Aries 3 Upper Seam

SILTSTONE : medium to dark grey, abundant (30-60%) siltstone.

COAL, stony: black. Aries 3 Lower Seam



Stickup to Lip of Steel Monument - 0.90 m

Grout from surface to 92.4 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 45.05 mbgl - 26/8/2019

Bentonite Seal - 92.4 to 93.4 mbgl

Gravel Pack - 93.4 to 100.45 mbgl

Screen - machine-slotted 50 mm PVC - 94.4 to 100.4 mbgl

JBT consulting

Easting: 730781.2

Northing: 7382393.8

Collar RL (mAHD): 133.92

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig: Gardner Denver 1400

Hole Diameter (mm): 120

Total Depth (m): 100.14

Project: Gemini Project

Bore ID: DW7068W

Drilled Date: 06-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL: light to dark brown, sandy, loose.

CLAY: medium to dark greyish-brown, lateritic and clayey near top of unit, firm.

CLAY: light brownish-white, firm.

SAND: light white, clayey, dense

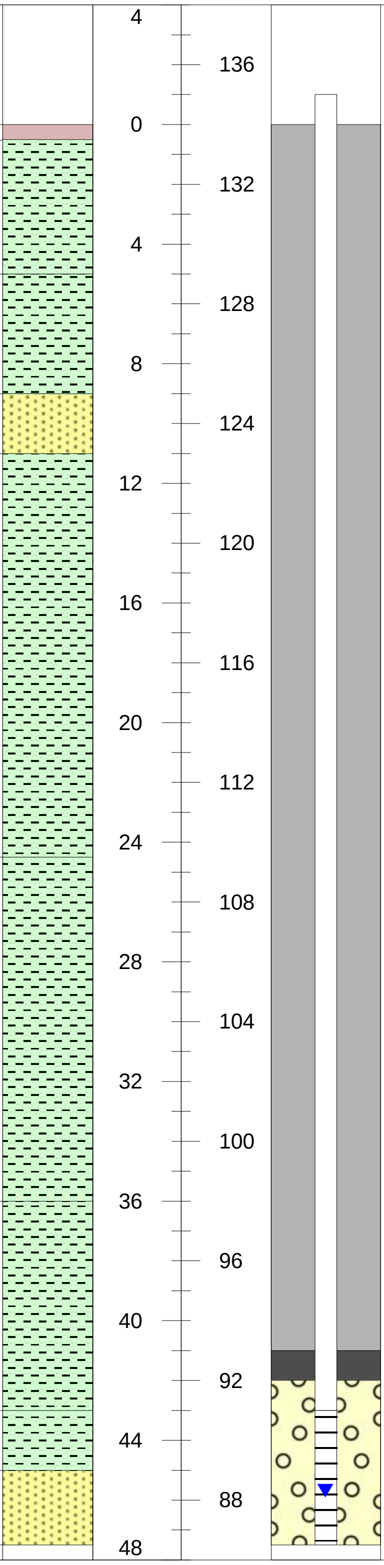
CLAY: light greyish-white, sandy with ferruginous traces.

CLAY: light white, sandy, firm.

CLAY, sandy: light to medium brownish-grey, ferruginous near base of unit, stiff.

CLAY, sandy: light to medium reddish-brown, sandy, stiff.

SAND, clayey: light to medium greyish-white, with ferruginous traces, dense.



Stickup to Lip of Steel Monument - 0.94 m

Grout from surface to 41 mbgl

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 41 to 42 mbgl

Gravel Pack - 42 to 47.5 mbgl

Screen - machine-slotted 50 mm PVC - 43 to 47.5 mbgl

Water level - 45.68 mbgl - 26/8/2019

Easting: 730785.4	Drilling Company: Hodge Drilling
Northing: 7382391.3	Drill Rig: Gardner Denver 1400
Collar RL (mAHD): 134	Hole Diameter (mm): 120
Co-ord System: GDA94	Total Depth (m): 47.5

Project: Gemini Project

Bore ID: DW7069W

Drilled Date: 07-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL: light to dark brown, sandy, loose.

CLAY : light to medium brown, silty and laminae (2-20mm), firm, finer near top of unit. Base of Tertiary at 16 mbgl.

SILTSTONE : light to medium orangey-brown, with clayey bands, extremely weathered.

SILTSTONE : medium to dark grey, slightly weathered.

COAL, weathered : black, slightly weathered. Aries 3 Upper Seam

SILTSTONE : grey, slightly weathered, very low strength rock

COAL, weathered : black, slightly weathered. Aries 3 Seam

CARBONACEOUS SILTSTONE: light to dark greyish-black, with siltstone bands, slightly weathered, very low strength rock

COAL, weathered: black, Aries 3 Lower Seam

SILTSTONE: medium to dark grey, thin sandstone laminae (2-20mm) near base of unit, fresh

SANDSTONE, medium: light to medium grey, fresh

SILTSTONE: medium to dark grey, fresh

COAL: black, fresh. Castor Upper Seam

SANDSTONE, fine to medium: light to medium grey, with common (15-30%) siltstone bands, fresh

SILTSTONE: medium to dark grey, fresh

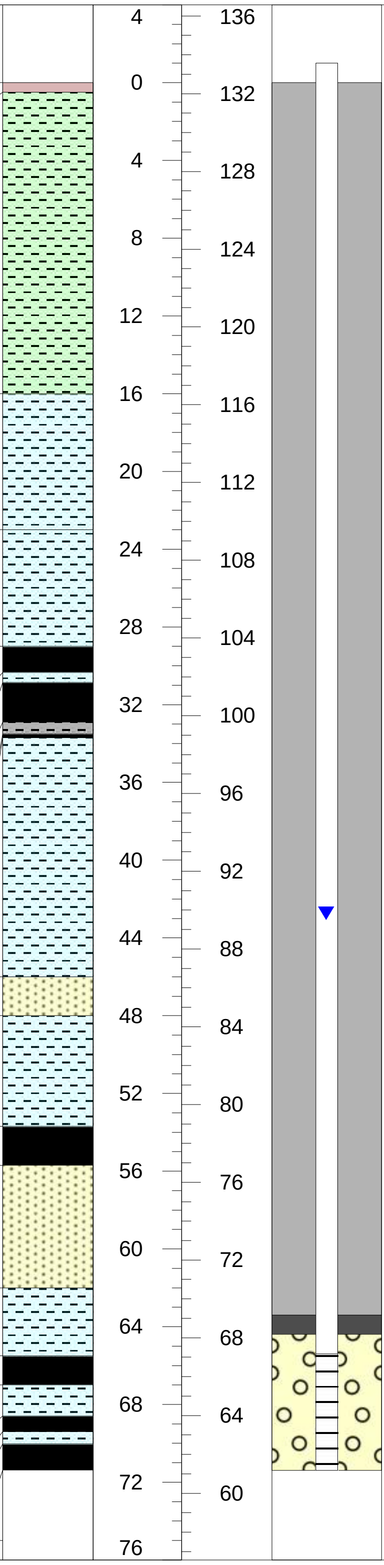
COAL: black, fresh. Castor Lower Seam.

SILTSTONE: medium to dark grey, carbonaceous in part, fresh

COAL: black, fresh. Pollux Upper Seam

SILTSTONE: medium to dark grey, fresh

COAL: black, thin siltstone bands near base of unit, fresh. Pollux Upper 1 Seam



Stickup to Lip of Steel Monument - 0.95 m

Grout from surface to 63.4 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 42.73 mbgl - 26/8/2019

Bentonite Seal - 63.4 to 64.4 mbgl

Gravel Pack - 64.4 to 71.4 mbgl

Screen - machine-slotted 50 mm PVC - 65.4 to 71.4 mbgl

JBT consulting

Easting: 730397.1
Northing: 7382699
Collar RL (mAHD): 132.57
Co-ord System: GDA94

Drilling Company: Hodge Drilling
Drill Rig: Gardner Denver 1400
Hole Diameter (mm): 120
Total Depth (m): 71.38

Project: Gemini Project

Bore ID: DW7071W

Drilled Date: 08-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL: light to medium reddish-brown, very loose

CLAY : light to medium brown, silty and laminae (2-20mm)

CLAY : light white, ferruginous, granules traces near top of unit, firm

CLAY, sandy : light to medium reddish-brown, ferruginous, firm, haematitic. Base of Tertiary at 18 mbgl.

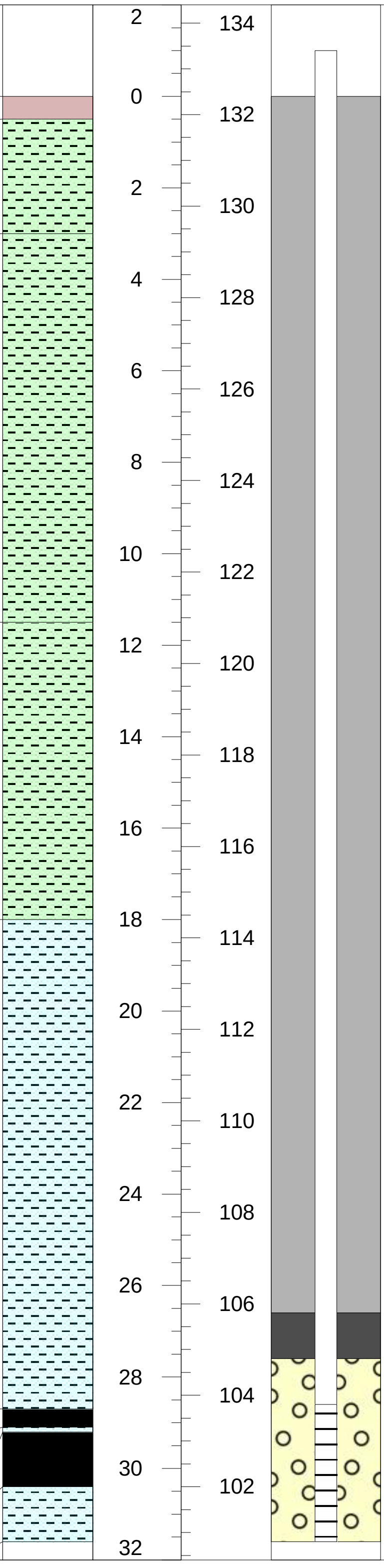
SILTSTONE : light to medium greyish-brown, clayey, extremely weathered

COAL: black, extremely weathered. Aries 3 Upper Seam

SILTSTONE : medium to dark greyish-grey, extremely weathered.

COAL: extremely weathered. Aries 3 Seam

SILTSTONE : medium to dark brownish-grey, soil and clayey, slightly weathered.



Stickup to Lip of Steel Monument - 0.97 m

Grout from surface to 26.6 mbgl

50 mm Class 18 PVC Environmental Casing

Bore Dry - 26/8/2019

Bentonite Seal - 26.6 to 27.6 mbgl

Gravel Pack - 27.6 to 31.6 mbgl

Screen - machine-slotted 50 mm PVC - 28.6 to 31.6 mbgl

JBT consulting

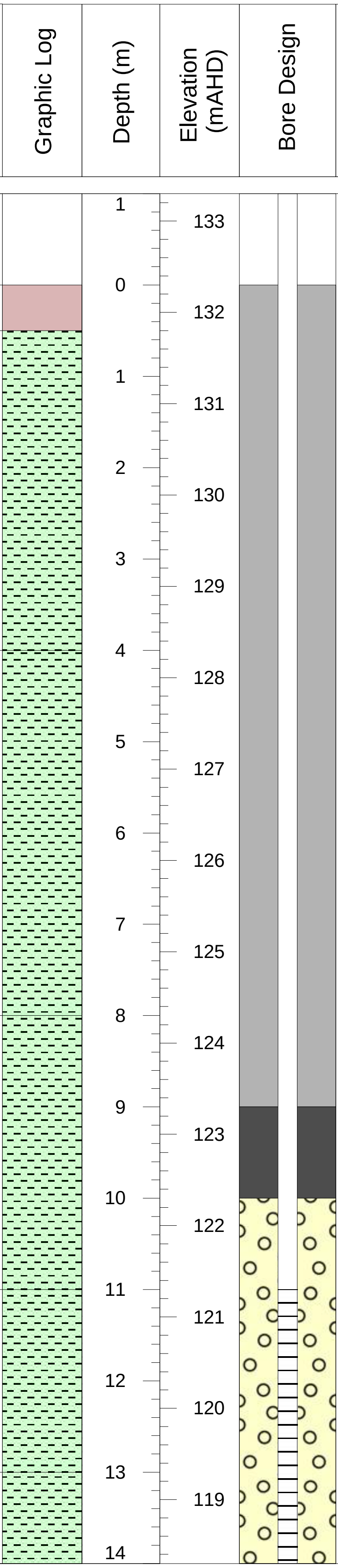
Easting:	730394.4	Drilling Company:	Hodge Drilling
Northing:	7382702.7	Drill Rig:	Gardner Denver 1400
Collar RL (mAHD):	132.4	Hole Diameter (mm):	120
Co-ord System:	GDA94	Total Depth (m):	31.59

Project: Gemini Project

Bore ID: DW7072W

Drilled Date: 08-Apr-2018

Lithological Description
SOIL: light to medium reddish-brown, very loose.
CLAY: light to medium brown, silty
CLAY: light greyish-white, lateritic
CLAY, silty: light white
CLAY, silty: light creamy-white, rare (<1%) ferruginous traces, firm.
CLAY: medium to dark reddish-brown, ferruginous with limonitic traces, firm, haematitic. Base of Tertiary at 14 mbgl



Bore Construction/ General Drilling Notes

Stickup to Lip of Steel Monument - 0.93 m

Grout from surface to 9 mbgl

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 9 to 10 mbgl

Gravel Pack - 10 to 14 mbgl

Screen - machine-slotted 50 mm PVC - 11 to 14 mbgl

Bore Dry - 26/8/2019

JBT consulting

Easting: 730403.1
Northing: 7382686.8
Collar RL (mAHD): 132.3
Co-ord System: GDA94

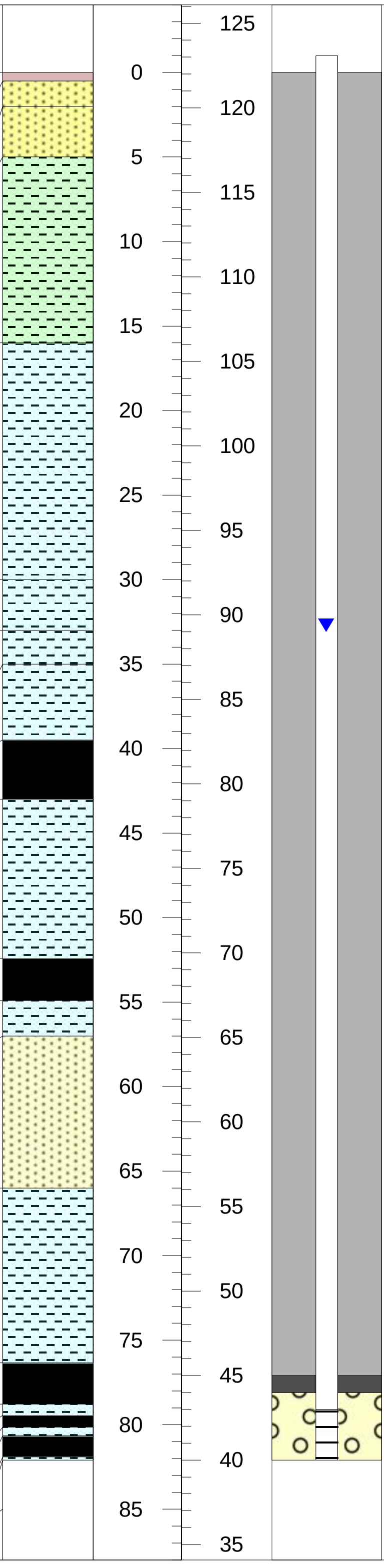
Drilling Company: Hodge Drilling
Drill Rig: Gardner Denver 1400
Hole Diameter (mm): 120
Total Depth (m): 14.01

Project: Gemini Project

Bore ID: DW7073W

Drilled Date: 11-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



SOIL: light brownish-red, lithic, oxidised, medium dense, earthy, haematitic

SAND, clayey: light brownish-red, oxidised, ferruginous, firm, haematitic

SAND, clayey: light creamy-white, firm, chalky

CLAY: light greyish-white, firm, light reddish-brown and ferruginous towards base of unit. Base of Tertiary at 16 mbgl.

SILTSTONE: light to medium greyish-brown, clayey bands near base of unit, extremely weathered,

SILTSTONE: medium to dark greyish-brown, carbonaceous, extremely weathered

SILTSTONE: medium to dark grey, oxidised, ferruginous in part, slightly weathered, haematitic. Base of weathering at 35 mbgl

SILTSTONE: medium to dark grey, shaly near base of unit, fresh.

COAL: black, fresh, Aries Seam. Ground water observed by the driller.

SILTSTONE: medium to dark grey, claystone bands near top of unit, fresh

COAL: black, fresh, Castor Upper Seam

SILTSTONE: light to dark grey, carbonaceous, fresh, low strength rock, common (15-30%) plant fragments

SANDSTONE, fine to medium: light to medium grey, with siltstone laminae (2-20mm)

SILTSTONE: medium to dark grey

COAL: black, Castor Lower Seam

SILTSTONE: medium to dark grey.

COAL: black, Pollux Upper Seam

SILTSTONE: medium to dark grey

COAL: black, Pollux Upper 1 Seam

SILTSTONE: medium to dark grey

Stickup to Lip of Steel Monument - 0.90 m

Grout from surface to 77.1 mbgl

Water level - 32.71 mbgl - 26/8/2019

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 77.1 to 78.1 mbgl

Gravel Pack - 78.1 to 82.1 mbgl

Screen - machine-slotted 50 mm PVC - 79.1 to 82.1 mbgl

Easting: 729925.9

Northing: 7382666

Collar RL (mAHD): 122.09

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig: Gardner Denver 1400

Hole Diameter (mm): 120

Total Depth (m): 82.1

Project: Gemini Project

Bore ID: DW7074W

Drilled Date: 11-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL: light brownish-red, lithic, oxidised, medium dense, earthy, haematitic

SAND, clayey: light brownish-red, oxidised, ferruginous, firm, haematitic.

SAND, clayey: light creamy-white, firm, chalky

CLAY: light greyish-white, firm, chalky

CLAY: mottled yellowish-brown, firm

CLAY: light reddish-white, oxidised, ferruginous near middle of unit.
Base of Tertiary at 16 mbgl.

SILTSTONE: light to medium greyish-brown, clayey bands near base of unit, extremely weathered

SILTSTONE: medium to dark reddish-brown, extremely weathered

SILTSTONE: medium to dark grey, oxidised, ferruginous in part, slightly weathered.
Base of Weathering at 35 mbgl

SILTSTONE: medium to dark grey, shaly near base of unit

COAL: black, Aries 3 Seam

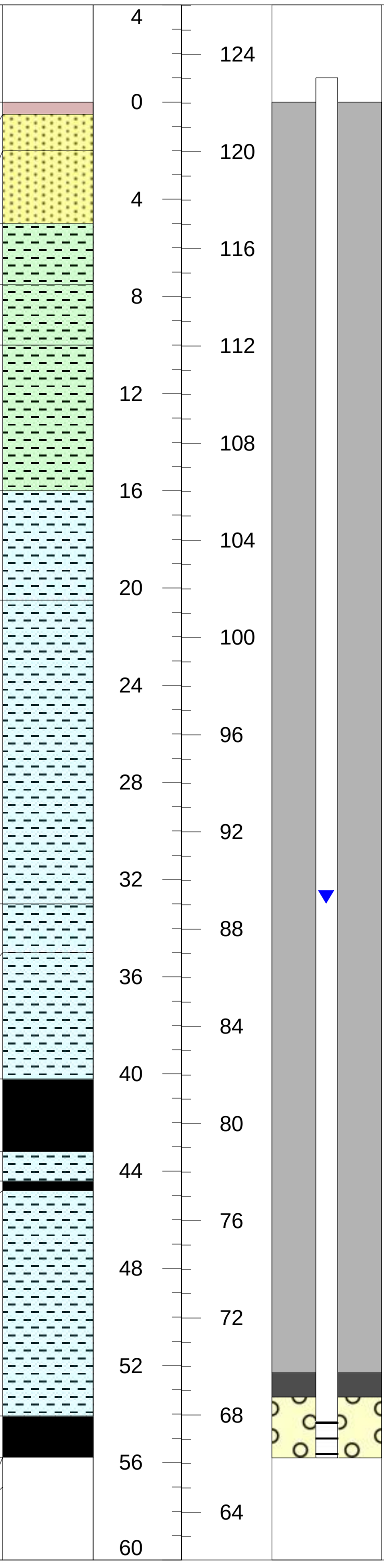
SILTSTONE: medium to dark grey

COAL: black, Aries 3 Lower Seam

SILTSTONE: medium to dark grey

COAL: black, Castor Upper Seam

SILTSTONE: light to dark grey, carbonaceous, fresh, low strength rock, common (15-30%) plant fragments



Stickup to Lip of Steel Monument - 0.91 m

Grout from surface to 52.3 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 32.72 mbgl - 26/8/2019

Bentonite Seal - 52.3 to 53.3 mbgl

Gravel Pack - 53.3 to 55.8 mbgl

Screen - machine-slotted 50 mm PVC - 54.3 to 55.8 mbgl

JBT consulting

Easting: 729921.7

Northing: 7382665.9

Collar RL (mAHD): 122.04

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig: Gardner Denver 1400

Hole Diameter (mm): 120

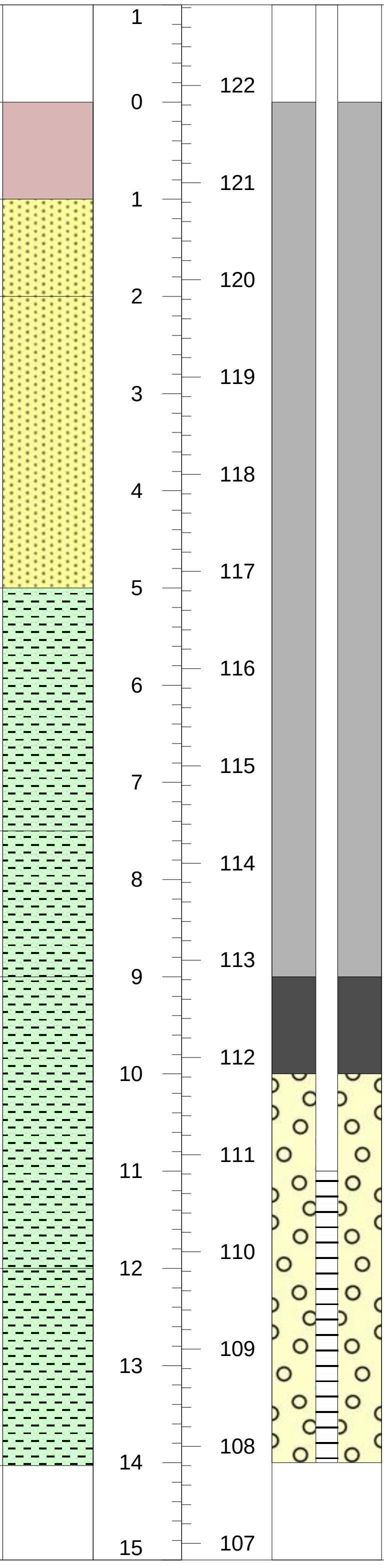
Total Depth (m): 55.78

Project: Gemini Project

Bore ID: DW7075W

Drilled Date: 11-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



Lithological Description:

- SOIL: light brownish-red, lithic, oxidised, medium dense, earthy, haematitic
- SAND, clayey: light brownish-red, oxidised, ferruginous, firm, haematitic
- SAND, clayey: light creamy-white, firm, chalky
- CLAY: light greyish-white, firm, chalky
- CLAY: mottled yellowish-brown, limonitic traces near top of unit, firm.
- CLAY: medium to dark greyish-brown, oxidised, ferruginous, firm, haematitic
- CLAY: light greyish-white, minor (1-15%) limonitic traces, firm.

Bore Construction/ General Drilling Notes:

Stickup to Lip of Steel Monument - 1.09 m

Grout from surface to 9 mbgl

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 9 to 10 mbgl

Gravel Pack - 10 to 14 mbgl

Screen - machine-slotted 50 mm PVC - 11 to 14 mbgl

Bore Dry - 26/8/2019

Easting: 729917.9

Northing: 7382665.7

Collar RL (mAHD): 121.83

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig: Gardner Denver 1400

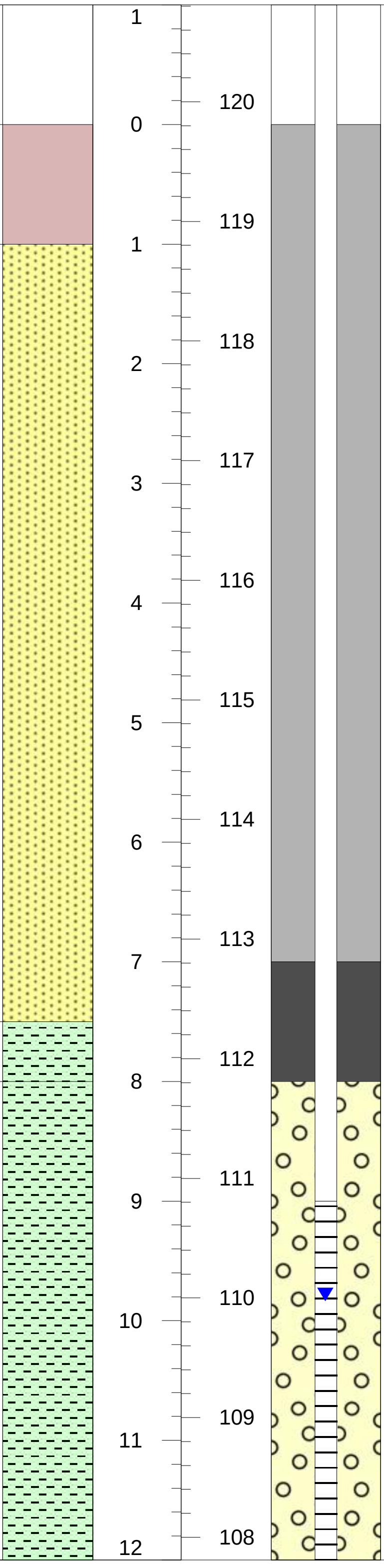
Hole Diameter (mm): 120

Total Depth (m): 14.03

Project: Gemini Project **Bore ID: DW7076W**

Drilled Date: 12-Apr-2018

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



SOIL: medium to dark brown, loose.

SAND: medium to dark reddish-brown, clayey near top of unit near base of unit, medium dense.

CLAY: light to medium whitish-grey, ferruginous, granules throughout, firm.

CLAY, sandy: light to medium white, minor (1-15%) limonitic traces, stiff.

Stickup to Lip of Steel Monument - 1.14 m

Grout from surface to 7 mbgl

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 7 to 8 mbgl

Water level - 9.78 mbgl - 26/8/2019

Gravel Pack - 8 to 12 mbgl

Screen - machine-slotted 50 mm PVC - 9 to 12 mbgl

Easting:	729749.5	Drilling Company:	Hodge Drilling
Northing:	7382722.8	Drill Rig:	Gardner Denver 1400
Collar RL (mAHD):	119.81	Hole Diameter (mm):	120
Co-ord System:	GDA94	Total Depth (m):	12

Project: Gemini Project

Bore ID: DW7082W1

Drilled Date: 16-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, dark brownish-grey

CLAY, silty, medium to dark

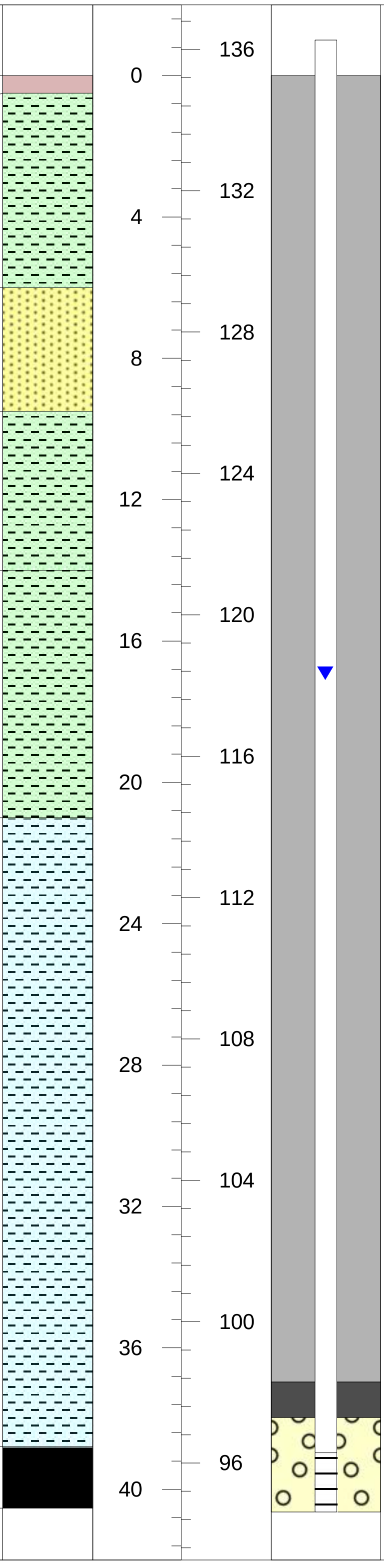
SAND

CLAY, sandy, medium greyish-brown

CLAY, light to medium brownish-grey, sandy

SILTSTONE, light to medium brownish-grey, sandy towards base of unit

COAL, Castor Lower Seam



Stickup to Lip of Steel Monument - 1.08 m

Grout from surface to 37 mbgl

Water level - 16.91 mbgl - 22/8/2019

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 37 to 38 mbgl

Gravel Pack - 38 to 40.6 mbgl

Screen - machine-slotted 50 mm PVC - 39 to 40.5 mbgl

Easting: 728989.3
Northing: 7378745.8
Collar RL (mAHD): 135.26
Co-ord System: GDA94

Drilling Company: Hodge Drilling
Drill Rig:
Hole Diameter (mm): 120
Total Depth (m): 40.58

Project: Gemini Project **Bore ID: DW7082W2**

Drilled Date: 16-Jun-2019

Lithological Description

SOIL, dark brownish-grey

CLAY, silty, medium to dark

SAND

CLAY, sandy, medium greyish-brown

CLAY, light to medium brownish-grey, sandy

SILTSTONE, light to medium brownish-grey, sandy towards base of unit

COAL, Castor Lower Seam

SILTSTONE

CARBONACEOUS MUDSTONE, black

SILTSTONE

COALY SHALE, black

CARBONACEOUS SILTSTONE, black

SANDSTONE, fine to medium grained, light to medium grey

SILTSTONE, light to dark grey

SANDSTONE, light to medium grey

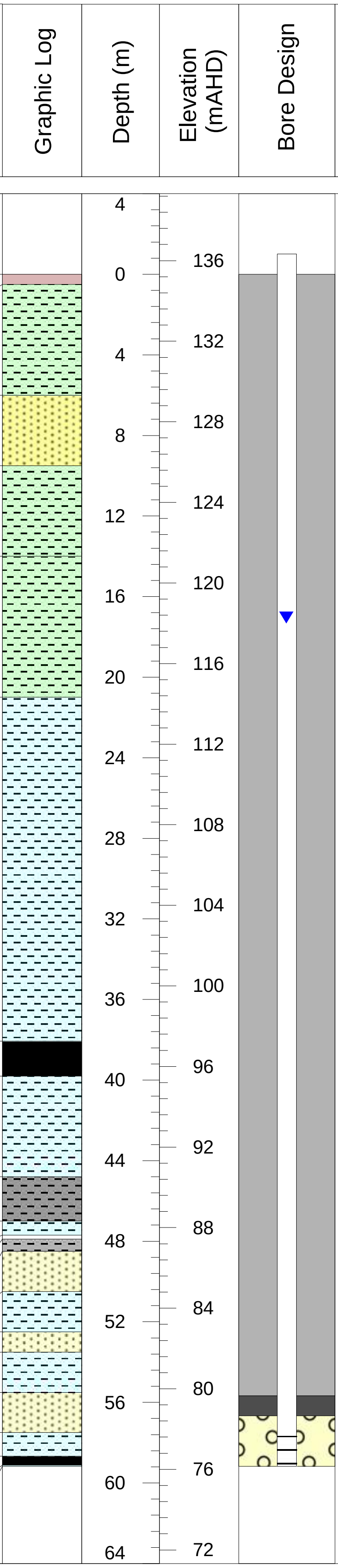
SILTSTONE, sandstone bands

SANDSTONE, fine to medium grained, grey

SILTSTONE, light to dark grey

COAL, Pisces Upper Seam

SILTSTONE, light to dark grey



Bore Construction/ General Drilling Notes

Stickup to Lip of Steel Monument - 0.99 m

Grout from surface to 55.7 mbgl

Water level - 17.04 mbgl - 22/8/2019

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 55.7 to 56.7 mbgl

Gravel Pack - 56.7 to 59.2 mbgl

Screen - machine-slotted 50 mm PVC - 57.7 to 59.2 mbgl

Easting: 728986.3

Northing: 7378742.2

Collar RL (mAHD): 135.33

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 59.17

Project: Gemini Project

Bore ID: DW7093W1

Drilled Date: 13-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL

CLAY, medium yellowish-grey to reddish-grey, base of Tertiary at 31 mbgl

CLAYSTONE, blackish-grey

MUDSTONE, dark brownish-grey

SILTSTONE, light to dark brownish grey, clayey with sandstone bands, base of weathering at 41 mbgl

SANDSTONE, fine to medium grained, light grey

MUDSTONE, dark grey

COAL, Pisces Lower Upper 1

SILTSTONE, medium to dark grey

SANDSTONE, fine to medium-grained

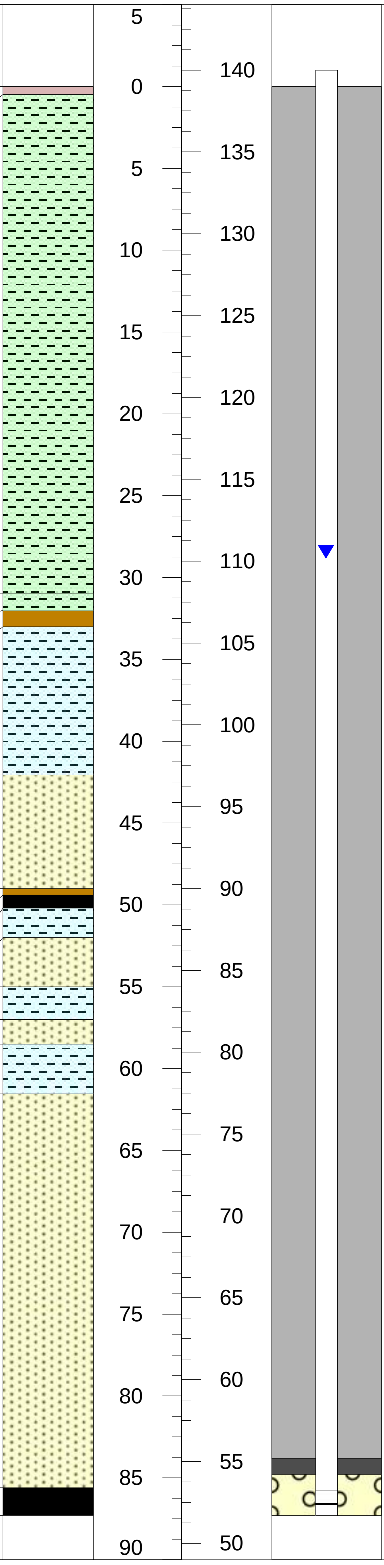
SILTSTONE

SANDSTONE, fine to medium-grained

SILTSTONE, light to dark grey, coaly shale band in middle of unit

SANDSTONE, medium-grained, light to dark grey

COAL, Pisces Lower Upper 2



Stickup to Lip of Steel Monument - 1.14 m

Grout from surface to 83.8 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 28.44 mbgl - 2/9/2019

Bentonite Seal - 83.8 to 84.8 mbgl

Gravel Pack - 84.8 to 87.3 mbgl

Screen - machine-slotted 50 mm PVC - 85.8 to 87.3 mbgl

JBT consulting

Easting: 730095.9

Northing: 7378973.6

Collar RL (mAHD): 139

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 87.3

Project: Gemini Project **Bore ID: DW7093W2**

Drilled Date: 12-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL

CLAY, medium yellowish-grey to reddish-grey, base of Tertiary at 31 mbgl

CLAYSTONE, blackish-grey

MUDSTONE, dark brownish-grey

SILTSTONE, light to dark brownish grey, clayey with sandstone bands, base of weathering at 41 mbgl

SANDSTONE, fine to medium grained, light grey

MUDSTONE, dark grey

COAL, Pisces Lower Upper 1

SILTSTONE, medium to dark grey

SANDSTONE, fine to medium-grained

SILTSTONE

SANDSTONE, fine to medium-grained

SILTSTONE, light to dark grey, coaly shale band in middle of unit

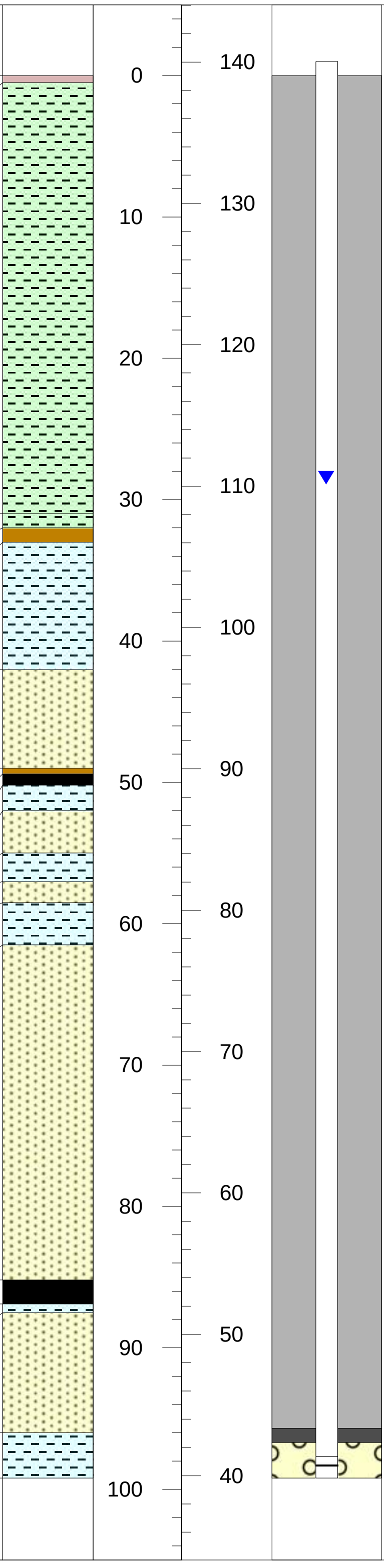
SANDSTONE, medium-grained, light to dark grey

COAL, Pisces Lower Upper 2

SILTSTONE, light to dark grey

SANDSTONE, medium-grained

SILTSTONE, light to dark grey



Stickup to Lip of Steel Monument - 1.14 m

Grout from surface to 95.7 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 28.45 mbgl - 2/9/2019

Bentonite Seal - 95.7 to 96.7 mbgl

Gravel Pack - 96.7 to 99.2 mbgl

Screen - machine-slotted 50 mm PVC - 97.7 to 99.2 mbgl

JBT consulting

Easting: 730095.9	Drilling Company: Hodge Drilling
Northing: 7378973.6	Drill Rig:
Collar RL (mAHD): 139	Hole Diameter (mm): 120
Co-ord System: GDA94	Total Depth (m): 87.3

Project: Gemini Project

Bore ID: DW7093W3

Drilled Date: 11-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL

CLAY, medium yellowish-grey to reddish-grey, base of Tertiary at 31 mbgl

CLAYSTONE, blackish-grey

MUDSTONE, dark brownish-grey

SILTSTONE, light to dark brownish grey, clayey with sandstone bands, base of weathering at 41 mbgl

SANDSTONE, fine to medium grained, light grey

MUDSTONE, dark grey

COAL, Pisces Lower Upper 1

SILTSTONE, medium to dark grey

SANDSTONE, fine to medium-grained

SILTSTONE

SANDSTONE, fine to medium-grained

SILTSTONE, light to dark grey, coaly shale band in middle of unit

SANDSTONE, medium-grained, light to dark grey

COAL, Pisces Lower Upper 2

SILTSTONE, light to dark grey

SANDSTONE, medium-grained

SILTSTONE, light to dark grey

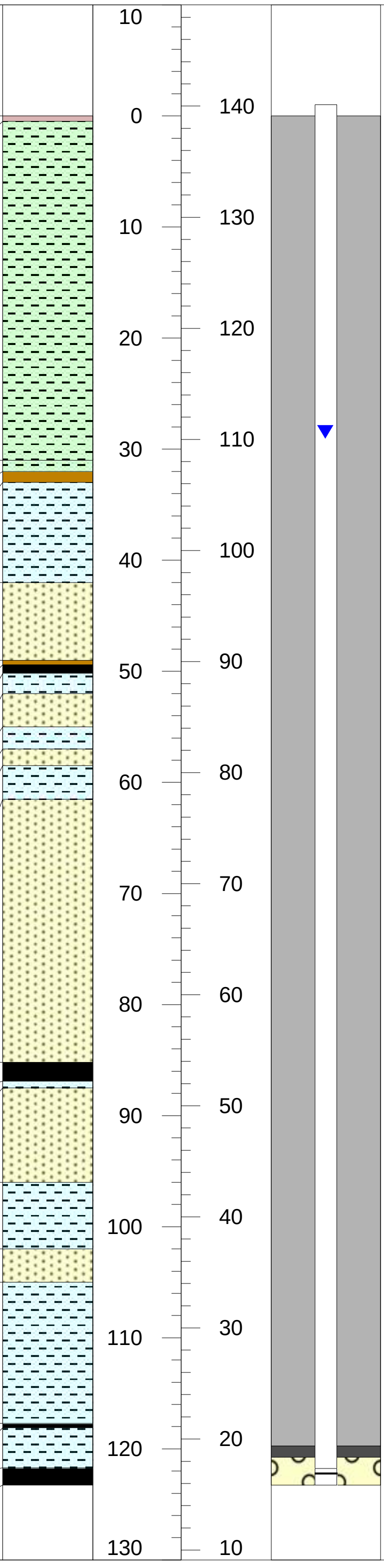
SANDSTONE, fine-grained

SILTSTONE, light to dark grey

COAL, Pisces Lower Lower 1

SILTSTONE, light to dark grey

COAL, Pisces Lower Lower 2



Stickup to Lip of Steel Monument - 1.05 m

Grout from surface to 119.8 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 28.46 mbgl - 2/9/2019

Bentonite Seal - 119.8 to 120.8 mbgl
Gravel Pack - 120.8 to 123.3 mbgl
Screen - machine-slotted 50 mm PVC - 121.8 to 123.3 mbgl

JBT consulting

Easting: 730088

Northing: 7378973.6

Collar RL (mAHD): 139.12

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 123.25

Project: Gemini Project

Bore ID: DW7105W1

Drilled Date: 17-Jun-2019

Lithological Description

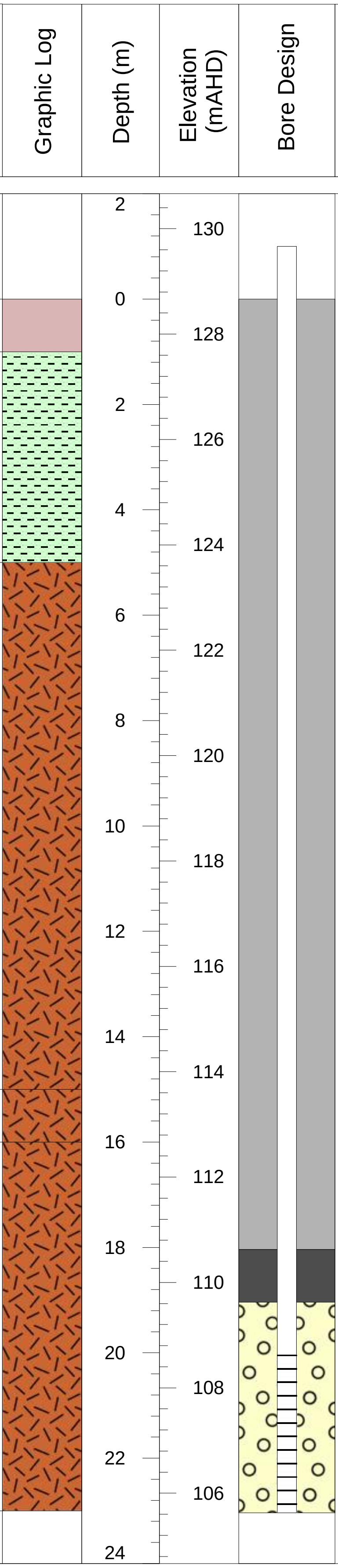
SOIL, medium to dark brown

CLAY, medium to dark brown

BASALT, medium to dark yellowish brown, highly weathered

BASALT, medium to dark orangey grey, common ferruginous lenses

BASALT, sandy beneath base of unit, base of Tertiary at 23 mbgl



Bore Construction/ General Drilling Notes

Stickup to Lip of Steel Monument - 0.95 m

Grout from surface to 18 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - DRY - 25/7/2018

Bentonite Seal - 18 to 19 mbgl

Gravel Pack - 19 to 23 mbgl

Screen - machine-slotted 50 mm PVC - 20 to 23 mbgl

Easting: 730192.1

Northing: 7380733

Collar RL (mAHD): 128.67

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

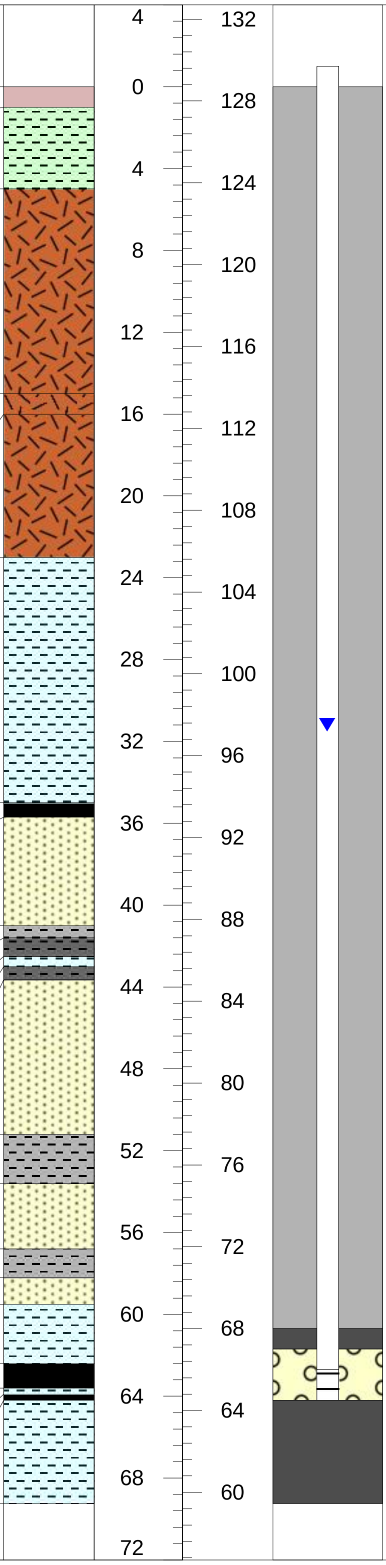
Hole Diameter (mm): 120

Total Depth (m): 23.04

Project: Gemini Project **Bore ID: DW7105W2**

Drilled Date: 16-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



SOIL, medium to dark brown

CLAY, medium to dark brown

BASALT, medium to dark yellowish brown, highly weathered

BASALT, medium to dark orangey grey, common ferruginous lenses

BASALT, sandy beneath base of unit, base of Tertiary at 23 mbgl

SILTSTONE, medium to dark brown and orangey-brown

COAL, Pisces Upper Seam

SANDSTONE, fine-grained, light to dark grey to black

CARBONACEOUS SILTSTONE

COALY SHALE

SILTSTONE

COALY SHALE

SANDSTONE, fine-grained, light to dark grey

CARBONACEOUS SILTSTONE

SANDSTONE, fine to medium-grained, medium to dark grey

CARBONACEOUS SILTSTONE

SANDSTONE, grey

SILTSTONE, light to dark grey

COAL, Pisces Lower Upper 1 Seam

SILTSTONE, grey

COAL, Pisces Lower Upper 1 Seam

SILTSTONE, light to dark grey

Stickup to Lip of Steel Monument - 1.02 m

Grout from surface to 60.7 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 31.08 mbgl - 22/8/2019

Bentonite Seal - 60.7 to 61.7 mbgl

Gravel Pack - 61.7 to 64.2 mbgl

Screen - machine-slotted 50 mm PVC - 62.7 to 64.2 mbgl

Bentonite seal in overdrilled zone below casing

JBT consulting

Easting: 730193

Northing: 7380729

Collar RL (mAHD): 128.7

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 69.25

Project: Gemini Project

Bore ID: DW7178W1

Drilled Date: 24-May-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, medium to dark brown

CLAY

CLAY, lateritic

FERRICRETE, dark reddish-brown

CLAY

SAND, fine-grained, light to medium yellow

CLAY, sandy, light to medium whitish-cream

CLAY, lateritic

FERRICRETE, dark reddish-brown

CLAY, ferruginous traces

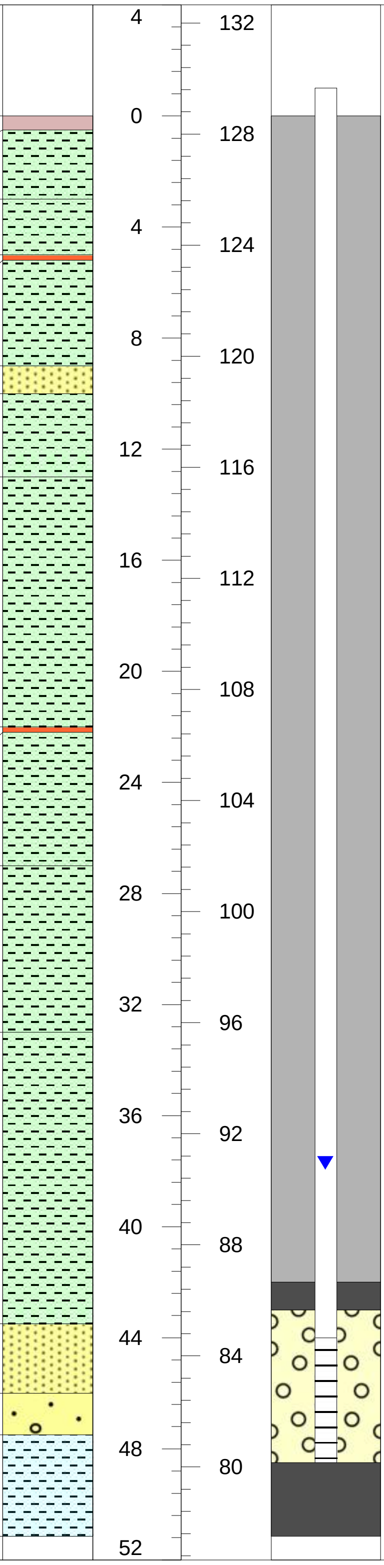
CLAY, sandy, light to medium whitish-cream

CLAY, light to medium pinkish cream, lateritic

SAND, fine to medium-grained, orangey-cream

GRAVEL, sandy, base of Tertiary at 47.5 mbgl

SILTSTONE, medium to dark orangey-brown



Stickup to Lip of Steel Monument - 0.97 m

Grout from surface to 42 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 37.17 mbgl - 16/7/2019

Bentonite Seal - 42 to 43 mbgl

Gravel Pack - 43 to 48.5 mbgl

Screen - machine-slotted 50 mm PVC - 44 to 48.5 mbgl

Bentonite seal in overdrilled zone below casing

Easting: 732173.7

Northing: 7383260

Collar RL (mAHD): 128.65

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 51.15

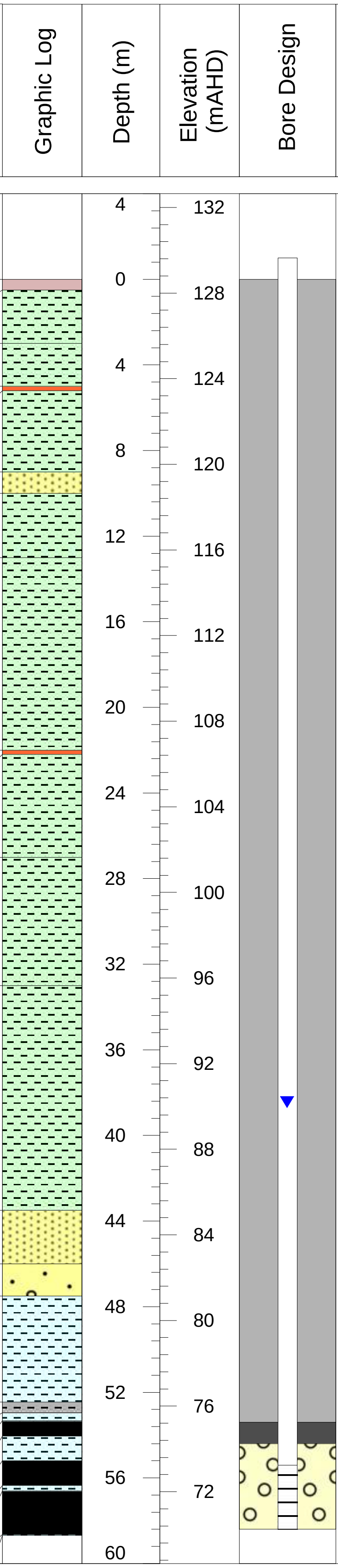
Project: Gemini Project

Bore ID: DW7178W2

Drilled Date: 24-May-2019

Lithological Description

- SOIL, medium to dark brown
- CLAY
- CLAY, lateritic
- FERRICRETE, dark reddish-brown
- CLAY
- SAND, fine-grained, light to medium yellow
- CLAY, sandy, light to medium whitish-cream
- CLAY, lateritic
- FERRICRETE, dark reddish-brown
- CLAY, ferruginous traces
- CLAY, sandy, light to medium whitish-cream
- CLAY, light to medium pinkish cream, lateritic
- SAND, fine to medium-grained, orangey-cream
- GRAVEL, sandy
- SILTSTONE, medium to dark orangey-brown
- CARBONACEOUS SILTSTONE, black
- SILTSTONE, brownish-grey
- COAL, Pisces Upper Seam
- SILTSTONE, brownish-grey
- COAL, Pisces Lower Upper 1 Seam
- SILTSTONE, light to dark grey
- COAL, Pisces Lower Upper 2 Seam



Bore Construction/ General Drilling Notes

Stickup to Lip of Steel Monument - 1.02 m

Grout from surface to 53.4 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 38.45 mbgl - 16/7/2019

Bentonite Seal - 53.4 to 54.4 mbgl

Gravel Pack - 54.4 to 58.4 mbgl

Screen - machine-slotted 50 mm PVC - 55.4 to 58.4 mbgl

Easting: 732174.4
Northing: 7383256
Collar RL (mAHD): 128.64
Co-ord System: GDA94

Drilling Company: Hodge Drilling
Drill Rig:
Hole Diameter (mm): 120
Total Depth (m): 58.69

Project: Gemini Project

Bore ID: DW7220W1

Drilled Date: 02-Jun-2019

Lithological Description

SOIL

CLAY, medium to dark brown

CLAY, sandy, medium to dark orangey-brown

CLAY, light to medium yellowish-white

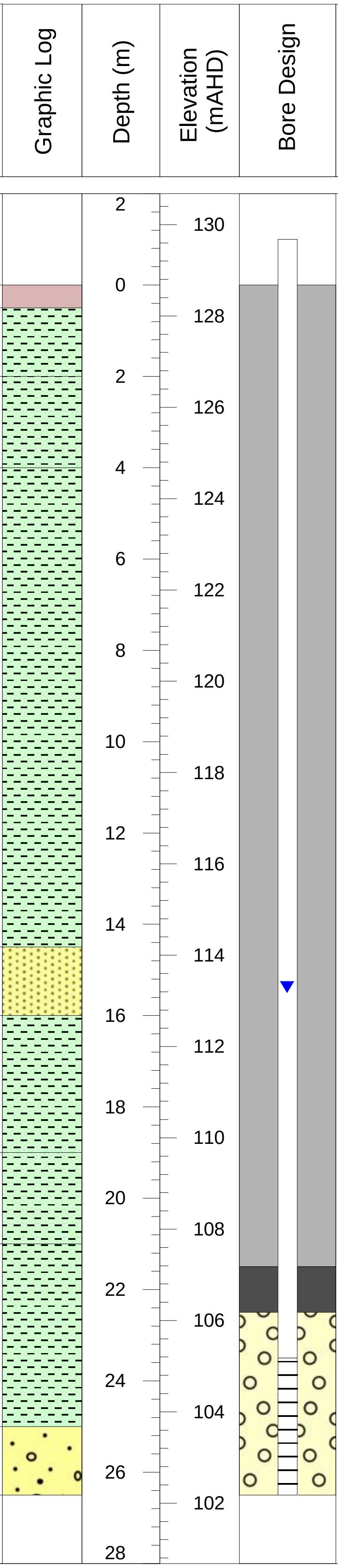
SAND

CLAY, light white

CLAY, sandy, light to medium yellowish-cream

CLAY, light to medium reddish-cream

GRAVEL, sandy, base of Tertiary at 26.5 mbgl



Bore Construction/
General Drilling Notes

Stickup to Lip of Steel Monument - 1.04 m

Grout from surface to 21.5 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 15.38 mbgl - 19/7/2019

Bentonite Seal - 21.5 to 22.5 mbgl

Gravel Pack - 22.5 to 26.5 mbgl

Screen - machine-slotted 50 mm PVC - 23.5 to 26.5 mbgl

JBT consulting

Easting: 729775

Northing: 7379648

Collar RL (mAHD): 128.68

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 26.5

Project: Gemini Project

Bore ID: DW7220W2

Drilled Date: 02-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL

CLAY, medium to dark brown

CLAY, sandy, medium to dark orangey-brown

CLAY, light to medium yellowish-white

SAND

CLAY, light white

CLAY, sandy, light to medium yellowish-cream

CLAY, light to medium reddish-cream

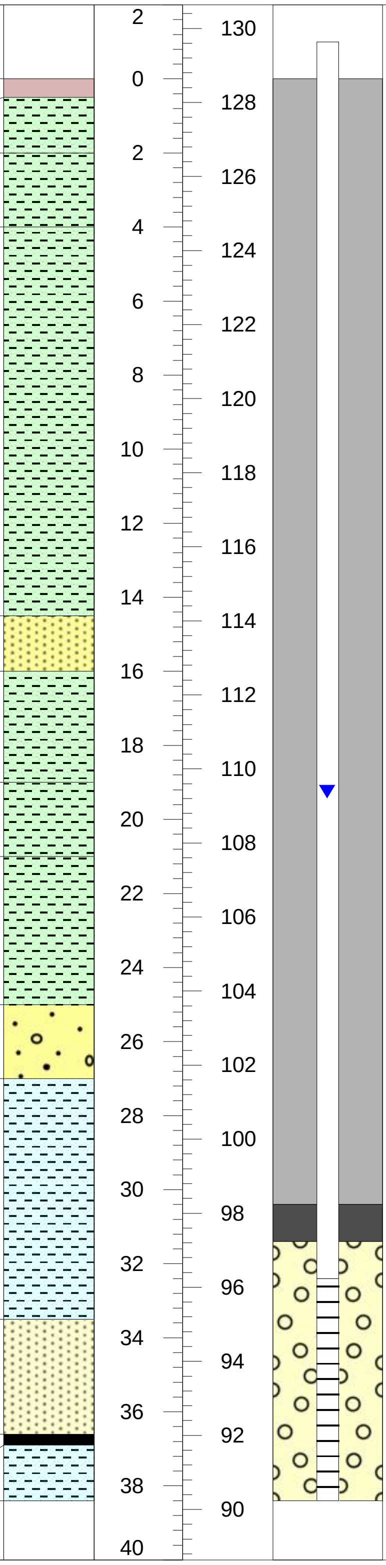
GRAVEL, sandy, base of Tertiary at 27 mbgl

SILTSTONE, light to medium orangey-grown, clayey bands throughout

SANDSTONE, medium-grained, medium to dark orangey-brown

COAL, Castor Seam, weathered

SILTSTONE, medium to dark grey



Stickup to Lip of Steel Monument - 0.98 m

Grout from surface to 30.4 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 19.25 mbgl - 19/7/2019

Bentonite Seal - 30.4 to 31.4 mbgl

Gravel Pack - 31.4 to 38.4 mbgl

Screen - machine-slotted 50 mm PVC - 32.4 to 38.4 mbgl

JBT consulting

Easting: 729774.5

Northing: 7379651

Collar RL (mAHD): 128.64

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

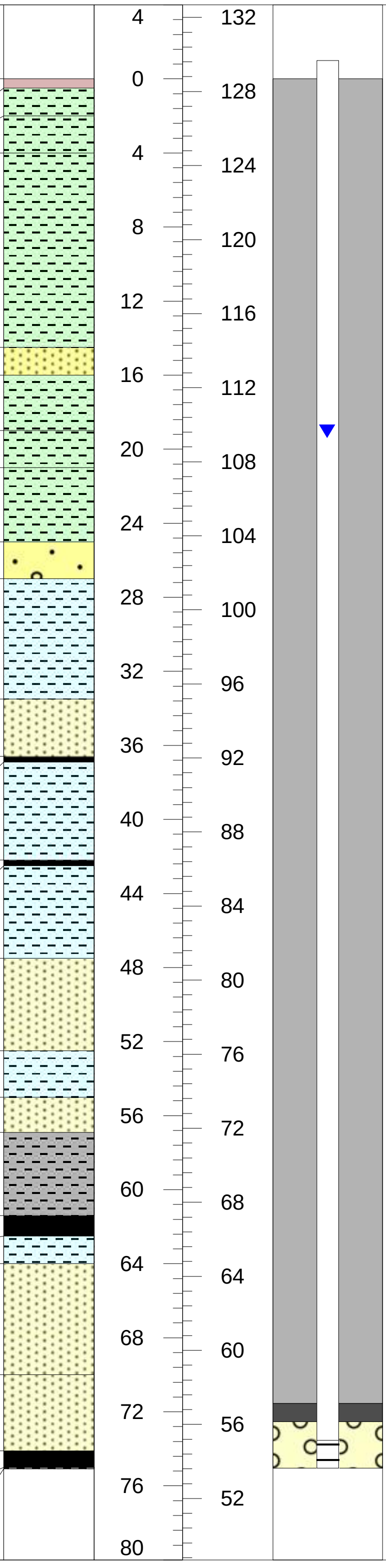
Total Depth (m): 38.4

Project: Gemini Project

Bore ID: DW7220W3

Drilled Date: 02-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



Lithological Description:

- SOIL
- CLAY, medium to dark brown
- CLAY, sandy, medium to dark orangey-brown
- CLAY, light to medium yellowish-white
- SAND
- CLAY, light white
- CLAY, sandy, light to medium yellowish-cream
- CLAY, light to medium reddish-cream
- GRAVEL, sandy, base of Tertiary at 27 mbgl
- SILTSTONE, light to medium orangey-grown, clayey bands throughout
- SANDSTONE, medium-grained, medium to dark orangey-brown
- COAL, Castor Seam, weathered
- SILTSTONE, medium to dark grey
- COAL, Castor Seam
- SILTSTONE, medium to dark grey, sandy bands
- SANDSTONE, fine to medium grained, medium to dark grey
- SILTSTONE, light to dark grey, sandy bands
- SANDSTONE, fine to medium grained, medium to dark grey
- CARBONACEOUS SILTSTONE, black
- COAL, Pisces Upper Seam
- SILTSTONE, medium to dark grey
- SANDSTONE, fine to medium grained, medium to dark grey
- SANDSTONE, medium to coarse-grained, light to dark grey
- COAL, Pisces Lower Upper 1 Seam
- CARBONACEOUS SILTSTONE, black

Bore Construction/ General Drilling Notes:

Stickup to Lip of Steel Monument - 0.99 m

Grout from surface to 71.5 mbgl

Water level - 19.04 mbgl - 23/8/2019

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 71.5 to 72.5 mbgl

Gravel Pack - 72.5 to 75 mbgl

Screen - machine-slotted 50 mm PVC - 73.5 to 75 mbgl

JBT consulting

Easting: 729774.4

Northing: 7379655

Collar RL (mAHD): 128.68

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 75.08

Project: Gemini Project

Bore ID: DW7221W1

Drilled Date: 03-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, medium brown

CLAY, sandy, medium to dark orangey-brown

CLAY, medium orangey-cream to purplish-cream

CLAY, sandy, medium to dark creamy-white

SAND, clayey, light to medium yellowish-cream

CLAY, sandy, medium to dark purplish-cream

SILTSTONE, medium to dark orangey-brown

SANDSTONE, medium-grained, medium to dark orangey-brown

COAL, weathered

SANDSTONE, medium to dark orangey-brown

SILTSTONE, medium to dark orangey-brown

SANDSTONE

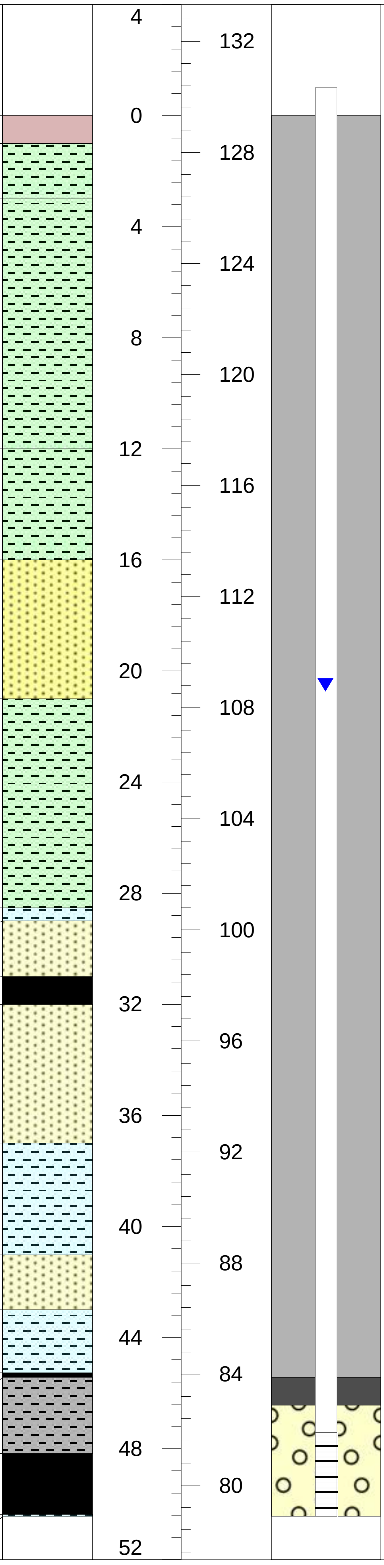
SILTSTONE, medium to dark brownish-grey

COAL

CARBONACEOUS SILTSTONE, black

COAL, Aries 3 Seam

SILTSTONE



Stickup to Lip of Steel Monument - 1.02 m

Grout from surface to 45.4 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 20.5 mbgl - 23/8/2019

Bentonite Seal - 45.4 to 46.4 mbgl

Gravel Pack - 46.4 to 50.4 mbgl

Screen - machine-slotted 50 mm PVC - 47.4 to 50.4 mbgl

Easting: 729846.2

Northing: 7379745

Collar RL (mAHD): 129.32

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 50.43

Project: Gemini Project

Bore ID: DW7221W2

Drilled Date: 03-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, medium brown

CLAY, sandy, medium to dark orangey-brown

CLAY, medium orangey-cream to purplish-cream

CLAY, sandy, medium to dark creamy-white

SAND, clayey, light to medium yellowish-cream

CLAY, sandy, medium to dark purplish-cream

SILTSTONE, medium to dark orangey-brown

SANDSTONE, medium-grained, medium to dark orangey-brown

COAL, weathered

SANDSTONE, medium to dark orangey-brown

SILTSTONE, medium to dark orangey-brown

SANDSTONE

SILTSTONE, medium to dark brownish-grey

COAL

CARBONACEOUS SILTSTONE, black

COAL, Aries 3 Seam

SILTSTONE

SANDSTONE, fine to medium grained, dark grey, silty and sandy bands

SANDSTONE, medium to coarse-grained, light to medium grey

SANDSTONE, fine to medium grained, dark grey, silty and sandy bands

SILTSTONE, light to dark grey

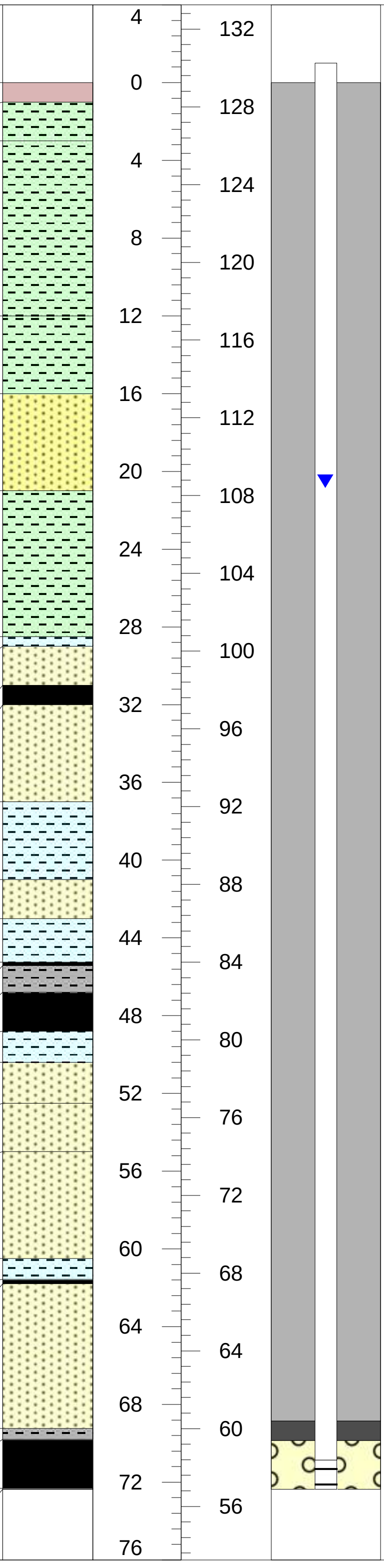
COAL

SANDSTONE, medium to dark grey

CARBONACEOUS SILTSTONE, black

COAL, Castor Seam

CARBONACEOUS SILTSTONE, black



Stickup to Lip of Steel Monument - 1.07 m

Grout from surface to 68.9 mbgl

Water level - 20.5 mbgl - 23/8/2019

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 68.9 to 69.9 mbgl

Gravel Pack - 69.9 to 72.4 mbgl

Screen - machine-slotted 50 mm PVC - 70.9 to 72.4 mbgl

JBT consulting

Easting: 729844.6

Northing: 7379742

Collar RL (mAHD): 129.25

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 72.36

Project: Gemini Project

Bore ID: DW7225W1

Drilled Date: 14-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, medium to dark brown

CLAY, mottled purplish-cream

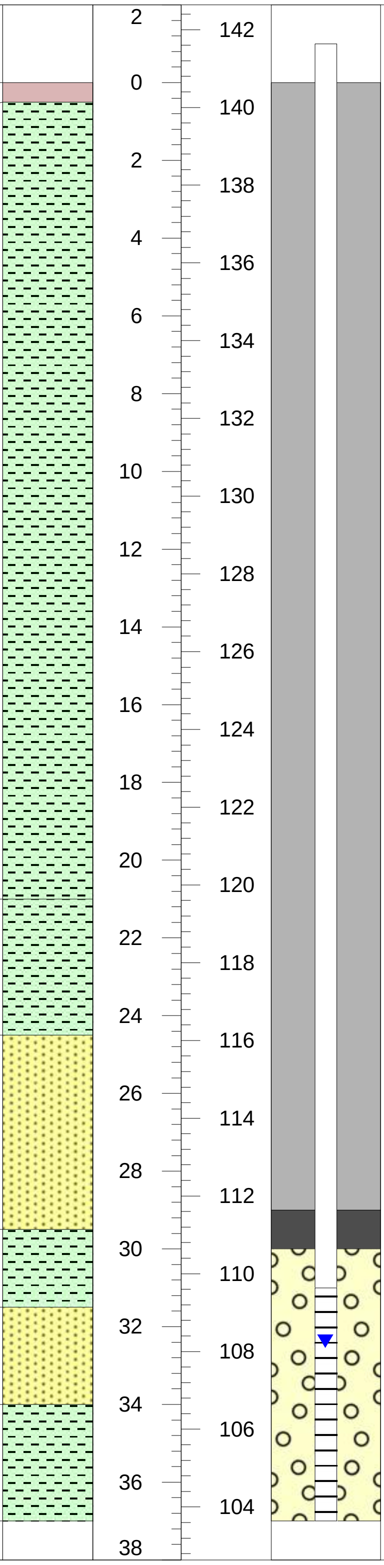
CLAY, medium purplish-cream, lateritic

SAND, fine to medium-grained, light yellowish-brown, becoming medium to coarse near base

CLAY, medium purplish-cream, lateritic

SAND, medium to coarse, light creamy-brown

CLAY, medium purplish-cream. Base of Tertiary at 37 mbgl



Stickup to Lip of Steel Monument - 1.06 m

Grout from surface to 29 mbgl

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 29 to 30 mbgl

Gravel Pack - 30 to 37 mbgl

Water level - 32.37 mbgl - 3/9/2019

Screen - machine-slotted 50 mm PVC - 31 to 37 mbgl

JBT consulting

Easting: 730467.5

Northing: 7378359

Collar RL (mAHD): 140.64

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 37

Project: Gemini Project

Bore ID: DW7225W2

Drilled Date: 14-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, medium to dark brown

CLAY, mottled purplish-cream

CLAY, medium purplish-cream, lateritic

SAND, fine to medium-grained, light yellowish-brown, becoming medium to coarse near base

CLAY, medium purplish-cream, lateritic

SAND, medium to coarse, light creamy-brown

CLAY, medium purplish-cream. Base of Tertiary at 37 mbgl

SILTSTONE, medium to dark orangey-brown, becoming sandy towards base

SANDSTONE, fine-grained, medium grey

SILTSTONE, medium greyish-brown

COAL, weathered

CARBONACEOUS MUDSTONE

SANDSTONE, fine to medium-grained, medium to dark grey

SILTSTONE, medium grey, common sandstone bands

SANDSTONE, medium grained, light grey

SILTSTONE, medium grey

SANDSTONE, fine to medium-grained, light to medium grey, abundant siltstone bands

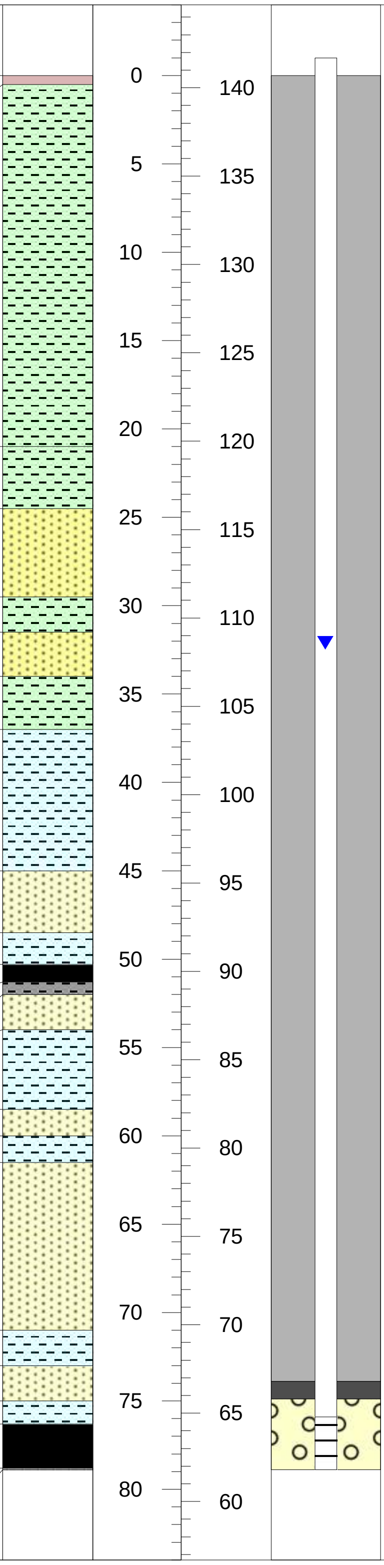
SILTSTONE, medium grey

SANDSTONE, fine grained, medium to dark grey

SILTSTONE, medium to dark grey

COAL, Aries 3 Seam

CARBONACEOUS SILTSTONE, blackish-grey



Stickup to Lip of Steel Monument - 1.07 m

Grout from surface to 73.9 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 32.1 mbgl - 3/9/2019

Bentonite Seal - 73.9 to 74.9 mbgl

Gravel Pack - 74.9 to 78.9 mbgl

Screen - machine-slotted 50 mm PVC - 75.9 to 78.9 mbgl

JBT consulting

Easting: 730465.7

Northing: 7378355

Collar RL (mAHD): 140.69

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

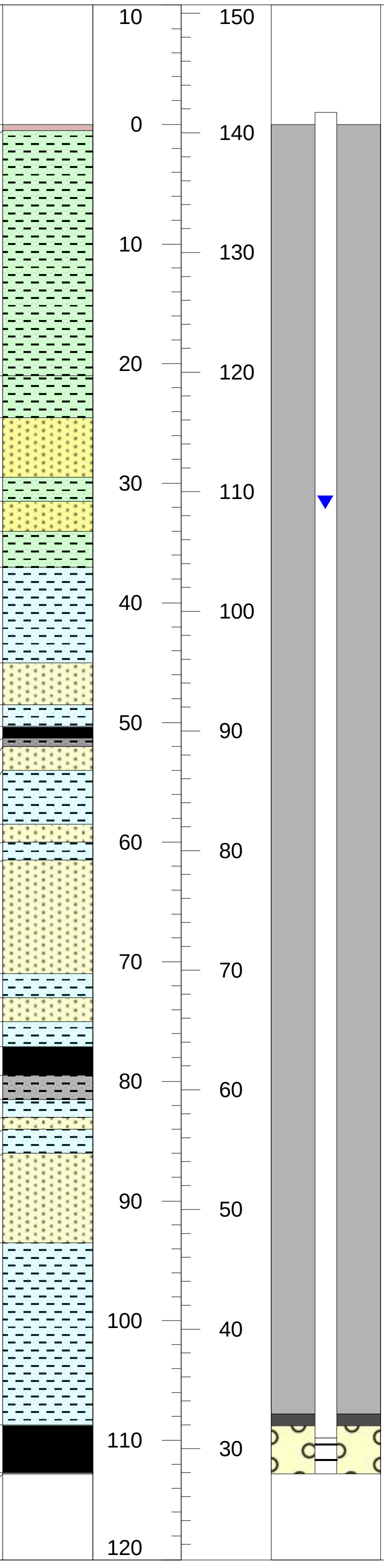
Total Depth (m): 78.9

Project: Gemini Project

Bore ID: DW7225W3

Drilled Date: 13-Jun-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



SOIL, medium to dark brown

CLAY, mottled purplish-cream

CLAY, medium purplish-cream, lateritic

SAND, fine to medium-grained, light yellowish-brown, becoming medium to coarse near base

CLAY, medium purplish-cream, lateritic

SAND, medium to coarse, light creamy-brown

CLAY, medium purplish-cream. Base of Tertiary at 37 mbgl

SILTSTONE, medium to dark orangey-brown, becoming sandy towards base

SANDSTONE, fine-grained, medium grey

SILTSTONE, medium greyish-brown

COAL, weathered

CARBONACEOUS MUDSTONE

SANDSTONE, fine to medium-grained, medium to dark grey

SILTSTONE, medium grey, common sandstone bands

SANDSTONE, medium grained, light grey

SILTSTONE, medium grey

SANDSTONE, fine to medium-grained, light to medium grey, abundant siltstone bands

SILTSTONE, medium grey

SANDSTONE, fine grained, medium to dark grey

SILTSTONE, medium to dark grey

COAL, Aries 3 Seam

CARBONACEOUS SILTSTONE, blackish-grey

SILTSTONE, dark grey

SANDSTONE, fine grained, light to medium grey

SILTSTONE, medium grey, common sandstone bands

SANDSTONE, fine grained, common siltstone bands

SANDSTONE, fine grained, light to medium grey

COAL, Castor Seam

CARBONACEOUS SILTSTONE, blackish-grey

Stickup to Lip of Steel Monument - 1.04 m

Grout from surface to 107.8 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 31.6 mbgl - 3/9/2019

Bentonite Seal - 107.8 to 108.8 mbgl
Gravel Pack - 108.8 to 112.8 mbgl
Screen - machine-slotted 50 mm PVC - 109.8 to 112.8 mbgl

Easting: 730464.7

Northing: 7378351

Collar RL (mAHD): 140.7

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 112.8

Project: Gemini Project

Bore ID: DW7264W1

Drilled Date: 14-May-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

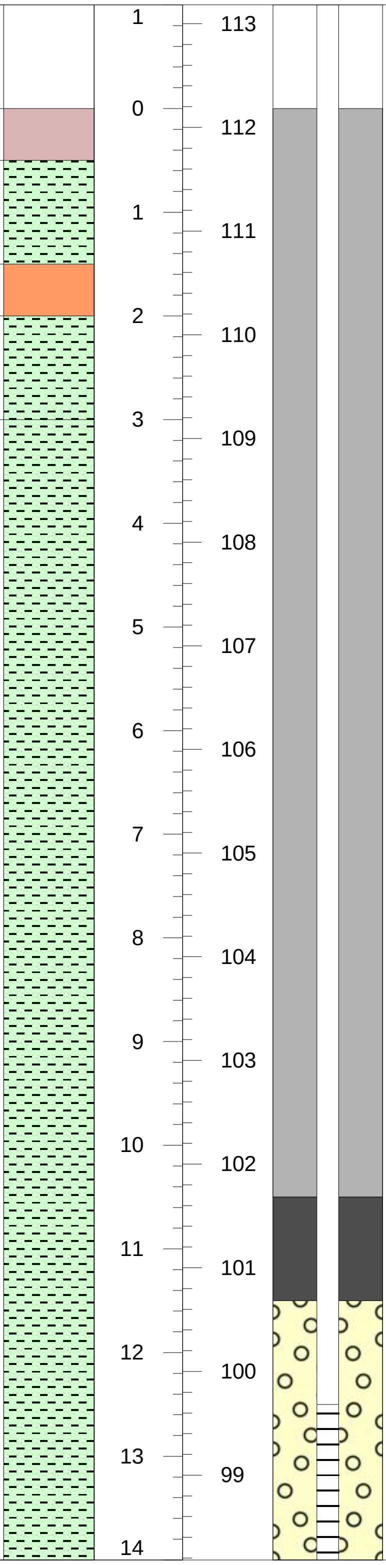
SOIL, medium to dark brown

CLAY

SILCRETE, medium to dark orangey-brown

CLAY, sandy, medium to dark brown

CLAY, medium to dark orangey-brown, base of Tertiary at 14 mbgl



Stickup to Lip of Steel Monument - 0.98 m

Grout from surface to 10.5 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - DRY - 25/7/2018

Bentonite Seal - 10.5 to 11.5 mbgl

Gravel Pack - 11.5 to 14 mbgl

Screen - machine-slotted 50 mm PVC - 12.5 to 14 mbgl

JBT consulting

Easting: 733392.2

Northing: 7382915

Collar RL (mAHD): 112.18

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

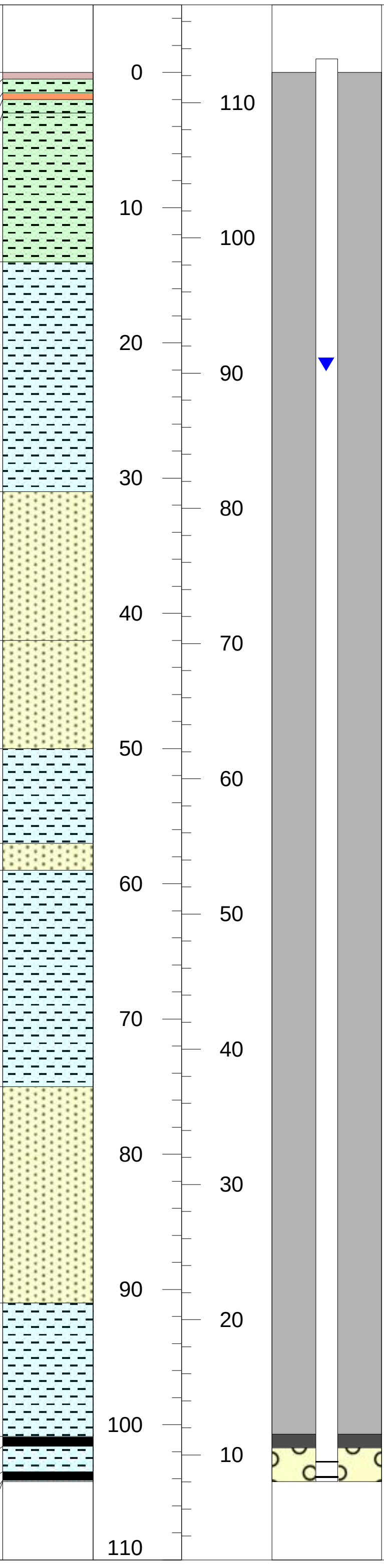
Total Depth (m): 14

Project: Gemini Project

Bore ID: DW7264W2

Drilled Date: 14-May-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



Lithological Description:

- SOIL, medium to dark brown
- CLAY
- SILCRETE, medium to dark orangey-brown
- CLAY, sandy, medium to dark brown
- CLAY, medium to dark orangey-brown, base of Tertiary at 14 mbgl
- SILTSTONE, medium to dark brownish-grey
- SANDSTONE, fine grained, medium to dark brownish grey, minor siltstone bands, base of weathering at 42 mbgl
- SANDSTONE, fine to medium-grained, medium to dark grey, fresh
- SILTSTONE, light to dark grey, minor sandstone bands
- SANDSTONE, fine to medium-grained, medium to dark grey
- SILTSTONE, light to dark grey
- SANDSTONE, fine grained, medium to dark grey, minor siltstone bands
- SILTSTONE, light to dark grey, minor sandstone bands
- COAL, Aries 1 Upper Seam
- SILTSTONE, light to dark grey
- COAL, Aries 1 Lower Seam
- SILTSTONE, light to dark grey

Bore Construction/ General Drilling Notes:

Stickup to Lip of Steel Monument - 0.98 m

Grout from surface to 100.7 mbgl

Water level - 21.59 mbgl - 15/7/2019

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 100.7 to 101.7 mbgl

Gravel Pack - 101.7 to 104.2 mbgl

Screen - machine-slotted 50 mm PVC - 102.7 to 104.2 mbgl

JBT consulting

Easting: 733391.5

Northing: 7382921

Collar RL (mAHD): 112.24

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

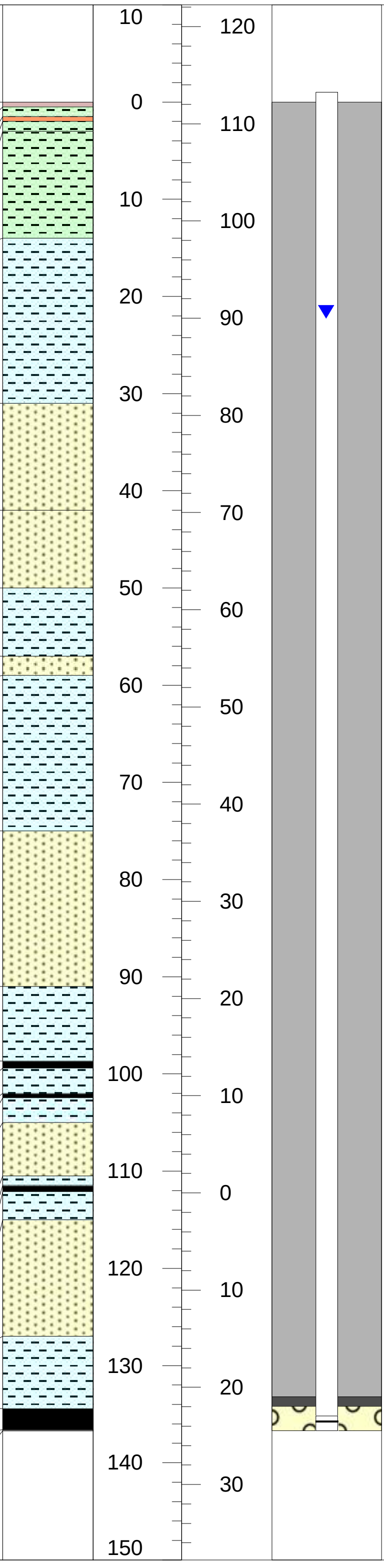
Total Depth (m): 104.21

Project: Gemini Project

Bore ID: DW7264W3

Drilled Date: 13-May-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes



SOIL, medium to dark brown

CLAY

SILCRETE, medium to dark orangey-brown

CLAY, sandy, medium to dark brown

CLAY, medium to dark orangey-brown, base of Tertiary at 14 mbgl

SILTSTONE, medium to dark brownish-grey

SANDSTONE, fine grained, medium to dark brownish grey, minor siltstone bands, base of weathering at 42 mbgl

SANDSTONE, fine to medium-grained, medium to dark grey, fresh

SILTSTONE, light to dark grey, minor sandstone bands

SANDSTONE, fine to medium-grained, medium to dark grey

SILTSTONE, light to dark grey

SANDSTONE, fine grained, medium to dark grey, minor siltstone bands

SILTSTONE, light to dark grey, minor sandstone bands

COAL, Aries 1 Upper Seam

SILTSTONE, light to dark grey

COAL, Aries 1 Lower Seam

SILTSTONE, light to dark grey

SANDSTONE, medium to dark grey, fine to medium-grained, becoming medium to coarse-grained at base

SILTSTONE, light to dark grey

COAL, Aries 2 Seam

SILTSTONE, light to dark grey

SANDSTONE, medium to dark grey, fined to medium grained, medium to coarse-grained in middle of unit

SILTSTONE, light to dark grey

COAL, Aries 3 Seam

CARBONACEOUS SILTSTONE, black

Stickup to Lip of Steel Monument - 1.00 m

Grout from surface to 133.2 mbgl

Water level - 21.58 mbgl - 15/7/2019

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 133.2 to 134.2 mbgl
Gravel Pack - 134.2 to 136.7 mbgl
Screen - machine-slotted 50 mm PVC - 135.2 to 136.7 mbgl

Easting: 733390.9

Northing: 7382925

Collar RL (mAHD): 112.24

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 136.7

Project: Gemini Project

Bore ID: DW7282W1

Drilled Date: 26-May-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, light brown

SAND, light creamy-white

CLAY, light whitish-grey, lithic traces

FERRICRETE, dark reddish-brown

CLAY

SILCRETE, light brownish-grey

CLAY, light to medium brownish grey with lithic traces and ferruginous lenses, base of Tertiary at 13 mbgl

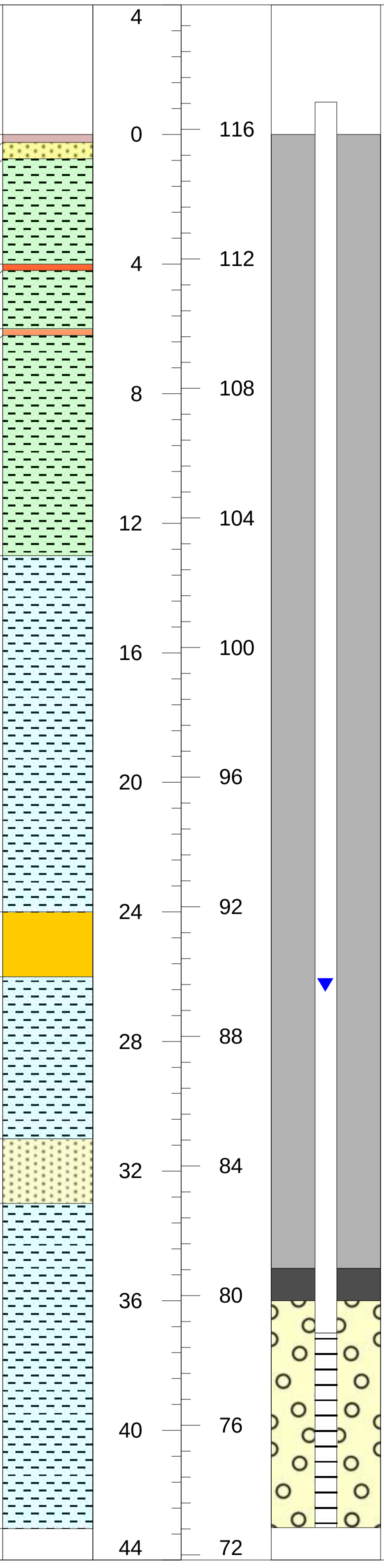
SILTSTONE, medium to dark brownish-grey

LIMONITE, light to medium brownish-yellow

SILTSTONE, medium to dark brownish-grey, base of weathering at 29 mbgl

SANDSTONE, fine to medium-grained, medium to dark grey

SILTSTONE, medium to dark grey



Stickup to Lip of Steel Monument - 1.00 m

Grout from surface to 35 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 26.25 mbgl - 18/7/2019

Bentonite Seal - 35 to 36 mbgl

Gravel Pack - 36 to 43 mbgl

Screen - machine-slotted 50 mm PVC - 37 to 43 mbgl

JBT consulting

Easting: 732118.6

Northing: 7381433

Collar RL (mAHD): 115.84

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 43.03

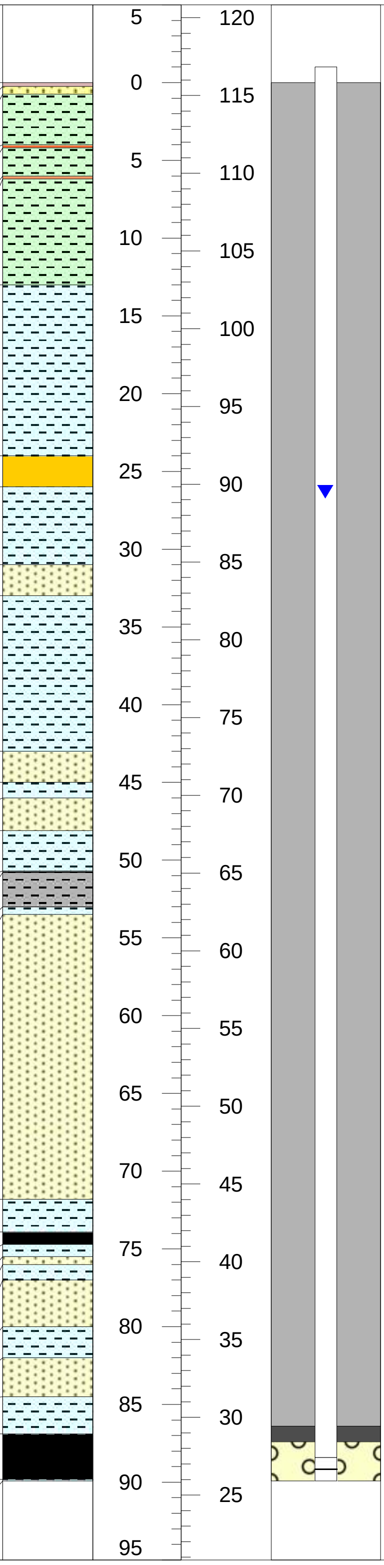
Project: Gemini Project

Bore ID: DW7282W2

Drilled Date: 25-May-2019

Lithological Description	Graphic Log	Depth (m)	Elevation (mAHD)	Bore Design	Bore Construction/ General Drilling Notes

SOIL, light brown
SAND, light creamy-white
CLAY, light whitish-grey, lithic traces
FERRICRETE, dark reddish-brown
CLAY
SILCRETE, light brownish-grey
CLAY, light to medium brownish grey with lithic traces and ferruginous lenses, base of Tertiary at 13 mbgl
SILTSTONE, medium to dark brownish-grey
LIMONITE, light to medium brownish-yellow
SILTSTONE, medium to dark brownish-grey, base of weathering at 29 mbgl
SANDSTONE, fine to medium-grained, medium to dark grey
SILTSTONE, medium to dark grey
SANDSTONE, fine to medium-grained, light to dark grey
SILTSTONE, dark grey
SANDSTONE, fine to medium-gained, light to medium grey
SILTSTONE, medium to dark grey, with sandstone and siderite bands
COAL, Aries 1 Seam
CARBONACEOUS SILTSTONE, black
SILTSTONE, medium to dark grey
SANDSTONE, fine to medium grained, becoming medium to coarse grained towards base, light to dark grey with carbonaceous claystone and siderite bands
SILTSTONE, medium to dark grey
COAL, Aries 2 Seam
SILTSTONE, medium to dark grey
SANDSTONE, medium to coarse-grained, light to dark grey
SILTSTONE, medium to dark grey
SANDSTONE, fine-grained, medium to dark grey
SILTSTONE, medium to dark grey
SANDSTONE, fine to medium-grained, medium to dark grey
SILTSTONE, dark grey
COAL, Aries 3 Seam
SILTSTONE, dark blackish-grey



Stickup to Lip of Steel Monument - 0.99 m

Grout from surface to 86.4 mbgl

50 mm Class 18 PVC Environmental Casing

Water level - 26.32 mbgl - 18/7/2019

Bentonite Seal - 86.4 to 87.4 mbgl

Gravel Pack - 87.4 to 89.9 mbgl

Screen - machine-slotted 50 mm PVC - 88.4 to 89.9 mbgl

Easting: 732122.9	Drilling Company: Hodge Drilling
Northing: 7381433	Drill Rig:
Collar RL (mAHD): 115.83	Hole Diameter (mm): 120
Co-ord System: GDA94	Total Depth (m): 89.91

Project: Gemini Project

Bore ID: DW7292W1

Drilled Date: 26-May-2019

Lithological Description

SOIL, medium to dark brown

CLAY, medium to dark orangey-brown

Silty CLAY, light to dark grey

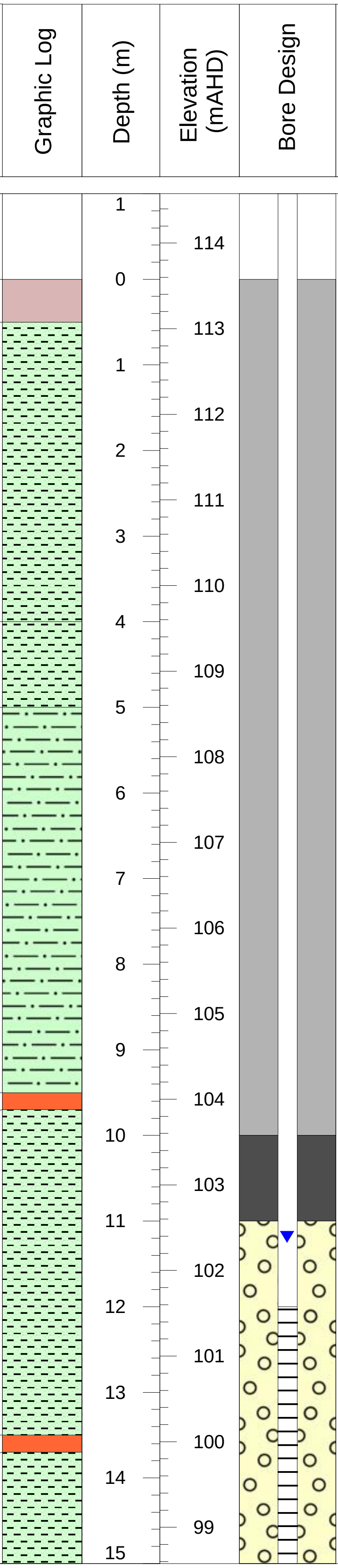
Sandy CLAY, medium to dark brownish-orange

FERRICRETE, dark reddish-brown

Silty CLAY, light white, lithic traces

FERRICRETE, dark reddish-brown

Silty CLAY, light white, lithic traces



Bore Construction/
General Drilling Notes

Stickup to Lip of Steel Monument - 0.83 m

Grout from surface to 10 mbgl

50 mm Class 18 PVC Environmental Casing

Bentonite Seal - 10 to 11 mbgl

Water level - 11.19 mbgl - 23/8/2019

Gravel Pack - 11 to 15 mbgl

Screen - machine-slotted 50 mm PVC - 12 to 15 mbgl

Easting: 732904.7

Northing: 7381108

Collar RL (mAHD): 113.58

Co-ord System: GDA94

Drilling Company: Hodge Drilling

Drill Rig:

Hole Diameter (mm): 120

Total Depth (m): 15

APPENDIX B

GROUNDWATER CHEMISTRY DATA

Appendix B1: pH, EC, TDS, Major Ion Data

Site	Groundwater Unit	Date	pH (Lab)	pH (Field)	EC (Lab)	EC (Field)	TDS	Na	Ca	Mg	K	Cl	SO4	Alkalinity			
														Carbonate	Bicarbonate	Hydroxide	Total
			Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
DW7065W	AR3	12-Dec-2018	8.21	6.33	28400	27187	19800	4720	439	724	24	9380	679	<1	608	<1	608
DW7065W	AR3	07-Jan-2019	6.85	6.37	27300	28450	19700	5190	456	849	24	9470	711	<1	589	<1	589
DW7065W	AR3	18-Feb-2019	6.81	6.42	28200	28360	19100	5100	458	774	23	9720	789	<1	568	<1	568
DW7065W	AR3	11-Mar-2019	7.01	6.46	28100	27619	19700	5390	508	846	24	9970	781	<1	583	<1	583
DW7065W	AR3	17-Apr-2019	7.03	6.45	26800	27639	19200	5000	551	815	24	9750	733	<1	599	<1	599
DW7065W	AR3	13-May-2019	7.11	6.48	25800	27367	19300	5010	442	792	24	9620	776	<1	610	<1	610
DW7065W	AR3	19-Jun-2019		6.59		27033		4820	516	760	22	9730	763	<1	592	<1	592
DW7065W	AR3	11-Jul-2019	7.78		27400		18100	4860	482	757	26	9120	741	<1	654	<1	654
DW7065W	AR3	26-Aug-2019	7.05	6.47	27400	27509	18900	4740	488	752	24	10200	826	<1	614	<1	614
DW7067W	AR3	12-Dec-2018	8.21	6.29	28500	27457	19900	4660	421	729	26	9590	716	<1	589	<1	589
DW7067W	AR3	07-Jan-2019	6.86	6.29	28000	29175	19900	5040	471	863	28	9720	767	<1	599	<1	599
DW7067W	AR3	18-Feb-2019	6.79	6.38	28500	28613	19300	5160	456	793	27	9820	841	<1	580	<1	580
DW7067W	AR3	11-Mar-2019	6.99	6.45	28500	28023	20500	5480	494	865	26	10100	780	<1	603	<1	603
DW7067W	AR3	17-Apr-2019	6.98	6.41	27200	28021	18600	5060	540	820	27	9750	746	<1	597	<1	597
DW7067W	AR3	13-May-2019	7.01	6.43	26300	28004	20100	5130	435	816	27	9840	764	<1	608	<1	608
DW7067W	AR3	19-Jun-2019		6.84		27800		4900	508	808	26	10100	798	<1	583	<1	583
DW7067W	AR3	11-Jul-2019	7.73		28400		19000	4930	462	784	26	9400	777	<1	634	<1	634
DW7067W	AR3	26-Aug-2019	7.04	6.43	27700	27930	19200	4740	482	769	27	10400	837	<1	614	<1	614
DW7069W	Castor Lower/Pollux Upper	12-Dec-2018	8.28	6.3	25500	24484	17600	4590	349	627	23	8490	623	<1	587	<1	587
DW7069W	Castor Lower/Pollux Upper	07-Jan-2019	6.87	6.25	25000	25868	17700	4500	321	636	21	8670	610	<1	580	<1	580
DW7069W	Castor Lower/Pollux Upper	18-Feb-2019	6.77	6.33	22100	22731	14500	4210	312	553	20	7720	645	<1	530	<1	530
DW7069W	Castor Lower/Pollux Upper	11-Mar-2019	6.92	6.38	23500	23087	16300	4590	352	634	22	8590	387	<1	566	<1	566
DW7069W	Castor Lower/Pollux Upper	17-Apr-2019	7.02	6.33	23000	23682	14900	4300	396	612	21	8210	618	<1	578	<1	578
DW7069W	Castor Lower/Pollux Upper	13-May-2019	6.91	6.39	22600	23989	16000	4110	299	574	20	8470	653	<1	595	<1	595
DW7069W	Castor Lower/Pollux Upper	19-Jun-2019		6.51		24483		4280	388	622	21	8800	671	<1	573	<1	573
DW7069W	Castor Lower/Pollux Upper	11-Jul-2019	7.67		24800		16400	4340	343	606	21	8270	642	<1	606	<1	606
DW7069W	Castor Lower/Pollux Upper	26-Aug-2019	6.98	6.36	24500	24741	16800	4350	379	615	23	9090	762	<1	599	<1	599
DW7073W	Castor Lower/Pollux Upper	13-Dec-2018	8.23	6.26	24500	23392	17100	4340	423	485	21	8240	341	<1	411	<1	411
DW7073W	Castor Lower/Pollux Upper	07-Jan-2019	6.84	6.21	24100	25049	16800	4380	401	512	20	8150	346	<1	423	<1	423
DW7073W	Castor Lower/Pollux Upper	18-Feb-2019	6.77	6.32	24100	24459	16000	4530	432	502	21	8180	404	<1	414	<1	414
DW7073W	Castor Lower/Pollux Upper	11-Mar-2019	6.97	6.39	24300	23980	17200	4930	483	557	22	9080	550	<1	436	<1	436
DW7073W	Castor Lower/Pollux Upper	17-Apr-2019	6.98	6.33	23100	23847	16400	4380	514	517	21	8470	387	<1	423	<1	423
DW7073W	Castor Lower/Pollux Upper	13-May-2019	6.94	6.38	22600	23963	15900	4180	367	477	20	8510	388	<1	449	<1	449
DW7073W	Castor Lower/Pollux Upper	19-Jun-2019		6.52		23989		4230	476	501	20	8780	383	<1	422	<1	422
DW7073W	Castor Lower/Pollux Upper	11-Jul-2019	7.64		24400		15800	4300	430	498	20	8160	373	<1	452	<1	452
DW7073W	Castor Lower/Pollux Upper	26-Aug-2019	6.98	6.35	24000	24057	15800	4280	452	491	21	8730	417	<1	460	<1	460
DW7074W	Castor Upper	13-Dec-2018	8.34	6.71	26100	25085	18000	4720	327	606	25	8670	488	20	585	<1	605
DW7074W	Castor Upper	07-Jan-2019	7.18	6.57	25500	26576	18200	4650	302	616	23	8890	511	<1	624	<1	624
DW7074W	Castor Upper	18-Feb-2019	6.99	6.55	25700	26043	16900	4880	329	605	24	8920	600	<1	605	<1	605
DW7074W	Castor Upper	11-Mar-2019	7.23	6.65	26000	25523	18000	5060	350	654	23	9220	574	<1	642	<1	642
DW7074W	Castor Upper	17-Apr-2019	7.19	6.56	24500	25280	17000	4700	380	619	23	8850	546	<1	620	<1	620
DW7074W	Castor Upper	13-May-2019	7.17	6.59	24200	25440	16900	4450	285	571	22	8980	570	<1	637	<1	637
DW7074W	Castor Upper	19-Jun-2019		6.69		25929		4640	372	612	22	9080	560	<1	635	<1	635
DW7074W	Castor Upper	11-Jul-2019	7.8		25800		16900	4790	332	612	23	8570	528	<1	661	<1	661
DW7074W	Castor Upper	26-Aug-2019	7.2	6.55	25300	25483	17000	4570	358	587	24	9180	578	<1	634	<1	634
DW7076W	Alluvium	12-Dec-2018	8.04	7.24	16200	14782	10600	2410	42	279	10	4170	214	<1	3600	<1	3600
DW7076W	Alluvium	07-Jan-2019	8.04	7.05	16600	17106	10500	3720	62	407	15	4290	205	<1	3620	<1	3620
DW7076W	Alluvium	18-Feb-2019	7.57	7.2	16000	16262	10000	3490	67	368	13	4140	231	<1	3480	<1	3480
DW7076W	Alluvium	11-Mar-2019	7.66	7.37	16200	16145	10400	3760	65	383	14	4190	249	<1	3540	<1	3540
DW7076W	Alluvium	17-Apr-2019	7.37	7.38	15400	15760	10300	3420	73	357	14	4060	212	<1	3510	<1	3510

Appendix B1: pH, EC, TDS, Major Ion Data

Site	Groundwater Unit	Date	pH (Lab)	pH (Field)	EC (Lab)	EC (Field)	TDS	Na	Ca	Mg	K	Cl	SO4	Alkalinity			
														Carbonate	Bicarbonate	Hydroxide	Total
			Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
DW7076W	Alluvium	13-May-2019	7.84	7.36	15200	15632	10100	3370	47	329	15	4120	204	<1	3680	<1	3680
DW7076W	Alluvium	19-Jun-2019		7.49		15602		3340	49	335	13	4030	220	<1	3480	<1	3480
DW7076W	Alluvium	11-Jul-2019	7.76		15400		9980	3410	48	317	15	3750	210	<1	1840	<1	1840
DW7076W	Alluvium	26-Aug-2019	7.79	7.29	15300	14975	9200	3170	45	292	16	4040	209	562	2960	<1	3520

DW7068W	Tertiary	12-Dec-2018	8.29	6.86	20200	19273	14000	3530	216	523	101	6940	291	<1	607	<1	607
DW7068W	Tertiary	07-Jan-2019	7.26	6.78	20600	21433	14300	3710	211	575	82	7240	295	<1	601	<1	601
DW7068W	Tertiary	18-Feb-2019	7.23	6.98	21000	21493	13400	3880	226	563	77	7390	344	<1	578	<1	578
DW7068W	Tertiary	11-Mar-2019	7.38	6.95	21200	20960	14900	4040	234	596	73	8160	635	<1	593	<1	593
DW7068W	Tertiary	17-Apr-2019	7.57	7.06	20800	21270	13700	3780	259	577	72	7480	338	<1	600	<1	600
DW7068W	Tertiary	13-May-2019	7.42	6.93	20200	21301	14700	3790	202	568	72	7650	334	<1	602	<1	602
DW7068W	Tertiary	11-Jul-2019	7.89		21900		14300	4120	246	647	68	7220	334	<1	619	<1	619

Alluvium	Count			8	8	8	8	9	9	9	9	9	9	1	9	0	9
	Min			7.05	15200	14782	9200	2410	42	279	10	3750	204	562	1840		1840
	Max			7.49	16600	17106	10600	3760	73	407	16	4290	249	562	3680		3680
	Mean			7.2975	15788	15783	10135	3343	55	341	14	4088	217		3301		3363
	Median			7.325	15700	15696	10200	3410	49	335	14	4120	212		3510		3520
	StDev			0.13	491	691	413	373	11	40	2	142	14		553		542
Tertiary	Count			6	7	6	7	7	7	7	7	7	7	0	7	0	7
	Min			6.78	20200	19273	13400	3530	202	523	68	6940	291		578		578
	Max			7.06	21900	21493	14900	4120	259	647	101	8160	635		619		619
	Mean			6.93	20843	20955	14186	3836	228	578	78	7440	367		600		600
	Median			6.94	20800	21286	14300	3790	226	575	73	7390	334		601		601
	StDev			0.09	555	771	491	185	19	35	10	360	111		12		12
Coal Seams	Count			40	40	40	40	45	45	45	45	45	45	1	45	0	45
	Min			6.21	22100	22731	14500	4110	285	477	20	7720	341	20	411		411
	Max			6.84	28500	29175	20500	5480	551	865	28	10400	841		661		661
	Mean			6.44	25693	25934	17760	4694	417	663	23	9081	622		568		569
	Median			6.42	25600	25696	17650	4700	430	622	23	9080	642		592		595
	StDev			0.14	1913	1823	1573	343	72	121	2	661	153		73		73

Appendix B2: Dissolved Metals/ Metalloid Data

Site	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
DW7065W	AR3	12-Dec-2018	0.01	0.023	0.076	<0.001	1.22	0.0002	<0.001	0.019	0.081	2.48	0.007	0.312	<0.0001	0.002	0.022	<0.01	<0.001	0.016	<0.01	0.21
DW7065W	AR3	07-Jan-2019	<0.01	0.029	0.168	<0.001	1.2	0.0001	<0.001	0.011	0.005	2.82	<0.001	0.247	<0.0001	0.002	0.015	<0.01	<0.001	0.01	<0.01	0.176
DW7065W	AR3	18-Feb-2019	<0.01	0.02	0.117	<0.001	1.37	<0.0001	<0.001	0.009	0.002	4.41	<0.001	0.227	<0.0001	0.001	0.017	<0.01	<0.001	0.008	<0.01	0.03
DW7065W	AR3	11-Mar-2019	<0.05	0.012	0.075	<0.005	1.21	<0.0005	<0.005	0.009	<0.005	3.99	<0.005	0.295	<0.0001	<0.005	0.011	<0.05	<0.005	<0.005	<0.05	0.075
DW7065W	AR3	17-Apr-2019	<0.01	0.019	0.105	<0.001	1.27	<0.0001	<0.001	0.007	0.001	3.43	<0.001	0.249	<0.0005	0.001	0.009	<0.01	<0.001	0.007	<0.01	0.094
DW7065W	AR3	13-May-2019	<0.01	0.019	0.279	<0.001	1.25	<0.0001	<0.001	0.007	0.003	3.74	<0.001	0.327	<0.0001	<0.001	0.013	<0.01	<0.001	0.008	<0.01	0.136
DW7065W	AR3	19-Jun-2019	<0.01	0.018	0.184	<0.001	1.1	<0.0001	<0.001	0.008	<0.001	3.99	<0.001	0.318	<0.0001	<0.001	0.013	<0.01	<0.001	0.008	<0.01	0.103
DW7065W	AR3	11-Jul-2019	<0.05	0.006	0.276	<0.005	1.29	<0.0005	<0.005	0.005	<0.005	1.55	<0.005	0.397	<0.0001	<0.005	0.013	<0.05	<0.005	0.005	<0.05	0.105
DW7065W	AR3	26-Aug-2019	<0.01	0.018	0.477	<0.001	1.25	<0.0001	<0.001	0.006	<0.001	4.37	<0.001	0.293	<0.0001	0.006	0.01	<0.01	<0.001	0.008	<0.01	0.07
DW7067W	AR3	12-Dec-2018	<0.01	0.006	0.06	<0.001	1.26	<0.0001	<0.001	0.005	0.047	1.99	0.004	0.107	<0.0001	0.001	0.007	<0.01	<0.001	0.004	<0.01	0.105
DW7067W	AR3	07-Jan-2019	<0.05	0.012	0.087	<0.005	1.48	<0.0005	<0.005	<0.005	0.009	2.85	<0.005	0.119	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.147
DW7067W	AR3	18-Feb-2019	<0.01	0.012	0.077	<0.001	1.44	<0.0001	<0.001	0.002	0.002	4.23	<0.001	0.104	<0.0001	0.001	0.007	<0.01	<0.001	0.003	<0.01	0.047
DW7067W	AR3	11-Mar-2019	<0.05	0.008	0.066	<0.005	1.22	<0.0005	<0.005	<0.005	<0.005	3.61	<0.005	0.103	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.062
DW7067W	AR3	17-Apr-2019	<0.01	0.008	0.068	<0.001	1.34	<0.0001	<0.001	0.001	<0.001	3.35	<0.001	0.105	<0.0001	<0.001	0.003	<0.01	<0.001	0.002	<0.01	0.066
DW7067W	AR3	13-May-2019	<0.01	0.007	0.133	<0.001	1.23	<0.0001	<0.001	0.001	0.014	3.02	<0.001	0.114	<0.0001	<0.001	0.005	<0.01	<0.001	0.002	<0.01	0.094
DW7067W	AR3	19-Jun-2019	<0.01	0.004	0.096	<0.001	1.2	<0.0001	<0.001	0.002	0.005	0.43	<0.001	0.087	<0.0001	0.001	0.006	<0.01	<0.001	0.002	<0.01	0.088
DW7067W	AR3	11-Jul-2019	<0.05	<0.005	0.129	<0.005	1.38	<0.0005	<0.005	<0.005	<0.005	2.16	<0.005	0.151	<0.0001	<0.005	0.009	<0.05	<0.005	<0.005	<0.05	0.143
DW7067W	AR3	26-Aug-2019	<0.01	0.006	0.183	<0.001	1.32	<0.0001	<0.001	0.001	<0.001	3	<0.001	0.114	<0.0001	0.002	0.006	<0.01	<0.001	0.002	<0.01	0.059
DW7069W	Castor Lower/Pollux Upper	12-Dec-2018	<0.01	0.003	0.059	<0.001	1.25	0.0001	<0.001	0.002	0.067	2.16	0.003	0.19	<0.0001	0.002	0.005	<0.01	<0.001	0.002	<0.01	0.146
DW7069W	Castor Lower/Pollux Upper	07-Jan-2019	<0.01	0.004	0.066	<0.001	1.15	<0.0001	<0.001	<0.001	0.024	2.45	<0.001	0.168	<0.0001	0.002	0.003	<0.01	<0.001	0.001	<0.01	0.124
DW7069W	Castor Lower/Pollux Upper	18-Feb-2019	<0.01	0.003	0.072	<0.001	1.4	<0.0001	<0.001	<0.001	0.008	2.37	<0.001	0.157	<0.0001	0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.085
DW7069W	Castor Lower/Pollux Upper	11-Mar-2019	<0.05	<0.005	0.062	<0.005	1.11	<0.0005	<0.005	<0.005	<0.005	2.31	<0.005	0.173	<0.0001	<0.005	<0.005	<0.05	0.007	<0.005	<0.05	0.068
DW7069W	Castor Lower/Pollux Upper	17-Apr-2019	<0.01	0.002	0.06	<0.001	1.3	<0.0001	<0.001	<0.001	0.002	2.38	<0.001	0.162	<0.0001	0.001	0.002	<0.01	<0.001	<0.001	<0.01	0.064
DW7069W	Castor Lower/Pollux Upper	13-May-2019	<0.01	0.003	0.104	<0.001	1.23	<0.0001	<0.001	<0.001	0.011	2.22	<0.001	0.161	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.07
DW7069W	Castor Lower/Pollux Upper	19-Jun-2019	<0.01	0.003	0.081	<0.001	1.18	<0.0001	<0.001	<0.001	0.005	2.34	<0.001	0.157	<0.0001	0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.101
DW7069W	Castor Lower/Pollux Upper	11-Jul-2019	<0.05	<0.005	0.085	<0.005	1.34	<0.0005	<0.005	<0.005	<0.005	1.83	<0.005	0.159	<0.0001	<0.005	0.007	<0.05	<0.005	<0.005	<0.05	0.129
DW7069W	Castor Lower/Pollux Upper	26-Aug-2019	<0.01	0.003	0.103	<0.001	1.3	<0.0001	<0.001	<0.001	0.002	2.63	<0.001	0.158	<0.0001	0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.045
DW7073W	Castor Lower/Pollux Upper	13-Dec-2018	<0.01	<0.001	0.116	<0.001	1.04	<0.0001	<0.001	<0.001	0.047	1.13	<0.001	0.306	<0.0001	0.002	0.004	<0.01	<0.001	<0.001	<0.01	0.103
DW7073W	Castor Lower/Pollux Upper	07-Jan-2019	<0.01	<0.001	0.118	<0.001	0.94	<0.0001	<0.001	<0.001	0.018	1.85	<0.001	0.325	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.096
DW7073W	Castor Lower/Pollux Upper	18-Feb-2019	<0.01	0.001	0.132	<0.001	1.18	<0.0001	<0.001	<0.001	0.013	3.52	<0.001	0.339	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.097
DW7073W	Castor Lower/Pollux Upper	11-Mar-2019	<0.05	<0.005	0.122	<0.005	0.88	<0.0005	<0.005	<0.005	0.008	3.99	<0.005	0.352	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.068
DW7073W	Castor Lower/Pollux Upper	17-Apr-2019	<0.01	0.002	0.11	<0.001	1.05	<0.0001	<0.001	<0.001	0.002	4.22	<0.001	0.337	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.058
DW7073W	Castor Lower/Pollux Upper	13-May-2019	<0.01	0.002	0.153	<0.001	0.99	<0.0001	<0.001	<0.001	0.007	3.95	<0.001	0.323	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.048
DW7073W	Castor Lower/Pollux Upper	19-Jun-2019	<0.01	0.002	0.119	<0.001	1.07	<0.0001	<0.001	<0.001	0.003	3.94	<0.001	0.334	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.084
DW7073W	Castor Lower/Pollux Upper	11-Jul-2019	<0.05	<0.005	0.123	<0.005	1.15	<0.0005	<0.005	<0.005	<0.005	3.37	<0.005	0.335	<0.0001	<0.005	0.005	<0.05	<0.005	<0.005	<0.05	0.118
DW7073W	Castor Lower/Pollux Upper	26-Aug-2019	<0.01	0.001	0.137	<0.001	1.02	<0.0001	<0.001	<0.001	<0.001	3.84	<0.001	0.315	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.038
DW7074W	Castor Upper	13-Dec-2018	0.02	0.001	0.079	<0.001	1.33	<0.0001	<0.001	0.001	0.032	<0.05	0.002	0.216	<0.0001	0.01	0.004	<0.01	<0.001	0.002	<0.01	0.087
DW7074W	Castor Upper	07-Jan-2019	<0.01	0.001	0.086	<0.001	1.19	<0.0001	<0.001	0.001	0.015	0.08	<0.001	0.24	<0.0001	0.008	0.003	<0.01	<0.001	0.003	<0.01	0.065
DW7074W	Castor Upper	18-Feb-2019	<0.01	0.002	0.086	<0.001	1.45	<0.0001	<0.001	0.002	0.013	0.29	<0.001	0.243	<0.0001	0.007	0.006	<0.01	<0.001	0.003	<0.01	0.065
DW7074W	Castor Upper	11-Mar-2019	<0.05	<0.005	0.072	<0.005	1.13	<0.0005	<0.005	<0.005	<0.005	1.47	<0.005	0.249	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.043
DW7074W	Castor Upper	17-Apr-2019	<0.01	0.005	0.068	<0.001	1.3	<0.0001	<0.001	0.001	<0.001	1.74	<0.001	0.228	<0.0001	0.005	0.003	<0.01	<0.001	0.002	<0.01	0.042
DW7074W	Castor Upper	13-May-2019	<0.01	0.005	0.104	<0.001	1.28	<0.0001	<0.001	<0.001	0.008	2.41	<0.001	0.251	<0.0001	0.004	0.004	<0.01	<0.001	0.003	<0.01	0.046
DW7074W	Castor Upper	19-Jun-2019	<0.01	0.006	0.083	<0.001	1.34	<0.0001	<0.001	<0.001	0.006	1.8	<0.001	0.237	<0.0001	0.006	0.005	<0.01	<0.001	0.002	<0.01	0.073
DW7074W	Castor Upper	11-Jul-2019	<0.05	<0.005	0.094	<0.005	1.49	<0.0005	<0.005	<0.005	<0.005	0.96	<0.005	0.258	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.067
DW7074W	Castor Upper	26-Aug-2019	0.01	0.002	0.106	<0.001	1.31	<0.0001	<0.001	<0.001	<0.001	1.68	<0.001	0.258	<0.0001	0.004	0.005	<0.01	<0.001	0.002	<0.01	0.025
DW7068W	Tertiary	12-Dec-2018	<0.01	<0.001	0.203	<0.001	1.16	<0.0001	<0.001	0.002	0.008	<0.05	<0.001	0.035	<0.0001	0.008	0.006	<0.01	<0.001	0.012	<0.01	0.017
DW7068W	Tertiary	07-Jan-2019	0.02	<0.001	0.199	<0.001	1.15	<0.0001	<0.001	0.002	0.014	<0.05	<0.001	0.036	<0.0001	0.005	0.005	<0.01	<0.001	0.01	<0.01	0.086
DW7068W	Tertiary	18-Feb-2019	<0.01	<0.001	0.216	<0.001	1.37	<0.0001	<0.001	0.002	0.002	<0.05	<0.001	0.032	<0.0001	0.006	0.004	<0.01	0.001	0.011	<0.01	0.035
DW7068W	Tertiary	11-Mar-2019	<0.05	<0.005	0.186	<0.005	1.14	<0.0005	<0.005	<0.005	<0.005	<0.05	<0.005	0.025	<0.0001	<0.005	<0.005	<0.05	<0.005	0.009	<0.05	0.03
DW7068W	Tertiary	17-Apr-2019	<0.01	<0.001	0.192	<0.001	1.34	<0.0001	<0.001	0.002	<0.001	0.08	<0.001	0.038	<0.0001	0.005	0.006	<0.01	<0.001	0.01	<0.01	0.032
DW7068W	Tertiary	13-May-2019	<0.01	0.001	0.201	<0.001	1.26	<0.0001	<0.001	0.001	0.001	<0.05	<0.001	0.039	<0.0001	0.005	0.006	<0.01	<0.001	0.011	<0.01	0.047
DW7068W	Tertiary	11-Jul-2019	<0.05	<0.005	0.198	<0.005	1.52	<0.0005	<0.005	<0.005	<0.005	0.08	<0.005	0.059	<0.0001	0.006	0.012	<0.05	<0.005	0.01	<0.05	0.096
DW7076W	Alluvium	12-Dec-2018	0.02	0.002	0.181	<0.001	0.56	<0.0001	<0.001	0.003	0.006	0.09	<0.001	0.112	<0.0001	<0.001	0.004	<0.01	<0.001	0.01	<0.01	<0.005
DW7076W	Alluvium	07-Jan-2019	<0.01	0.002	0.278	<0.001	3.81	<0.0001	<0.001	0.004	0.011	<0.05	<0.001	0.118	<0.0001	0.004	0.004	<0.01	<0.001	0.058	0.01	0.007
DW7076W	Alluvium	18-Feb-2019	<0.01	0.002	0.344	<0.001	3.94	<0.0001	<0.001	0.002	0.019	0.12	<0.001	0.072	<0.0001	0.002	0.004	<0.01	<0.001	0.058	0.03	0.007
DW7076W	Alluvium	11-Mar-2019	<0.05	<0.005	0.26	<0.005	3.3	<0.0005	<0.005	<0.005	0.023	0.13	<0.005	0.075	<0.0001	<0.005	<0.005	<0.05	<0.005	0.051	<0.05	0.028
DW7076W	Alluvium	17-Apr-2019	<0.01	0.002	0.233	<0.001	3.62	<0.0001	<0.001	0.002	0.01	0.05	<0.001	0.059	<0.0001	0.002	0.003	<0.01	<0.001	0.034	0.01	0.012
DW7076W	Alluvium	13-May-2019	0.01	0.002	0.232	<0.001	4.03	<0.0001	<0.001	0.002	0.015	0.13	<0.001	0.063	<0.0001	0.002	0.002	<0.01	<0.001	0.053	0.01	0.01
DW7076W	Alluvium	19-Jun-2019	0.05	0.003	0.186	<0.001	3.69	<0.0001	<0.001	0.004	0.018	0.15	<0.001	0.09	<0.0001	0.002	0.006	<0.01	<0.001	0.058	0.02	0.025
DW7076W	Alluvium	11-Jul-2019	<0.05	<0.005	0.2	<0.005	4.56	<0.0005	<0.005	<0.005	0.009	<0.05	<0.005	0.064	<0.0001	<0.005	<0.005	<0.05	<0.005	0.041	<0.05	<0.025
DW7076W	Alluvium	26-Aug-2019	0.06	0.002	0.189	<0.001	3.98	<0.0001	<0.001	0.002	0.002	<0.05	<0.001	0.07	<0.0001	0.002	0.004	<0.01	<0.001	0.04	0.01	0.019

Alluvium	Count		9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	Count >LOR		4	7	9	0	9	0	0	7	9	6	0	9	0	6	7	0	0	9	6	7
	Min		0.01	0.002	0.181		0.56			0.002	0.002	0.05		0.059		0.002	0.002			0.01	0.01	0.007
	Max		0.06	0.003	0.344		4.56			0.004	0.023	0.15		0.118		0.004	0.006			0.058	0.03	0.028
	Mean		0.035	0.002	0.234		3.50			0.003	0.013	0.083		0.080		0.002	0.004			0.045	0.016	0.014
	Median		0.035	0.002	0.232		3.81			0.002	0.011	0.090		0.072		0.002	0.004			0.051	0.010	0.011
	StDev		0.024	0.0004	0.054		1.15			0.001	0.007	0.052		0.022		0.001	0.001			0.016	0.009	0.009

Appendix B2: Dissolved Metals/ Metalloid Data

Site	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
Tertiary	Count		7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	Count >LOR		1	1	7	0	7	0	0	5	4	2	0	7	0	6	6	0	1	7	0	7
	Min		0.02	0.001	0.186	0	1.14			0.001	0.001	0.08		0.025		0.005	0.004		0.001	0.009		0.017
	Max		0.02	0.001	0.216		1.52			0.002	0.014	0.08		0.059		0.008	0.012		0.001	0.012		0.096
	Mean				0.199		1.28			0.002	0.004			0.038		0.005	0.006			0.010		0.049
	Median				0.199		1.26			0.002	0.003			0.036		0.005	0.006			0.010		0.035
	StDev				0.009		0.14			0.001	0.005			0.010		0.002	0.003			0.001		0.030
Coal Seams	Count		45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
	Count >LOR		3	36	45	0	45	3	0	20	29	44	4	45	0	30	40	0	1	23	0	45
	Min		0.01	0.001	0.059	0	0.88	0.0001		0.001	0.001	0.08	0.002	0.087		0.001	0.002		0.007	0.001		0.025
	Max		0.02	0.029	0.477		1.49	0.0002		0.019	0.081	4.41	0.007	0.397		0.01	0.022		0.007	0.016		0.21
	Mean*			0.007	0.117		1.23			0.003	0.011	2.59	0.004	0.229		0.003	0.006			0.003		0.086
	Median*			0.003	0.103		1.25			0.002	0.003	2.45	0.004	0.240		0.002	0.005			0.003		0.075
	Standard Deviation*			0.007	0.073		0.14			0.004	0.018	1.20	0.002	0.086		0.002	0.005			0.003		0.039

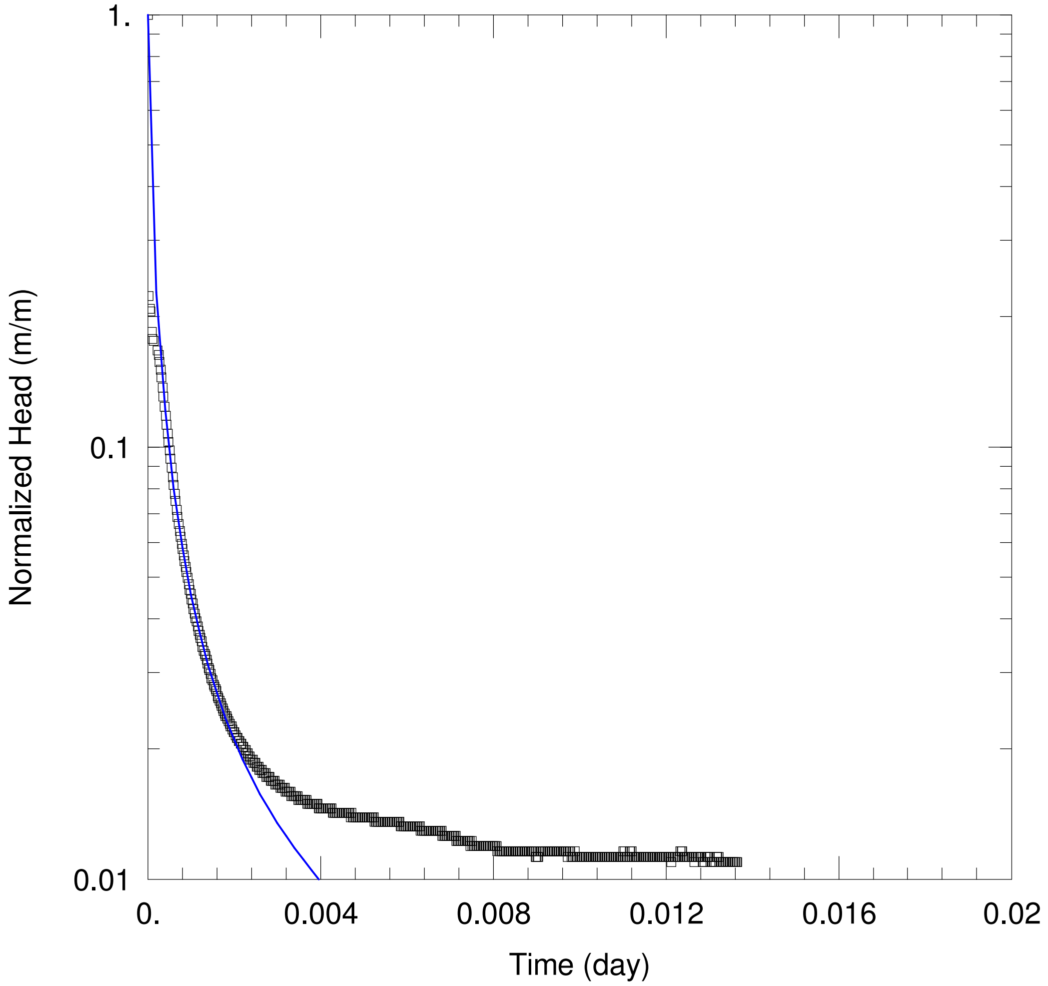
* For the purpose of statistical analysis, samples <LOR were converted to 0.5 x the LOR value

Appendix B3: Total Metals/ Metalloid Data

Site	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
DW7065W	AR3	12-Dec-2018	0.33	0.022	0.082	<0.001	1.33	0.0002	<0.001	0.018	0.102	2.82	0.012	0.316	<0.0001	0.001	0.022	<0.01	<0.001	0.013	<0.01	0.19
DW7065W	AR3	07-Jan-2019	0.1	0.033	0.204	<0.001	1.58	0.0002	<0.001	0.012	0.057	3.24	0.002	0.264	<0.0001	0.003	0.015	<0.01	<0.001	0.011	<0.01	0.204
DW7065W	AR3	18-Feb-2019	0.11	0.025	0.12	<0.001	1.29	0.0002	<0.001	0.009	0.03	4.66	<0.001	0.238	<0.0001	0.001	0.016	<0.01	<0.001	0.007	<0.01	0.124
DW7065W	AR3	11-Mar-2019	0.28	0.017	0.094	<0.005	1.64	<0.0005	<0.005	0.01	0.045	5.39	<0.005	0.362	<0.0001	<0.005	0.014	<0.05	<0.005	0.006	<0.05	0.09
DW7065W	AR3	17-Apr-2019	0.06	0.017	0.106	<0.001	1.13	<0.0001	<0.001	0.006	0.031	3.37	<0.001	0.231	<0.0005	0.001	0.008	<0.01	<0.001	0.007	<0.01	0.1
DW7065W	AR3	13-May-2019	0.06	0.022	0.32	<0.001	1.37	<0.0001	<0.001	0.008	0.039	4.15	<0.001	0.35	<0.0001	0.001	0.014	<0.01	<0.001	0.008	<0.01	0.149
DW7065W	AR3	19-Jun-2019	0.04	0.018	0.178	<0.001	1.14	<0.0001	<0.001	0.006	0.006	3.87	<0.001	0.295	<0.0001	<0.001	0.011	<0.01	<0.001	0.008	<0.01	0.103
DW7065W	AR3	11-Jul-2019	0.12	0.008	0.284	<0.005	1.47	<0.0005	<0.005	0.006	0.01	2.12	<0.005	0.406	<0.0001	<0.005	0.011	<0.05	<0.005	0.006	<0.05	0.121
DW7065W	AR3	26-Aug-2019	0.17	0.019	0.474	<0.001	1.52	<0.0001	<0.001	0.006	0.008	4.39	0.001	0.279	<0.0001	<0.001	0.01	<0.01	<0.001	0.009	<0.01	0.42
DW7067W	AR3	12-Dec-2018	0.06	0.006	0.059	<0.001	1.44	<0.0001	<0.001	0.005	0.046	2.32	0.005	0.11	<0.0001	0.001	0.006	<0.01	<0.001	0.004	<0.01	0.111
DW7067W	AR3	07-Jan-2019	<0.05	0.012	0.089	<0.005	1.47	<0.0005	<0.005	<0.005	0.027	3.23	<0.005	0.122	<0.0001	<0.005	0.006	<0.05	<0.005	<0.005	<0.05	0.149
DW7067W	AR3	18-Feb-2019	0.01	0.013	0.077	<0.001	1.36	<0.0001	<0.001	0.002	0.021	4.31	<0.001	0.112	<0.0001	0.002	0.007	0.01	<0.001	0.002	<0.01	0.067
DW7067W	AR3	11-Mar-2019	<0.05	0.01	0.079	<0.005	1.76	<0.0005	<0.005	<0.005	0.014	3.88	<0.005	0.119	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.09
DW7067W	AR3	17-Apr-2019	0.02	0.008	0.069	<0.001	1.19	<0.0001	<0.001	0.001	0.012	3.38	<0.001	0.102	<0.0001	<0.001	0.002	<0.01	<0.001	0.002	<0.01	0.063
DW7067W	AR3	13-May-2019	0.01	0.008	0.156	<0.001	1.44	<0.0001	<0.001	0.001	0.022	3.34	<0.001	0.121	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.098
DW7067W	AR3	19-Jun-2019	0.02	0.004	0.11	<0.001	1.24	<0.0001	<0.001	0.002	0.007	0.52	<0.001	0.092	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.092
DW7067W	AR3	11-Jul-2019	<0.05	<0.005	0.134	<0.005	1.5	<0.0005	<0.005	<0.005	0.013	2.35	<0.005	0.154	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.148
DW7067W	AR3	26-Aug-2019	0.04	0.007	0.184	<0.001	1.6	<0.0001	<0.001	0.001	0.007	2.98	<0.001	0.107	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.06
DW7068W	Tertiary	12-Dec-2018	1.27	<0.001	0.186	<0.001	1.26	<0.0001	0.004	0.002	0.004	0.53	0.001	0.036	<0.0001	0.007	0.005	<0.01	<0.001	0.011	<0.01	0.019
DW7068W	Tertiary	07-Jan-2019	1.82	<0.001	0.268	<0.001	1.48	0.0002	0.006	0.002	0.017	0.91	0.002	0.044	<0.0001	0.007	0.006	<0.01	<0.001	0.012	<0.01	0.106
DW7068W	Tertiary	18-Feb-2019	4.11	0.002	0.234	<0.001	1.3	<0.0001	0.013	0.002	0.01	2.2	0.003	0.045	<0.0001	0.005	0.006	<0.01	<0.001	0.009	0.02	0.067
DW7068W	Tertiary	11-Mar-2019	3.12	<0.005	0.214	<0.005	1.48	<0.0005	0.009	<0.005	0.007	1.5	<0.005	0.033	<0.0001	<0.005	0.006	<0.05	<0.005	0.012	<0.05	<0.026
DW7068W	Tertiary	17-Apr-2019	2.43	<0.001	0.237	<0.001	1.16	<0.0001	0.008	0.002	0.008	1.55	0.002	0.041	<0.0001	0.005	0.006	<0.01	<0.001	0.01	<0.01	0.043
DW7068W	Tertiary	13-May-2019	2.81	0.002	0.242	<0.001	1.4	<0.0001	0.01	0.002	0.028	2	0.003	0.054	<0.0001	0.005	0.009	<0.01	<0.001	0.011	<0.01	0.094
DW7068W	Tertiary	11-Jul-2019	3.9	<0.005	0.22	<0.005	1.55	<0.0005	0.009	<0.005	0.007	1.24	<0.005	0.063	<0.0001	0.006	0.014	<0.05	<0.005	0.01	<0.05	0.126
DW7069W	Castor Lower/Pollux Upper	12-Dec-2018	0.1	0.003	0.056	<0.001	1.37	0.0001	<0.001	0.002	0.06	2.4	0.005	0.174	<0.0001	0.001	0.004	<0.01	<0.001	0.002	<0.01	0.137
DW7069W	Castor Lower/Pollux Upper	07-Jan-2019	0.07	0.004	0.083	<0.001	1.41	0.0001	<0.001	<0.001	0.028	2.86	0.001	0.184	<0.0001	0.002	0.003	<0.01	<0.001	0.002	<0.01	0.144
DW7069W	Castor Lower/Pollux Upper	18-Feb-2019	0.09	0.003	0.072	<0.001	1.31	<0.0001	<0.001	<0.001	0.02	2.4	<0.001	0.158	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.089
DW7069W	Castor Lower/Pollux Upper	11-Mar-2019	0.08	<0.005	0.069	<0.005	1.73	<0.0005	<0.005	<0.005	0.014	2.48	<0.005	0.188	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.088
DW7069W	Castor Lower/Pollux Upper	17-Apr-2019	0.04	0.002	0.064	<0.001	1.14	<0.0001	<0.001	<0.001	0.01	2.42	<0.001	0.154	<0.0001	<0.001	0.002	<0.01	<0.001	<0.001	<0.01	0.064
DW7069W	Castor Lower/Pollux Upper	13-May-2019	0.03	0.004	0.117	<0.001	1.41	0.0002	<0.001	<0.001	0.02	2.64	<0.001	0.185	<0.0001	0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.082
DW7069W	Castor Lower/Pollux Upper	19-Jun-2019	0.02	0.002	0.084	<0.001	1.21	<0.0001	<0.001	<0.001	0.014	2.38	<0.001	0.153	<0.0001	<0.001	0.003	<0.01	<0.001	<0.001	<0.01	0.104
DW7069W	Castor Lower/Pollux Upper	11-Jul-2019	0.13	<0.005	0.087	<0.005	1.5	<0.0005	<0.005	<0.005	0.012	2.05	<0.005	0.168	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.133
DW7069W	Castor Lower/Pollux Upper	26-Aug-2019	0.12	0.003	0.113	<0.001	1.56	<0.0001	<0.001	<0.001	0.006	2.57	<0.001	0.147	<0.0001	0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.045
DW7073W	Castor Lower/Pollux Upper	13-Dec-2018	0.3	0.001	0.108	<0.001	1.14	<0.0001	<0.001	<0.001	0.05	3.61	0.005	0.288	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.097
DW7073W	Castor Lower/Pollux Upper	07-Jan-2019	0.64	0.001	0.149	<0.001	1.26	0.0001	<0.001	<0.001	0.02	4.59	0.003	0.36	<0.0001	0.003	0.002	<0.01	<0.001	<0.001	<0.01	0.115
DW7073W	Castor Lower/Pollux Upper	18-Feb-2019	0.23	0.002	0.129	<0.001	1.08	0.0001	<0.001	<0.001	0.017	4.16	<0.001	0.35	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.104
DW7073W	Castor Lower/Pollux Upper	11-Mar-2019	0.23	<0.005	0.142	<0.005	1.39	<0.0005	<0.005	<0.005	0.011	5.2	<0.005	0.405	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.097
DW7073W	Castor Lower/Pollux Upper	17-Apr-2019	0.18	0.001	0.115	<0.001	0.94	<0.0001	<0.001	<0.001	0.009	4.31	<0.001	0.318	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.055
DW7073W	Castor Lower/Pollux Upper	13-May-2019	0.27	0.003	0.167	<0.001	1.1	<0.0001	<0.001	<0.001	0.015	4.66	<0.001	0.345	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.054
DW7073W	Castor Lower/Pollux Upper	19-Jun-2019	0.15	0.002	0.128	<0.001	1.02	<0.0001	<0.001	<0.001	0.015	4.2	<0.001	0.325	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.065
DW7073W	Castor Lower/Pollux Upper	11-Jul-2019	0.22	<0.005	0.133	<0.005	1.2	<0.0005	<0.005	<0.005	0.011	3.83	<0.005	0.347	<0.0001	<0.005	0.006	<0.05	<0.005	<0.005	<0.05	0.116
DW7073W	Castor Lower/Pollux Upper	26-Aug-2019	0.23	0.001	0.14	<0.001	1.21	<0.0001	<0.001	<0.001	0.006	4.01	<0.001	0.301	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.037
DW7074W	Castor Upper	13-Dec-2018	0.05	0.001	0.073	<0.001	1.45	<0.0001	<0.001	0.001	0.034	0.09	0.003	0.203	<0.0001	0.009	0.003	<0.01	<0.001	0.002	<0.01	0.078
DW7074W	Castor Upper	07-Jan-2019	0.03	0.001	0.112	<0.001	1.52	0.0001	<0.001	0.002	0.016	0.22	0.001	0.274	<0.0001	0.012	0.003	<0.01	<0.001	0.003	<0.01	0.082
DW7074W	Castor Upper	18-Feb-2019	0.02	0.003	0.087	<0.001	1.34	<0.0001	<0.001	0.002	0.019	0.43	<0.001	0.26	<0.0001	0.008	0.005	<0.01	<0.001	0.002	<0.01	0.071
DW7074W	Castor Upper	11-Mar-2019	<0.05	<0.005	0.084	<0.005	1.64	<0.0005	<0.005	<0.005	0.012	1.63	<0.005	0.264	<0.0001	0.007	<0.005	<0.05	<0.005	<0.005	<0.05	<0.026
DW7074W	Castor Upper	17-Apr-2019	0.03	0.005	0.078	<0.001	1.18	<0.0001	<0.001	<0.001	0.008	1.86	<0.001	0.227	<0.0001	0.006	0.003	<0.01	<0.001	0.002	<0.01	0.043
DW7074W	Castor Upper	13-May-2019	0.06	0.006	0.117	<0.001	1.45	<0.0001	<0.001	<0.001	0.016	2.77	<0.001	0.27	<0.0001	0.005	0.005	<0.01	<0.001	0.003	<0.01	0.054
DW7074W	Castor Upper	19-Jun-2019	0.02	0.004	0.088	<0.001	1.27	<0.0001	<0.001	<0.001	0.014	1.87	<0.001	0.227	<0.0001	0.005	0.004	<0.01	<0.001	0.002	<0.01	0.059
DW7074W	Castor Upper	11-Jul-2019	0.07	<0.005	0.1	<0.005	1.53	<0.0005	<0.005	<0.005	0.006	1.11	<0.005	0.256	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.068
DW7074W	Castor Upper	26-Aug-2019	0.21	0.003	0.119	<0.001	1.52	<0.0001	<0.001	<0.001	0.008	2.01	<0.001	0.245	<0.0001	0.004	0.005	<0.01	<0.001	0.002	<0.01	0.04
DW7076W	Alluvium	12-Dec-2018	2.06	0.002	0.301	<0.001	3.87	<0.0001	0.001	0.005	0.002	0.89	0.001	0.17	<0.0001	0.002	0.005	<0.01	<0.001	0.062	<0.01	0.009
DW7076W	Alluvium	07-Jan-2019	7.22	0.003	0.389	<0.001	4.43	<0.0001	0.011	0.007	0.098	2.93	0.005	0.291	<0.0001	0.004	0.007	<0.01	<0.001	0.073	0.04	0.05
DW7076W	Alluvium	18-Feb-2019	2.86	0.002	0.352	<0.001	3.56	<0.0001	0.006	0.004	0.103	1.28	0.002	0.154	<0.0001	0.003	0.005	<0.01	<0.001	0.053	0.04	0.024
DW7076W	Alluvium	11-Mar-2019	6.6	<0.005	0.331	<0.005	4.71	<0.0005	0.009	0.006	0.308	2.52	0.006	0.236	<0.0001	<0.005	0.006	<0.05	<0.005	0.065	<0.05	<0.026
DW7076W	Alluvium	17-Apr-2019	3.88	0.002	0.31	<0.001	3.41	<0.0001	0.008	0.004	0.164	1.92	0.003	0.158	<0.0001	0.002	0.004	<0.01	<0.001	0.053	0.02	0.041
DW7076W	Alluvium	13-May-2019	4.8	0.003	0.27	<0.001	4.2	0.0001	0.007	0.004	0.313	2.22	0.003	0.176	<0.0001	0.002	0.004	<0.01	<0.001	0.055	0.02	0.036
DW7076W	Alluvium	19-Jun-2019	2.05	0.002	0.209	<0.001	3.82	<0.0001	0.005	0.004	0.232	1.24	0.002	0.144	<0.0001	0.002	0.005	<0.01	<0.001	0.05	0.02	0.035
DW7076W		11-Jul-2019	4.96	<0.005	0.224	<0.005	4.61	<0.0005	0.006	<0.005	0.452	2.2	<0.005	0.154	<0.0001	<0.005	0.007	<0.05	<0.005	0.044	<0.05	0.058
DW7076W	Alluvium	26-Aug-2019	20.1	0.004	0.318	0.004	4.57	<0.0001	0.02	0.008	0.37	6.91	0.02	0.29	<0.0001	0.001	0.013	<0.01	<0.001	0.046	0.04	0.124

APPENDIX C

SLUG TEST ANALYSIS SHEETS



WELL TEST ANALYSIS

Data Set: D:\...\DW7033W1_KGS Model.aqt
Date: 09/07/19 Time: 15:12:19

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7033W1
Test Date: 17 July 2019

AQUIFER DATA

Saturated Thickness: 14.81 m

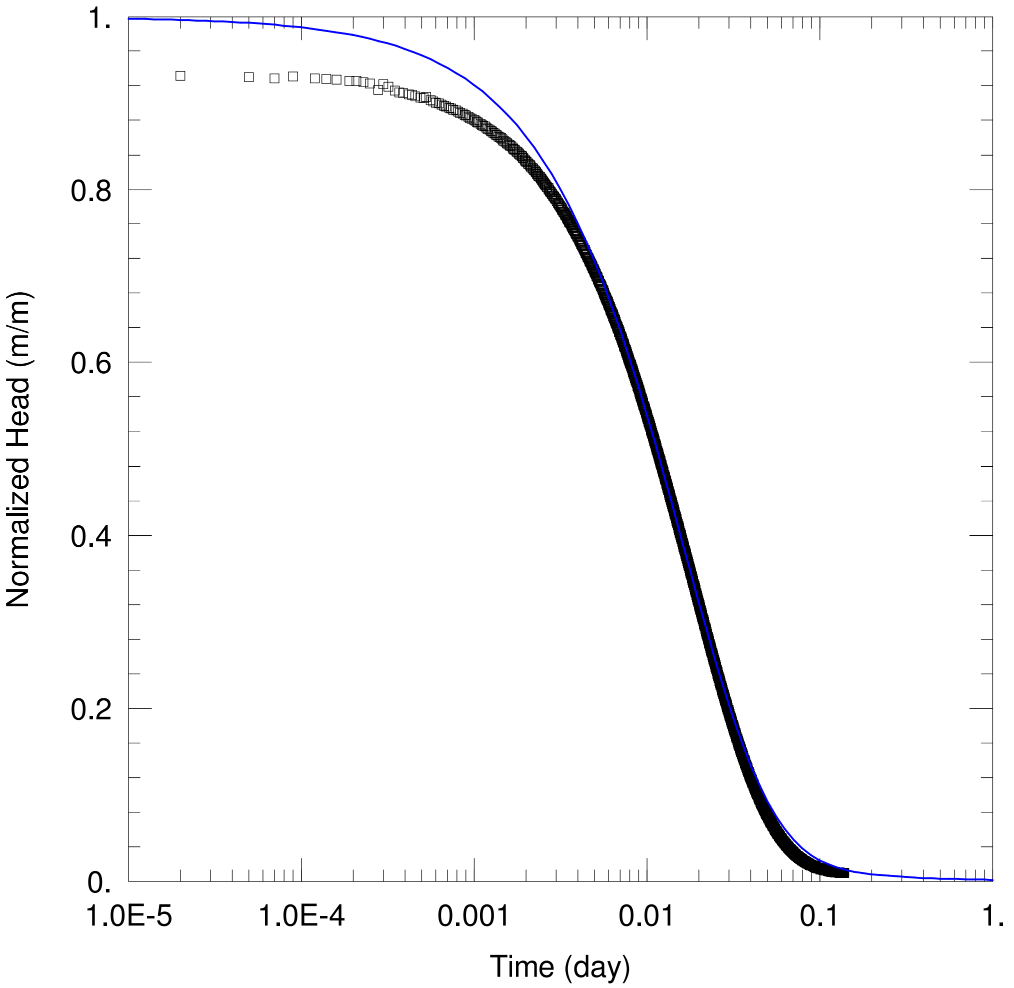
WELL DATA (DW7033W1)

Initial Displacement: 30.18 m
Total Well Penetration Depth: 14.81 m
Casing Radius: 0.025 m
Static Water Column Height: 14.81 m
Screen Length: 6. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.7028 m/day
Kz/Kr = 0.1
Ss = 0.02476 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7033W2_KGS Model.aqt
Date: 09/07/19 Time: 15:14:31

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7033W2
Test Date: 17 July 2019

AQUIFER DATA

Saturated Thickness: 2. m

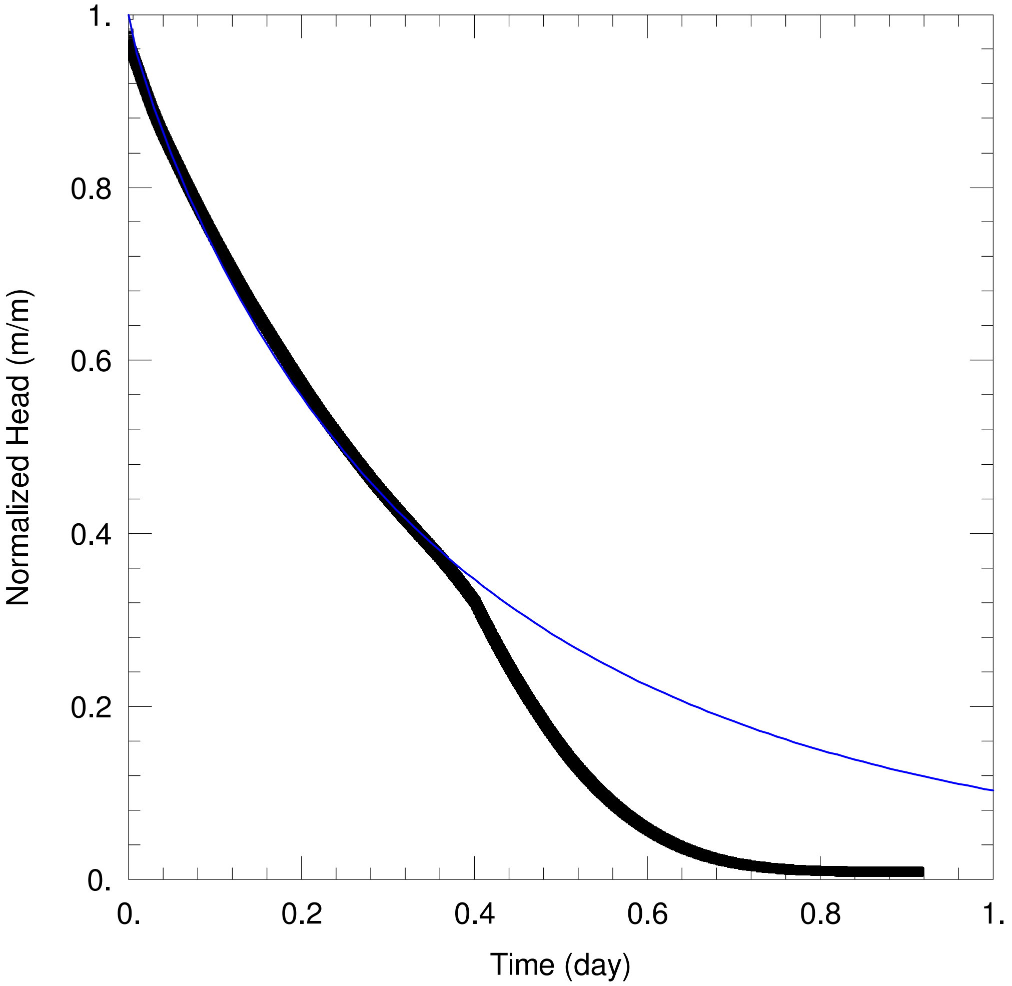
WELL DATA (DW7033W2)

Initial Displacement: 29.22 m
Total Well Penetration Depth: 45.28 m
Casing Radius: 0.025 m
Static Water Column Height: 45.28 m
Screen Length: 1.5 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.06068 m/day
Kz/Kr = 1.
Ss = 0.0002924 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7033W3_KGS Model.aqt
Date: 09/07/19 Time: 17:55:00

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7033W3
Test Date: 17 July 2019

AQUIFER DATA

Saturated Thickness: 6.7 m

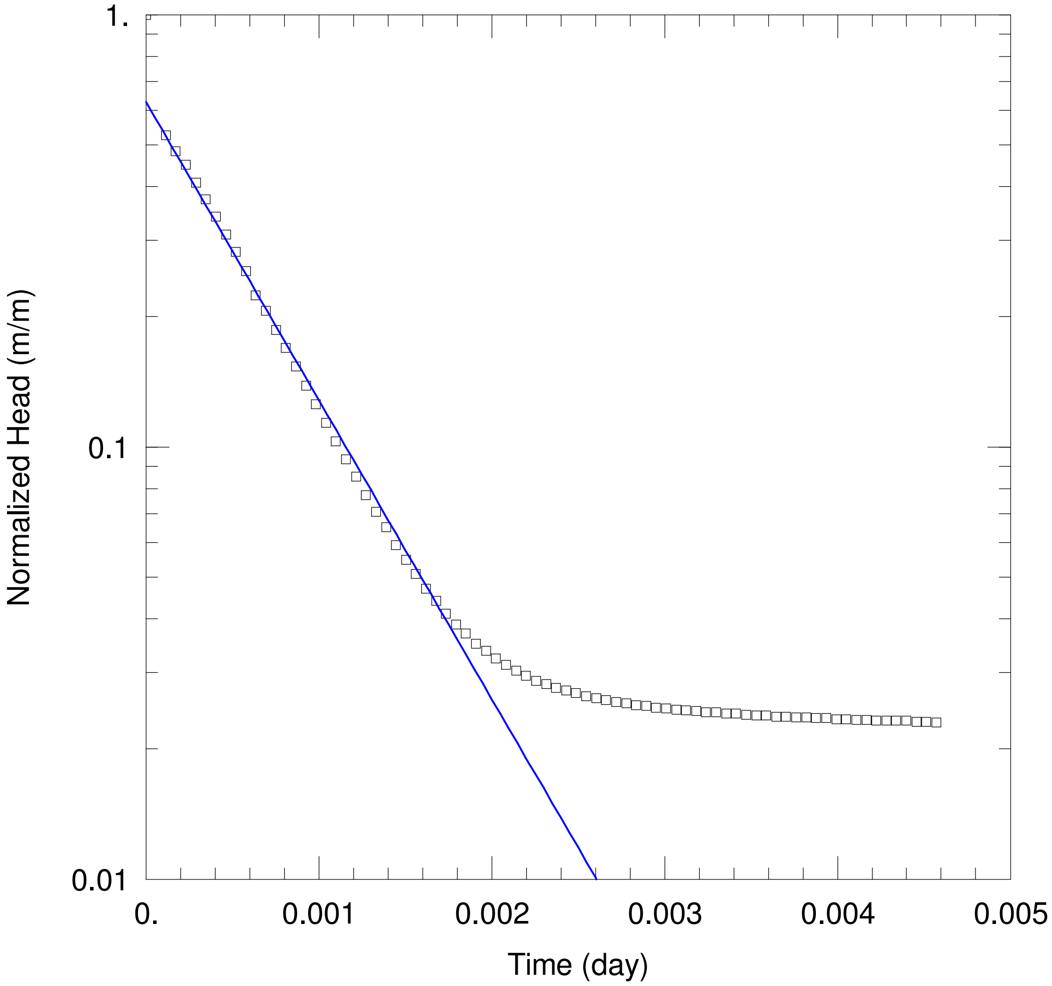
WELL DATA (DW7033W3)

Initial Displacement: 29.17 m
Total Well Penetration Depth: 51.83 m
Casing Radius: 0.025 m
Static Water Column Height: 51.83 m
Screen Length: 1.5 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.002308 m/day
Kz/Kr = 0.1
Ss = 0.0002924 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7035W3_Bouwer-Rice.aqt
Date: 09/07/19
Time: 15:25:54

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7035W3
Test Date: 16 July 2019

AQUIFER DATA

Saturated Thickness: 2. m
Anisotropy Ratio (Kz/Kr): 1.

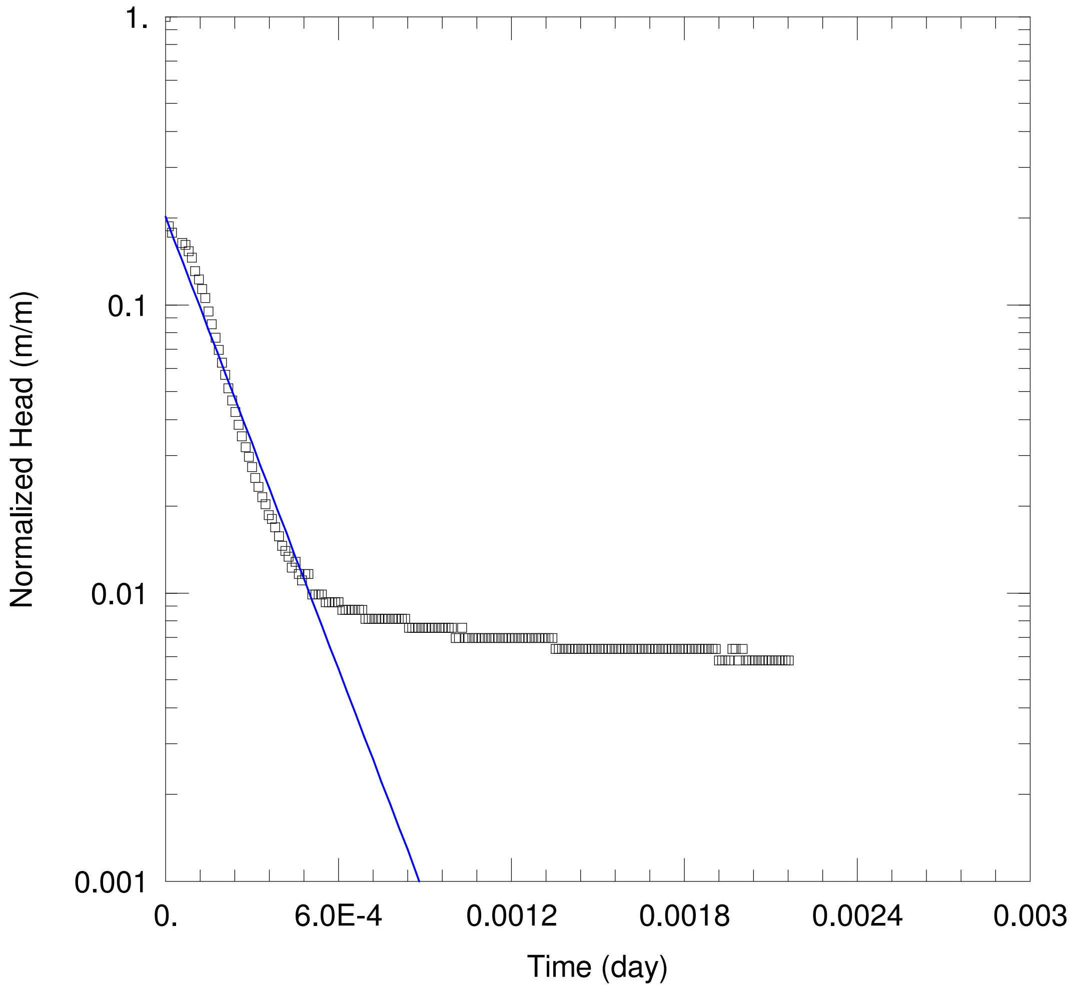
WELL DATA (DW7035W3)

Initial Displacement: 22.01 m
Static Water Column Height: 26.43 m
Total Well Penetration Depth: 26.43 m
Screen Length: 1.5 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 1.593 m/day
y0 = 13.82 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7082W1_Bouwer-Rice.aqt
Date: 09/07/19 Time: 15:24:28

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7082W1
Test Date: 22 August 2019

AQUIFER DATA

Saturated Thickness: 2. m
Anisotropy Ratio (Kz/Kr): 1.

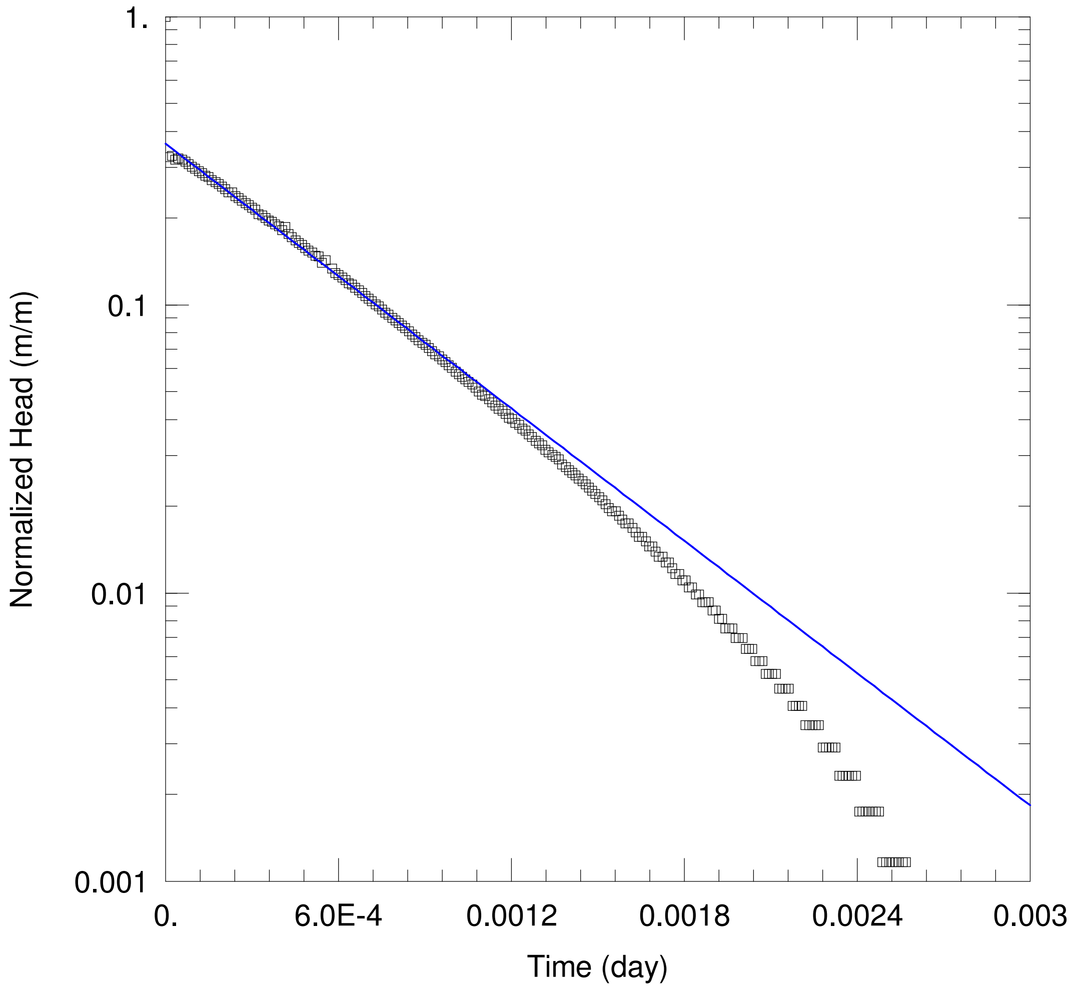
WELL DATA (DW7082W1)

Initial Displacement: 17.19 m
Static Water Column Height: 23.39 m
Total Well Penetration Depth: 23.39 m
Screen Length: 1.67 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 5.387 m/day
y0 = 3.468 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7082W2_Bouwer-Rice.aqt
Date: 09/07/19 Time: 15:30:14

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7082W2
Test Date: 22 August 2019

AQUIFER DATA

Saturated Thickness: 2. m
Anisotropy Ratio (Kz/Kr): 1.

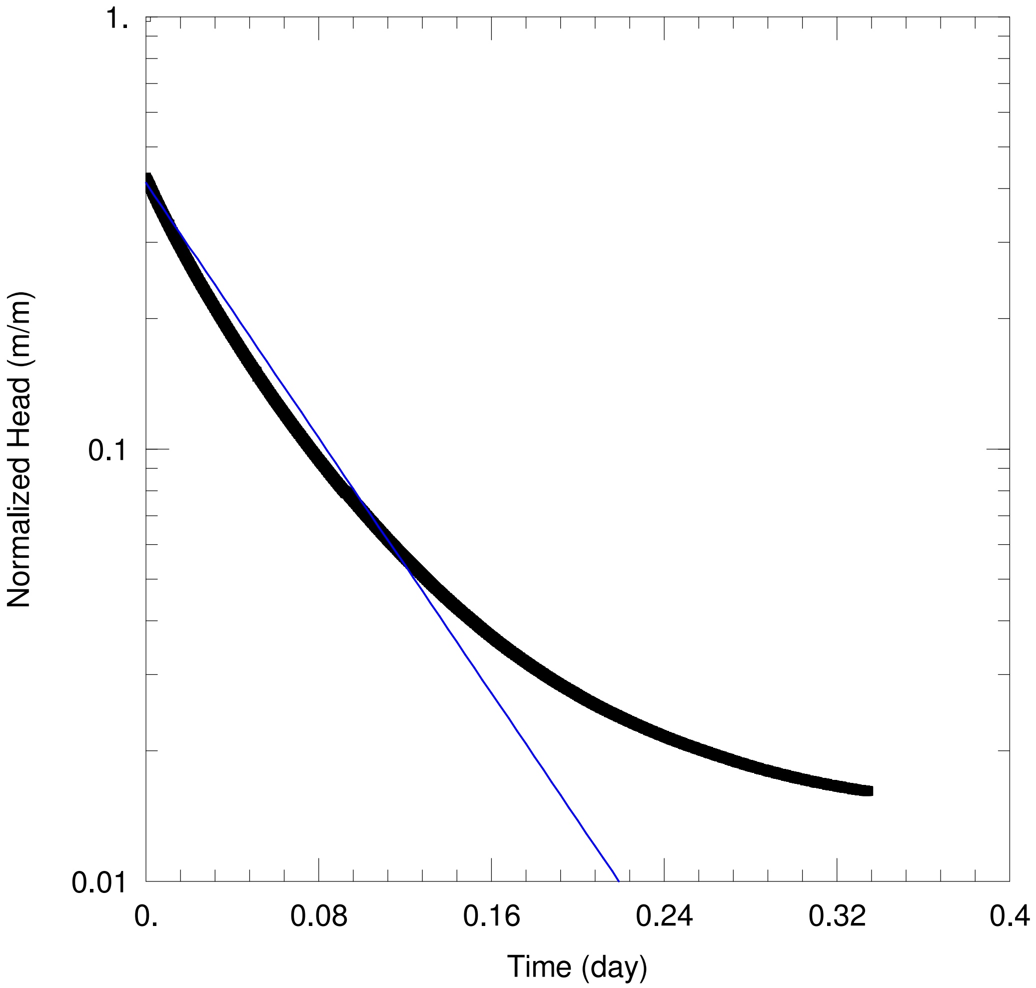
WELL DATA (DW7082W2)

Initial Displacement: 17.23 m
Static Water Column Height: 41.94 m
Total Well Penetration Depth: 41.94 m
Screen Length: 1.5 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 1.855 m/day
y0 = 6.243 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7093W1_Bouwer-Rice.aqt
Date: 09/07/19 Time: 15:36:35

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7092W1
Test Date: 2 September 2019

AQUIFER DATA

Saturated Thickness: 2. m
Anisotropy Ratio (Kz/Kr): 0.1

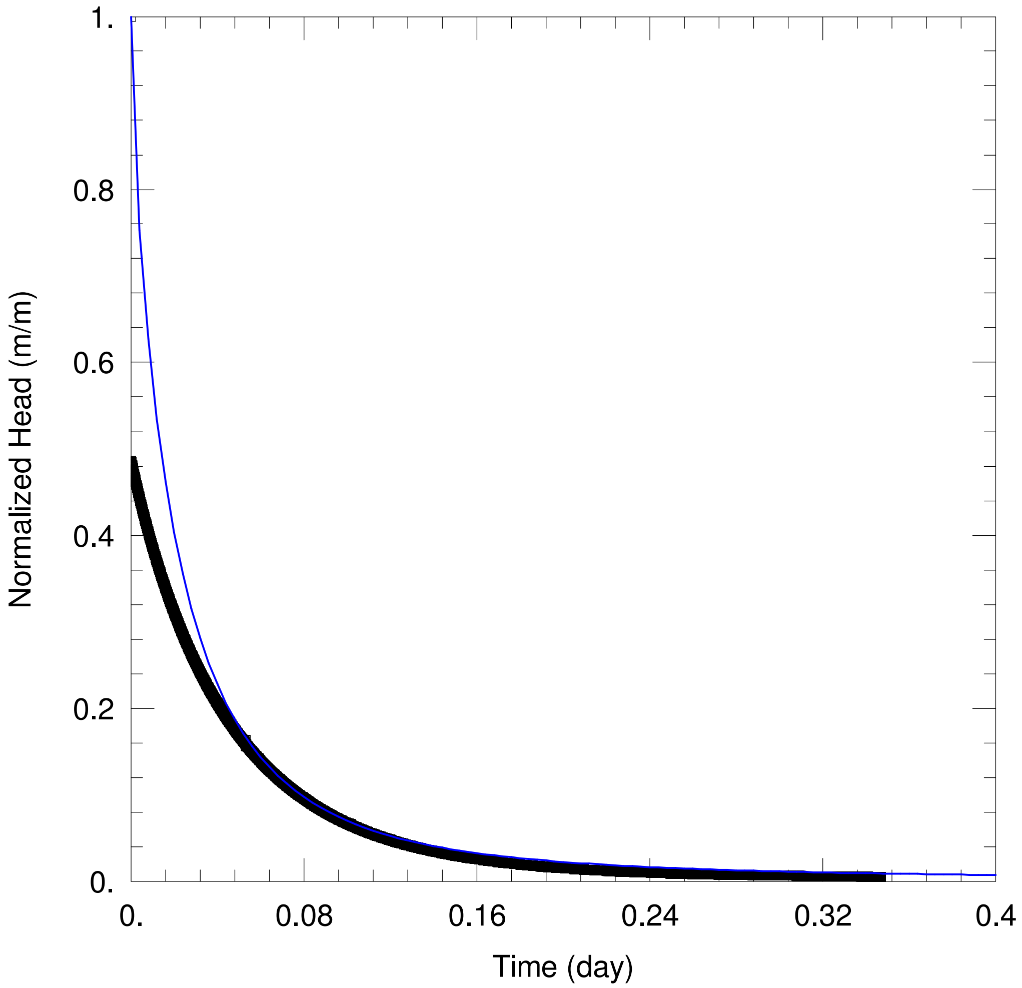
WELL DATA (DW7093W1)

Initial Displacement: 28.78 m
Static Water Column Height: 58.52 m
Total Well Penetration Depth: 58.52 m
Screen Length: 1.5 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.02229 m/day
y0 = 11.88 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7093W3_KGS Model.aqt
Date: 09/07/19 Time: 15:40:14

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7092W3
Test Date: 2 September 2019

AQUIFER DATA

Saturated Thickness: 2. m

WELL DATA (DW7093W3)

Initial Displacement: 28.71 m
Total Well Penetration Depth: 94.54 m
Casing Radius: 0.025 m

Static Water Column Height: 94.54 m
Screen Length: 1.5 m
Well Radius: 0.025 m

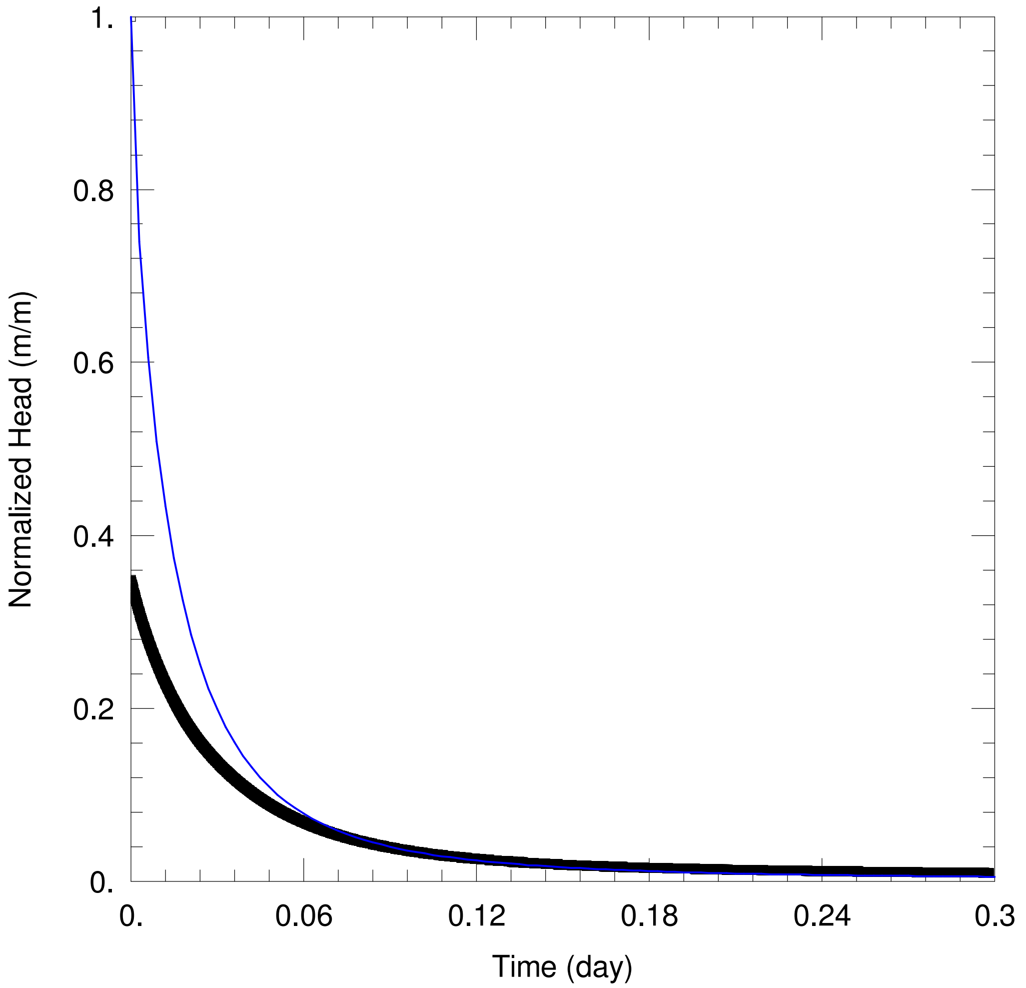
SOLUTION

Aquifer Model: Confined

Solution Method: KGS Model

Kr = 0.03877 m/day
Kz/Kr = 1.

Ss = 0.01774 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7105W2_KGS Model.aqt
Date: 09/07/19 Time: 15:47:39

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7105W2
Test Date: 22 August 2019

AQUIFER DATA

Saturated Thickness: 2. m

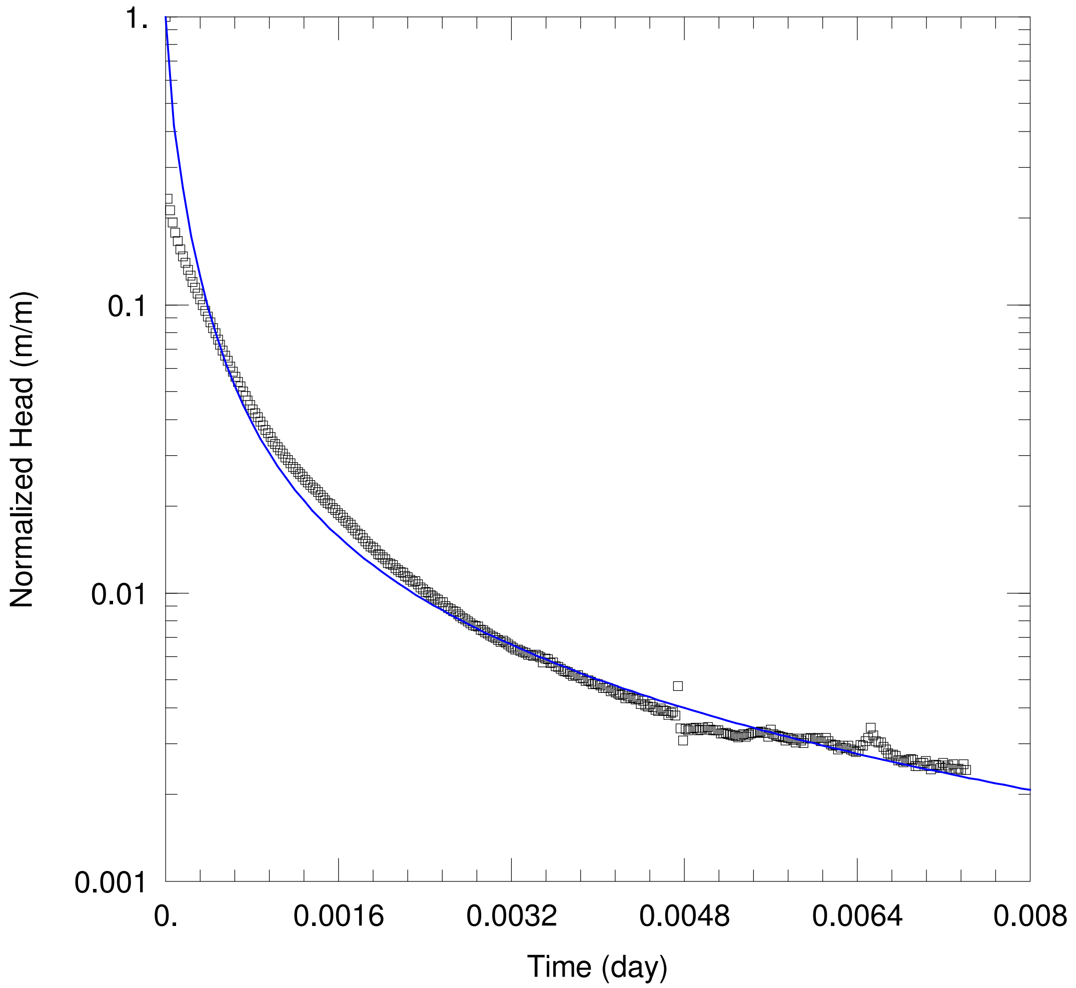
WELL DATA (DW7105W2)

Initial Displacement: 31.4 m
Total Well Penetration Depth: 32.8 m
Casing Radius: 0.025 m
Static Water Column Height: 32.8 m
Screen Length: 1.5 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.066 m/day
Kz/Kr = 1.
Ss = 0.01774 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7178W1_KGS Model.aqt
Date: 09/07/19 Time: 15:50:25

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7178W1
Test Date: 16 July 2019

AQUIFER DATA

Saturated Thickness: 23.39 m

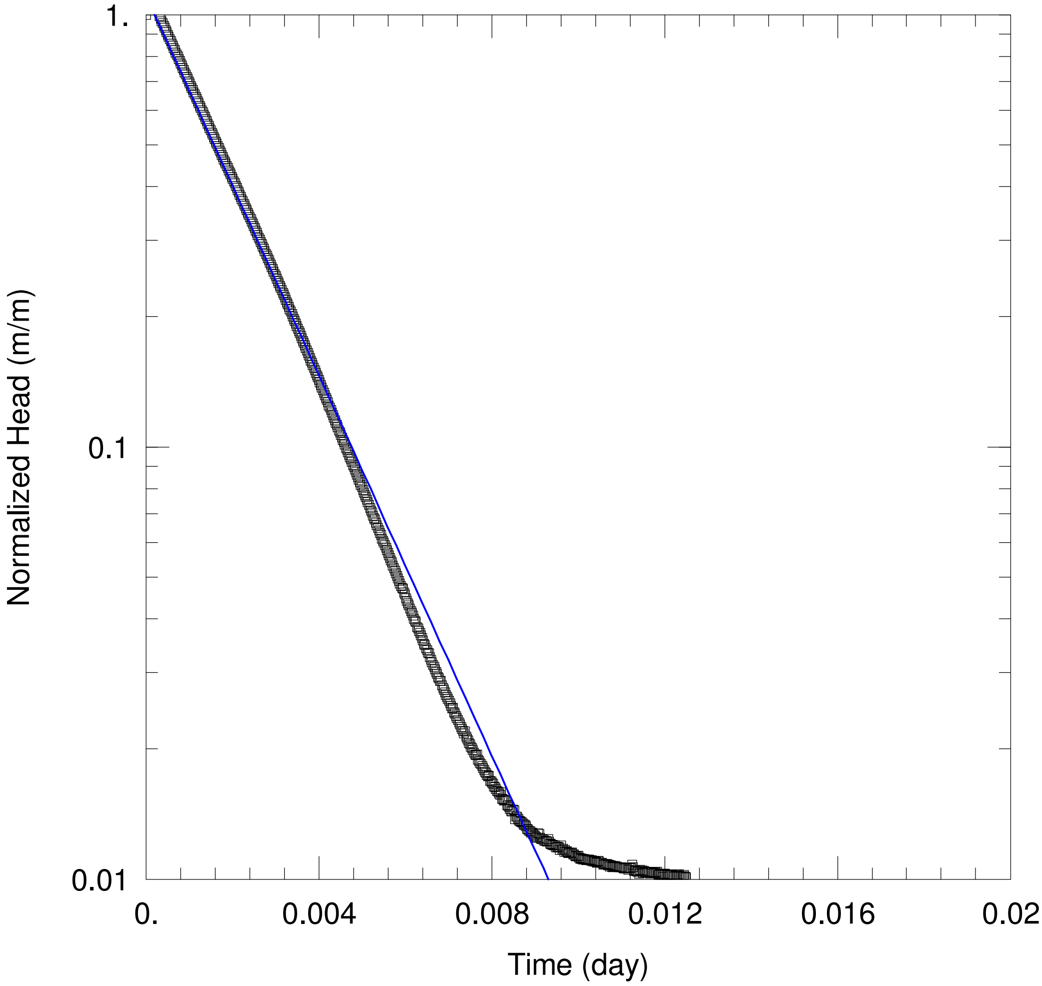
WELL DATA (DW7178W1)

Initial Displacement: 17.19 m
Total Well Penetration Depth: 23.42 m
Casing Radius: 0.025 m
Static Water Column Height: 23.39 m
Screen Length: 1.7 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 3.805 m/day
Kz/Kr = 1.
Ss = 0.02476 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7178W2_KGS Model.aqt
Date: 09/07/19 Time: 16:23:06

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7178W2
Test Date: 16 July 2019

AQUIFER DATA

Saturated Thickness: 3. m
Anisotropy Ratio (Kz/Kr): 1.

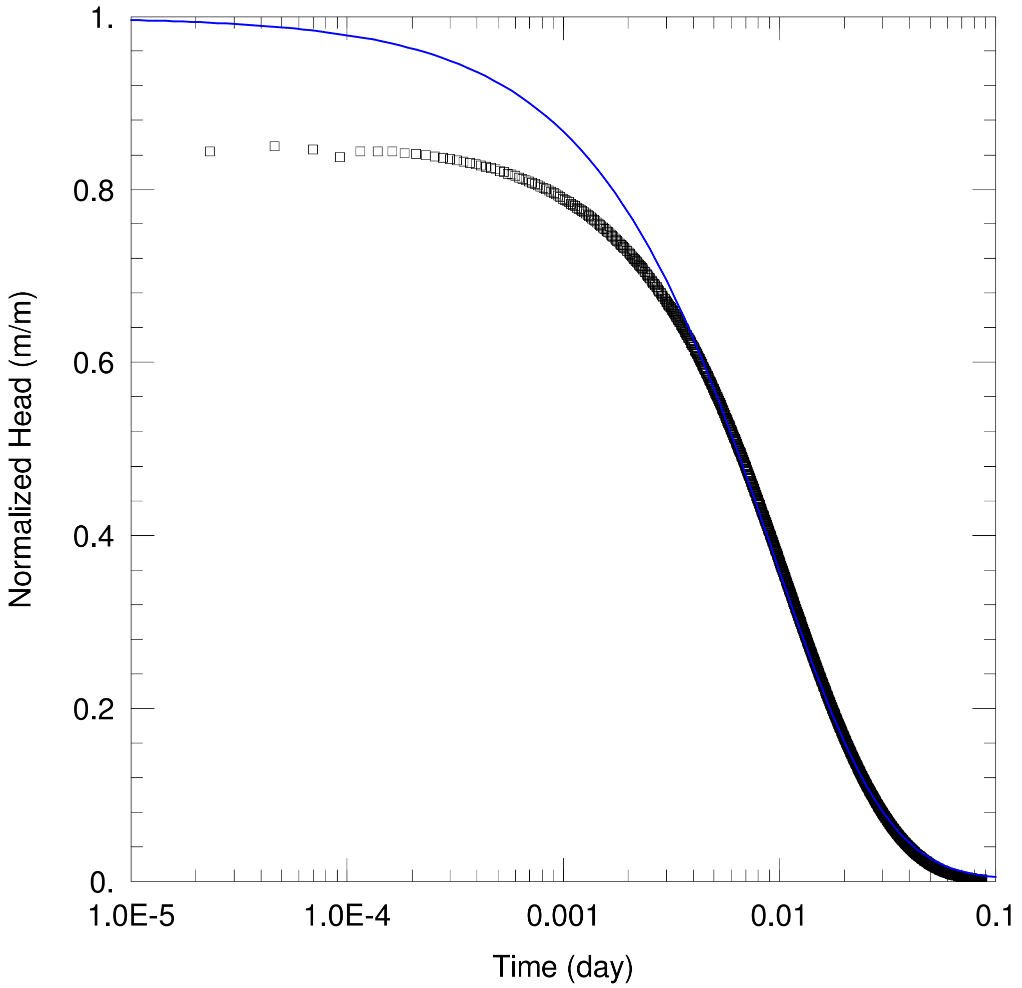
WELL DATA (DW7178W2)

Initial Displacement: 17.23 m
Static Water Column Height: 41.94 m
Total Well Penetration Depth: 41.94 m
Screen Length: 1.5 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.5322 m/day
y0 = 19.08 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7220W1_KGS Model.aqt
Date: 09/07/19 Time: 16:59:12

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7220W1
Test Date: 19 July 2019

AQUIFER DATA

Saturated Thickness: 10.88 m

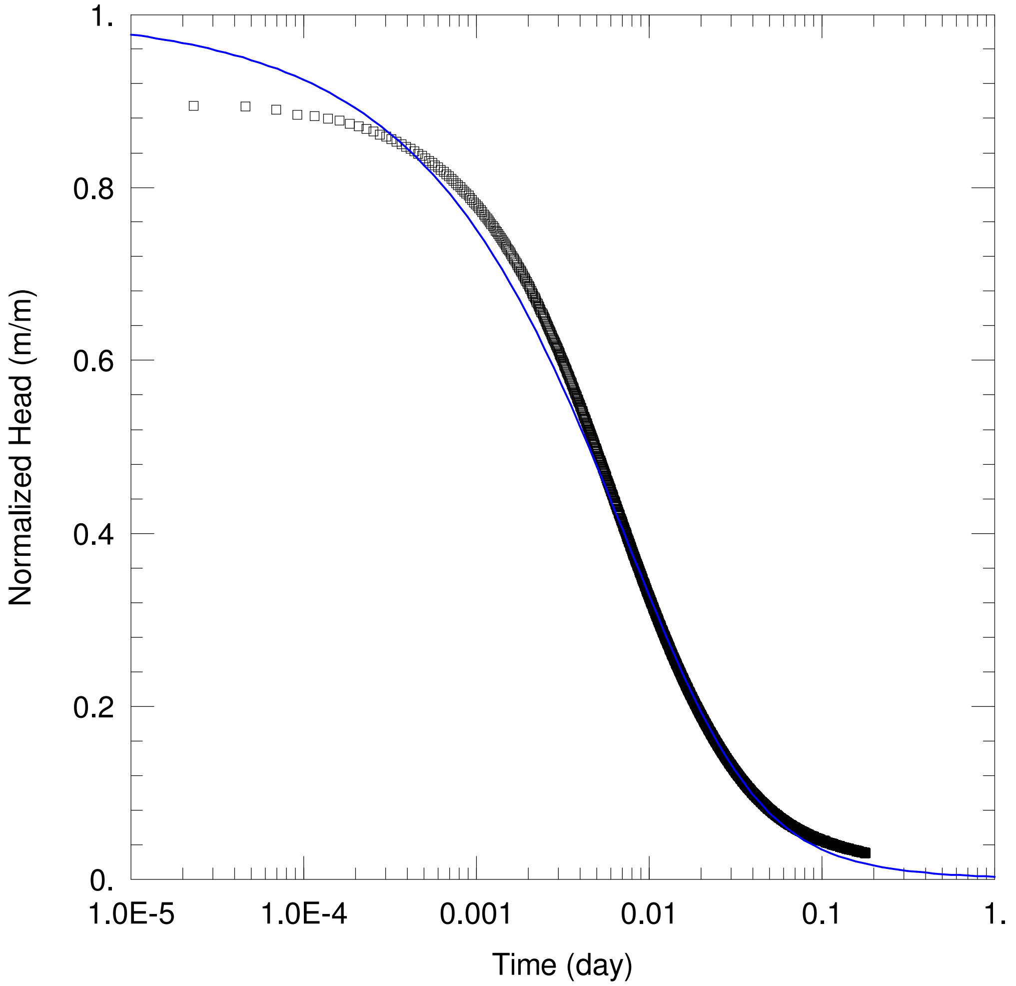
WELL DATA (DW7220W1)

Initial Displacement: 15.62 m
Total Well Penetration Depth: 10.88 m
Casing Radius: 0.025 m
Static Water Column Height: 10.88 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.04546 m/day
Kz/Kr = 1.
Ss = 0.0001408 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7220W2_KGS Model.aqt
Date: 09/07/19 Time: 17:03:33

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7220W2
Test Date: 19 July 2019

AQUIFER DATA

Saturated Thickness: 6. m

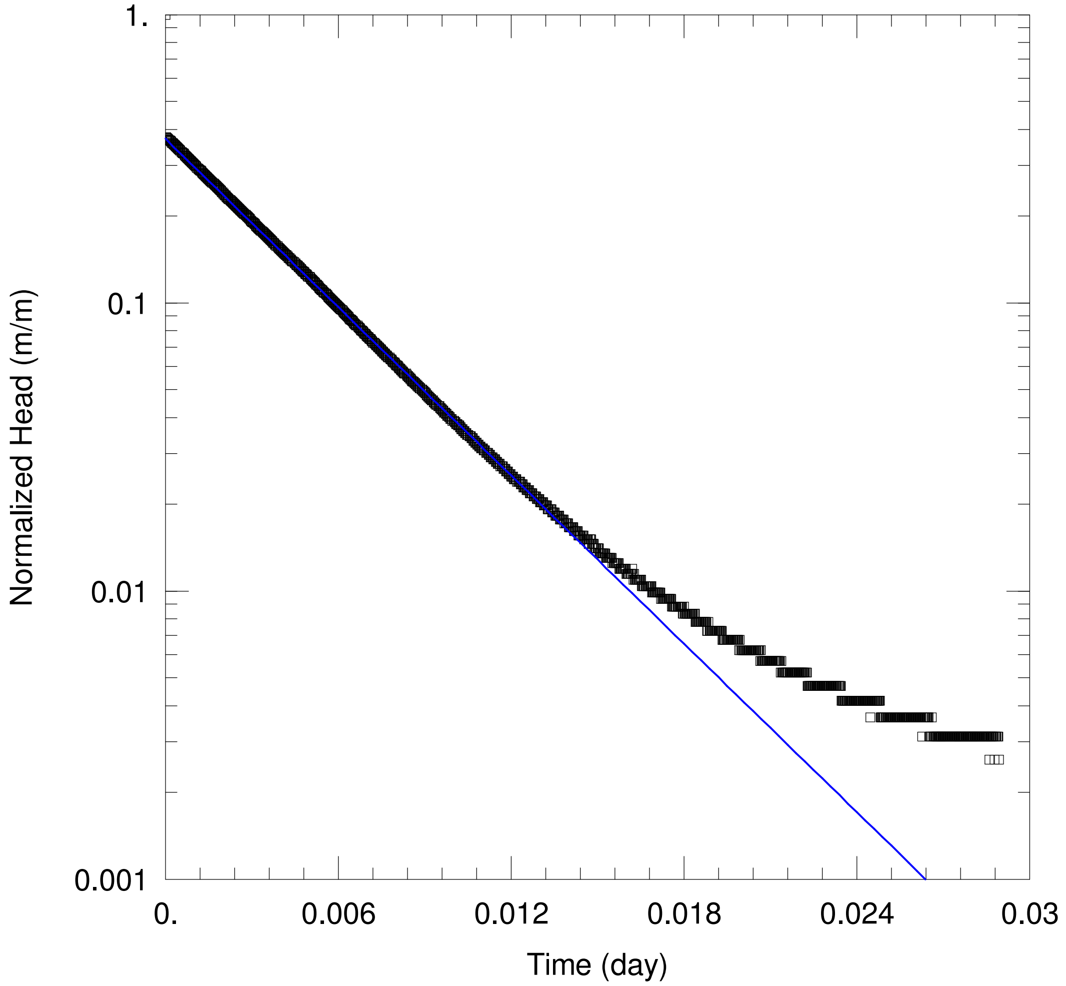
WELL DATA (DW7220W2)

Initial Displacement: 19.43 m
Static Water Column Height: 18.97 m
Total Well Penetration Depth: 18.97 m
Screen Length: 6. m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.01219 m/day
Ss = 0.02476 m^{-1}
Kz/Kr = 0.1



WELL TEST ANALYSIS

Data Set: D:\...\DW7220W3_Bouwer-Rice.aqt
Date: 09/07/19 Time: 16:57:40

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7220W3
Test Date: 23 August 2019

AQUIFER DATA

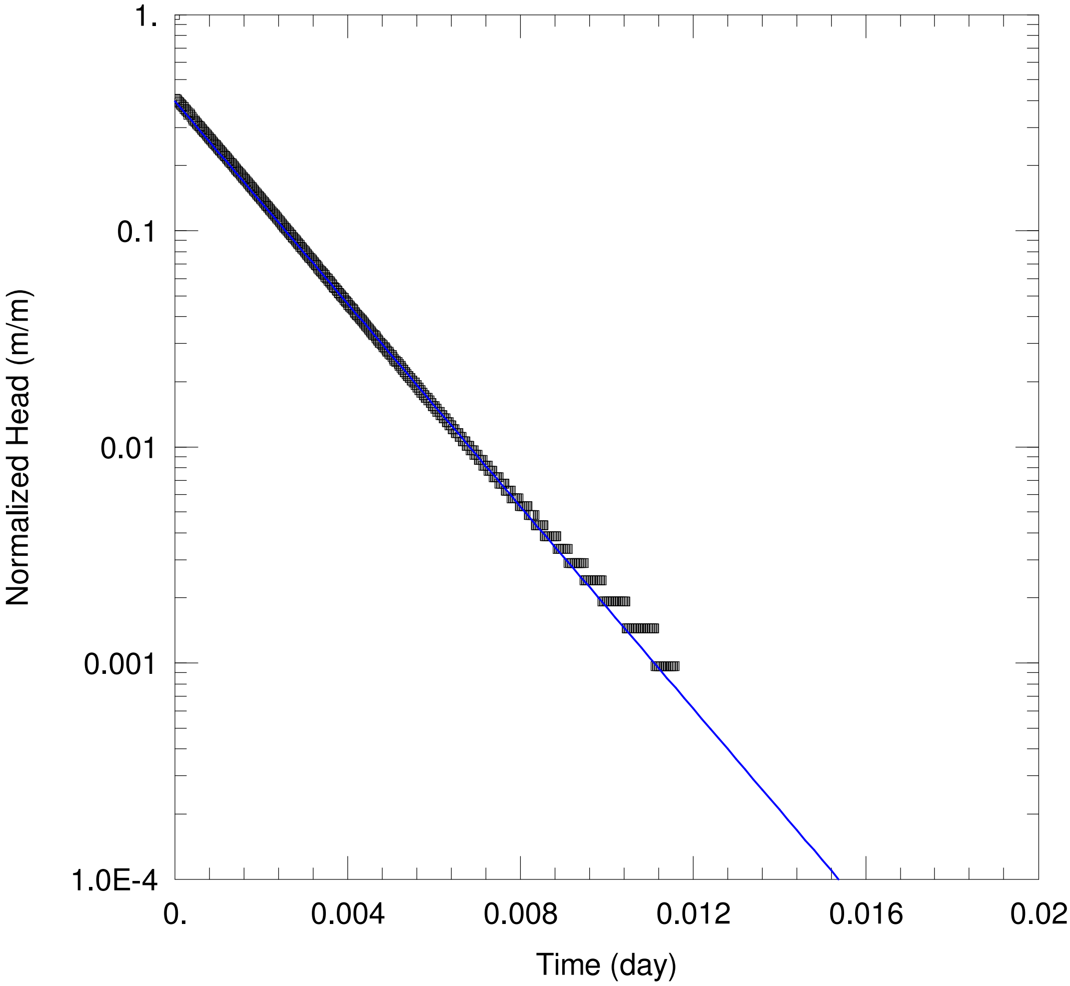
Saturated Thickness: 2. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (DW7220W3)

Initial Displacement: 19.23 m
Static Water Column Height: 55.81 m
Total Well Penetration Depth: 55.81 m
Screen Length: 1.5 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.293 m/day
y0 = 7.131 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7221W1_Bouwer-Rice.aqt
Date: 09/07/19 Time: 17:12:37

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7221W1
Test Date: 23 August 2019

AQUIFER DATA

Saturated Thickness: 3. m
Anisotropy Ratio (Kz/Kr): 1.

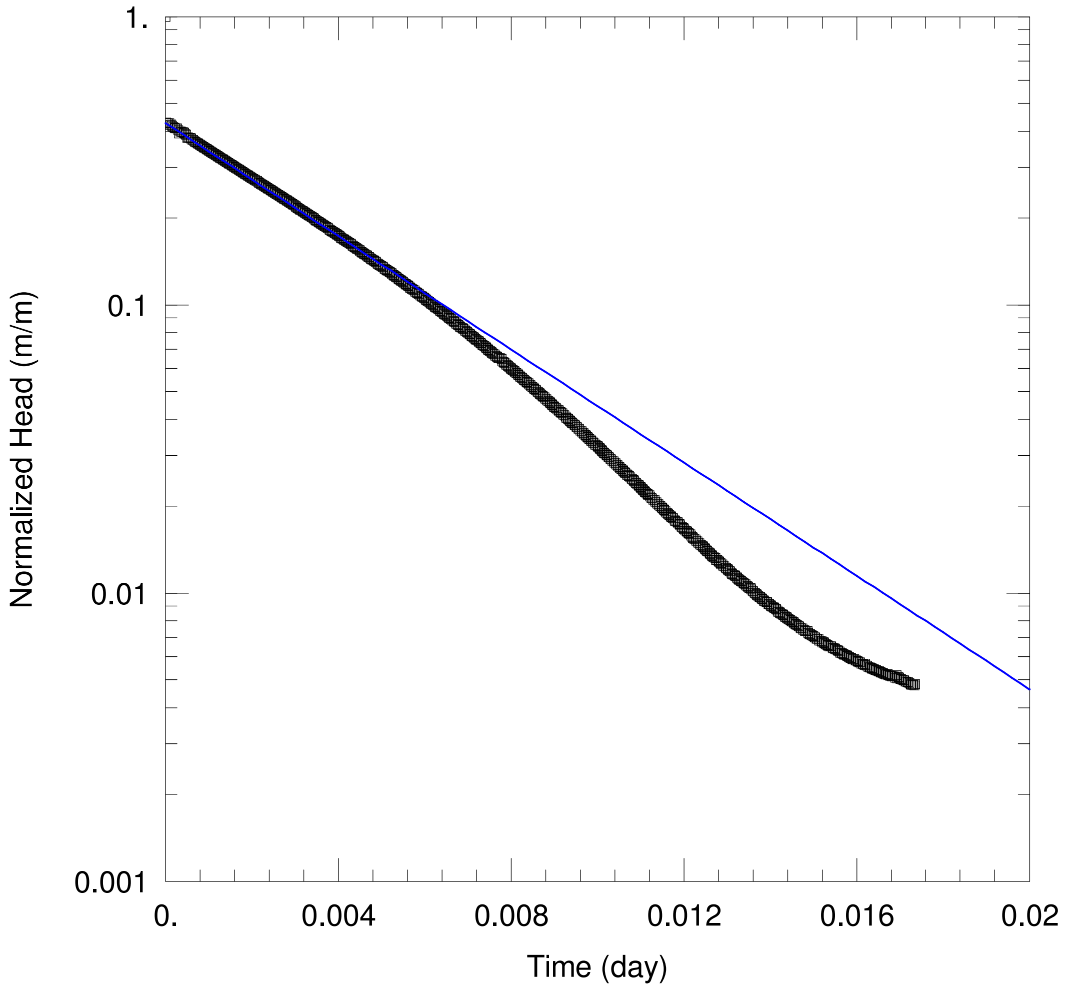
WELL DATA (DW7221W1)

Initial Displacement: 20.72 m
Total Well Penetration Depth: 29.71 m
Casing Radius: 0.025 m
Static Water Column Height: 29.71 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.2859 m/day
y0 = 8.245 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7221W2_Bouwer-Rice.aqt
Date: 09/07/19 Time: 17:11:22

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7221W2
Test Date: 23 August 2019

AQUIFER DATA

Saturated Thickness: 2. m
Anisotropy Ratio (Kz/Kr): 1.

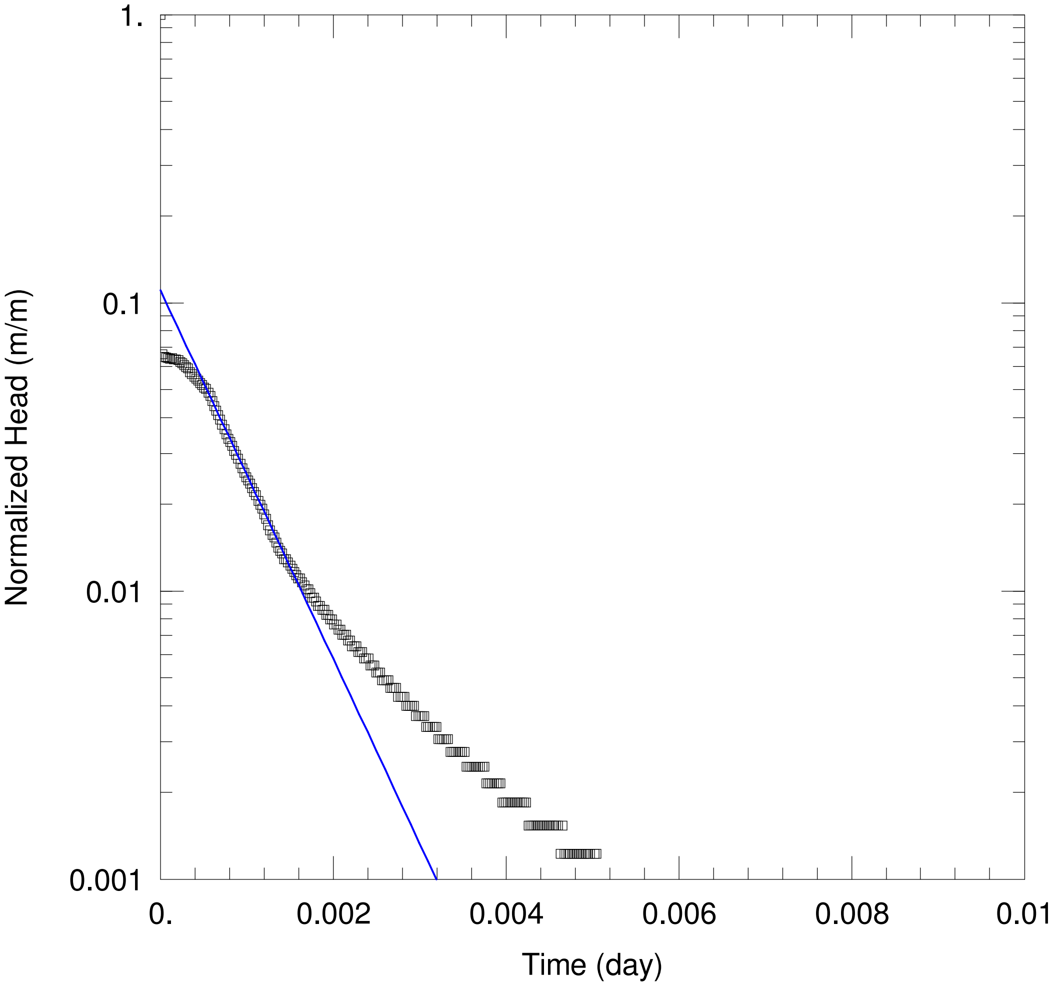
WELL DATA (DW7221W2)

Initial Displacement: 20.77 m
Static Water Column Height: 51.59 m
Total Well Penetration Depth: 51.59 m
Screen Length: 1.5 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.2429 m/day
y0 = 8.882 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7225W1 Bouwer-Rice.aqt
Date: 09/07/19 Time: 17:14:14

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7225W1
Test Date: 3 September 2019

AQUIFER DATA

Saturated Thickness: 4.37 m
Anisotropy Ratio (Kz/Kr): 1.

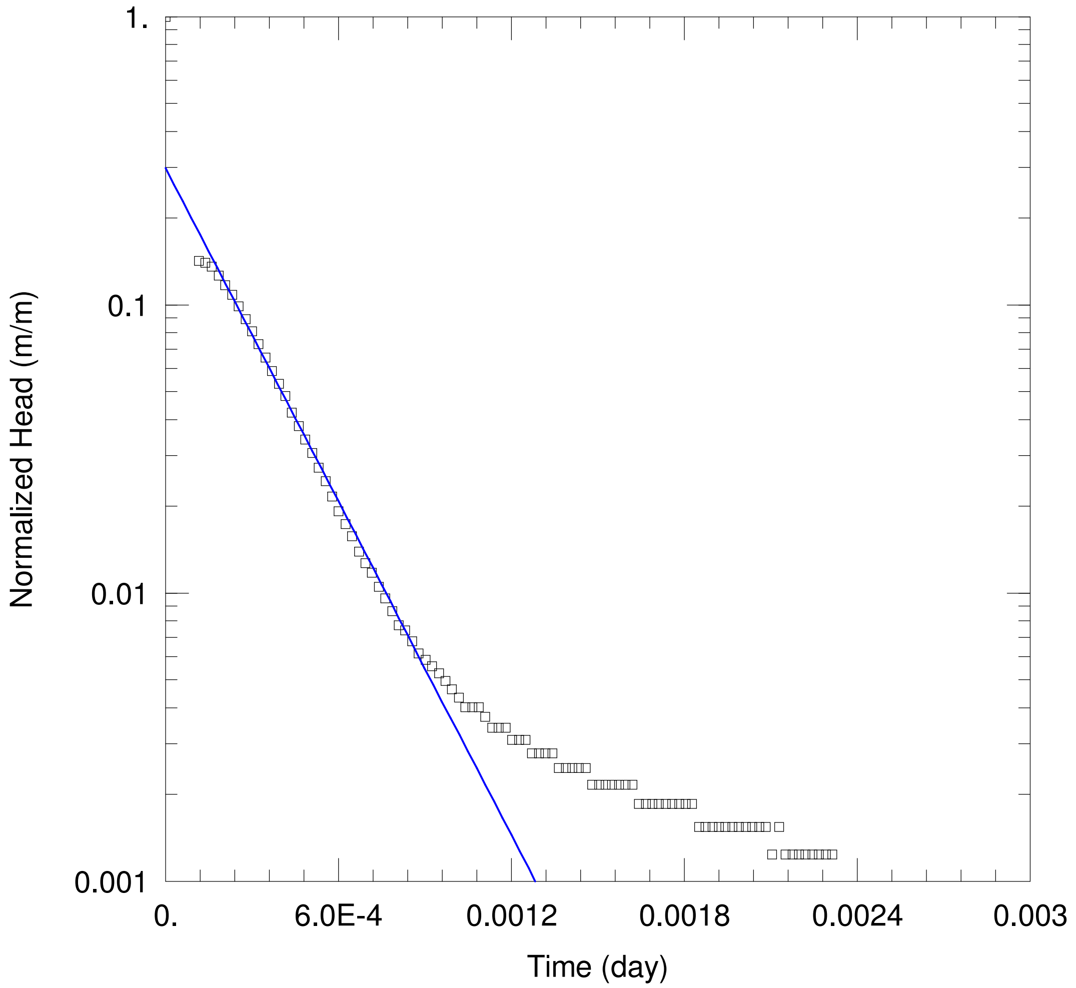
WELL DATA (DW7225W1)

Initial Displacement: 32.63 m
Static Water Column Height: 4.37 m
Total Well Penetration Depth: 6. m
Screen Length: 6. m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.4438 m/day
y0 = 3.6 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7225W2 Bouwer-Rice.aqt
Date: 09/07/19 Time: 17:16:29

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7225W2
Test Date: 3 September 2019

AQUIFER DATA

Saturated Thickness: 3.5 m
Anisotropy Ratio (Kz/Kr): 1.

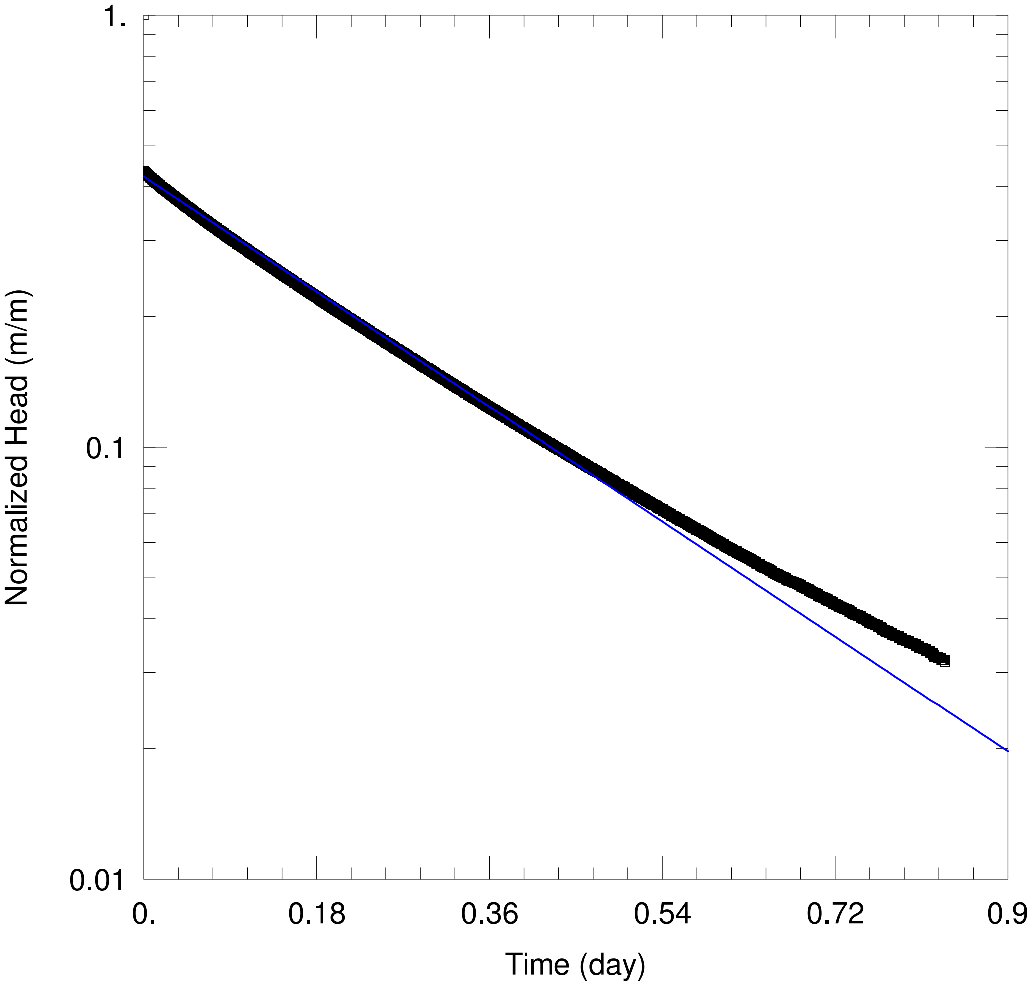
WELL DATA (DW7225W2)

Initial Displacement: 32.37 m
Static Water Column Height: 46.53 m
Total Well Penetration Depth: 47.03 m
Screen Length: 3.5 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 2.141 m/day
y0 = 9.66 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7225W3 Bouwer-Rice.aqt

Date: 09/07/19 Time: 17:17:59

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7225W3
Test Date: 3 September 2019

AQUIFER DATA

Saturated Thickness: 3. m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (DW7225W3)

Initial Displacement: 31.84 m
Total Well Penetration Depth: 80.96 m
Casing Radius: 0.025 m

Static Water Column Height: 80.96 m
Screen Length: 3. m
Well Radius: 0.025 m

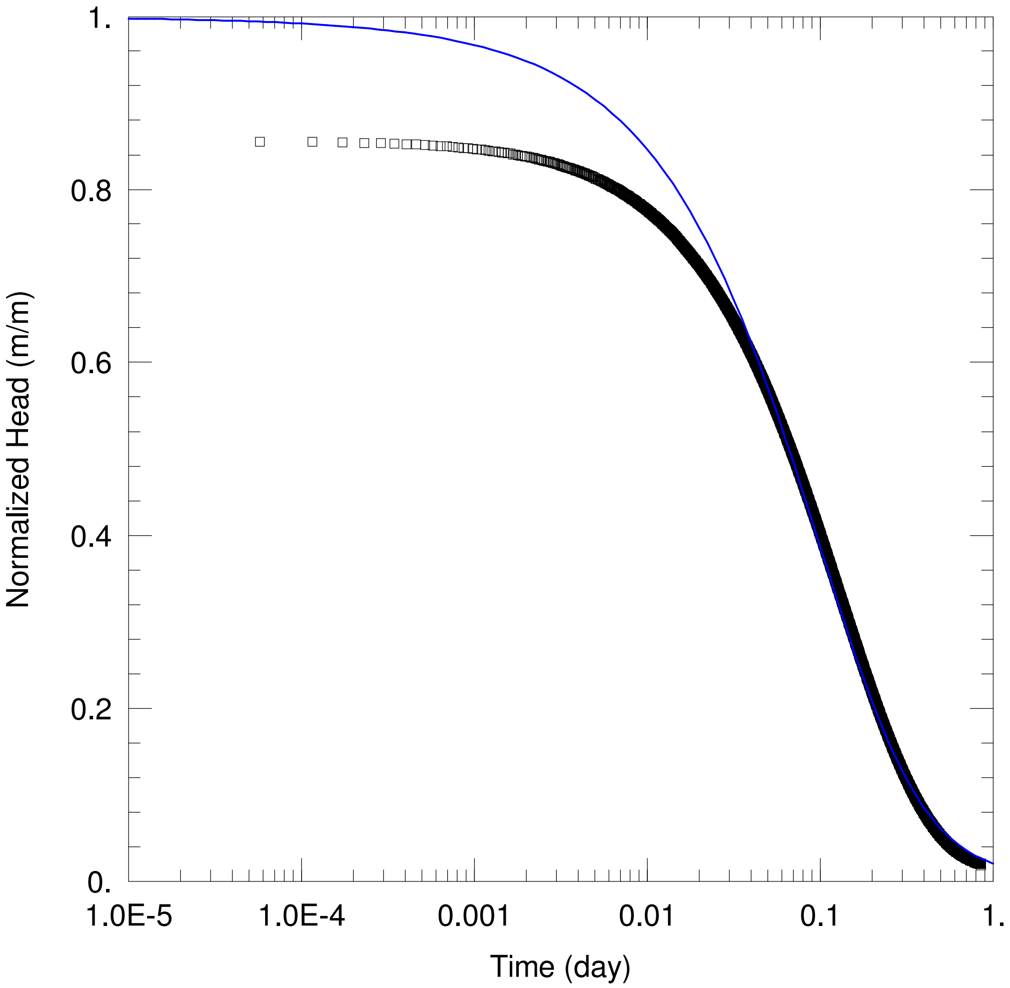
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 0.002001 m/day

y0 = 13.44 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7264W2.aqt
Date: 09/07/19 Time: 12:00:13

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7265W2
Test Date: 15 July 2019

AQUIFER DATA

Saturated Thickness: 2. m

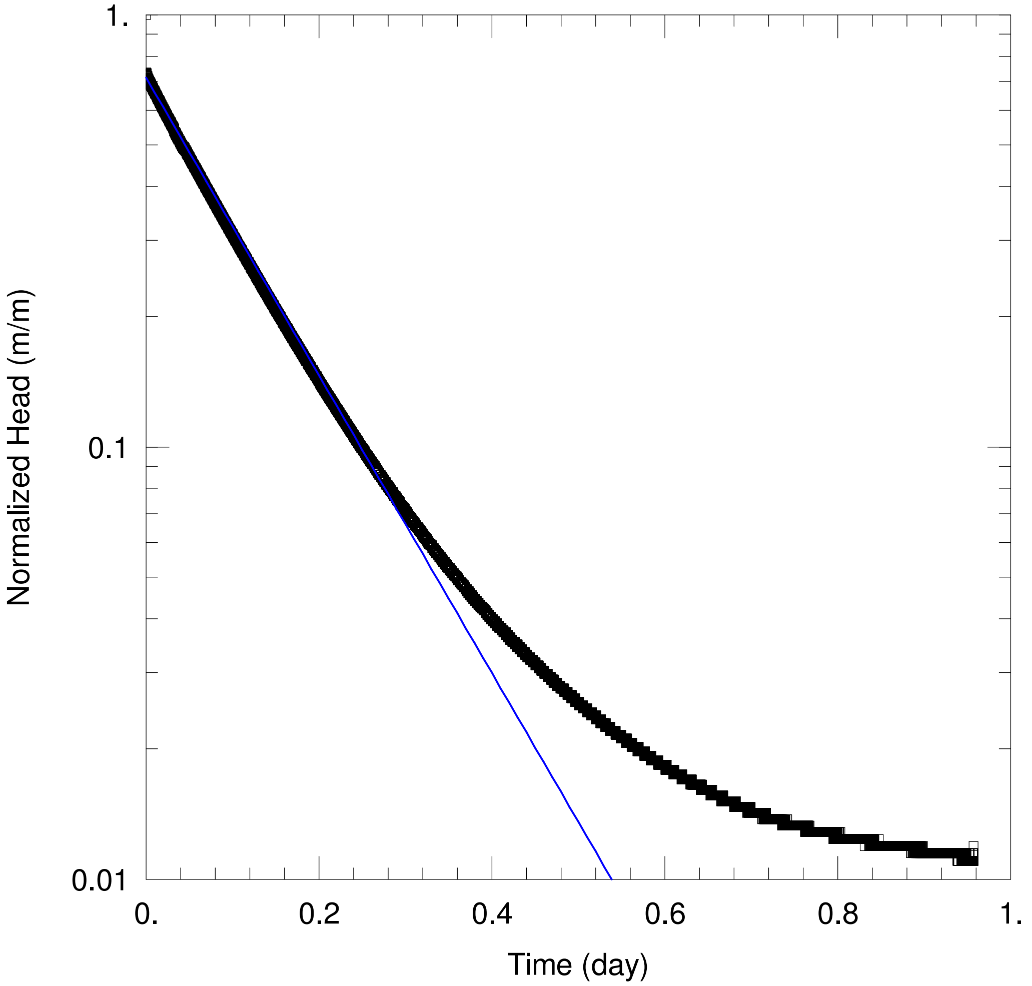
WELL DATA (DW7264W2)

Initial Displacement: 21.77 m
Total Well Penetration Depth: 82.44 m
Casing Radius: 0.025 m
Static Water Column Height: 82.44 m
Screen Length: 1.5 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.009237 m/day
Kz/Kr = 0.1
Ss = 0.006874 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7264W3.aqt
Date: 09/07/19
Time: 12:22:15

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7265W3
Test Date: 15 July 2019

AQUIFER DATA

Saturated Thickness: 2. m
Anisotropy Ratio (Kz/Kr): 0.1

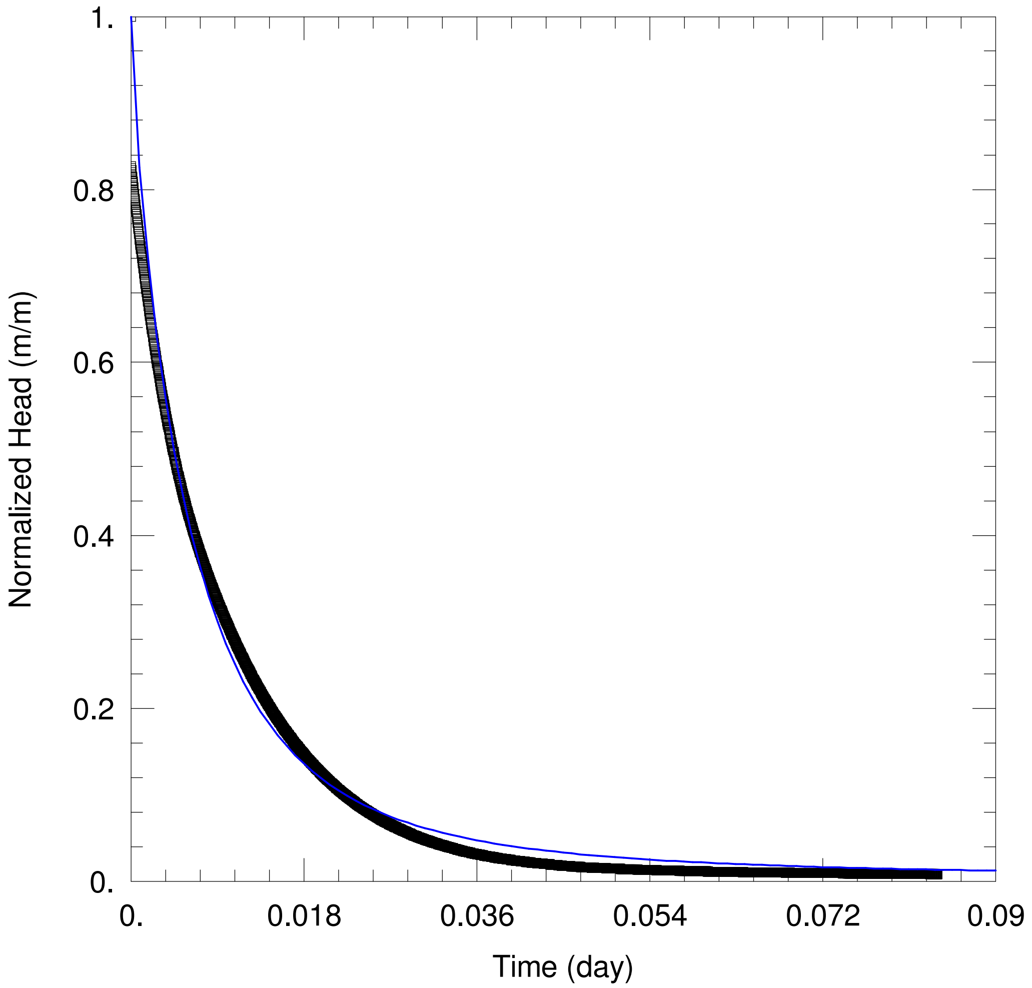
WELL DATA (DW7264W3)

Initial Displacement: 21.78 m
Static Water Column Height: 114.9 m
Total Well Penetration Depth: 114.9 m
Screen Length: 1.5 m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.01101 m/day
y0 = 15.58 m



WELL TEST ANALYSIS

Data Set: D:\...\DW7282W1_KGS Model.aqt
Date: 09/07/19 Time: 14:33:09

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7282W1
Test Date: 18 July 2019

AQUIFER DATA

Saturated Thickness: 16.58 m

WELL DATA (DW7282W1)

Initial Displacement: 26.45 m
Total Well Penetration Depth: 16.58 m
Casing Radius: 0.025 m

Static Water Column Height: 16.58 m
Screen Length: 6. m
Well Radius: 0.025 m

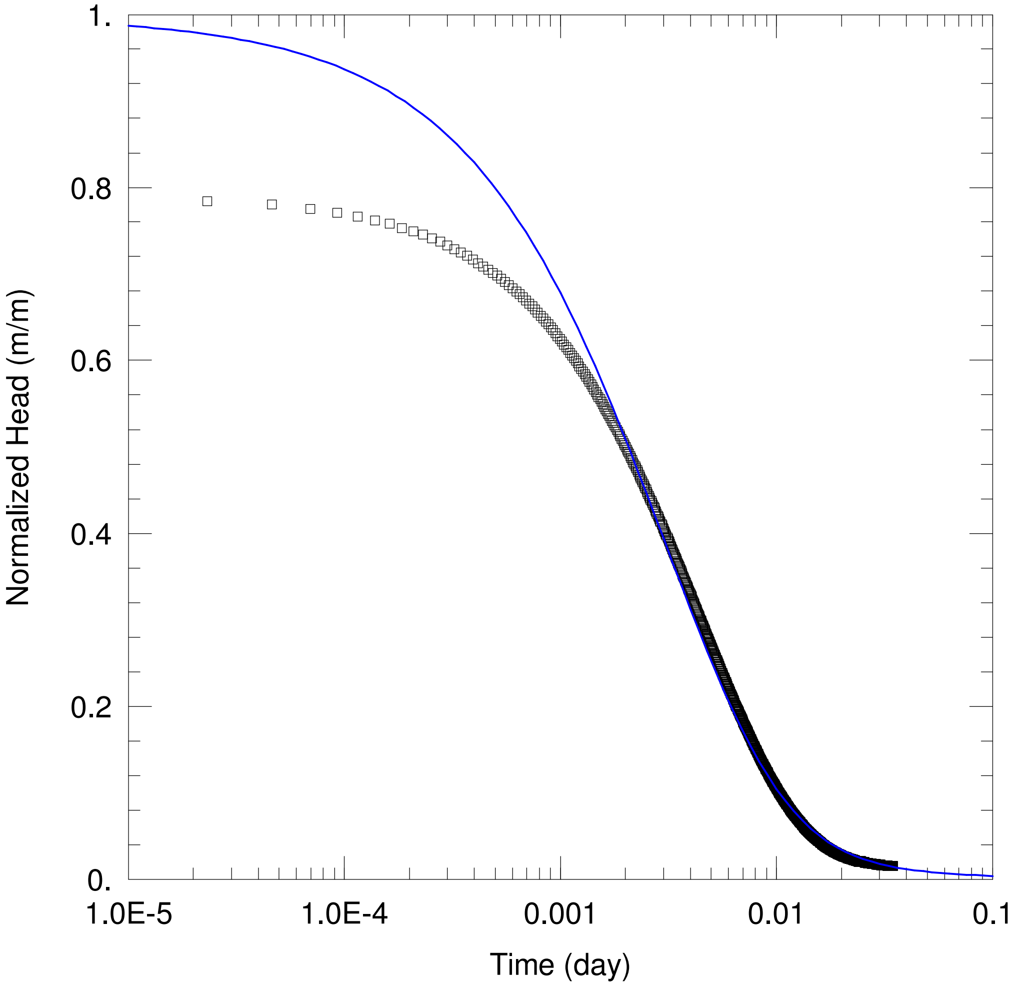
SOLUTION

Aquifer Model: Confined

Solution Method: KGS Model

Kr = 0.02744 m/day
Kz/Kr = 0.1

Ss = 0.0003112 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7282W2_KGS Model.aqt
Date: 09/07/19 Time: 14:51:10

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7282W2
Test Date: 18 July 2019

AQUIFER DATA

Saturated Thickness: 2. m

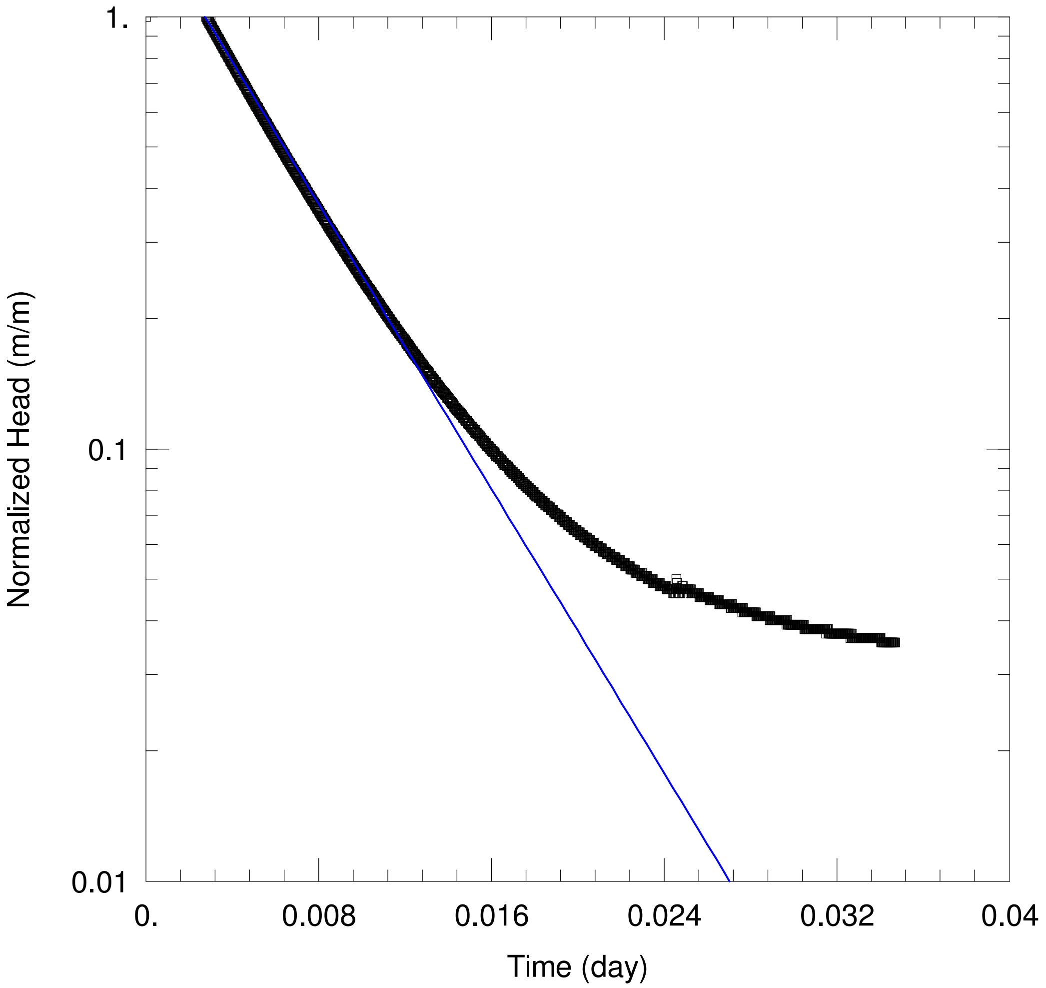
WELL DATA (DW7282W2)

Initial Displacement: 26.51 m
Total Well Penetration Depth: 63.4 m
Casing Radius: 0.025 m
Static Water Column Height: 63.4 m
Screen Length: 1.5 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.2446 m/day
Kz/Kr = 0.1
Ss = 0.00214 m^{-1}



WELL TEST ANALYSIS

Data Set: D:\...\DW7291W1.aqt
Date: 09/07/19 Time: 15:07:11

PROJECT INFORMATION

Company: Gemini Project
Test Well: DW7292W1
Test Date: 23 August 2019

AQUIFER DATA

Saturated Thickness: 3.78 m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (DW7292W1)

Initial Displacement: 11.22 m
Static Water Column Height: 3.78 m
Total Well Penetration Depth: 3.78 m
Screen Length: 3. m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.09701 m/day
y0 = 18.86 m

Appendix D Groundwater Monitoring Data

Appendix A: Summary Bore Details

Site	Bore ID	Unit Monitored	Easting (GDA94)	Northing (GDA94)	Collar RL (mAHD)	RL TOC	Casing Stickup	Bore Depth (m)	Gravel Pack		Slotted Interval	
									From	To	From	To
1	DW7065W	Aries 3 Seam	730860	7382307	135.97	136.65	0.68	77.27	70.3	77.3	71.3	77.3
	DW7066W	Tertiary sediments	730863	7382304	136.37	137.19	0.82	17.35	10.35	17.35	11.35	17.35
2	DW7067W	Aries 3 Seam	730781	7382394	133.92	134.81	0.89	100.14	96.1	100.1	97.1	100.1
	DW7068W	Tertiary sediments	730785	7382391	134	134.94	0.94	47.5	42	47.5	43	47.5
3	DW7069W	Pollux Upper Seam	730397	7382699	132.57	133.46	0.89	71.38	64.4	71.4	65.4	71.4
	DW7071W	Aries 3 Seam	730394	7382703	132.4	133.22	0.82	31.59	27.6	31.6	28.6	31.6
	DW7072W	Tertiary sediments	730403	7382687	132.3	133.14	0.84	14.01	10	14	11	14
4	DW7073W	Castor/ Pollux Seams	729926	7382666	122.09	123.04	0.95	82.1	78.1	82.1	79.1	82.1
	DW7074W	Castor Upper Seams	729922	7382666	122.04	122.94	0.90	55.78	53.3	55.8	54.3	55.8
	DW7075W	Tertiary sediments	729918	7382666	121.83	122.83	1.00	14.03	10	14	11	14
5	DW7076W	Quaternary Alluvium	729750	7382723	119.81	120.82	1.01	12	8	12	9	12
6	DW7033W1	Tertiary	731543	7383768	124.4	125.44	1.04	45.23	38	44.99	38.99	44.99
	DW7033W2	Orion 5 Seam	731546	7383773	124.45	125.46	1.01	74.77	72	74.5	73	74.5
	DW7033W3	Interburden	731548	7383777	124.43	125.47	1.04	81	78.5	81	79.5	81
7	DW7035W3	Orion 1 Seam	730957	7384050	116.67	117.73	1.06	48.47	45.9	48.44	46.94	48.44
8	DW7082W1	Castor Lower Seam	728989	7378746	135.26	136.34	1.08	40.58	38.1	40.64	38.97	40.64
	DW7082W2	Pollux Upper Seam	728986	7378742	135.33	136.32	0.99	59.17	57.6	59.17	57.67	59.17
9	DW7093W1	Pollux Lower Upper Seam	730096	7378974	139	140.14	1.14	87.3	84.5	87.3	85.8	87.3
	DW7093W2	Interburden	730092	7378973	139.05	140.14	1.09	99.2	97.5	99.2	97.7	99.2
	DW7093W3	Pollux Lower Lower Seam	730088	7378974	139.12	140.17	1.05	123.25	120.7	123.25	121.75	123.25
10	DW7105W1	Tertiary	730192	7380733	128.67	129.62	0.95	23.04	19	23.04	20.04	23.04
	DW7105W2	Pollux Lower Upper Seam	730193	7380729	128.7	129.72	1.02	69.25	61.7	64.2	62.7	64.2
11	DW7178W1	Tertiary	732174	7383260	128.65	129.62	0.97	51.15	43	48.5	44	48.5
	DW7178W2	Pollux Lower Upper Seam	732174	7383256	128.64	129.66	1.02	58.69	54.4	58.4	55.4	58.4
12	DW7220W1	Tertiary	729775	7379648	128.68	129.72	1.04	26.5	22.5	26.5	23.5	26.5
	DW7220W2	Castor Seam	729775	7379651	128.64	129.62	0.98	38.4	34.4	38.4	32.4	38.4
	DW7220W3	Pollux Lower Upper Seam	729774	7379655	128.68	129.67	0.99	75.08	72.5	75.04	73.54	75.04
13	DW7221W1	Aries 3 Seam	729846	7379745	129.32	130.34	1.02	50.43	46.4	50.43	47.43	50.43
	DW7221W2	Castor Seam	729845	7379742	129.25	130.32	1.07	72.36	69.8	72.36	70.86	72.36
14	DW7225W1	Tertiary	730467	7378359	140.64	141.70	1.06	37	30	37	31	37
	DW7225W2	Aries 3 Seam	730466	7378355	140.69	141.76	1.07	78.9	74.2	78.9	75.9	78.9
	DW7225W3	Castor Seam	730465	7378351	140.7	141.74	1.04	112.8	107	112.8	109.8	112.8
15	DW7264W1	Tertiary	733392	7382915	112.18	113.16	0.98	14	11.5	14	12.5	14
	DW7264W2	Aries 1 Seam	733391	7382921	112.24	113.22	0.98	104.21	101.7	104.21	102.71	104.21
	DW7264W3	Aries 3 Seam	733391	7382925	112.24	113.24	1.00	136.7	134.2	136.7	135.2	136.7
16	DW7282W1	Overburden	732119	7381433	115.84	116.84	1.00	43.03	36	43	37	43
	DW7282W2	Aries 3 Seam	732123	7381433	115.83	116.82	0.99	89.91	87.4	89.91	88.41	89.91
17	DW7292W1	Quaternary Alluvium	732905	7381108	113.58	114.41	0.83	15	11	15	12	15

Appendix B - Groundwater Level Data (water level below to of casing (mTOC)

Site	Groundwater Unit	Collar RL (mAHD)	Casing Stickup (m)	RL TOC (mAHD)	Dec-2018	Jan-2019	Feb-2019	Apr-2019	May-2019	Jun-2019	Jul-2019	Aug-2019	Sep-2019	Oct-2019	Nov-2019	Dec-2019	Jan-2020	Feb-2020	Mar-2020	Apr-2020	May-2020	Jun-2020	Jul-2020	Aug-2020	Sep-2020	Oct-2020
DW7033W1	Tertiary	124.4	1.04	125.44									30.98	30.99	30.97	31.07	No Access	31.07	31.15	31.13	31.12	31.19	31.12	31.15	31.15	31.18
DW7033W2	Orion 5 Seam	124.45	1.01	125.46									29.93	29.94	29.96	30.22	No Access	30.27	30.39	30.44	30.48	30.47	30.51	30.54	30.58	30.61
DW7033W3	Interburden	124.43	1.04	125.47									29.91	29.91	29.93	30.19	No Access	30.25	30.34	30.42	30.47	30.45	30.49	30.53	30.56	30.59
DW7035W1	Quaternary Alluvium	116.63	1.05	115.58									Dry	Dry	Dry	Dry	No Access	No Access	Dry	Dry	Dry	Dry	Dry.	Dry.	Dry.	Dry.
DW7035W2	Tertiary	116.68	1.02	115.66									Blocked	21.35	Blocked	Blocked	No Access	No Access	Blocked	Blocked	Blocked	20.69	21.63	21.65	21.68	21.7
DW7035W3	Orion 1 Seam	116.67	1.06	117.73									22.69	22.69	22.69	23.25	No Access	No Access	23.19	23.24	23.25	23.27	23.27	23.28	23.3	23.31
DW7065W	Aries 3 Seam	135.97	0.68	136.65	48.94	48.51	48.39	48.33	48.33	48.28	48.30	48.30	48.17	48.19	48.17				48.07	48.12	48.1	48.08	48.05	48.08	48.06	48.01
DW7066W	Tertiary sediments	136.37	0.82	137.19	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	18.23				Dry	Dry	Dry	Dry	Dry.	Dry.	Dry.	Dry.
DW7067W	Aries 3 Seam	133.92	0.89	134.81	46.07	46.08	45.97	45.95	45.96	45.91	45.93	45.95	45.82	45.82	45.82				45.69	45.78	45.75	45.73	45.7	45.73	45.72	45.72
DW7068W	Tertiary sediments	134	0.94	134.94	46.68	46.63	46.64	46.63	46.61	Dry	46.65	46.62	46.60	46.6	46.59				46.59	46.58	46.59	46.57	46.57	46.57	46.58	46.56
DW7069W	Pollux Upper Seam	132.57	0.89	133.46	43.83	43.82	43.75	43.75	43.73	43.73	43.72	43.68	43.68	43.68	43.62				43.54	43.59	43.57	43.43	43.51	43.53	43.52	43.49
DW7071W	Aries 3 Seam	132.4	0.82	133.22	Dry	Dry	Dry	Dry	Dry	Dry		Dry	Dry	Dry	Dry				Dry	Dry	Dry	Dry	Dry.	Dry.	Dry.	Dry.
DW7072W	Tertiary sediments	132.3	0.84	133.14	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry				Dry	Dry	Dry	Dry	Dry.	Dry.	Dry.	Dry.
DW7073W	Castor/ Pollux Seams	122.09	0.95	123.04	33.81	33.77	33.72	33.72	33.69	33.66	33.65	33.61	33.61	33.61	33.52				33.48	33.48	33.44	33.43	33.36	33.41	33.39	33.34
DW7074W	Castor Upper Seams	122.04	0.90	122.94	33.82	33.79	33.74	33.73	33.70	33.68	33.69	33.63	33.62	33.61	33.54				33.47	33.48	33.43	33.38	33.36	33.4	33.39	33.33
DW7075W	Tertiary sediments	121.83	1.00	122.83	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry				Dry	Dry	Dry	Dry	Dry.	Dry.	Dry.	Dry.
DW7076W	Quaternary Alluvium	119.81	1.01	120.82	10.46	10.45	10.41	10.47	10.53	10.59	10.72	10.92	11.10	11.27	11.4				10.88	10.75	10.66	10.7	10.71	10.93	11.05	11.17
DW7082W1	Castor Lower Seam	135.26	1.08	136.34									17.83	17.81	17.8	17.78	No Access	17.67	17.73	17.77	17.76	17.69	17.7	17.67	17.66	17.64
DW7082W2	Pollux Upper Seam	135.33	0.99	136.32									17.90	17.88	17.85	17.82	No Access	17.71	17.76	17.81	17.79	17.73	17.73	17.7	17.69	17.92
DW7093W1	Pollux Lower Upper Seam	139	1.14	140.14									29.31	29.35	29.36	29.36	29.32	29.24	29.28	29.33	29.36	29.32	29.33	29.28	29.31	29.31
DW7093W2	Interburden	139.05	1.09	140.14									30.53	32.17	30.36	30.85	29.94	30.61	30.22	29.99	30.82	30.56	30.47	30.02	29.83	29.99
DW7093W3	Pollux Lower Lower Seam	139.12	1.05	140.17									29.25	29.245	30.72	29.25	29.18	29.14	29.06	29.15	29.13	29.17	29.14	29.2	29.23	29.52
DW7105W1	Tertiary	128.67	0.95	129.62									23.87	23.87	Dry	23.87	Dry	Dry	Dry	Dry	Dry	Dry	Dry.	Dry.	Dry.	Dry.
DW7105W2	Pollux Lower Upper Seam	128.7	1.02	129.72									32.11	32.13	32.12	32.13	32.08	31.99	32.05	32.11	32.14	32.12	32.12	32.11	32.13	32.14
DW7178W1	Tertiary	128.65	0.97	129.62									38.57	38.55	38.6	38.62	38.58	38.54	38.61	38.57	38.6	38.6	38.54	38.5	38.54	38.51
DW7178W2	Pollux Lower Upper Seam	128.64	1.02	129.66									39.21	39.21	39.74	39.57	39.34	39.26	39.26	39.18	39.17	39.14	39.1	39.05	39.04	39.01
DW7220W1	Tertiary	128.68	1.04	129.72									16.41	16.38	16.39	16.38	16.39	16.39	16.44	16.38	16.45	16.4	16.4	16.41	16.39	16.47
DW7220W2	Castor Seam	128.64	0.98	129.62									20.29	20.39	20.45	20.5	20.45	20.3	20.28	20.39	20.42	20.32	20.32	20.29	20.31	20.6
DW7220W3	Pollux Lower Upper Seam	128.68	0.99	129.67									20.14	20.16	20.2	20.23	20.23	20.1	20.06	20.16	20.17	20.13	20.15	20.12	20.12	20.23
DW7221W1	Aries 3 Seam	129.32	1.02	130.34									21.51	21.62	21.68	21.7	21.71	21.52	21.48	21.47	21.51	21.46	21.47	21.43	21.45	21.5
DW7221W2	Castor Seam	129.25	1.07	130.32									21.52	21.58	21.67	21.7	21.69	21.47	21.46	21.45	21.48	21.43	21.47	21.45	21.45	21.58
DW7225W1	Tertiary	140.64	1.06	141.70									33.36	33.38	33.41	33.37	33.37	33.37	33.4	33.34	33.33	33.35	33.31	33.28	33.29	33.45
DW7225W2	Aries 3 Seam	140.69	1.07	141.76									32.87	32.87	32.86	32.84	32.79	32.76	32.8	32.84	32.85	32.82	32.8	32.75	32.79	32.79
DW7225W3	Castor Seam	140.7	1.04	141.74									32.36	32.3	32.3	32.3	32.24	32.19	32.15	32.32	32.32	32.26	32.27	32.23	32.26	32.25
DW7264W1	Tertiary	112.18	0.98	113.16									Dry	Dry	Dry	Dry	No Access	No Access	Dry	Dry	Dry	Dry	Dry.	Dry.	Dry.	Dry.
DW7264W2	Aries 1 Seam	112.24	0.98	113.22									22.31	22.27	22.47	22.46	No Access	No Access	22.37	22.39	22.4	22.37	22.34	22.32	22.32	22.3
DW7264W3	Aries 3 Seam	112.24	1.00	113.24									22.31	22.21	22.36	22.4	No Access	No Access	22.3	22.31	22.34	22.29	22.27	22.26	22.11	22.22
DW7282W1	Overburden	115.84	1.00	116.84									27.34	27.325	27.29	27.26	No Access	27.15	27.19	27.14	27.15	27.15	27.12	27.04	27.06	27.02
DW7282W2	Aries 3 Seam	115.83	0.99	116.82									27.17	27.28	27.19	27.13	No Access	27.01	27.05	27.02	27.03	27.01	26.98	26.98	26.93	26.89
DW7292W1	Quaternary Alluvium	113.58	0.83	114.41									12.26	12.32	12.43	Dry	No Access	No Access	12.47	12.41	12.39	12.33	12.23	12.16	12.27	12.32

Appendix C-1: pH, EC, TDS, Major Ion Data

Site No.	Bore No.	Groundwater Unit	Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
				Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
				Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	Livestock Trigger Levels (ANZECC 2000)			n/a	n/a	5970	5970	4000	n/a	1000	n/a	n/a	n/a	1000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1	DW7065W	Aries 3 Seam	12-Dec-2018	8.21	6.33	28400	27187	19800	4720	439	724	24	9380	679	<1	608	<1	608					
1	DW7065W	Aries 3 Seam	07-Jan-2019	6.85	6.37	27300	28450	19700	5190	456	849	24	9470	711	<1	589	<1	589					
1	DW7065W	Aries 3 Seam	18-Feb-2019	6.81	6.42	28200	28360	19100	5100	458	774	23	9720	789	<1	568	<1	568					
1	DW7065W	Aries 3 Seam	11-Mar-2019	7.01	6.46	28100	27619	19700	5390	508	846	24	9970	781	<1	583	<1	583					
1	DW7065W	Aries 3 Seam	17-Apr-2019	7.03	6.45	26800	27639	19200	5000	551	815	24	9750	733	<1	599	<1	599					
1	DW7065W	Aries 3 Seam	13-May-2019	7.11	6.48	25800	27367	19300	5010	442	792	24	9620	776	<1	610	<1	610					
1	DW7065W	Aries 3 Seam	19-Jun-2019		6.59		27033		4820	516	760	22	9730	763	<1	592	<1	592					
1	DW7065W	Aries 3 Seam	11-Jul-2019	7.78		27400		18100	4860	482	757	26	9120	741	<1	654	<1	654					
1	DW7065W	Aries 3 Seam	26-Aug-2019	7.05	6.47	27400	27509	18900	4740	488	752	24	10200	826	<1	614	<1	614					
1	DW7065W	Aries 3 Seam	23-Sep-2019	7.06	6.46	26400	27157	18800	4850	477	771	25	9570	729	<1	610	<1	610					
1	DW7065W	Aries 3 Seam	23-Oct-2019	7.99	6.35	26200	26533	20300	4810	414	746	23	9420	716	<1	589	<1	589					
1	DW7065W	Aries 3 Seam	20-Nov-2019	7.9	6.39	28100	26858	20500	4840	391	787	22	9440	774	<1	670	<1	670					
1	DW7065W	Aries 3 Seam	16-Mar-2020	7.15	6.51	27400	27751	18700	5790	498	972	28	9460	710	<1	571	<1	571					
1	DW7065W	Aries 3 Seam	23-Apr-2020	7.03	6.49	27000	28570	18200	4550	364	768	23	9710	735	<1	573	<1	573	<20	<50	<100	<50	<50
1	DW7065W	Aries 3 Seam	25-May-2020	6.84	6.59	26700	27696	18100	4810	401	745	24	9510	773	<1	588	<1	588					
1	DW7065W	Aries 3 Seam	30-Jun-2020	6.91	6.46	28200	28857	19400	4520	407	754	22	9470	777	<1	628	<1	628					
1	DW7065W	Aries 3 Seam	28-Jul-2020	7.2	6.49	27600	28701	19300	4870	401	786	24	9590	695	<1	592	<1	592					
1	DW7065W	Aries 3 Seam	31-Aug-2020	6.95	6.44	28000	27980	19400	4860	358	813	23	9760	768	<1	598	<1	598					
1	DW7065W	Aries 3 Seam	28-Sep-2020	7.16	6.48	27500	28097	18400	4670	380	788	23	9440	689	<1	548	<1	548					
1	DW7065W	Aries 3 Seam	21-Oct-2020	7.09	6.44	27300	27813	17800	4770	386	800	23	9550	754	<1	595	<1	595					
2	DW7067W	Aries 3 Seam	12-Dec-2018	8.21	6.29	28500	27457	19900	4660	421	729	26	9590	716	<1	589	<1	589					
2	DW7067W	Aries 3 Seam	07-Jan-2019	6.86	6.29	28000	29175	19900	5040	471	863	28	9720	767	<1	599	<1	599					
2	DW7067W	Aries 3 Seam	18-Feb-2019	6.79	6.38	28500	28613	19300	5160	456	793	27	9820	841	<1	580	<1	580					
2	DW7067W	Aries 3 Seam	11-Mar-2019	6.99	6.45	28500	28023	20500	5480	494	865	26	10100	780	<1	603	<1	603					
2	DW7067W	Aries 3 Seam	17-Apr-2019	6.98	6.41	27200	28021	18600	5060	540	820	27	9750	746	<1	597	<1	597					
2	DW7067W	Aries 3 Seam	13-May-2019	7.01	6.43	26300	28004	20100	5130	435	816	27	9840	764	<1	608	<1	608					
2	DW7067W	Aries 3 Seam	19-Jun-2019		6.84		27800		4900	508	808	26	10100	798	<1	583	<1	583					
2	DW7067W	Aries 3 Seam	11-Jul-2019	7.73		28400		19000	4930	462	784	26	9400	777	<1	634	<1	634					
2	DW7067W	Aries 3 Seam	26-Aug-2019	7.04	6.43	27700	27930	19200	4740	482	769	27	10400	837	<1	614	<1	614					
2	DW7067W	Aries 3 Seam	23-Sep-2019	7.02	6.39	26400	27467	19100	4340	408	692	24	9890	728	<1	608	<1	608					
2	DW7067W	Aries 3 Seam	23-Oct-2019	8.04	6.41	26400	26825	19900	4900	410	776	26	9520	732	<1	583	<1	583					
2	DW7067W	Aries 3 Seam	20-Nov-2019	7.73	6.32	28400	27303	19900	4660	397	743	25	9640	799	<1	628	<1	628					
2	DW7067W	Aries 3 Seam	16-Mar-2020	7.17	6.38	27800	28245	19200	6060	496	998	32	9440	749	<1	573	<1	573					
2	DW7067W	Aries 3 Seam	23-Apr-2020	7.02	6.42	27100	28792	18200	4570	350	771	24	9800	743	<1	568	<1	568	<20	<50	<100	<50	<50
2	DW7067W	Aries 3 Seam	25-May-2020	6.86	6.52	27200	28221	18600	4820	396	738	26	9660	798	<1	592	<1	592					
2	DW7067W	Aries 3 Seam	30-Jun-2020	6.91	6.43	28300	29112	19700	4460	389	747	24	9410	778	<1	628	<1	628					
2	DW7067W	Aries 3 Seam	28-Jul-2020	7.17	6.46	27600	28865	19500	4780	396	784	26	9750	695	<1	644	<1	644					
2	DW7067W	Aries 3 Seam	31-Aug-2020	6.96	6.42	28500	28438	19400	5050	364	847	25	9900	783	<1	594	<1	594					
2	DW7067W	Aries 3 Seam	28-Sep-2020	7.11	6.43	27600	28250	19000	4680	382	797	26	9510	691	<1	560	<1	560					
2	DW7067W	Aries 3 Seam	21-Oct-2020	7.09	6.39	28000	28414	18300	4410	372	722	25	9850	776	<1	602	<1	602					
2	DW7068W	Tertiary sediments	12-Dec-2018	8.29	6.86	20200	19273	14000	3530	216	523	101	6940	291	<1	607	<1	607					
2	DW7068W	Tertiary sediments	07-Jan-2019	7.26	6.78	20600	21433	14300	3710	211	575	82	7240	295	<1	601	<1	601					
2	DW7068W	Tertiary sediments	18-Feb-2019	7.23	6.98	21000	21493	13400	3880	226	563	77	7390	344	<1	578	<1	578					
2	DW7068W	Tertiary sediments	11-Mar-2019	7.38	6.95	21200	20960	14900	4040	234	596	73	8160	635	<1	593	<1	593					
2	DW7068W	Tertiary sediments	17-Apr-2019	7.57	7.06	20800	21270	13700	3780	259	577	72	7480	338	<1	600	<1	600					
2	DW7068W	Tertiary sediments	13-May-2019	7.42	6.93	20200	21301	14700	3790	202	568	72	7650	334	<1	602	<1	602					
2	DW7068W	Tertiary sediments	11-Jul-2019	7.89		21900		14300	4120	246	647	68	7220	334	<1	619	<1	619					
2	DW7068W	Tertiary sediments	23-Sep-2019	7.22	6.7	20600	20338	15000	3330	198	497	53	7500	334	<1	570	<1	570					
2	DW7068W	Tertiary sediments	20-Nov-2019	7.93	6.58	22100	21014	15700	3740	181	558	50	7560	348	<1	568	<1	568					
2	DW7068W	Tertiary sediments	16-Mar-2020	7.45	6.73	21400	21553	14200	4540	238	709	57	7470	300	<1	524	<1	524					
2	DW7068W	Tertiary sediments	28-Jul-2020	7.32	6.7	21600	22783	13900	3790	198	575	41	7630	322	<1	553	<1	553					
2	DW7068W	Tertiary sediments	31-Aug-2020	7.04	6.6	22600	22426	14800	3980	185	619	39	7880	364	<1	554	<1	554					
2	DW7068W	Tertiary sediments	28-Sep-2020	7.3	6.67	22100	22524	14600	3720	196	586	39	7770	341	<1	506	<1	506					
2	DW7068W	Tertiary sediments	21-Oct-2020	7.42	6.64	22300	22540	14500	3610	198	549	38	7970	359	<1	552	<1	552					
3	DW7069W	Pollux Upper Seam	12-Dec-2018	8.28	6.3	25500	24484	17600	4590	349	627	23	8490	623	<1	587	<1	587					
3	DW7069W	Pollux Upper Seam	07-Jan-2019	6.87	6.25	25000	25868	17700	4500	321	636	21	8670	610	<1	580	<1	580					
3	DW7069W	Pollux Upper Seam	18-Feb-2019	6.77	6.33	22100	22731	14500	4210	312	553	20	7720	645	<1	530	<1	530					
3	DW7069W	Pollux Upper Seam	11-Mar-2019	6.92	6.38	23500	23087	16300	4590	352	634	22	8590	387	<1	566	<1	566					
3	DW7069W	Pollux Upper Seam	17-Apr-2019	7.02	6.33	23000	23682	14900	4300	396	612	21	8210	618	<1	578	<1	578					
3	DW7069W	Pollux Upper Seam	13-May-2019	6.91	6.39	22600	23989	16000	4110	299	574	20	8470	653	<1	595	<1	595					
3	DW7069W	Pollux Upper Seam	19-Jun-2019		6.51		24483		4280	388	622	21	8800	671	<1	573	<1	573					
3	DW7069W	Pollux Upper Seam	11-Jul-2019	7.67		24800		16400	4340	343	606	21	8270	642	<1	606	<1	606					
3	DW7069W	Pollux Upper Seam	26-Aug-2019	6.98	6.36	24500	24741	16800	4350	379	615	23	9090	762	<1	599	<1	599					
3	DW7069W	Pollux Upper Seam	23-Sep-2019	6.96	6.33	23300	24130	16300	3870	310	534	20	8320	615	<1	585	<1	585					
3	DW7069W	Pollux Upper Seam	23-Oct-2019	7.99	6.29	23200	23607	17700	4420	313	611	20	8360	646	<1	570	<1	570					

Appendix C-1: pH, EC, TDS, Major Ion Data

Site No.	Bore No.	Groundwater Unit	Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
				Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
				Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	Livestock Trigger Levels (ANZECC 2000)			n/a	n/a	5970	5970	4000	n/a	1000	n/a	n/a	n/a	1000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3	DW7069W	Pollux Upper Seam	20-Nov-2019	7.67	6.23	24800	23963	17800	4200	312	581	21	8420	669	<1	612	<1	612					
3	DW7069W	Pollux Upper Seam	16-Mar-2020	7.09	6.36	23900	24452	16300	5100	363	740	25	8000	615	<1	577	<1	577					
3	DW7069W	Pollux Upper Seam	23-Apr-2020	7.13	6.54	21800	22930	14600	3750	236	525	19	7730	586	<1	533	<1	533	<20	<50	<100	<50	<50
3	DW7069W	Pollux Upper Seam	25-May-2020	6.79	6.44	24500	25609	17300	4480	316	624	22	8730	705	<1	582	<1	582					
3	DW7069W	Pollux Upper Seam	30-Jun-2020	6.87	6.36	24600	25630	16700	4260	314	587	21	8240	586	<1	554	<1	554					
3	DW7069W	Pollux Upper Seam	28-Jul-2020	7.2	6.38	25000	25848	16700	4330	307	615	21	8680	561	<1	584	<1	584					
3	DW7069W	Pollux Upper Seam	31-Aug-2020	6.89	6.36	25000	25128	16400	4460	262	636	21	8720	655	<1	586	<1	586					
3	DW7069W	Pollux Upper Seam	28-Sep-2020	7.1	6.38	24600	25189	16600	4460	296	655	22	8500	590	<1	535	<1	535					
3	DW7069W	Pollux Upper Seam	22-Oct-2020	7.08	6.34	25000	25584	16500	4080	277	586	21	8720	676	<1	577	<1	577					
4	DW7073W	Castor/ Pollux Seams	13-Dec-2018	8.23	6.26	24500	23392	17100	4340	423	485	21	8240	341	<1	411	<1	411					
4	DW7073W	Castor/ Pollux Seams	07-Jan-2019	6.84	6.21	24100	25049	16800	4380	401	512	20	8150	346	<1	423	<1	423					
4	DW7073W	Castor/ Pollux Seams	18-Feb-2019	6.77	6.32	24100	24459	16000	4530	432	502	21	8180	404	<1	414	<1	414					
4	DW7073W	Castor/ Pollux Seams	11-Mar-2019	6.97	6.39	24300	23980	17200	4930	483	557	22	9080	550	<1	436	<1	436					
4	DW7073W	Castor/ Pollux Seams	17-Apr-2019	6.98	6.33	23100	23847	16400	4380	514	517	21	8470	387	<1	423	<1	423					
4	DW7073W	Castor/ Pollux Seams	13-May-2019	6.94	6.38	22600	23963	15900	4180	367	477	20	8510	388	<1	449	<1	449					
4	DW7073W	Castor/ Pollux Seams	19-Jun-2019		6.52		23989		4230	476	501	20	8780	383	<1	422	<1	422					
4	DW7073W	Castor/ Pollux Seams	11-Jul-2019	7.64		24400		15800	4300	430	498	20	8160	373	<1	452	<1	452					
4	DW7073W	Castor/ Pollux Seams	26-Aug-2019	6.98	6.35	24000	24057	15800	4280	452	491	21	8730	417	<1	460	<1	460					
4	DW7073W	Castor/ Pollux Seams	23-Sep-2019	6.9	6.33	22800	23610	16100	3800	377	437	19	8310	388	<1	440	<1	440					
4	DW7073W	Castor/ Pollux Seams	23-Oct-2019	7.95	6.26	22800	23053	17500	4290	376	501	19	8320	397	<1	442	<1	442					
4	DW7073W	Castor/ Pollux Seams	20-Nov-2019	7.66	6.22	24500	23611	17200	4150	326	485	19	8410	400	<1	469	<1	469					
4	DW7073W	Castor/ Pollux Seams	16-Mar-2020	7.09	6.35	23700	24395	15900	5090	433	617	24	8250	388	<1	418	<1	418					
4	DW7073W	Castor/ Pollux Seams	23-Apr-2020	6.94	6.33	23400	24629	15700	4070	315	500	19	8500	378	<1	427	<1	427	<20	<50	<100	<50	<50
4	DW7073W	Castor/ Pollux Seams	25-May-2020	6.79	6.44	23700	24545	15500	4400	309	529	20	8520	418	<1	450	<1	450					
4	DW7073W	Castor/ Pollux Seams	30-Jun-2020	6.9	6.39	24400	25369	16400	4150	370	522	20	8360	424	<1	476	<1	476					
4	DW7073W	Castor/ Pollux Seams	28-Jul-2020	7.17	6.39	23800	24988	16400	4260	350	505	20	8380	361	<1	488	<1	488					
4	DW7073W	Castor/ Pollux Seams	31-Aug-2020	6.84	6.35	24800	24766	16200	4520	330	568	21	8700	436	<1	454	<1	454					
4	DW7073W	Castor/ Pollux Seams	28-Sep-2020	7.02	6.35	24100	24761	16200	4160	341	520	20	8490	377	<1	420	<1	420					
4	DW7073W	Castor/ Pollux Seams	22-Oct-2020	7.03	6.35	24400	24760	16000	3930	322	491	20	8630	415	<1	464	<1	464					
4	DW7074W	Castor Upper Seams	13-Dec-2018	8.34	6.71	26100	25085	18000	4720	327	606	25	8670	488	20	585	<1	605					
4	DW7074W	Castor Upper Seams	07-Jan-2019	7.18	6.57	25500	26576	18200	4650	302	616	23	8890	511	<1	624	<1	624					
4	DW7074W	Castor Upper Seams	18-Feb-2019	6.99	6.55	25700	26043	16900	4880	329	605	24	8920	600	<1	605	<1	605					
4	DW7074W	Castor Upper Seams	11-Mar-2019	7.23	6.65	26000	25523	18000	5060	350	654	23	9220	574	<1	642	<1	642					
4	DW7074W	Castor Upper Seams	17-Apr-2019	7.19	6.56	24500	25280	17000	4700	380	619	23	8850	546	<1	620	<1	620					
4	DW7074W	Castor Upper Seams	13-May-2019	7.17	6.59	24200	25440	16900	4450	285	571	22	8980	570	<1	637	<1	637					
4	DW7074W	Castor Upper Seams	19-Jun-2019		6.69		25929		4640	372	612	22	9080	560	<1	635	<1	635					
4	DW7074W	Castor Upper Seams	11-Jul-2019	7.8		25800		16900	4790	332	612	23	8570	528	<1	661	<1	661					
4	DW7074W	Castor Upper Seams	26-Aug-2019	7.2	6.55	25300	25483	17000	4570	358	587	24	9180	578	<1	634	<1	634					
4	DW7074W	Castor Upper Seams	23-Sep-2019	7.13	6.53	24300	25167	17200	4040	295	519	21	8930	524	<1	596	<1	596					
4	DW7074W	Castor Upper Seams	23-Oct-2019	8.11	6.46	24300	24536	18500	4690	295	599	22	8670	522	<1	625	<1	625					
4	DW7074W	Castor Upper Seams	20-Nov-2019	7.98	6.4	25800	24993	18200	4420	272	565	20	8730	535	<1	625	<1	625					
4	DW7074W	Castor Upper Seams	16-Mar-2020	7.26	6.49	25100	25877	17100	5600	376	785	28	8550	525	<1	595	<1	595					
4	DW7074W	Castor Upper Seams	23-Apr-2020	7.15	6.56	25000	26156	16400	4370	261	592	21	8940	501	<1	597	<1	597	<20	<50	<100	<50	<50
4	DW7074W	Castor Upper Seams	25-May-2020	6.95	6.6	25000	25886	16600	4570	287	572	23	8790	576	<1	616	<1	616					
4	DW7074W	Castor Upper Seams	30-Jun-2020	7.07	6.57	26200	27068	17700	4620	318	658	23	8810	576	<1	641	<1	641					
4	DW7074W	Castor Upper Seams	28-Jul-2020	7.35	6.56	25500	26658	17400	4610	301	627	23	8910	493	<1	674	<1	674					
4	DW7074W	Castor Upper Seams	31-Aug-2020	7.06	6.53	26100	26023	17000	4720	273	658	23	9020	553	<1	626	<1	626					
4	DW7074W	Castor Upper Seams	28-Sep-2020	7.24	6.55	25800	26200	17600	4580	288	637	23	8810	493	<1	576	<1	576					
4	DW7074W	Castor Upper Seams	22-Oct-2020	7.26	6.53	25500	25920	16900	4170	273	554	22	8960	537	<1	622	<1	622					
5	DW7076W	Quaternary Alluvium	12-Dec-2018	8.04	7.24	16200	14782	10600	2410	42	279	10	4170	214	<1	3600	<1	3600					
5	DW7076W	Quaternary Alluvium	07-Jan-2019	8.04	7.05	16600	17106	10500	3720	62	407	15	4290	205	<1	3620	<1	3620					
5	DW7076W	Quaternary Alluvium	18-Feb-2019	7.57	7.2	16000	16262	10000	3490	67	368	13	4140	231	<1	3480	<1	3480					
5	DW7076W	Quaternary Alluvium	11-Mar-2019	7.66	7.37	16200	16145	10400	3760	65	383	14	4190	249	<1	3540	<1	3540					
5	DW7076W	Quaternary Alluvium	17-Apr-2019	7.37	7.38	15400	15760	10300	3420	73	357	14	4060	212	<1	3510	<1	3510					
5	DW7076W	Quaternary Alluvium	13-May-2019	7.84	7.36	15200	15632	10100	3370	47	329	15	4120	204	<1	3680	<1	3680					
5	DW7076W	Quaternary Alluvium	19-Jun-2019		7.49		15602		3340	49	335	13	4030	220	<1	3480	<1	3480					
5	DW7076W	Quaternary Alluvium	11-Jul-2019	7.76		15400		9980	3410	48	317	15	3750	210	<1	1840	<1	1840					
5	DW7076W	Quaternary Alluvium	26-Aug-2019	7.79	7.29	15300	14975	9200	3170	45	292	16	4040	209	562	2960	<1	3520					
5	DW7076W	Quaternary Alluvium	23-Sep-2019	7.79	7.27	14600	14552	11300	2660	33	237	14	3680	201	<1	2980	<1	2980					
5	DW7076W	Quaternary Alluvium	23-Oct-2019	8.51	7.27	14400	14079	9800	3010	46	267	15	3590	184	<1	3200	<1	3200					
5	DW7076W	Quaternary Alluvium	20-Nov-2019	8.27	7.19	15100	14439	9860	3220	33	277	15	3700	202	<1	3320	<1	3320					
5	DW7076W	Quaternary Alluvium	31-Mar-2020	8.02	6.9	14100	15036	9150	3440	31	295	16	3570	175	<1	2830	<1	2830					
5	DW7076W	Quaternary Alluvium	23-Apr-2020	7.72	7.34	14500	14860	9510	3050	29	282	14	3730	122	<1	3360	<1	3360	<20	<50	<100	<50	<50
5	DW7076W	Quaternary Alluvium	25-May-2020	8.08	7.38	14300	14716	9460	3180	30	293	14	3630	178	<1	1730	<1	1730					
5	DW7076W	Quaternary Alluvium	30-Jun-2020	7.66	7.3	14500	14889	8870	3110	38	300	16	3630	195	<1	3300	<1	3300					

Appendix C-1: pH, EC, TDS, Major Ion Data

				pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
Site No.	Bore No.	Groundwater Unit	Date	Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
				Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	Livestock Trigger Levels (ANZECC 2000)			n/a	n/a	5970	5970	4000	n/a	1000	n/a	n/a	n/a	1000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	DW7076W	Quaternary Alluvium	28-Jul-2020	7.98	7.36	14100	14747	9500	3120	40	261	14	3810	191	<1	2020	<1	2020					
5	DW7076W	Quaternary Alluvium	31-Aug-2020	8.06	7.29	14400	14448	9470	3610	35	336	17	3620	186	<1	3100	<1	3100					
5	DW7076W	Quaternary Alluvium	28-Sep-2020	7.81	7.29	14300	14282	9390	3120	35	285	16	3500	192	<1	3200	<1	3200					
5	DW7076W	Quaternary Alluvium	22-Oct-2020	7.73	7.22	14300	14509	9340	2850	30	245	16	3670	180	<1	3420	<1	3420					
6	DW7033W1	Tertiary	26-Sep-2019	7.9	6.75	7210	7214	4220	1240	122	205	6	2220	78	<1	727	<1	727					
6	DW7033W1	Tertiary	30-Oct-2019	7.3	6.66	7300	7001	4280	1190	96	183	6	2210	81	<1	724	<1	724					
6	DW7033W1	Tertiary	26-Nov-2019	7.72	6.61	7730	7253	4350	1210	106	200	6	2280	87	<1	721	<1	721					
6	DW7033W1	Tertiary	18-Dec-2019	7.3	6.65	7380	7320	4700	1280	104	203	6	2240	93	<1	711	<1	711					
6	DW7033W1	Tertiary	20-Feb-2020	7.3	6.74	7380	7303	4330	1240	93	189	6	2220	75	<1	672	<1	672					
6	DW7033W1	Tertiary	20-Mar-2020	7.21	6.78	7230	7238	4290	1190	100	189	6	1950	76	<1	682	<1	682					
6	DW7033W1	Tertiary	28-Apr-2020	7.24	6.68	7570	7607	4780	1230	103	188	7	2300	86	<1	663	<1	663	<20	<300	440	<300	440
6	DW7033W1	Tertiary	20-May-2020	7	6.77	7180	7390	4470	1190	94	179	6	2190	77	<1	687	<1	687					
6	DW7033W1	Tertiary	17-Jun-2020	7.42	7.47	7450	7748	4320	1240	116	191	6	2210	85	<1	550	<1	550					
6	DW7033W1	Tertiary	15-Jul-2020	7.14	6.77	7560	7643	4470	1270	113	200	6	2250	90	<1	697	<1	697					
6	DW7033W1	Tertiary	21-Aug-2020	7.54	6.71	8000	7923	4730	1320	126	214	7	2360	89	<1	740	<1	740					
6	DW7033W1	Tertiary	24-Sep-2020	7.69	6.68	7770	7788	4650	1310	100	204	6	2310	89	<1	710	<1	710					
6	DW7033W1	Tertiary	21-Oct-2020	7.25	6.67	7430	7537	4550	1140	102	185	6	2170	77	<1	716	<1	716					
6	DW7033W2	Orion 5 Seam	26-Sep-2019	7.86	6.8	14800	14884	10800	2510	443	428	12	5290	202	<1	537	<1	537					
6	DW7033W2	Orion 5 Seam	30-Oct-2019	7.37	6.68	15000	14393	9540	2380	335	377	10	5310	311	<1	540	<1	540					
6	DW7033W2	Orion 5 Seam	26-Nov-2019	7.69	6.61	15500	14698	10400	2470	325	411	11	5280	333	<1	584	<1	584					
6	DW7033W2	Orion 5 Seam	18-Dec-2019	7.14	6.49	15200	15378	12100	2580	313	409	12	5310	294	<1	582	<1	582					
6	DW7033W2	Orion 5 Seam	20-Feb-2020	7.46	6.82	15200	15152	10600	2530	289	386	12	5430	223	<1	537	<1	537					
6	DW7033W2	Orion 5 Seam	20-Mar-2020	7.24	6.78	15200	15017	9750	2510	283	402	11	5020	227	<1	550	<1	550					
6	DW7033W2	Orion 5 Seam	28-Apr-2020	7.14	6.68	14500	15061	10400	2240	280	354	11	5200	210	<1	538	<1	538	<20	<50	<100	<50	<50
6	DW7033W2	Orion 5 Seam	20-May-2020	7.08	6.78	14500	15015	9600	2340	284	367	11	5200	200	<1	542	<1	542					
6	DW7033W2	Orion 5 Seam	17-Jun-2020	7.44	7.49	14900	15733	9180	2450	388	380	11	5090	250	<1	563	<1	563					
6	DW7033W2	Orion 5 Seam	15-Jul-2020	7.17	6.75	15000	15334	10300	2470	398	405	11	5110	210	<1	522	<1	522					
6	DW7033W2	Orion 5 Seam	21-Aug-2020	7.44	6.7	15000	15277	9680	2380	391	389	11	5220	231	<1	608	<1	608					
6	DW7033W2	Orion 5 Seam	24-Sep-2020	7.69	6.69	15300	15256	10300	2520	266	402	11	5240	207	<1	552	<1	552					
6	DW7033W2	Orion 5 Seam	21-Oct-2020	7.32	6.66	15100	15265	9950	2200	276	380	11	5200	211	<1	555	<1	555					
6	DW7033W3	Interburden	26-Sep-2019	7.74	6.68	15200	15280	10600	2650	511	382	14	5270	654	<1	607	<1	607					
6	DW7033W3	Interburden	30-Oct-2019	7.33	6.63	15200	14571	10500	2460	388	340	11	5250	642	<1	621	<1	621					
6	DW7033W3	Interburden	26-Nov-2019	7.66	6.59	14800	14103	9760	2450	358	357	13	4880	612	<1	665	<1	665					
6	DW7033W3	Interburden	18-Dec-2019	7.13	6.47	14600	14800	10500	2540	340	365	12	4930	603	<1	745	<1	745					
6	DW7033W3	Interburden	20-Feb-2020	7.36	6.71	15100	15099	10400	2600	331	352	12	5180	516	<1	741	<1	741					
6	DW7033W3	Interburden	20-Mar-2020	7.22	6.82	14600	12973	9780	2600	319	335	12	4630	494	<1	755	<1	755					
6	DW7033W3	Interburden	28-Apr-2020	7.15	6.69	14500	15100	9980	2360	309	339	11	4900	424	<1	693	<1	693	<20	<50	160	<50	160
6	DW7033W3	Interburden	20-May-2020	7.07	6.76	14400	14881	9460	2380	304	334	11	4940	425	<1	725	<1	725					
6	DW7033W3	Interburden	17-Jun-2020	7.39	7.12	14500	15095	8860	2410	409	339	12	4680	470	<1	706	<1	706					
6	DW7033W3	Interburden	15-Jul-2020	7.1	6.72	14600	14983	9540	2440	419	356	11	4810	395	<1	754	<1	754					
6	DW7033W3	Interburden	21-Aug-2020	7.35	6.7	13500	13611	8740	2140	365	313	11	4450	347	<1	715	<1	715					
6	DW7033W3	Interburden	24-Sep-2020	7.65	6.7	14700	14988	10000	2480	283	375	11	4840	417	<1	685	<1	685					
6	DW7033W3	Interburden	21-Oct-2020	7.31	6.64	14500	14750	9370	2110	273	320	10	4860	343	<1	699	<1	699					
7	DW7035W3	Orion 1 Seam	26-Sep-2019	7.74	6.65	14200	14132	9540	2340	326	371	15	5020	319	<1	421	<1	421					
7	DW7035W3	Orion 1 Seam	30-Oct-2019	7.25	6.56	14300	13785	8820	2310	264	346	13	4960	325	<1	615	<1	615					
7	DW7035W3	Orion 1 Seam	26-Nov-2019	7.64	6.5	14300	13574	9110	2420	248	372	15	4790	296	<1	640	<1	640					
7	DW7035W3	Orion 1 Seam	18-Dec-2019	7.05	6.24	14400	14528	10600	2420	260	407	15	4950	314	<1	652	<1	652					
7	DW7035W3	Orion 1 Seam	31-Mar-2020	7.2	6.64	12600	13516	8220	2260	215	357	13	4070	430	<1	712	<1	712					
7	DW7035W3	Orion 1 Seam	28-Apr-2020	7.08	6.53	13100	13547	9360	2070	232	357	13	4430	347	<1	666	<1	666	<20	<50	140	<50	140
7	DW7035W3	Orion 1 Seam	20-May-2020	7.05	6.67	13200	13579	8650	2160	226	355	13	4450	358	<1	731	<1	731					
7	DW7035W3	Orion 1 Seam	17-Jun-2020	7.4	7.27	13600	14335	8350	2250	287	382	14	4480	361	<1	640	<1	640					
7	DW7035W3	Orion 1 Seam	15-Jul-2020	7.06	6.66	13400	13801	8670	2280	294	399	13	4410	376	<1	786	<1	786					
7	DW7035W3	Orion 1 Seam	21-Aug-2020	7.29	6.59	13600	13790	8700	2100	274	381	13	4490	351	<1	748	<1	748					
7	DW7035W3	Orion 1 Seam	24-Sep-2020	7.59	6.58	13500	13720	9100	2160	215	385	12	4420	344	<1	715	<1	715					
7	DW7035W3	Orion 1 Seam	21-Oct-2020	7.28	6.56	13800	14047	8920	1980	230	362	13	4480	351	<1	685	<1	685					
8	DW7082W1	Castor Lower Seam	24-Sep-2019	7.13	6.63	12200	12026	8280	2370	152	307	10	4170	274	<1	724	<1	724					
8	DW7082W1	Castor Lower Seam	24-Oct-2019	7.59	6.53	11900	11328	7070	1960	125	270	9	3710	276	<1	762	<1	762					
8	DW7082W1	Castor Lower Seam	21-Nov-2019	7.82	6.45	11800	11656	7470	2170	142	292	9	3900	280	<1	836	<1	836					
8	DW7082W1	Castor Lower Seam	13-Dec-2019	7.3	6.43	12100	11812	7420	2180	118	283	9	4030	256	<1	854	<1	854					
8	DW7082W1	Castor Lower Seam	19-Feb-2020	7.29	6.57	11300	11115	6770	2030	104	244	9	3630	223	<1	825	<1	825					
8	DW7082W1	Castor Lower Seam	17-Mar-2020	7.25	6.63	11300	11659	7000	1990	119	259	9	3620	232	<1	786	<1	786					
8	DW7082W1	Castor Lower Seam	29-Apr-2020		6.42		12779		2170	132	323	10	4010	234	35	643	<1	678	<20	<50	<100	<50	<50
8	DW7082W1	Castor Lower Seam	20-May-2020	7.06	6.66	11300	11515	6940	2000	109	233	9	3650	200	<1	809	<1	809					
8	DW7082W1	Castor Lower Seam	30-Jun-2020	7.36	6.61	11900	12307	6930	1950	111	254	9	3640	238	<1	846	<1	846					
8	DW7082W1	Castor Lower Seam	15-Jul-2020	7.03	6.66	11700	12057	7200	2120	132	265	9	3690	208	<1	829	<1	829					

Appendix C-1: pH, EC, TDS, Major Ion Data

Site No.	Bore No.	Groundwater Unit	Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
				Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
				Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	Livestock Trigger Levels (ANZECC 2000)			n/a	n/a	5970	5970	4000	n/a	1000	n/a	n/a	n/a	1000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	DW7082W1	Castor Lower Seam	20-Aug-2020	7.3	6.59	12200	12202	6970	2180	122	299	10	3840	219	<1	824	<1	824					
8	DW7082W1	Castor Lower Seam	23-Sep-2020	7.61	6.56	11600	11877	7080	2090	102	254	8	3600	206	<1	825	<1	825					
8	DW7082W1	Castor Lower Seam	20-Oct-2020	7.13	6.51	12900	13103	7980	2030	125	281	10	4170	250	<1	680	<1	680					
8	DW7082W2	Pollux Upper Seam	24-Sep-2019	7.03	6.47	14100	14402	9960	3010	143	334	11	5000	311	<1	714	<1	714					
8	DW7082W2	Pollux Upper Seam	24-Oct-2019	7.56	6.42	14400	13664	8910	2530	121	304	10	4720	284	<1	669	<1	669					
8	DW7082W2	Pollux Upper Seam	21-Nov-2019	7.77	6.35	13800	13558	8740	2510	131	310	10	4600	278	<1	737	<1	737					
8	DW7082W2	Pollux Upper Seam	13-Dec-2019	7.24	6.3	14300	13837	8630	2510	104	301	10	4750	266	<1	717	<1	717					
8	DW7082W2	Pollux Upper Seam	19-Feb-2020	7.21	6.48	13400	13317	8370	2480	101	277	10	4610	254	<1	661	<1	661					
8	DW7082W2	Pollux Upper Seam	17-Mar-2020	7.23	6.52	13200	13649	8310	2350	108	280	10	4440	280	<1	672	<1	672					
8	DW7082W2	Pollux Upper Seam	29-Apr-2020		6.39		13894		2550	115	324	10	4370	279	23	660	<1	683	<20	<50	<100	<50	<50
8	DW7082W2	Pollux Upper Seam	20-May-2020	6.94	6.53	13300	13695	8470	2380	105	278	10	4530	256	<1	683	<1	683					
8	DW7082W2	Pollux Upper Seam	30-Jun-2020	7.31	6.52	13600	14100	8220	2270	101	276	9	4310	278	<1	656	<1	656					
8	DW7082W2	Pollux Upper Seam	15-Jul-2020	6.95	6.56	13400	13766	8220	2520	128	301	10	4400	272	<1	741	<1	741					
8	DW7082W2	Pollux Upper Seam	20-Aug-2020	7.21	6.51	13600	13663	7970	2530	117	324	10	4400	265	<1	715	<1	715					
8	DW7082W2	Pollux Upper Seam	23-Sep-2020	7.52	6.47	13500	13675	8460	2500	102	301	9	4420	258	<1	673	<1	673					
8	DW7082W2	Pollux Upper Seam	20-Oct-2020	7.05	6.43	13500	13756	8290	2180	107	275	10	4430	283	<1	674	<1	674					
9	DW7093W1	Pollux Lower Upper Seam	24-Sep-2019	7.67	7.29	14000	14156	8880	3200	171	96	7	4990	147	<1	566	<1	566					
9	DW7093W1	Pollux Lower Upper Seam	24-Oct-2019	7.92	6.99	15400	14642	9470	3130	183	115	7	4890	514	<1	634	<1	634					
9	DW7093W1	Pollux Lower Upper Seam	21-Nov-2019	8.01	6.92	15600	15241	9700	3280	214	115	7	4990	711	<1	758	<1	758					
9	DW7093W1	Pollux Lower Upper Seam	16-Dec-2019	7.73	6.83	16500	15868	10100	3320	159	108	7	5260	733	<1	889	<1	889					
9	DW7093W1	Pollux Lower Upper Seam	29-Jan-2020	7.64	7	15600	15451	9680	3170	134	102	8	4750	619	<1	858	<1	858					
9	DW7093W1	Pollux Lower Upper Seam	19-Feb-2020	7.83	7.28	14400	14304	8460	3060	110	92	7	5010	153	<1	613	<1	613					
9	DW7093W1	Pollux Lower Upper Seam	18-Mar-2020	7.67	7.25	14600	13310	9030	3240	128	95	7	4610	419	<1	969	<1	969					
9	DW7093W1	Pollux Lower Upper Seam	29-Apr-2020		7.12		15406		3160	152	121	8	4710	279	<1	838	<1	838	<30	<50	160	<50	160
9	DW7093W1	Pollux Lower Upper Seam	19-May-2020	7.61	7.18	14900	15376	9110	3160	136	94	7	4960	213	<1	1000	<1	1000					
9	DW7093W1	Pollux Lower Upper Seam	15-Jun-2020	7.88	7.21	14800	15141	8620	3120	171	89	7	4680	203	<1	978	<1	978					
9	DW7093W1	Pollux Lower Upper Seam	14-Jul-2020	7.67	7.26	14300	14692	8430	3050	171	89	7	4600	138	<1	993	<1	993					
9	DW7093W1	Pollux Lower Upper Seam	19-Aug-2020	7.86	7.15	15300	15423	8860	3220	149	116	8	4990	114	<1	913	<1	913					
9	DW7093W1	Pollux Lower Upper Seam	22-Sep-2020	8.16	7.17	14400	14604	8380	3050	96	88	6	4780	75	<1	797	<1	797					
9	DW7093W1	Pollux Lower Upper Seam	20-Oct-2020	7.77	7.1	15000	15233	8720	2810	103	93	7	4990	66	<1	764	<1	764					
9	DW7093W2	Interburden	24-Sep-2019	7.44	7.08	15700	15894	10600	3520	257	100	13	5600	439	<1	589	<1	589					
9	DW7093W2	Interburden	24-Oct-2019	7.97	7.09	16100	15310	9690	3480	236	98	12	5330	440	<1	582	<1	582					
9	DW7093W2	Interburden	21-Nov-2019	8.14	7.03	16000	15602	9610	3300	240	90	11	5310	390	<1	613	<1	613					
9	DW7093W2	Interburden	16-Dec-2019	7.78	6.94	16600	15944	9340	3710	194	97	12	5640	321	<1	646	<1	646					
9	DW7093W2	Interburden	29-Jan-2020	7.68	7.07	15900	15898	9640	3330	149	86	11	5170	249	<1	609	<1	609					
9	DW7093W2	Interburden	19-Feb-2020	7.7	7.17	16300	15752	9570	3400	157	87	11	5490	192	<1	598	<1	598					
9	DW7093W2	Interburden	20-Mar-2020	7.6	7.2	15900	13699	9110	3360	160	80	10	5050	179	<1	645	<1	645					
9	DW7093W2	Interburden	29-Apr-2020		7.15		15920		3200	166	87	10	5130	155	<1	576	<1	576	<20	<50	300	<50	300
9	DW7093W2	Interburden	19-May-2020	7.59	7.2	15600	16117	8900	3360	157	89	10	5470	124	<1	649	<1	649					
9	DW7093W2	Interburden	15-Jun-2020	7.9	7.16	15500	15898	9050	3270	211	75	10	5170	87	<1	479	<1	479					
9	DW7093W2	Interburden	14-Jul-2020	7.67	7.18	15500	15870	8990	3340	227	82	9	5230	71	<1	756	<1	756					
9	DW7093W2	Interburden	19-Aug-2020	7.94	7.16	16200	15917	9090	3260	177	90	9	5240	45	<1	734	<1	734					
9	DW7093W2	Interburden	22-Sep-2020	8.22	7.12	15800	15712	8970	3160	128	76	8	5220	30	<1	692	<1	692					
9	DW7093W2	Interburden	20-Oct-2020	7.91	7.12	15600	15843	8610	3050	135	76	8	5300	18	<1	677	<1	677					
9	DW7093W3	Pollux Lower Lower Seam	25-Sep-2019	8.08	7.18	17300	17227	10800	3460	137	190	9	6040	274	<1	586	<1	586					
9	DW7093W3	Pollux Lower Lower Seam	28-Oct-2019	8.01	7.13	18000	17043	10900	3580	171	203	10	5940	348	<1	523	<1	523					
9	DW7093W3	Pollux Lower Lower Seam	21-Nov-2019	8.06	6.92	17800	17325	11000	3580	171	243	9	6070	340	<1	711	<1	711					
9	DW7093W3	Pollux Lower Lower Seam	16-Dec-2019	7.81	7.01	18600	17790	11000	3620	126	193	10	6460	282	<1	613	<1	613					
9	DW7093W3	Pollux Lower Lower Seam	29-Jan-2020	7.71	7.17	17800	17824	11100	3490	93	188	10	5910	280	<1	557	<1	557					
9	DW7093W3	Pollux Lower Lower Seam	19-Feb-2020	7.72	7.17	18100	17523	10800	3580	118	186	10	6260	269	<1	555	<1	555					
9	DW7093W3	Pollux Lower Lower Seam	31-Mar-2020	7.7	7.31	17600	18467	11000	3850	113	203	10	5760	261	<1	548	<1	548					
9	DW7093W3	Pollux Lower Lower Seam	29-Apr-2020		7.29		18013		3510	127	201	10	5880	271	14	535	<1	549	<20	<50	<100	<50	<50
9	DW7093W3	Pollux Lower Lower Seam	19-May-2020	7.59	7.25	17800	18344	11800	3590	132	202	10	6220	278	<1	586	<1	586					
9	DW7093W3	Pollux Lower Lower Seam	15-Jun-2020	7.66	6.98	17900	18438	10900	3650	153	235	10	5980	349	<1	704	<1	704					
9	DW7093W3	Pollux Lower Lower Seam	14-Jul-2020	7.38	7.01	17900	18271	11100	3690	167	250	10	6010	344	<1	766	<1	766					
9	DW7093W3	Pollux Lower Lower Seam	19-Aug-2020	7.6	6.94	19000	18531	10500	3670	133	281	10	6100	346	<1	776	<1	776					
9	DW7093W3	Pollux Lower Lower Seam	22-Sep-2020	8	6.91	18600	18561	11300	3610	104	243	9	6160	326	<1	731	<1	731					
9	DW7093W3	Pollux Lower Lower Seam	20-Oct-2020	7.61	6.94	18300	18335	11100	3280	94	237	9	6030	376	<1	740	<1	740					
10	DW7105W2	Pollux Lower Upper Seam	26-Sep-2019	8.7	8.5	959	984	606	237	5	4	2	81	2	41	388	<1	429					
10	DW7105W2	Pollux Lower Upper Seam	24-Oct-2019	8.6	8.3	1140	1159	722	261	7	6	2	100	25	35	378	<1	413					
10	DW7105W2	Pollux Lower Upper Seam	25-Nov-2019	8.61	8.04	1100	1066	659	248	7	4	2	70	29	29	413	<1	442					
10	DW7105W2	Pollux Lower Upper Seam	13-Dec-2019	8.42	7.86	1190	1175	689	270	4	7	2	108	31	13	430	<1	443					
10	DW7105W2	Pollux Lower Upper Seam	31-Jan-2020	8.19	7.93	1080	1030	635	245	6	4	2	70	27	<1	404	<1	404					
10	DW7105W2	Pollux Lower Upper Seam	19-Feb-2020	8.45	8.44	1150	1220	720	274	5	6	2	125	27	22	390	<1	412					
10	DW7105W2	Pollux Lower Upper Seam	18-Mar-2020	7.91	7.57	1060	949	624	250	8	4	2	76	26	<1	426	<1	426					

Appendix C-1: pH, EC, TDS, Major Ion Data

Site No.	Bore No.	Groundwater Unit	Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
				Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
				Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	Livestock Trigger Levels (ANZECC 2000)			**n/a**	**n/a**	**5970**	**5970**	**4000**	**n/a**	**1000**	**n/a**	**n/a**	**n/a**	**1000**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
10	DW7105W2	Pollux Lower Upper Seam	28-Apr-2020	8.23	8.21	1290	1326	780	282	8	10	2	163	29	<1	426	<1	426	<20	<50	<100	<50	<50
10	DW7105W2	Pollux Lower Upper Seam	20-May-2020	8.23	8.41	1200	1258	791	281	6	9	2	152	18	<1	412	<1	412					
10	DW7105W2	Pollux Lower Upper Seam	16-Jun-2020	8.57	8.42	1140	1167	756	266	6	6	2	117	17	30	358	<1	388					
10	DW7105W2	Pollux Lower Upper Seam	14-Jul-2020	8.46	8.34	1240	1275	730	285	8	9	2	152	21	21	440	<1	461					
10	DW7105W2	Pollux Lower Upper Seam	18-Aug-2020	8.48	8.12	1190	1199	732	268	5	8	2	128	19	21	425	<1	446					
10	DW7105W2	Pollux Lower Upper Seam	22-Sep-2020	8.65	8.22	1220	1241	714	273	6	8	2	140	23	24	397	<1	422					
10	DW7105W2	Pollux Lower Upper Seam	20-Oct-2020	8.35	7.98	1250	1291	723	269	7	10	2	167	22	9	404	<1	413					
11	DW7178W1	Tertiary	27-Sep-2019	7.87	6.87	20800	21290	14400	3720	229	546	45	7470	212	<1	716	<1	716					
11	DW7178W1	Tertiary	25-Oct-2019	7.75	6.69	21000	19786	14300	3680	203	538	50	7180	213	<1	589	<1	589					
11	DW7178W1	Tertiary	26-Nov-2019	7.64	6.47	21500	20404	14300	3820	174	560	42	7530	235	<1	653	<1	653					
11	DW7178W1	Tertiary	18-Dec-2019	7.48	6.78	20300	20055	14900	3760	162	529	56	7070	238	<1	657	<1	657					
11	DW7178W1	Tertiary	29-Jan-2020	7	6.45	21700	21746	14700	3830	143	552	41	7440	225	<1	546	<1	546					
11	DW7178W1	Tertiary	19-Feb-2020	7.19	6.49	21400	20981	14200	3830	140	520	39	7700	214	<1	536	<1	536					
11	DW7178W1	Tertiary	20-Mar-2020	7.2	6.67	21000	20820	13600	3940	158	536	48	7060	200	<1	628	<1	628					
11	DW7178W1	Tertiary	27-Apr-2020	7.32	6.85	19800	20627	16400	3590	152	484	62	7760	190	<1	591	<1	591	50	<50	<100	<50	<50
11	DW7178W1	Tertiary	18-May-2020	7.08	6.61	21400	22244	14600	3830	174	526	36	7920	229	<1	622	<1	622					
11	DW7178W1	Tertiary	17-Jun-2020	7.27	6.5	20700	21491	12500	3780	172	502	54	7210	225	<1	531	<1	531					
11	DW7178W1	Tertiary	13-Jul-2020	7	6.58	21400	21712	13900	3990	180	550	54	7450	233	<1	606	<1	606					
11	DW7178W1	Tertiary	18-Aug-2020	7.29	6.51	22300	21926	13700	3810	157	575	48	7550	224	<1	600	<1	600					
11	DW7178W1	Tertiary	21-Sep-2020	7.73	6.69	21500	21481	14300	3850	146	532	61	7410	232	<1	629	<1	629					
11	DW7178W1	Tertiary	19-Oct-2020	7.3	6.53	21300	21683	13600	3370	144	487	46	7440	258	<1	596	<1	596					
11	DW7178W2	Pollux Lower Upper Seam	27-Sep-2019	7.55	6.38	25600	26600	18300	4500	349	706	26	9560	308	<1	540	<1	540					
11	DW7178W2	Pollux Lower Upper Seam	25-Oct-2019	7.5	6.29	26800	25459	19000	4880	321	759	26	9480	303	<1	515	<1	515					
11	DW7178W2	Pollux Lower Upper Seam	25-Nov-2019	7.53	6.28	24100	23933	16600	4180	246	643	25	8630	308	<1	544	<1	544					
11	DW7178W2	Pollux Lower Upper Seam	17-Dec-2019	6.94	6.19	25600	25541	19400	4670	257	696	26	9210	321	<1	538	<1	538					
11	DW7178W2	Pollux Lower Upper Seam	29-Jan-2020	6.97	6.3	26400	26307	18300	4560	219	700	25	9140	304	<1	517	<1	517					
11	DW7178W2	Pollux Lower Upper Seam	18-Feb-2020	7.18	6.48	25800	26496	17600	4640	242	659	25	9530	286	<1	525	<1	525					
11	DW7178W2	Pollux Lower Upper Seam	20-Mar-2020	6.99	6.47	26400	23026	17600	4780	250	758	26	8970	291	<1	554	<1	554					
11	DW7178W2	Pollux Lower Upper Seam	27-Apr-2020	6.93	6.39	24900	26267	19300	4650	244	728	26	9210	298	<1	516	<1	516	<20	<50	<100	<50	<50
11	DW7178W2	Pollux Lower Upper Seam	18-May-2020	6.92	6.48	24300	25195	17800	4220	228	617	25	9020	284	<1	527	<1	527					
11	DW7178W2	Pollux Lower Upper Seam	17-Jun-2020	7.25	6.43	26000	26921	16600	4710	306	678	30	9250	313	<1	525	<1	525					
11	DW7178W2	Pollux Lower Upper Seam	13-Jul-2020	6.92	6.46	25900	26285	17600	4770	332	694	26	9160	320	<1	545	<1	545					
11	DW7178W2	Pollux Lower Upper Seam	18-Aug-2020	7.33	6.41	27300	27006	17500	4490	264	728	25	9400	310	<1	568	<1	568					
11	DW7178W2	Pollux Lower Upper Seam	21-Sep-2020	7.51	6.37	27100	27270	19500	4900	250	736	25	9630	327	<1	536	<1	536					
11	DW7178W2	Pollux Lower Upper Seam	19-Oct-2020	7.11	6.36	26800	27165	17700	4170	240	652	26	9440	335	<1	549	<1	549					
12	DW7220W1	Tertiary	25-Sep-2019	7.73	6.5	1410	1439	861	181	119	10	6	288	47	<1	323	<1	323					
12	DW7220W1	Tertiary	25-Oct-2019	7.43	6.38	1720	1666	1050	210	149	11	5	314	47	<1	407	<1	407					
12	DW7220W1	Tertiary	22-Nov-2019	7.59	6.31	1770	1757	1110	219	169	15	4	296	57	<1	489	<1	489					
12	DW7220W1	Tertiary	17-Dec-2019	6.78	6.07	1680	1715	1040	210	162	14	5	298	48	<1	450	<1	450					
12	DW7220W1	Tertiary	31-Jan-2020	6.79	6.07	1740	1696	990	212	137	17	4	316	40	<1	378	<1	378					
12	DW7220W1	Tertiary	21-Feb-2020	6.6	6.03	1660	1628	938	216	117	18	4	306	38	<1	352	<1	352					
12	DW7220W1	Tertiary	18-Mar-2020	6.57	6.16	1590	1415	953	202	127	17	5	296	38	<1	364	<1	364					
12	DW7220W1	Tertiary	30-Apr-2020		5.91		1697		218	113	20	3	336	37	<1	343	<1	343	<20	<50	<100	<50	<50
12	DW7220W1	Tertiary	21-May-2020	6.23	5.96	1500	1569	1360	204	97	16	3	328	34	<1	308	<1	308					
12	DW7220W1	Tertiary	16-Jun-2020	6.48	5.85	1550	1584	897	218	90	17	3	330	33	<1	273	<1	273					
12	DW7220W1	Tertiary	16-Jul-2020	6.24	5.89	1550	1596	882	220	95	19	3	352	33	<1	292	<1	292					
12	DW7220W1	Tertiary	21-Aug-2020	6.4	5.81	1480	1490	848	204	79	16	3	334	29	<1	268	<1	268					
12	DW7220W1	Tertiary	23-Sep-2020	6.59	5.77	1530	1554	862	217	78	18	3	349	30	<1	263	<1	263					
12	DW7220W1	Tertiary	19-Oct-2020	6.22	5.84	1400	1497	823	190	78	14	3	332	25	<1	243	<1	243					
12	DW7220W2	Castor Seam	25-Sep-2019	6.78	5.96	1560	1629	911	305	33	26	5	314	46	<1	364	<1	364					
12	DW7220W2	Castor Seam	25-Oct-2019	6.62	5.78	1770	1744	1040	326	26	24	3	380	54	<1	316	<1	316					
12	DW7220W2	Castor Seam	22-Nov-2019	6.69	5.66	1750	1801	989	340	30	25	3	386	52	<1	344	<1	344					
12	DW7220W2	Castor Seam	17-Dec-2019	6.14	5.56	1760	1792	1030	342	19	24	4	394	49	<1	315	<1	315					
12	DW7220W2	Castor Seam	30-Jan-2020	6.29	5.75	1900	1878	1080	332	22	25	4	398	52	<1	304	<1	304					
12	DW7220W2	Castor Seam	21-Feb-2020	6.33	5.82	1850	1871	1020	342	22	28	4	390	49	<1	302	<1	302					
12	DW7220W2	Castor Seam	18-Mar-2020	6.19	5.87	1790	1594	1020	329	19	22	3	393	50	<1	284	<1	284					
12	DW7220W2	Castor Seam	30-Apr-2020		5.68		1751		315	23	23	3	375	47	<1	288	<1	288	<20	<50	<100	<50	<50
12	DW7220W2	Castor Seam	21-May-2020	6.02	5.78	1700	1777	1070	333	16	22	3	403	47	<1	259	<1	259					
12	DW7220W2	Castor Seam	16-Jun-2020	6.31	5.72	1770	1799	1010	334	16	22	3	404	50	<1	243	<1	243					
12	DW7220W2	Castor Seam	16-Jul-2020	6.1	5.76	1690	1742	977	316	20	21	3	402	50	<1	273	<1	273					
12	DW7220W2	Castor Seam	21-Aug-2020	6.17	5.7	1780	1793	981	326	14	21	3	432	46	<1	252	<1	252					
12	DW7220W2	Castor Seam	23-Sep-2020	6.46	5.64	1730	1733	953	316	15	20	3	410	49	<1	250	<1	250					
12	DW7220W2	Castor Seam	19-Oct-2020	6.04	5.72	1810	1808	1010	331	15	19	3	453	49	<1	220	<1	220					
12	DW7220W3	Pollux Lower Upper Seam	25-Sep-2019	7.75	6.53	19100	19211	12700	3750	206	395	11	6760	488	<1	778	<1	778					
12	DW7220W3	Pollux Lower Upper Seam	25-Oct-2019	7.57	6.44	19600	18337	12700	3550	174	385	10	6560	461	<1	736	<1	736					

Appendix C-1: pH, EC, TDS, Major Ion Data

Site No.	Bore No.	Groundwater Unit	Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
				Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
				Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	Livestock Trigger Levels (ANZECC 2000)			**n/a**	**n/a**	**5970**	**5970**	**4000**	**n/a**	**1000**	**n/a**	**n/a**	**n/a**	**1000**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
12	DW7220W3	Pollux Lower Upper Seam	22-Nov-2019	7.63	6.35	19200	18769	12500	3590	188	414	10	6500	490	<1	754	<1	754					
12	DW7220W3	Pollux Lower Upper Seam	17-Dec-2019	6.99	6.16	19100	19193	12700	3840	153	405	11	6610	472	<1	756	<1	756					
12	DW7220W3	Pollux Lower Upper Seam	30-Jan-2020	7.05	6.4	19400	19593	12600	3660	148	401	11	6380	477	<1	698	<1	698					
12	DW7220W3	Pollux Lower Upper Seam	21-Feb-2020	7.12	6.49	19500	19324	12300	3700	142	409	10	6220	450	<1	737	<1	737					
12	DW7220W3	Pollux Lower Upper Seam	18-Mar-2020	7.09	6.61	19600	17398	12300	3880	149	408	10	6380	462	<1	740	<1	740					
12	DW7220W3	Pollux Lower Upper Seam	30-Apr-2020		6.43		19646		3670	156	419	10	6410	496	24	712	<1	736	<20	<50	<100	<50	<50
12	DW7220W3	Pollux Lower Upper Seam	21-May-2020	7.02	6.58	19000	19614	13200	3610	149	377	10	6660	463	<1	748	<1	748					
12	DW7220W3	Pollux Lower Upper Seam	16-Jun-2020	7.33	6.53	19500	20041	11900	3780	181	386	10	6510	466	<1	736	<1	736					
12	DW7220W3	Pollux Lower Upper Seam	16-Jul-2020	7.04	6.54	19400	19817	12200	3770	185	398	10	6480	498	<1	781	<1	781					
12	DW7220W3	Pollux Lower Upper Seam	20-Aug-2020	7.39	6.54	19400	19848	12100	3620	167	414	10	6560	491	<1	778	<1	778					
12	DW7220W3	Pollux Lower Upper Seam	23-Sep-2020	7.66	6.44	19700	19547	11100	3700	139	383	10	6530	473	<1	724	<1	724					
12	DW7220W3	Pollux Lower Upper Seam	19-Oct-2020	7.11	6.55	19800	20693	12200	3630	144	391	10	6720	527	<1	762	<1	762					
13	DW7221W1	Aries 3 Seam	25-Sep-2019	7.42	6.21	3870	3888	2280	641	190	72	6	851	144	<1	849	<1	849					
13	DW7221W1	Aries 3 Seam	25-Oct-2019	7.11	6.16	3900	3768	2340	600	181	76	6	842	96	<1	762	<1	762					
13	DW7221W1	Aries 3 Seam	22-Nov-2019	6.8	6	3970	3977	2320	640	192	79	5	910	81	<1	786	<1	786					
13	DW7221W1	Aries 3 Seam	16-Dec-2019	6.7	6.02	3940	3848	2180	578	176	68	6	856	81	<1	807	<1	807					
13	DW7221W1	Aries 3 Seam	30-Jan-2020	6.61	6.07	3790	3799	2160	549	176	67	5	816	68	<1	708	<1	708					
13	DW7221W1	Aries 3 Seam	21-Feb-2020	6.65	6.11	3650	3591	2060	566	172	79	6	770	63	<1	715	<1	715					
13	DW7221W1	Aries 3 Seam	18-Mar-2020	6.62	6.24	3710	3325	2130	552	162	66	5	798	60	<1	715	<1	715					
13	DW7221W1	Aries 3 Seam	30-Apr-2020		6		3895		580	167	71	4	864	60	<1	692	<1	692	<20	<50	<100	<50	<50
13	DW7221W1	Aries 3 Seam	21-May-2020	6.62	6.2	3620	3749	2110	537	143	63	5	858	54	<1	701	<1	701					
13	DW7221W1	Aries 3 Seam	17-Jun-2020	6.77	6.13	3520	3599	1980	545	159	61	5	794	56	<1	644	<1	644					
13	DW7221W1	Aries 3 Seam	16-Jul-2020	6.54	6.18	3640	3746	2090	567	161	68	5	866	66	<1	707	<1	707					
13	DW7221W1	Aries 3 Seam	20-Aug-2020	6.67	6.1	3670	3675	2020	581	156	71	5	845	59	<1	680	<1	680					
13	DW7221W1	Aries 3 Seam	23-Sep-2020	7.12	6.08	3710	3706	1990	565	133	63	4	868	66	<1	631	<1	631					
13	DW7221W1	Aries 3 Seam	19-Oct-2020	6.49	6.19	3620	3720	2060	544	134	68	5	869	64	<1	615	<1	615					
13	DW7221W2	Castor Seam	26-Sep-2019	7.52	6.28	8240	8196	5400	1340	202	233	8	2740	194	<1	438	<1	438					
13	DW7221W2	Castor Seam	24-Oct-2019	7.35	6.26	8310	7851	5430	1240	176	219	7	2580	191	<1	395	<1	395					
13	DW7221W2	Castor Seam	22-Nov-2019	7.29	6.11	8040	7906	5090	1280	191	229	7	2580	176	<1	463	<1	463					
13	DW7221W2	Castor Seam	16-Dec-2019	7.01	6.08	8400	8092	5390	1230	176	213	7	2760	185	<1	470	<1	470					
13	DW7221W2	Castor Seam	30-Jan-2020	6.82	6.17	8420	8443	5530	1260	188	223	8	2570	159	<1	411	<1	411					
13	DW7221W2	Castor Seam	21-Feb-2020	6.96	6.24	10100	9844	6320	1690	265	342	9	3120	228	<1	412	<1	412					
13	DW7221W2	Castor Seam	18-Mar-2020	6.97	6.47	13400	12181	8720	2220	252	361	9	4360	335	<1	542	<1	542					
13	DW7221W2	Castor Seam	30-Apr-2020		6.38		14212		2230	256	371	9	4540	367	<1	548	<1	548	<20	<50	<100	<50	<50
13	DW7221W2	Castor Seam	21-May-2020	6.9	6.51	13800	14170	9360	2310	233	347	9	4730	344	<1	559	<1	559					
13	DW7221W2	Castor Seam	17-Jun-2020	7.31	6.48	14400	14661	8810	2490	290	366	9	4730	354	<1	556	<1	556					
13	DW7221W2	Castor Seam	16-Jul-2020	7.08	6.57	14700	15112	9530	2530	299	381	9	4920	397	<1	637	<1	637					
13	DW7221W2	Castor Seam	20-Aug-2020	7.31	6.5	15000	15049	9200	2510	263	399	10	4930	386	<1	614	<1	614					
13	DW7221W2	Castor Seam	24-Sep-2020	7.75	6.49	15300	15127	9900	2490	231	373	9	5040	382	<1	577	<1	577					
13	DW7221W2	Castor Seam	19-Oct-2020	7.16	6.64	15300	15972	9630	2620	245	402	9	5120	421	<1	622	<1	622					
14	DW7225W1	Tertiary	24-Sep-2019	6.88	6.32	9360	9579	6870	1870	90	250	11	3360	144	<1	401	<1	401					
14	DW7225W1	Tertiary	24-Oct-2019	7.39	6.27	9930	9425	6220	1660	77	236	10	3220	142	<1	361	<1	361					
14	DW7225W1	Tertiary	21-Nov-2019	7.64	6.2	9760	9628	6370	1740	88	246	10	3340	139	<1	420	<1	420					
14	DW7225W1	Tertiary	13-Dec-2019	7.06	6.11	10400	9980	6490	1780	77	247	10	3410	140	<1	422	<1	422					
14	DW7225W1	Tertiary	30-Jan-2020	6.92	6.21	9870	9828	6290	1670	70	232	11	3160	146	<1	385	<1	385					
14	DW7225W1	Tertiary	18-Feb-2020	7.04	6.26	9830	10053	6250	1680	66	223	10	3290	134	<1	374	<1	374					
14	DW7225W1	Tertiary	17-Mar-2020	7	6.36	9860	10157	6230	1700	76	235	10	3350	173	<1	377	<1	377					
14	DW7225W1	Tertiary	29-Apr-2020		6.3		10348		1760	69	249	10	3190	153	8	402	<1	410	<20	<50	<100	<50	<50
14	DW7225W1	Tertiary	19-May-2020	6.76	6.39	9730	10026	6360	1660	63	225	10	3330	134	<1	384	<1	384					
14	DW7225W1	Tertiary	16-Jun-2020	7.1	6.36	9740	9915	5700	1710	67	221	10	3160	147	<1	384	<1	384					
14	DW7225W1	Tertiary	14-Jul-2020	6.91	6.42	10100	10228	6280	1790	77	238	10	3310	151	<1	420	<1	420					
14	DW7225W1	Tertiary	19-Aug-2020	7.16	6.36	10200	10177	5970	1700	71	243	10	3280	144	<1	408	<1	408					
14	DW7225W1	Tertiary	22-Sep-2020	7.7	6.53	10200	10104	6420	1760	63	225	10	3330	152	<1	403	<1	403					
14	DW7225W1	Tertiary	20-Oct-2020	7.03	6.36	9890	9954	6070	1750	68	240	10	3220	149	<1	396	<1	396					
14	DW7225W2	Aries 3 Seam	24-Sep-2019	7.28	6.71	14600	15063	9860	2720	332	365	18	5460	308	<1	520	<1	520					
14	DW7225W2	Aries 3 Seam	24-Oct-2019	7.66	6.66	15600	14778	10600	2640	310	365	18	5270	290	<1	520	<1	520					
14	DW7225W2	Aries 3 Seam	21-Nov-2019	7.94	6.61	15000	14691	9970	2550	325	356	18	5210	281	<1	531	<1	531					
14	DW7225W2	Aries 3 Seam	13-Dec-2019	7.44	6.48	16000	15437	10900	2540	271	350	18	5650	270	<1	532	<1	532					
14	DW7225W2	Aries 3 Seam	30-Jan-2020	7.33	6.61	15200	15275	10400	2550	244	359	18	5130	260	<1	488	<1	488					
14	DW7225W2	Aries 3 Seam	18-Feb-2020	7.43	6.7	14800	15378	9770	2560	250	332	18	5260	249	<1	489	<1	489					
14	DW7225W2	Aries 3 Seam	17-Mar-2020	7.41	6.74	15100	15585	9920	2590	291	354	18	5230	285	<1	501	<1	501					
14	DW7225W2	Aries 3 Seam	29-Apr-2020		6.67		15569		2530	280	370	18	5050	255	<1	446	<1	446	<20	<50	<100	<50	<50
14	DW7225W2	Aries 3 Seam	19-May-2020	7.21	6.79	14800	15271	9830	2420	242	321	17	5270	243	<1	500	<1	500					
14	DW7225W2	Aries 3 Seam	16-Jun-2020	7.49	6.72	15300	15749	9460	2690	316	348	18	5200	268	<1	433	<1	433					
14	DW7225W2	Aries 3 Seam	14-Jul-2020	7.25	6.74	15100	15506	9740	2640	313	361	18	5120	260	<1	542	<1	542					

Appendix C-1: pH, EC, TDS, Major Ion Data

Site No.	Bore No.	Groundwater Unit	Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
				Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
				Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	Livestock Trigger Levels (ANZECC 2000)			**n/a**	**n/a**	**5970**	**5970**	**4000**	**n/a**	**1000**	**n/a**	**n/a**	**n/a**	**1000**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
14	DW7225W2	Aries 3 Seam	19-Aug-2020	7.5	6.68	15500	15607	9650	2600	282	368	19	5220	254	<1	535	<1	535					
14	DW7225W2	Aries 3 Seam	22-Sep-2020	7.88	6.69	15900	15820	10300	2650	255	355	17	5370	259	<1	504	<1	504					
14	DW7225W2	Aries 3 Seam	20-Oct-2020	7.48	6.71	15800	16036	9780	2660	272	367	18	5380	286	<1	530	<1	530					
14	DW7225W3	Castor Seam	25-Sep-2019	7.95	6.87	15400	15337	9820	3040	278	231	13	5510	141	<1	721	<1	721					
14	DW7225W3	Castor Seam	28-Oct-2019	7.83	6.82	16000	15202	9980	2990	237	231	12	5300	137	<1	644	<1	644					
14	DW7225W3	Castor Seam	21-Nov-2019	7.78	6.75	15600	15397	9820	2950	259	235	12	5490	128	<1	708	<1	708					
14	DW7225W3	Castor Seam	13-Dec-2019	7.57	6.68	16600	15980	10400	3110	196	245	12	5710	125	<1	726	<1	726					
14	DW7225W3	Castor Seam	30-Jan-2020	7.44	6.77	16200	16188	10100	2950	157	235	12	5330	138	<1	656	<1	656					
14	DW7225W3	Castor Seam	18-Feb-2020	7.52	6.87	16200	16333	10000	3100	181	220	12	5550	112	<1	669	<1	669					
14	DW7225W3	Castor Seam	17-Mar-2020	7.52	6.91	15400	16073	9880	2980	197	230	12	5390	138	<1	681	<1	681					
14	DW7225W3	Castor Seam	29-Apr-2020		6.85		16172		2940	204	252	12	5240	129	<1	556	<1	556	<20	<50	<100	<50	<50
14	DW7225W3	Castor Seam	19-May-2020	7.35	6.92	15700	16141	10100	2950	181	218	12	5470	117	<1	671	<1	671					
14	DW7225W3	Castor Seam	16-Jun-2020	7.63	6.91	15600	16166	9240	3020	240	219	12	5280	121	<1	605	<1	605					
14	DW7225W3	Castor Seam	15-Jul-2020	7.39	6.94	15800	16188	9780	3140	256	231	12	5340	119	<1	728	<1	728					
14	DW7225W3	Castor Seam	20-Aug-2020	7.68	6.88	16000	16213	9710	2950	205	237	12	5460	116	<1	732	<1	732					
14	DW7225W3	Castor Seam	22-Sep-2020	8.03	6.84	16500	16400	10100	3000	165	222	11	5500	123	<1	703	<1	703					
14	DW7225W3	Castor Seam	20-Oct-2020	7.59	6.85	16200	16340	9830	3050	168	235	12	5460	110	<1	711	<1	711					
15	DW7264W2	Aries 1 Seam	27-Sep-2019	7.91	7	21500	21755	14900	4370	341	374	26	7710	661	<1	484	<1	484					
15	DW7264W2	Aries 1 Seam	28-Oct-2019	7.84	6.87	22300	21131	14900	4440	355	392	20	7620	660	<1	501	<1	501					
15	DW7264W2	Aries 1 Seam	26-Nov-2019	8.26	7.7	21800	20756	13900	4330	99	332	36	7560	570	<1	345	<1	345					
15	DW7264W2	Aries 1 Seam	17-Dec-2019	7.79	7.33	22200	22218	14900	4560	114	362	36	7770	589	<1	376	<1	376					
15	DW7264W2	Aries 1 Seam	31-Mar-2020	7.77	7.45	21700	22690	14200	4570	157	364	32	7210	564	<1	422	<1	422					
15	DW7264W2	Aries 1 Seam	27-Apr-2020	7.28	6.83	22600	23687	17000	4630	375	423	17	7980	630	<1	587	<1	587	<20	<50	<100	<50	<50
15	DW7264W2	Aries 1 Seam	18-May-2020	7.38	6.89	22400	23379	15500	4160	304	354	17	8000	612	<1	576	<1	576					
15	DW7264W2	Aries 1 Seam	17-Jun-2020	7.57	6.82	23000	23852	14600	4490	430	385	17	7890	668	<1	546	<1	546					
15	DW7264W2	Aries 1 Seam	13-Jul-2020	7.36	6.9	23000	23373	15000	4550	436	399	18	7780	649	<1	619	<1	619					
15	DW7264W2	Aries 1 Seam	18-Aug-2020	7.65	6.87	23500	23281	14900	4150	342	396	18	7810	626	<1	593	<1	593					
15	DW7264W2	Aries 1 Seam	21-Sep-2020	7.92	6.78	23300	23355	15700	4340	312	386	16	7860	616	<1	560	<1	560					
15	DW7264W2	Aries 1 Seam	19-Oct-2020	7.6	6.78	23100	23433	14800	4200	318	378	16	7830	694	<1	574	<1	574					
15	DW7264W3	Aries 3 Seam	27-Sep-2019	8.12	7.62	18400	18608	12100	3780	227	206	22	6780	184	<1	236	<1	236					
15	DW7264W3	Aries 3 Seam	30-Oct-2019	7.96	7.49	18500	17890	11200	3520	156	176	18	6650	176	<1	214	<1	214					
15	DW7264W3	Aries 3 Seam	26-Nov-2019	8.17	7.56	18600	17757	11700	3600	153	190	19	6520	144	<1	227	<1	227					
15	DW7264W3	Aries 3 Seam	17-Dec-2019	7.85	7.41	19200	19259	12900	4000	150	210	21	6850	186	<1	244	<1	244					
15	DW7264W3	Aries 3 Seam	31-Mar-2020	7.89	7.71	18700	19307	11800	3960	144	195	19	6330	157	<1	229	<1	229					
15	DW7264W3	Aries 3 Seam	27-Apr-2020	7.78	7.53	18400	19060	13700	3720	149	174	18	6630	144	<1	220	<1	220	<20	<50	<100	<50	<50
15	DW7264W3	Aries 3 Seam	18-May-2020	7.8	7.49	18600	18987	12000	3620	159	168	17	6680	147	<1	231	<1	231					
15	DW7264W3	Aries 3 Seam	17-Jun-2020	7.89	7.49	18500	19177	11200	3790	243	172	18	6490	147	<1	220	<1	220					
15	DW7264W3	Aries 3 Seam	13-Jul-2020	7.79	7.47	18700	19015	12000	3860	267	179	17	6600	140	<1	236	<1	236					
15	DW7264W3	Aries 3 Seam	18-Aug-2020	7.9	7.42	19400	19095	11700	3490	196	175	16	6700	132	<1	246	<1	246					
15	DW7264W3	Aries 3 Seam	21-Sep-2020	8.15	7.3	19400	19191	12100	3740	173	178	15	6710	154	<1	235	<1	235					
15	DW7264W3	Aries 3 Seam	19-Oct-2020	7.93	7.36	19000	19096	12000	3480	160	166	16	6600	135	<1	231	<1	231					
16	DW7282W1	Overburden	26-Sep-2019	7.94	6.78	22600	22483	15500	4440	191	519	37	8030	571	<1	984	<1	984					
16	DW7282W1	Overburden	28-Oct-2019	7.76	6.7	25400	24125	16900	4990	190	588	38	8550	588	<1	961	<1	961					
16	DW7282W1	Overburden	25-Nov-2019	7.77	6.56	26200	25192	17200	5140	180	589	39	8910	628	<1	1050	<1	1050					
16	DW7282W1	Overburden	17-Dec-2019	7.2	6.42	26100	26226	18500	5310	190	613	39	8970	694	<1	1050	<1	1050					
16	DW7282W1	Overburden	20-Feb-2020	7.45	6.67	26200	25627	17500	5030	166	556	38	9190	609	<1	965	<1	965					
16	DW7282W1	Overburden	20-Mar-2020	7.32	6.78	26900	23577	17500	5310	167	645	38	8880	657	<1	1020	<1	1020					
16	DW7282W1	Overburden	27-Apr-2020	7.21	6.74	25800	27253	19100	5370	184	647	43	8930	623	<1	981	<1	981	<20	<50	<100	<50	<50
16	DW7282W1	Overburden	19-May-2020	7.33	6.79	25900	26831	17400	4790	173	534	38	9070	626	<1	1030	<1	1030					
16	DW7282W1	Overburden	17-Jun-2020	7.49	7.41	26300	28114	17100	5200	219	586	38	9040	697	<1	1010	<1	1010					
16	DW7282W1	Overburden	14-Jul-2020	7.29	6.79	26800	27420	17700	5390	174	615	40	8980	669	<1	1130	<1	1130					
16	DW7282W1	Overburden	19-Aug-2020	7.65	6.71	26500	26081	16600	4690	177	573	38	8760	626	<1	1060	<1	1060					
16	DW7282W1	Overburden	21-Sep-2020	7.91	6.7	27100	27281	18000	5280	174	596	37	9090	664	<1	1050	<1	1050					
16	DW7282W1	Overburden	19-Oct-2020	7.46	6.68	27000	27420	17500	4730	185	558	38	9040	670	<1	1060	<1	1060					
16	DW7282W2	Aries 3 Seam	26-Sep-2019	7.66	6.51	30800	31304	23400	5490	1050	751	23	11500	610	<1	413	<1	413					
16	DW7282W2	Aries 3 Seam	28-Oct-2019	7.56	6.45	32000	30641	24100	5780	945	791	22	11300	575	<1	403	<1	403					
16	DW7282W2	Aries 3 Seam	25-Nov-2019	7.63	6.42	31400	30478	22800	5410	722	747	22	11200	572	<1	437	<1	437					
16	DW7282W2	Aries 3 Seam	17-Dec-2019	7.02	6.27	31700	31532	23700	5470	724	756	20	11400	631	<1	436	<1	436					
16	DW7282W2	Aries 3 Seam	20-Feb-2020	7.33	6.53	31600	30974	25600	6040	714	803	25	11500	551	<1	398	<1	398					
16	DW7282W2	Aries 3 Seam	20-Mar-2020	7.04	6.52	32000	32227	22900	5460	712	774	22	11100	556	<1	409	<1	409					
16	DW7282W2	Aries 3 Seam	27-Apr-2020	7.04	6.51	30900	32847	24400	5840	817	818	24	11400	559	<1	426	<1	426	<20	<50	<100	<50	<50
16	DW7282W2	Aries 3 Seam	19-May-2020	7.11	6.6	30700	32026	24900	5580	776	792	24	11300	554	<1	418	<1	418					
16	DW7282W2	Aries 3 Seam	17-Jun-2020	7.3	7.23	31200	33343	22000	5530	925	723	22	11200	607	<1	406	<1	406					
16	DW7282W2	Aries 3 Seam	14-Jul-2020	7.13	6.59	31700	32637	23600	5830	696	780	22	11300	582	<1	443	<1	443					
16	DW7282W2	Aries 3 Seam	19-Aug-2020	7.37	6.53	32800	32450	23000	5620	655	775	21	11300	578	<1	434	<1	434					

Appendix C-1: pH, EC, TDS, Major Ion Data

Site No.	Bore No.	Groundwater Unit	Date	pH		Electrical Conductivity		TDS	Major Ions										Total Petroleum Hydrocarbons				
				Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
				Unit	Unit	µS/cm	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	Livestock Trigger Levels (ANZECC 2000)			**n/a**	**n/a**	**5970**	**5970**	**4000**	**n/a**	**1000**	**n/a**	**n/a**	**n/a**	**1000**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
16	DW7282W2	Aries 3 Seam	21-Sep-2020	7.8	6.51	32000	32418	25300	5820	627	806	22	11400	598	<1	432	<1	432					
16	DW7282W2	Aries 3 Seam	19-Oct-2020	7.33	6.48	32000	32489	23500	5640	651	765	22	11300	580	<1	419	<1	419					
17	DW7292W1	Quaternary Alluvium	25-Sep-2019	7.85	6.72	5980	5948	3460	1090	32	116	3	1640	178	<1	490	<1	490					
17	DW7292W1	Quaternary Alluvium	28-Oct-2019	7.32	6.25	3140	3054	2350	574	18	50	1	906	52	<1	186	<1	186					
17	DW7292W1	Quaternary Alluvium	25-Nov-2019	7.16	5.93	2460	2315	1520	428	16	33	1	700	31	<1	170	<1	170					
17	DW7292W1	Quaternary Alluvium	31-Mar-2020	6.46	5.81	1980	2009	1170	348	17	28	1	563	18	<1	100	<1	100					
17	DW7292W1	Quaternary Alluvium	27-Apr-2020	6.39	5.86	2080	2152	1370	359	14	29	1	646	21	<1	103	<1	103	<20	<50	100	60	160
17	DW7292W1	Quaternary Alluvium	18-May-2020	6.04	5.76	1610	1669	986	275	6	20	<1	513	12	<1	67	<1	67					
17	DW7292W1	Quaternary Alluvium	17-Jun-2020	6.64	5.78	1760	1765	970	308	8	23	<1	521	16	<1	71	<1	71					
17	DW7292W1	Quaternary Alluvium	13-Jul-2020	6.29	5.93	2020	2067	1220	372	7	28	<1	618	18	<1	96	<1	96					
17	DW7292W1	Quaternary Alluvium	18-Aug-2020	6.7	5.9	2060	2060	1150	348	7	27	<1	623	17	<1	89	<1	89					
17	DW7292W1	Quaternary Alluvium	21-Sep-2020	6.82	5.58	1660	1648	995	284	6	21	<1	506	17	<1	68	<1	68					
17	DW7292W1	Quaternary Alluvium	19-Oct-2020	6.12	5.53	1560	1594	932	267	5	22	<1	501	10	<1	54	<1	54					

Appendix C-2: Dissolved Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
1	DW7065W	Aries 3 Seam	12-Dec-2018	0.01	0.023	0.076	<0.001	1.22	0.0002	<0.001	0.019	0.081	2.48	0.007	0.312	<0.0001	0.002	0.022	<0.01	<0.001	0.016	<0.01	0.21
1	DW7065W	Aries 3 Seam	07-Jan-2019	<0.01	0.029	0.168	<0.001	1.2	0.0001	<0.001	0.011	0.005	2.82	<0.001	0.247	<0.0001	0.002	0.015	<0.01	<0.001	0.01	<0.01	0.176
1	DW7065W	Aries 3 Seam	18-Feb-2019	<0.01	0.02	0.117	<0.001	1.37	<0.0001	<0.001	0.009	0.002	4.41	<0.001	0.227	<0.0001	0.001	0.017	<0.01	<0.001	0.008	<0.01	0.03
1	DW7065W	Aries 3 Seam	11-Mar-2019	<0.05	0.012	0.075	<0.005	1.21	<0.0005	<0.005	0.009	<0.005	3.99	<0.005	0.295	<0.0001	<0.005	0.011	<0.05	<0.005	<0.005	<0.05	0.075
1	DW7065W	Aries 3 Seam	17-Apr-2019	<0.01	0.019	0.105	<0.001	1.27	<0.0001	<0.001	0.007	0.001	3.43	<0.001	0.249	<0.0005	0.001	0.009	<0.01	<0.001	0.007	<0.01	0.094
1	DW7065W	Aries 3 Seam	13-May-2019	<0.01	0.019	0.279	<0.001	1.25	<0.0001	<0.001	0.007	0.003	3.74	<0.001	0.327	<0.0001	<0.001	0.013	<0.01	<0.001	0.008	<0.01	0.136
1	DW7065W	Aries 3 Seam	19-Jun-2019	<0.01	0.018	0.184	<0.001	1.1	<0.0001	<0.001	0.008	<0.001	3.99	<0.001	0.318	<0.0001	<0.001	0.013	<0.01	<0.001	0.008	<0.01	0.103
1	DW7065W	Aries 3 Seam	11-Jul-2019	<0.05	0.006	0.276	<0.005	1.29	<0.0005	<0.005	0.005	<0.005	1.55	<0.005	0.397	<0.0001	<0.005	0.013	<0.05	<0.005	0.005	<0.05	0.105
1	DW7065W	Aries 3 Seam	26-Aug-2019	<0.01	0.018	0.477	<0.001	1.25	<0.0001	<0.001	0.006	<0.001	4.37	<0.001	0.293	<0.0001	0.006	0.01	<0.01	<0.001	0.008	<0.01	0.07
1	DW7065W	Aries 3 Seam	23-Sep-2019	<0.01	0.015	0.255	<0.001	1.32	<0.0001	<0.001	0.006	0.001	4.07	<0.001	0.313	<0.0001	0.002	0.01	<0.01	<0.001	0.007	<0.01	0.101
1	DW7065W	Aries 3 Seam	23-Oct-2019	<0.05	0.011	0.123	<0.005	1.3	<0.0005	<0.005	<0.005	<0.005	3.13	<0.005	0.283	<0.0001	<0.005	0.007	<0.05	<0.005	0.006	<0.05	0.067
1	DW7065W	Aries 3 Seam	20-Nov-2019	<0.01	0.009	0.944	<0.001	1.17	<0.0001	<0.001	0.004	<0.001	1.9	<0.001	0.526	<0.0001	0.001	0.007	<0.01	<0.001	0.006	<0.01	0.042
1	DW7065W	Aries 3 Seam	16-Mar-2020	<0.05	0.019	0.177	<0.005	1.35	<0.0005	<0.005	<0.005	<0.005	4.98	<0.005	0.332	<0.0001	<0.005	0.032	<0.05	<0.005	0.007	<0.05	0.064
1	DW7065W	Aries 3 Seam	23-Apr-2020	<0.01	0.013	0.089	<0.001	1.14	<0.0001	<0.001	0.004	0.002	3.53	<0.001	0.255	<0.0001	0.001	0.02	<0.01	<0.001	0.005	<0.01	0.126
1	DW7065W	Aries 3 Seam	25-May-2020	<0.01	0.015	0.121	<0.001	1.16	<0.0001	<0.001	0.005	<0.001	3.1	<0.001	0.264	<0.0001	0.002	0.02	<0.01	<0.001	0.006	<0.01	0.185
1	DW7065W	Aries 3 Seam	30-Jun-2020	<0.01	0.012	0.11	<0.001	1.11	<0.0001	<0.001	0.004	<0.001	3.41	0.002	0.262	<0.0001	0.003	0.027	<0.01	<0.001	0.006	<0.01	0.264
1	DW7065W	Aries 3 Seam	28-Jul-2020	<0.01	0.005	0.093	<0.001	1.33	<0.0001	<0.001	0.003	0.004	3.04	<0.001	0.24	<0.0001	0.001	0.017	<0.01	<0.001	0.004	<0.01	0.086
1	DW7065W	Aries 3 Seam	31-Aug-2020	<0.01	0.012	0.128	<0.001	1.26	<0.0001	<0.001	0.004	0.001	3.8	<0.001	0.284	<0.0001	0.001	0.016	<0.01	<0.001	0.008	<0.01	0.103
1	DW7065W	Aries 3 Seam	28-Sep-2020	<0.01	0.008	0.092	<0.001	1.34	<0.0001	<0.001	0.003	0.002	3.27	<0.001	0.252	<0.0001	<0.001	0.015	<0.01	<0.001	0.005	<0.01	0.066
1	DW7065W	Aries 3 Seam	21-Oct-2020	<0.01	0.012	0.1	<0.001	0.91	<0.0001	<0.001	0.002	<0.001	3.98	<0.001	0.249	<0.0001	0.001	0.011	<0.01	<0.001	0.005	<0.01	0.034
2	DW7067W	Aries 3 Seam	12-Dec-2018	<0.01	0.006	0.06	<0.001	1.26	<0.0001	<0.001	0.005	0.047	1.99	0.004	0.107	<0.0001	0.001	0.007	<0.01	<0.001	0.004	<0.01	0.105
2	DW7067W	Aries 3 Seam	07-Jan-2019	<0.05	0.012	0.087	<0.005	1.48	<0.0005	<0.005	<0.005	0.009	2.85	<0.005	0.119	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.147
2	DW7067W	Aries 3 Seam	18-Feb-2019	<0.01	0.012	0.077	<0.001	1.44	<0.0001	<0.001	0.002	0.002	4.23	<0.001	0.104	<0.0001	0.001	0.007	<0.01	<0.001	0.003	<0.01	0.047
2	DW7067W	Aries 3 Seam	11-Mar-2019	<0.05	0.008	0.066	<0.005	1.22	<0.0005	<0.005	<0.005	<0.005	3.61	<0.005	0.103	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.062
2	DW7067W	Aries 3 Seam	17-Apr-2019	<0.01	0.008	0.068	<0.001	1.34	<0.0001	<0.001	0.001	<0.001	3.35	<0.001	0.105	<0.0001	<0.001	0.003	<0.01	<0.001	0.002	<0.01	0.066
2	DW7067W	Aries 3 Seam	13-May-2019	<0.01	0.007	0.133	<0.001	1.23	<0.0001	<0.001	0.001	0.014	3.02	<0.001	0.114	<0.0001	<0.001	0.005	<0.01	<0.001	0.002	<0.01	0.094
2	DW7067W	Aries 3 Seam	19-Jun-2019	<0.01	0.004	0.096	<0.001	1.2	<0.0001	<0.001	0.002	0.005	0.43	<0.001	0.087	<0.0001	0.001	0.006	<0.01	<0.001	0.002	<0.01	0.088
2	DW7067W	Aries 3 Seam	11-Jul-2019	<0.05	<0.005	0.129	<0.005	1.38	<0.0005	<0.005	<0.005	<0.005	2.16	<0.005	0.151	<0.0001	<0.005	0.009	<0.05	<0.005	<0.005	<0.05	0.143
2	DW7067W	Aries 3 Seam	26-Aug-2019	<0.01	0.006	0.183	<0.001	1.32	<0.0001	<0.001	0.001	<0.001	3	<0.001	0.114	<0.0001	0.002	0.006	<0.01	<0.001	0.002	<0.01	0.059
2	DW7067W	Aries 3 Seam	23-Sep-2019	<0.01	0.007	0.122	<0.001	1.33	<0.0001	<0.001	0.002	0.004	2.55	<0.001	0.116	<0.0001	<0.001	0.005	<0.01	<0.001	0.002	<0.01	0.077
2	DW7067W	Aries 3 Seam	23-Oct-2019	<0.05	<0.005	0.093	<0.005	1.34	<0.0005	<0.005	<0.005	0.016	0.46	<0.005	0.115	<0.0001	<0.005	0.006	<0.05	<0.005	<0.005	<0.05	0.077
2	DW7067W	Aries 3 Seam	20-Nov-2019	<0.01	0.004	0.267	<0.001	1.26	<0.0001	<0.001	0.001	<0.001	0.23	<0.001	0.145	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.074
2	DW7067W	Aries 3 Seam	16-Mar-2020	<0.05	0.006	0.099	<0.005	1.29	<0.0005	<0.005	<0.005	0.084	4.57	<0.005	0.127	<0.0001	<0.005	0.024	<0.05	<0.005	<0.005	<0.05	0.111
2	DW7067W	Aries 3 Seam	23-Apr-2020	<0.01	0.006	0.071	<0.001	1.19	<0.0001	<0.001	<0.001	0.069	3.81	<0.001	0.102	<0.0001	<0.001	0.017	<0.01	<0.001	<0.001	<0.01	0.153
2	DW7067W	Aries 3 Seam	25-May-2020	<0.01	0.006	0.08	<0.001	1.28	<0.0001	<0.001	<0.001	<0.001	3.3	<0.001	0.114	<0.0001	<0.001	0.007	<0.01	<0.001	0.001	<0.01	0.101
2	DW7067W	Aries 3 Seam	30-Jun-2020	<0.01	0.005	0.078	<0.001	1.12	<0.0001	<0.001	<0.001	<0.001	2.92	<0.001	0.099	<0.0001	0.002	0.012	<0.01	<0.001	0.001	<0.01	0.107
2	DW7067W	Aries 3 Seam	28-Jul-2020	<0.01	0.002	0.076	<0.001	1.19	<0.0001	<0.001	<0.001	0.011	2.72	<0.001	0.101	<0.0001	<0.001	0.009	<0.01	<0.001	<0.001	<0.01	0.151
2	DW7067W	Aries 3 Seam	31-Aug-2020	<0.01	0.005	0.076	<0.001	1.32	<0.0001	0.001	<0.001	0.004	3.05	<0.001	0.122	<0.0001	0.002	0.01	<0.01	<0.001	0.002	<0.01	0.061
2	DW7067W	Aries 3 Seam	28-Sep-2020	<0.01	0.001	0.084	<0.001	1.31	<0.0001	<0.001	<0.001	0.061	2.18	<0.001	0.128	<0.0001	<0.001	0.021	<0.01	<0.001	<0.001	<0.01	0.118
2	DW7067W	Aries 3 Seam	21-Oct-2020	<0.01	0.002	0.086	<0.001	0.76	<0.0001	<0.001	<0.001	<0.001	3.05	<0.001	0.11	<0.0001	0.001	0.009	<0.01	<0.001	<0.001	<0.01	0.037
2	DW7068W	Tertiary sediments	12-Dec-2018	<0.01	<0.001	0.203	<0.001	1.16	<0.0001	<0.001	0.002	0.008	<0.05	<0.001	0.035	<0.0001	0.008	0.006	<0.01	<0.001	0.012	<0.01	0.017
2	DW7068W	Tertiary sediments	07-Jan-2019	0.02	<0.001	0.199	<0.001	1.15	<0.0001	<0.001	0.002	0.014	<0.05	<0.001	0.036	<0.0001	0.005	0.005	<0.01	<0.001	0.01	<0.01	0.086
2	DW7068W	Tertiary sediments	18-Feb-2019	<0.01	<0.001	0.216	<0.001	1.37	<0.0001	<0.001	0.002	0.002	<0.05	<0.001	0.032	<0.0001	0.006	0.004	<0.01	0.001	0.011	<0.01	0.035
2	DW7068W	Tertiary sediments	11-Mar-2019	<0.05	<0.005	0.186	<0.005	1.14	<0.0005	<0.005	<0.005	<0.005	<0.05	<0.005	0.025	<0.0001	<0.005	<0.005	<0.05	<0.005	0.009	<0.05	0.03
2	DW7068W	Tertiary sediments	17-Apr-2019	<0.01	<0.001	0.192	<0.001	1.34	<0.0001	<0.001	0.002	<0.001	0.08	<0.001	0.038	<0.0001	0.005	0.006	<0.01	<0.001	0.01	<0.01	0.032
2	DW7068W	Tertiary sediments	13-May-2019	<0.01	0.001	0.201	<0.001	1.26	<0.0001	<0.001	0.001	0.001	<0.05	<0.001	0.039	<0.0001	0.005	0.006	<0.01	<0.001	0.011	<0.01	0.047
2	DW7068W	Tertiary sediments	11-Jul-2019	<0.05	<0.005	0.198	<0.005	1.52	<0.0005	<0.005	<0.005	<0.005	0.08	<0.005	0.059	<0.0001	0.006	0.012	<0.05	<0.005	0.01	<0.05	0.096
2	DW7068W	Tertiary sediments	23-Sep-2019	<0.01	<0.001	0.161	<0.001	1.41	<0.0001	<0.001	0.002	<0.001	0.11	<0.001	0.044	<0.0001	0.004	0.007	<0.01	<0.001	0.009	<0.01	0.042
2	DW7068W	Tertiary sediments	20-Nov-2019	<0.01	0.001	0.163	<0.001	1.19	<0.0001	<0.001	0.001	<0.001	0.05	<0.001	0.042	<0.0001	0.003	0.002	<0.01	<0.001	0.009	<0.01	0.03
2	DW7068W	Tertiary sediments	16-Mar-2020	<0.05	<0.005	0.196	<0.005	1.12	<0.0005	<0.005	<0.005	<0.005	<0.05	<0.005	0.06	<0.0001	<0.005	0.011	<0.05	<0.005	0.009	<0.05	<0.025
2	DW7068W	Tertiary sediments	28-Jul-2020	<0.01	<0.001	0.171	<0.001	1.15	<0.0001	<0.001	0.002	0.001	<0.05	<0.001	0.034	<0.0001	0.002	0.007	<0.01	<0.001	0.007	<0.01	0.042
2	DW7068W	Tertiary sediments	31-Aug-2020	<0.01	0.001	0.168	<0.001	1.37	<0.0001	<0.001	0.001	0.002	0.24	<0.001	0.041	<0.0001	0.003	0.006	<0.01	<0.001	0.008	<0.01	0.035
2	DW7068W	Tertiary sediments	28-Sep-2020	<0.01	<0.001	0.162	<0.001	1.48	<0.0001	<0.001	0.001	0.001	0.08	<0.001	0.029	<0.0001	0.002	0.007	<0.01	<0.001	0.008	<0.01	0.09
2	DW7068W	Tertiary sediments	21-Oct-2020	<0.01	<0.001	0.174	<0.001	0.9	<0.0001	<0.001	0.002	0.001	0.26	<0.001	0.057	<0.0001	0.003	0.006	<0.01	0.001	0.008	<0.01	0.03
3	DW7069W	Pollux Upper Seam	12-Dec-2018	<0.01	0.003	0.059	<0.001	1.25	0.0001	<0.001	0.002	0.067	2.16	0.003	0.19	<0.0001	0.002	0.005	<0.01	<0.001	0.002	<0.01	0.146
3	DW7069W	Pollux Upper Seam	07-Jan-2019	<0.01	0.004	0.066	<0.001	1.15	<0.0001	<0.001	<0.001	0.024	2.45	<0.001	0.168	<0.0001	0.002	0.003	<0.01	<0.001	0.001	<0.01	0.124
3	DW7069W	Pollux Upper Seam	18-Feb-2019	<0.01	0.003	0.072	<0.001	1.4	<0.0001	<0.001	<0.001	0.008	2.37	<0.001	0.157	<0.0001	0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.085
3	DW7069W	Pollux Upper Seam	11-Mar-2019	<0.05	<0.005	0.062	<0.005	1.11	<0.0005	<0.005	<0.005	<0.005	2.31	<0.005	0.173	<0.0001	<0.005	<0.005	<0.05	0.007	<0.005	<0.05	0.068
3	DW7069W	Pollux Upper Seam	17-Apr-2019	<0.01	0.002	0.06	<0.001	1.3	<0.0001	<0.001	<0.001	0.002	2.38	<0.001	0.162	<0.0001	0.001	0.002	<0.01	<0.001	<0.001	<0.01	0.064

Appendix C-2: Dissolved Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
3	DW7069W	Pollux Upper Seam	13-May-2019	<0.01	0.003	0.104	<0.001	1.23	<0.0001	<0.001	<0.001	0.011	2.22	<0.001	0.161	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.07
3	DW7069W	Pollux Upper Seam	19-Jun-2019	<0.01	0.003	0.081	<0.001	1.18	<0.0001	<0.001	<0.001	0.005	2.34	<0.001	0.157	<0.0001	0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.101
3	DW7069W	Pollux Upper Seam	11-Jul-2019	<0.05	<0.005	0.085	<0.005	1.34	<0.0005	<0.005	<0.005	<0.005	1.83	<0.005	0.159	<0.0001	<0.005	0.007	<0.05	<0.005	<0.005	<0.05	0.129
3	DW7069W	Pollux Upper Seam	26-Aug-2019	<0.01	0.003	0.103	<0.001	1.3	<0.0001	<0.001	<0.001	0.002	2.63	<0.001	0.158	<0.0001	0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.045
3	DW7069W	Pollux Upper Seam	23-Sep-2019	<0.01	0.004	0.088	<0.001	1.3	<0.0001	<0.001	<0.001	0.014	2.07	<0.001	0.15	<0.0001	0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.067
3	DW7069W	Pollux Upper Seam	23-Oct-2019	<0.05	<0.005	0.071	<0.005	1.26	<0.0005	<0.005	<0.005	0.015	1.82	<0.005	0.162	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.058
3	DW7069W	Pollux Upper Seam	20-Nov-2019	<0.01	0.003	0.17	<0.001	1.14	<0.0001	<0.001	<0.001	<0.001	1.41	<0.001	0.186	<0.0001	<0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.076
3	DW7069W	Pollux Upper Seam	16-Mar-2020	<0.05	<0.005	0.083	<0.005	1.18	<0.0005	<0.005	<0.005	0.078	2.55	<0.005	0.205	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.098
3	DW7069W	Pollux Upper Seam	23-Apr-2020	<0.01	0.001	0.094	<0.001	1.12	<0.0001	<0.001	0.001	0.112	0.13	<0.001	0.19	<0.0001	0.003	0.036	<0.01	<0.001	<0.001	<0.01	0.212
3	DW7069W	Pollux Upper Seam	25-May-2020	<0.01	0.002	0.073	<0.001	1.2	<0.0001	<0.001	<0.001	<0.001	2.33	<0.001	0.16	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.099
3	DW7069W	Pollux Upper Seam	30-Jun-2020	<0.01	0.002	0.082	<0.001	1.08	<0.0001	<0.001	<0.001	0.015	2.47	0.004	0.202	<0.0001	0.002	0.009	<0.01	<0.001	<0.001	<0.01	0.067
3	DW7069W	Pollux Upper Seam	28-Jul-2020	<0.01	<0.001	0.081	<0.001	1.24	<0.0001	<0.001	<0.001	0.007	2.33	<0.001	0.196	<0.0001	0.002	0.007	<0.01	<0.001	<0.001	<0.01	0.061
3	DW7069W	Pollux Upper Seam	31-Aug-2020	<0.01	0.002	0.068	<0.001	1.24	<0.0001	<0.001	<0.001	0.006	2.18	<0.001	0.185	<0.0001	0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.042
3	DW7069W	Pollux Upper Seam	28-Sep-2020	<0.01	0.001	0.072	<0.001	1.33	<0.0001	<0.001	<0.001	0.008	1.81	<0.001	0.194	<0.0001	0.001	0.01	<0.01	<0.001	<0.001	<0.01	0.052
3	DW7069W	Pollux Upper Seam	22-Oct-2020	<0.01	0.002	0.071	<0.001	0.77	<0.0001	<0.001	<0.001	0.001	2.44	<0.001	0.178	<0.0001	0.002	0.008	<0.01	0.001	<0.001	<0.01	0.042
4	DW7073W	Castor/ Pollux Seams	13-Dec-2018	<0.01	<0.001	0.116	<0.001	1.04	<0.0001	<0.001	<0.001	0.047	1.13	<0.001	0.306	<0.0001	0.002	0.004	<0.01	<0.001	<0.001	<0.01	0.103
4	DW7073W	Castor/ Pollux Seams	07-Jan-2019	<0.01	<0.001	0.118	<0.001	0.94	<0.0001	<0.001	<0.001	0.018	1.85	<0.001	0.325	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.096
4	DW7073W	Castor/ Pollux Seams	18-Feb-2019	<0.01	0.001	0.132	<0.001	1.18	<0.0001	<0.001	<0.001	0.013	3.52	<0.001	0.339	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.097
4	DW7073W	Castor/ Pollux Seams	11-Mar-2019	<0.05	<0.005	0.122	<0.005	0.88	<0.0005	<0.005	<0.005	0.008	3.99	<0.005	0.352	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.068
4	DW7073W	Castor/ Pollux Seams	17-Apr-2019	<0.01	0.002	0.11	<0.001	1.05	<0.0001	<0.001	<0.001	0.002	4.22	<0.001	0.337	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.058
4	DW7073W	Castor/ Pollux Seams	13-May-2019	<0.01	0.002	0.153	<0.001	0.99	<0.0001	<0.001	<0.001	0.007	3.95	<0.001	0.323	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.048
4	DW7073W	Castor/ Pollux Seams	19-Jun-2019	<0.01	0.002	0.119	<0.001	1.07	<0.0001	<0.001	<0.001	0.003	3.94	<0.001	0.334	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.084
4	DW7073W	Castor/ Pollux Seams	11-Jul-2019	<0.05	<0.005	0.123	<0.005	1.15	<0.0005	<0.005	<0.005	<0.005	3.37	<0.005	0.335	<0.0001	<0.005	0.005	<0.05	<0.005	<0.005	<0.05	0.118
4	DW7073W	Castor/ Pollux Seams	26-Aug-2019	<0.01	0.001	0.137	<0.001	1.02	<0.0001	<0.001	<0.001	<0.001	3.84	<0.001	0.315	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.038
4	DW7073W	Castor/ Pollux Seams	23-Sep-2019	<0.01	0.002	0.12	<0.001	1.03	<0.0001	<0.001	<0.001	0.014	3.3	<0.001	0.316	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.052
4	DW7073W	Castor/ Pollux Seams	23-Oct-2019	<0.05	<0.005	0.113	<0.005	1.04	<0.0005	<0.005	<0.005	0.016	2.73	<0.005	0.336	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.043
4	DW7073W	Castor/ Pollux Seams	20-Nov-2019	<0.01	0.002	0.155	<0.001	0.89	<0.0001	<0.001	<0.001	0.001	1.95	<0.001	0.315	<0.0001	0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.074
4	DW7073W	Castor/ Pollux Seams	16-Mar-2020	<0.05	<0.005	0.153	<0.005	0.92	<0.0005	<0.005	<0.005	0.095	4.31	<0.005	0.405	<0.0001	<0.005	0.009	<0.05	<0.005	<0.005	<0.05	0.11
4	DW7073W	Castor/ Pollux Seams	23-Apr-2020	<0.01	<0.001	0.121	<0.001	0.88	<0.0001	<0.001	<0.001	0.131	3.78	<0.001	0.378	<0.0001	0.002	0.019	<0.01	<0.001	<0.001	<0.01	0.17
4	DW7073W	Castor/ Pollux Seams	25-May-2020	<0.01	<0.001	0.114	<0.001	1.06	<0.0001	<0.001	<0.001	<0.001	3.16	<0.001	0.323	<0.0001	0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.06
4	DW7073W	Castor/ Pollux Seams	30-Jun-2020	<0.01	<0.001	0.137	<0.001	0.95	<0.0001	<0.001	<0.001	0.019	3.08	0.003	0.355	<0.0001	0.002	0.009	<0.01	<0.001	<0.001	<0.01	0.079
4	DW7073W	Castor/ Pollux Seams	28-Jul-2020	<0.01	<0.001	0.13	<0.001	0.95	<0.0001	<0.001	<0.001	0.009	3.29	<0.001	0.378	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.07
4	DW7073W	Castor/ Pollux Seams	31-Aug-2020	<0.01	0.002	0.128	<0.001	1.02	<0.0001	<0.001	<0.001	0.006	3.87	<0.001	0.375	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.057
4	DW7073W	Castor/ Pollux Seams	28-Sep-2020	<0.01	<0.001	0.129	<0.001	1.08	<0.0001	<0.001	<0.001	0.005	2.94	<0.001	0.386	<0.0001	0.001	0.009	<0.01	<0.001	<0.001	<0.01	0.06
4	DW7073W	Castor/ Pollux Seams	22-Oct-2020	<0.01	<0.001	0.134	<0.001	0.6	<0.0001	<0.001	<0.001	0.003	2.95	<0.001	0.361	<0.0001	0.002	0.013	<0.01	<0.001	<0.001	<0.01	0.063
4	DW7074W	Castor Upper Seams	13-Dec-2018	0.02	0.001	0.079	<0.001	1.33	<0.0001	<0.001	0.001	0.032	<0.05	0.002	0.216	<0.0001	0.01	0.004	<0.01	<0.001	0.002	<0.01	0.087
4	DW7074W	Castor Upper Seams	07-Jan-2019	<0.01	0.001	0.086	<0.001	1.19	<0.0001	<0.001	0.001	0.015	0.08	<0.001	0.24	<0.0001	0.008	0.003	<0.01	<0.001	0.003	<0.01	0.065
4	DW7074W	Castor Upper Seams	18-Feb-2019	<0.01	0.002	0.086	<0.001	1.45	<0.0001	<0.001	0.002	0.013	0.29	<0.001	0.243	<0.0001	0.007	0.006	<0.01	<0.001	0.003	<0.01	0.065
4	DW7074W	Castor Upper Seams	11-Mar-2019	<0.05	<0.005	0.072	<0.005	1.13	<0.0005	<0.005	<0.005	<0.005	1.47	<0.005	0.249	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.043
4	DW7074W	Castor Upper Seams	17-Apr-2019	<0.01	0.005	0.068	<0.001	1.3	<0.0001	<0.001	0.001	<0.001	1.74	<0.001	0.228	<0.0001	0.005	0.003	<0.01	<0.001	0.002	<0.01	0.042
4	DW7074W	Castor Upper Seams	13-May-2019	<0.01	0.005	0.104	<0.001	1.28	<0.0001	<0.001	<0.001	0.008	2.41	<0.001	0.251	<0.0001	0.004	0.004	<0.01	<0.001	0.003	<0.01	0.046
4	DW7074W	Castor Upper Seams	19-Jun-2019	<0.01	0.006	0.083	<0.001	1.34	<0.0001	<0.001	<0.001	0.006	1.8	<0.001	0.237	<0.0001	0.006	0.005	<0.01	<0.001	0.002	<0.01	0.073
4	DW7074W	Castor Upper Seams	11-Jul-2019	<0.05	<0.005	0.094	<0.005	1.49	<0.0005	<0.005	<0.005	<0.005	0.96	<0.005	0.258	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.067
4	DW7074W	Castor Upper Seams	26-Aug-2019	0.01	0.002	0.106	<0.001	1.31	<0.0001	<0.001	<0.001	<0.001	1.68	<0.001	0.258	<0.0001	0.004	0.005	<0.01	<0.001	0.002	<0.01	0.025
4	DW7074W	Castor Upper Seams	23-Sep-2019	<0.01	0.004	0.085	<0.001	1.29	<0.0001	<0.001	<0.001	<0.001	1.73	<0.001	0.226	<0.0001	0.003	0.006	<0.01	<0.001	0.001	<0.01	0.03
4	DW7074W	Castor Upper Seams	23-Oct-2019	<0.05	<0.005	0.083	<0.005	1.34	<0.0005	<0.005	<0.005	0.007	1.08	<0.005	0.247	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	<0.025
4	DW7074W	Castor Upper Seams	20-Nov-2019	<0.01	0.002	0.115	<0.001	1.05	<0.0001	<0.001	<0.001	0.001	0.56	<0.001	0.236	<0.0001	0.002	0.005	<0.01	<0.001	0.001	<0.01	0.05
4	DW7074W	Castor Upper Seams	16-Mar-2020	<0.05	<0.005	0.118	<0.005	1.19	<0.0005	<0.005	<0.005	0.087	1.98	<0.005	0.312	<0.0001	0.007	0.021	<0.05	<0.005	<0.005	<0.05	0.072
4	DW7074W	Castor Upper Seams	23-Apr-2020	<0.01	0.002	0.084	<0.001	1.15	<0.0001	<0.001	<0.001	0.089	1.13	<0.001	0.26	<0.0001	0.002	0.016	<0.01	<0.001	<0.001	<0.01	0.108
4	DW7074W	Castor Upper Seams	25-May-2020	<0.01	0.002	0.088	<0.001	1.24	<0.0001	<0.001	<0.001	<0.001	1.08	<0.001	0.241	<0.0001	0.001	0.009	<0.01	<0.001	<0.001	<0.01	0.067
4	DW7074W	Castor Upper Seams	30-Jun-2020	<0.01	<0.001	0.103	<0.001	1.29	<0.0001	<0.001	<0.001	0.041	0.34	0.004	0.25	<0.0001	0.002	0.015	<0.01	<0.001	0.001	<0.01	0.083
4	DW7074W	Castor Upper Seams	28-Jul-2020	<0.01	0.001	0.087	<0.001	1.23	<0.0001	<0.001	0.001	0.009	0.14	<0.001	0.262	<0.0001	0.002	0.012	<0.01	<0.001	0.001	<0.01	0.102
4	DW7074W	Castor Upper Seams	31-Aug-2020	<0.01	0.002	0.09	<0.001	1.21	<0.0001	<0.001	<0.001	0.005	0.29	<0.001	0.273	<0.0001	0.002	0.009	<0.01	<0.001	<0.001	<0.01	0.064
4	DW7074W	Castor Upper Seams	28-Sep-2020	<0.01	<0.001	0.094	<0.001	1.4	<0.0001	<0.001	<0.001	0.006	0.15	<0.001	0.283	<0.0001	0.002	0.011	<0.01	<0.001	<0.001	<0.01	0.059
4	DW7074W	Castor Upper Seams	22-Oct-2020	<0.01	<0.001	0.096	<0.001	0.77	<0.0001	<0.001	<0.001	0.002	0.2	<0.001	0.272	<0.0001	0.002	0.011	<0.01	<0.001	<0.001	<0.01	0.052
5	DW7076W	Quaternary Alluvium	12-Dec-2018	0.02	0.002	0.181	<0.001	0.56	<0.0001	<0.001	0.003	0.006	0.09	<0.001	0.112	<0.0001	<0.001	0.004	<0.01	<0.001	0.01	<0.01	<0.005
5	DW7076W	Quaternary Alluvium	07-Jan-2019	<0.01	0.002	0.278	<0.001	3.81	<0.0001	<0.001	0.004	0.011	<0.05	<0.001	0.118	<0.0001	0.004	0.004	<0.01	<0.001	0.058	0.01	0.007
5	DW7076W	Quaternary Alluvium	18-Feb-2019	<0.01	0.002	0.344	<0.001	3.94	<0.0001	<0.001	0.002	0.019	0.12	<0.001	0.072	<0.0001	0.002	0.004	<0.01	<0.001	0.058	0.03	0.007
5	DW7076W	Quaternary Alluvium	11-Mar-2019	<0.05	<0.005	0.26	<0.005	3.3	<0.0005	<0.005	<0.005	0.023	0.13	<0.005	0.075	<0.0001	<0.005	<0.005	<0.05	<0.005	0.051	<0.05	0.028
5	DW7076W	Quaternary Alluvium	17-Apr-2019	<0.01	0.002	0.233	<0.001	3.62	<0.0001	<0.001	0.002	0.01	0.05	<0.001	0.059	<0.0001	0.002	0.003	<0.01	<0.001	0.034	0.01	0.012

Appendix C-2: Dissolved Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
5	DW7076W	Quaternary Alluvium	13-May-2019	0.01	0.002	0.232	<0.001	4.03	<0.0001	<0.001	0.002	0.015	0.13	<0.001	0.063	<0.0001	0.002	0.002	<0.01	<0.001	0.053	0.01	0.01
5	DW7076W	Quaternary Alluvium	19-Jun-2019	0.05	0.003	0.186	<0.001	3.69	<0.0001	<0.001	0.004	0.018	0.15	<0.001	0.09	<0.0001	0.002	0.006	<0.01	<0.001	0.058	0.02	0.025
5	DW7076W	Quaternary Alluvium	11-Jul-2019	<0.05	<0.005	0.2	<0.005	4.56	<0.0005	<0.005	<0.005	0.009	<0.05	<0.005	0.064	<0.0001	<0.005	<0.005	<0.05	<0.005	0.041	<0.05	<0.025
5	DW7076W	Quaternary Alluvium	26-Aug-2019	0.06	0.002	0.189	<0.001	3.98	<0.0001	<0.001	0.002	0.002	<0.05	<0.001	0.07	<0.0001	0.002	0.004	<0.01	<0.001	0.04	0.01	0.019
5	DW7076W	Quaternary Alluvium	23-Sep-2019	0.02	0.002	0.136	<0.001	2.45	<0.0001	<0.001	0.002	<0.001	<0.05	<0.001	0.049	<0.0001	0.001	0.005	<0.01	<0.001	0.041	0.01	0.008
5	DW7076W	Quaternary Alluvium	23-Oct-2019	0.09	0.002	0.167	<0.001	3.86	<0.0001	<0.001	0.002	0.001	<0.05	<0.001	0.051	<0.0001	0.001	0.004	<0.01	<0.001	0.032	0.02	0.011
5	DW7076W	Quaternary Alluvium	20-Nov-2019	0.02	0.002	0.149	<0.001	4.65	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.03	<0.0001	0.001	0.001	<0.01	<0.001	0.042	0.02	0.008
5	DW7076W	Quaternary Alluvium	31-Mar-2020	0.06	0.003	0.163	<0.001	4.5	<0.0001	0.001	0.001	<0.001	0.09	<0.001	0.117	<0.0001	0.002	0.003	<0.01	<0.001	0.017	<0.01	<0.005
5	DW7076W	Quaternary Alluvium	23-Apr-2020	0.02	0.003	0.187	<0.001	4.22	<0.0001	<0.001	0.001	<0.001	0.07	<0.001	0.224	<0.0001	0.002	0.004	<0.01	<0.001	0.021	<0.01	<0.005
5	DW7076W	Quaternary Alluvium	25-May-2020	0.05	0.003	0.168	<0.001	4.38	<0.0001	0.001	0.002	<0.001	0.1	<0.001	0.217	<0.0001	0.009	0.008	<0.01	<0.001	0.026	<0.01	<0.005
5	DW7076W	Quaternary Alluvium	30-Jun-2020	<0.01	0.002	0.24	<0.001	0.66	<0.0001	<0.001	<0.001	<0.001	0.1	<0.001	0.23	<0.0001	0.003	0.005	<0.01	<0.001	0.033	<0.01	<0.005
5	DW7076W	Quaternary Alluvium	28-Jul-2020	0.05	0.003	0.202	<0.001	4.48	<0.0001	<0.001	0.002	<0.001	<0.05	<0.001	0.289	<0.0001	0.003	0.005	<0.01	<0.001	0.025	<0.01	<0.005
5	DW7076W	Quaternary Alluvium	31-Aug-2020	0.06	0.002	0.217	<0.001	4.67	<0.0001	0.001	0.002	0.001	0.07	<0.001	0.218	<0.0001	0.003	0.006	<0.01	<0.001	0.01	<0.01	<0.005
5	DW7076W	Quaternary Alluvium	28-Sep-2020	0.04	0.002	0.179	<0.001	4.81	<0.0001	<0.001	0.002	<0.001	0.06	<0.001	0.138	<0.0001	0.002	0.005	<0.01	<0.001	0.02	<0.01	<0.005
5	DW7076W	Quaternary Alluvium	22-Oct-2020	0.02	0.002	0.164	<0.001	3.08	<0.0001	<0.001	0.002	<0.001	0.07	<0.001	0.077	<0.0001	0.003	0.002	<0.01	<0.001	0.012	<0.01	<0.005
6	DW7033W1	Tertiary	26-Sep-2019	<0.01	<0.001	0.125	<0.001	0.85	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.019	<0.0001	<0.001	0.005	<0.01	<0.001	0.007	<0.01	0.008
6	DW7033W1	Tertiary	30-Oct-2019	<0.01	<0.001	0.159	<0.001	0.8	<0.0001	0.003	<0.001	0.004	<0.05	<0.001	0.012	<0.0001	0.004	0.016	<0.01	<0.001	0.007	<0.01	0.044
6	DW7033W1	Tertiary	26-Nov-2019	<0.01	<0.001	0.144	<0.001	0.84	<0.0001	<0.001	0.001	0.003	0.08	<0.001	0.033	<0.0001	0.001	0.008	<0.01	<0.001	0.007	<0.01	0.008
6	DW7033W1	Tertiary	18-Dec-2019	<0.01	<0.001	0.104	<0.001	0.82	<0.0001	<0.001	0.001	<0.001	<0.05	<0.001	0.041	<0.0001	<0.001	0.004	<0.01	<0.001	0.008	<0.01	<0.005
6	DW7033W1	Tertiary	20-Feb-2020	0.01	<0.001	0.151	<0.001	0.79	<0.0001	<0.001	<0.001	<0.001	0.38	<0.001	0.013	<0.0001	<0.001	0.009	<0.01	<0.001	0.006	<0.01	0.007
6	DW7033W1	Tertiary	20-Mar-2020	<0.01	<0.001	0.156	<0.001	0.77	<0.0001	<0.001	<0.001	0.147	<0.05	<0.001	0.028	0.0004	0.001	0.02	<0.01	<0.001	0.003	<0.01	0.108
6	DW7033W1	Tertiary	28-Apr-2020	<0.01	<0.001	0.16	<0.001	0.72	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.023	<0.0001	<0.001	0.008	<0.01	<0.001	0.007	<0.01	0.023
6	DW7033W1	Tertiary	20-May-2020	<0.01	<0.001	0.136	<0.001	0.86	<0.0001	<0.001	<0.001	<0.001	0.12	<0.001	0.009	<0.0001	<0.001	0.007	<0.01	<0.001	0.006	<0.01	0.009
6	DW7033W1	Tertiary	17-Jun-2020	<0.01	<0.001	0.156	<0.001	0.79	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.016	<0.0001	<0.001	0.012	<0.01	<0.001	0.006	<0.01	0.079
6	DW7033W1	Tertiary	15-Jul-2020	<0.01	<0.001	0.146	<0.001	0.84	<0.0001	<0.001	<0.001	<0.001	0.12	<0.001	0.013	<0.0001	0.001	0.009	<0.01	<0.001	0.007	<0.01	0.014
6	DW7033W1	Tertiary	21-Aug-2020	<0.01	<0.001	0.15	<0.001	0.83	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.024	<0.0001	<0.001	0.01	<0.01	<0.001	0.007	<0.01	0.01
6	DW7033W1	Tertiary	24-Sep-2020	<0.01	<0.001	0.119	<0.001	0.9	<0.0001	<0.001	<0.001	<0.001	0.08	<0.001	0.015	<0.0001	<0.001	0.01	<0.01	<0.001	0.006	<0.01	0.014
6	DW7033W1	Tertiary	21-Oct-2020	<0.01	<0.001	0.157	<0.001	0.63	<0.0001	<0.001	<0.001	<0.001	0.16	<0.001	0.01	<0.0001	<0.001	0.008	<0.01	<0.001	0.006	<0.01	0.014
6	DW7033W2	Orion 5 Seam	26-Sep-2019	<0.01	0.001	0.142	<0.001	0.88	<0.0001	<0.001	0.003	<0.001	0.49	<0.001	0.238	<0.0001	0.001	0.006	<0.01	<0.001	0.004	<0.01	0.008
6	DW7033W2	Orion 5 Seam	30-Oct-2019	<0.01	<0.001	0.161	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	2.34	<0.001	0.279	<0.0001	<0.001	0.004	<0.01	<0.001	0.008	<0.01	<0.005
6	DW7033W2	Orion 5 Seam	26-Nov-2019	<0.01	0.001	0.138	<0.001	0.98	<0.0001	0.006	<0.001	<0.001	2.59	<0.001	0.293	<0.0001	<0.001	0.006	<0.01	<0.001	0.005	<0.01	<0.005
6	DW7033W2	Orion 5 Seam	18-Dec-2019	<0.01	0.002	0.154	<0.001	0.95	<0.0001	<0.001	<0.001	<0.001	3.78	<0.001	0.303	<0.0001	<0.001	0.005	<0.01	<0.001	0.002	<0.01	0.007
6	DW7033W2	Orion 5 Seam	20-Feb-2020	<0.01	<0.001	0.15	<0.001	0.89	<0.0001	<0.001	<0.001	<0.001	1.09	<0.001	0.251	<0.0001	<0.001	0.008	<0.01	<0.001	0.003	<0.01	<0.005
6	DW7033W2	Orion 5 Seam	20-Mar-2020	<0.01	<0.001	0.155	<0.001	0.9	<0.0001	<0.001	<0.001	<0.001	0.63	<0.001	0.251	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.018
6	DW7033W2	Orion 5 Seam	28-Apr-2020	<0.01	<0.001	0.172	<0.001	0.66	<0.0001	<0.001	<0.001	<0.001	0.65	<0.001	0.241	<0.0001	<0.001	0.007	<0.01	<0.001	0.002	<0.01	<0.005
6	DW7033W2	Orion 5 Seam	20-May-2020	<0.01	<0.001	0.155	<0.001	1.05	<0.0001	<0.001	<0.001	<0.001	0.74	<0.001	0.244	<0.0001	<0.001	0.007	<0.01	<0.001	0.002	<0.01	<0.005
6	DW7033W2	Orion 5 Seam	17-Jun-2020	<0.01	<0.001	0.187	<0.001	0.85	<0.0001	<0.001	<0.001	<0.001	0.92	<0.001	0.282	<0.0001	<0.001	0.012	<0.01	<0.001	0.002	<0.01	0.016
6	DW7033W2	Orion 5 Seam	15-Jul-2020	<0.01	<0.001	0.175	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	0.91	<0.001	0.254	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.021
6	DW7033W2	Orion 5 Seam	21-Aug-2020	<0.01	<0.001	0.163	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	0.66	<0.001	0.268	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.019
6	DW7033W2	Orion 5 Seam	24-Sep-2020	<0.01	<0.001	0.153	<0.001	0.94	<0.0001	<0.001	<0.001	<0.001	0.91	<0.001	0.257	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.016
6	DW7033W2	Orion 5 Seam	21-Oct-2020	<0.01	<0.001	0.182	<0.001	0.67	<0.0001	<0.001	<0.001	<0.001	1.04	<0.001	0.27	<0.0001	<0.001	0.005	<0.01	<0.001	0.002	<0.01	0.008
6	DW7033W3	Interburden	26-Sep-2019	<0.01	0.004	0.113	<0.001	1.01	<0.0001	<0.001	0.022	<0.001	1.36	<0.001	0.539	<0.0001	0.007	0.025	<0.01	0.001	0.034	<0.01	0.011
6	DW7033W3	Interburden	30-Oct-2019	<0.01	0.003	0.122	<0.001	1.02	<0.0001	<0.001	0.004	<0.001	2.45	<0.001	0.554	<0.0001	<0.001	0.006	<0.01	<0.001	0.026	<0.01	<0.005
6	DW7033W3	Interburden	26-Nov-2019	<0.01	0.002	0.119	<0.001	0.98	<0.0001	0.003	<0.001	<0.001	4.54	<0.001	0.47	<0.0001	<0.001	0.009	<0.01	<0.001	0.018	<0.01	<0.005
6	DW7033W3	Interburden	18-Dec-2019	<0.01	0.003	0.141	<0.001	1.02	<0.0001	<0.001	<0.001	<0.001	4.94	<0.001	0.508	<0.0001	<0.001	0.005	<0.01	<0.001	0.012	<0.01	<0.005
6	DW7033W3	Interburden	20-Feb-2020	<0.01	0.002	0.124	<0.001	0.96	<0.0001	<0.001	<0.001	<0.001	0.83	<0.001	0.464	<0.0001	<0.001	0.007	<0.01	<0.001	0.009	<0.01	<0.005
6	DW7033W3	Interburden	20-Mar-2020	0.01	0.001	0.309	<0.001	0.87	<0.0001	<0.001	<0.001	<0.001	0.84	<0.001	0.454	<0.0001	<0.001	0.006	<0.01	<0.001	0.008	<0.01	<0.005
6	DW7033W3	Interburden	28-Apr-2020	<0.01	<0.001	0.144	<0.001	0.76	<0.0001	<0.001	<0.001	<0.001	0.54	<0.001	0.399	<0.0001	<0.001	0.008	<0.01	<0.001	0.004	<0.01	<0.005
6	DW7033W3	Interburden	20-May-2020	<0.01	<0.001	0.128	<0.001	1.17	<0.0001	<0.001	<0.001	<0.001	0.49	<0.001	0.377	<0.0001	<0.001	0.007	<0.01	<0.001	0.004	<0.01	<0.005
6	DW7033W3	Interburden	17-Jun-2020	<0.01	<0.001	0.225	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	1.39	<0.001	0.402	<0.0001	<0.001	0.015	<0.01	<0.001	0.005	<0.01	<0.005
6	DW7033W3	Interburden	15-Jul-2020	<0.01	<0.001	0.159	<0.001	1.02	<0.0001	<0.001	<0.001	<0.001	0.29	<0.001	0.342	<0.0001	<0.001	0.005	<0.01	<0.001	0.004	<0.01	<0.005
6	DW7033W3	Interburden	21-Aug-2020	<0.01	<0.001	0.148	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	0.11	<0.001	0.321	<0.0001	<0.001	0.009	<0.01	<0.001	0.004	<0.01	0.015
6	DW7033W3	Interburden	24-Sep-2020	<0.01	<0.001	0.134	<0.001	1.04	<0.0001	<0.001	<0.001	<0.001	0.46	<0.001	0.287	<0.0001	<0.001	0.006	<0.01	<0.001	0.004	<0.01	0.011
6	DW7033W3	Interburden	21-Oct-2020	<0.01	<0.001	0.157	<0.001	0.74	<0.0001	<0.001	<0.001	<0.001	0.66	<0.001	0.316	<0.0001	<0.001	0.005	<0.01	<0.001	0.003	<0.01	<0.005
7	DW7035W3	Orion 1 Seam	26-Sep-2019	<0.01	0.001	0.156	<0.001	0.89	<0.0001	<0.001	<0.001	<0.001	0.36	<0.001	0.196	<0.0001	0.002	0.004	<0.01	<0.001	0.003	<0.01	0.025
7	DW7035W3	Orion 1 Seam	30-Oct-2019	<0.01	<0.001	0.11	<0.001	0.99	<0.0001	<0.001	<0.001	<0.001	1.11	<0.001	0.212	<0.0001	0.001	0.004	<0.01	<0.001	0.001	<0.01	0.017
7	DW7035W3	Orion 1 Seam	26-Nov-2019	<0.01	<0.001	0.14	<0.001	0.89	<0.0001	<0.001	<0.001	<0.001	1.11	<0.001	0.179	<0.0001	0.002	0.008	<0.01	<0.001	0.001	<0.01	0.014
7	DW7035W3	Orion 1 Seam	18-Dec-2019	<0.01	<0.001	0.147	<0.001	0.96	<0.0001	<0.001	0.001	0.014	0.24	<0.001	0.178	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.046
7	DW7035W3	Orion 1 Seam	31-Mar-2020	<0.01	<0.001	0.132	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	2.14	<0.001	0.313	<0.0001	<0.001	0.023	<0.01	<0.001	<0.001	<0.01	<0.005
7	DW7035W3	Orion 1 Seam	28-Apr-2020	<0.01	<0.001	0.117	<0.001	0.82	<0.0001	<0.001	<0.001	<0.001	0.99	<0.001	0.253	<0.0001	<0.001	0.011	<0.01	<0.001	<0.001	<0.01	<0.005

Appendix C-2: Dissolved Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
7	DW7035W3	Orion 1 Seam	20-May-2020	<0.01	0.001	0.109	<0.001	0.95	<0.0001	<0.001	<0.001	<0.001	1.74	<0.001	0.262	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	<0.005
7	DW7035W3	Orion 1 Seam	17-Jun-2020	<0.01	<0.001	0.112	<0.001	0.84	<0.0001	<0.001	<0.001	<0.001	1.14	<0.001	0.194	<0.0001	<0.001	0.011	<0.01	<0.001	<0.001	<0.01	<0.005
7	DW7035W3	Orion 1 Seam	15-Jul-2020	<0.01	0.002	0.1	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	1.94	<0.001	0.251	<0.0001	0.002	0.008	<0.01	<0.001	<0.001	<0.01	0.007
7	DW7035W3	Orion 1 Seam	21-Aug-2020	<0.01	0.001	0.104	<0.001	0.98	<0.0001	<0.001	<0.001	<0.001	1.12	<0.001	0.235	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.014
7	DW7035W3	Orion 1 Seam	24-Sep-2020	<0.01	<0.001	0.08	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	1.22	<0.001	0.227	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	<0.005
7	DW7035W3	Orion 1 Seam	21-Oct-2020	<0.01	<0.001	0.115	<0.001	0.64	<0.0001	<0.001	<0.001	<0.001	1.29	<0.001	0.19	<0.0001	0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.006
8	DW7082W1	Castor Lower Seam	24-Sep-2019	<0.01	0.019	0.1	<0.001	0.78	0.0007	<0.001	0.01	0.016	0.36	<0.001	0.217	<0.0001	2.85	0.012	<0.01	<0.001	0.004	<0.01	0.092
8	DW7082W1	Castor Lower Seam	24-Oct-2019	<0.01	0.039	0.07	<0.001	0.94	<0.0001	<0.001	0.008	0.004	0.96	<0.001	0.231	<0.0001	0.629	0.009	<0.01	<0.001	0.004	<0.01	0.033
8	DW7082W1	Castor Lower Seam	21-Nov-2019	<0.01	0.025	0.107	<0.001	0.82	<0.0001	<0.001	0.005	0.001	1.17	<0.001	0.247	<0.0001	0.213	0.01	<0.01	<0.001	0.004	<0.01	0.046
8	DW7082W1	Castor Lower Seam	13-Dec-2019	<0.01	0.021	0.282	<0.001	0.58	<0.0001	<0.001	0.004	0.003	2.76	<0.001	0.242	<0.0001	0.141	0.007	<0.01	<0.001	0.003	<0.01	0.036
8	DW7082W1	Castor Lower Seam	19-Feb-2020	<0.01	0.016	0.101	<0.001	0.59	<0.0001	<0.001	0.003	0.001	2.24	<0.001	0.224	<0.0001	0.076	0.01	<0.01	<0.001	0.002	<0.01	0.012
8	DW7082W1	Castor Lower Seam	17-Mar-2020	<0.01	0.013	0.127	<0.001	0.64	<0.0001	<0.001	0.001	0.002	2.95	<0.001	0.191	<0.0001	0.164	0.006	<0.01	<0.001	0.002	<0.01	<0.005
8	DW7082W1	Castor Lower Seam	29-Apr-2020	<0.01	0.008	0.142	<0.001	0.77	<0.0001	<0.001	<0.001	<0.001	2.35	<0.001	0.145	<0.0001	0.096	0.007	<0.01	<0.001	<0.001	<0.01	0.064
8	DW7082W1	Castor Lower Seam	20-May-2020	<0.01	0.009	0.149	<0.001	0.75	<0.0001	<0.001	<0.001	<0.001	3.18	<0.001	0.166	<0.0001	0.082	0.01	<0.01	<0.001	0.001	<0.01	0.027
8	DW7082W1	Castor Lower Seam	30-Jun-2020	<0.01	0.006	0.09	<0.001	0.7	<0.0001	<0.001	<0.001	<0.001	2.99	<0.001	0.166	<0.0001	0.08	0.006	<0.01	<0.001	<0.001	<0.01	0.019
8	DW7082W1	Castor Lower Seam	15-Jul-2020	<0.01	0.005	0.249	<0.001	0.67	<0.0001	<0.001	<0.001	<0.001	3.14	<0.001	0.159	<0.0001	0.095	0.012	<0.01	<0.001	<0.001	<0.01	0.048
8	DW7082W1	Castor Lower Seam	20-Aug-2020	<0.01	0.005	0.143	<0.001	0.67	<0.0001	0.002	<0.001	<0.001	3.46	<0.001	0.16	<0.0001	0.078	0.018	<0.01	<0.001	<0.001	<0.01	0.057
8	DW7082W1	Castor Lower Seam	23-Sep-2020	<0.01	0.004	0.16	<0.001	0.63	<0.0001	<0.001	<0.001	<0.001	3.32	<0.001	0.163	<0.0001	0.052	0.008	<0.01	<0.001	<0.001	<0.01	0.049
8	DW7082W1	Castor Lower Seam	20-Oct-2020	<0.01	0.003	0.146	<0.001	0.54	<0.0001	<0.001	<0.001	<0.001	3.3	<0.001	0.133	<0.0001	0.051	0.008	<0.01	<0.001	<0.001	<0.01	0.007
8	DW7082W2	Pollux Upper Seam	24-Sep-2019	<0.01	0.005	0.084	<0.001	0.95	<0.0001	<0.001	0.006	0.011	0.44	<0.001	0.161	<0.0001	0.179	0.01	<0.01	<0.001	0.001	<0.01	0.055
8	DW7082W2	Pollux Upper Seam	24-Oct-2019	<0.01	0.012	0.067	<0.001	0.6	<0.0001	<0.001	0.005	0.005	0.83	<0.001	0.153	<0.0001	0.163	0.007	<0.01	<0.001	0.001	<0.01	0.027
8	DW7082W2	Pollux Upper Seam	21-Nov-2019	<0.01	0.009	0.096	<0.001	0.95	<0.0001	<0.001	0.004	<0.001	0.84	<0.001	0.166	<0.0001	0.112	0.008	<0.01	<0.001	<0.001	<0.01	0.049
8	DW7082W2	Pollux Upper Seam	13-Dec-2019	<0.01	0.009	0.122	0.001	0.7	<0.0001	<0.001	0.003	<0.001	1.36	<0.001	0.171	<0.0001	0.099	0.007	<0.01	<0.001	<0.001	<0.01	0.032
8	DW7082W2	Pollux Upper Seam	19-Feb-2020	<0.01	0.014	0.082	<0.001	0.77	<0.0001	<0.001	0.003	0.002	2.2	<0.001	0.145	<0.0001	0.054	0.008	<0.01	<0.001	0.001	<0.01	0.034
8	DW7082W2	Pollux Upper Seam	17-Mar-2020	<0.01	0.01	0.079	<0.001	0.73	<0.0001	<0.001	0.002	0.001	2.72	<0.001	0.142	<0.0001	0.036	0.006	<0.01	<0.001	<0.001	<0.01	<0.005
8	DW7082W2	Pollux Upper Seam	29-Apr-2020	<0.01	0.009	0.101	<0.001	0.88	<0.0001	<0.001	<0.001	<0.001	2.51	<0.001	0.147	<0.0001	0.032	0.007	<0.01	<0.001	<0.001	<0.01	0.032
8	DW7082W2	Pollux Upper Seam	20-May-2020	<0.01	0.007	0.093	<0.001	0.8	<0.0001	<0.001	<0.001	<0.001	2.15	<0.001	0.132	<0.0001	0.026	0.008	<0.01	<0.001	<0.001	<0.01	0.034
8	DW7082W2	Pollux Upper Seam	30-Jun-2020	<0.01	0.008	0.074	<0.001	0.84	<0.0001	<0.001	<0.001	<0.001	2.1	<0.001	0.134	<0.0001	0.034	0.007	<0.01	<0.001	<0.001	<0.01	0.015
8	DW7082W2	Pollux Upper Seam	15-Jul-2020	<0.01	0.007	0.103	<0.001	0.81	<0.0001	<0.001	<0.001	<0.001	2.23	<0.001	0.139	<0.0001	0.041	0.007	<0.01	<0.001	<0.001	<0.01	0.042
8	DW7082W2	Pollux Upper Seam	20-Aug-2020	<0.01	0.006	0.099	<0.001	0.78	<0.0001	<0.001	<0.001	<0.001	2.52	<0.001	0.141	<0.0001	0.036	0.011	<0.01	<0.001	<0.001	<0.01	0.06
8	DW7082W2	Pollux Upper Seam	23-Sep-2020	<0.01	0.005	0.089	<0.001	0.76	<0.0001	<0.001	<0.001	<0.001	2	<0.001	0.133	<0.0001	0.023	0.006	<0.01	<0.001	<0.001	<0.01	0.038
8	DW7082W2	Pollux Upper Seam	20-Oct-2020	<0.01	0.004	0.105	<0.001	0.57	<0.0001	<0.001	<0.001	<0.001	1.63	<0.001	0.141	<0.0001	0.019	0.009	<0.01	<0.001	<0.001	<0.01	0.074
9	DW7093W1	Pollux Lower Upper Seam	24-Sep-2019	<0.01	0.005	0.494	<0.001	0.44	<0.0001	<0.001	<0.001	<0.001	0.95	<0.001	0.078	<0.0001	0.003	0.003	<0.01	<0.001	0.01	<0.01	0.005
9	DW7093W1	Pollux Lower Upper Seam	24-Oct-2019	<0.01	0.017	0.22	<0.001	0.48	<0.0001	<0.001	<0.001	<0.001	1.76	<0.001	0.173	<0.0001	0.002	0.003	<0.01	<0.001	0.008	<0.01	0.007
9	DW7093W1	Pollux Lower Upper Seam	21-Nov-2019	<0.01	0.02	0.499	<0.001	0.63	<0.0001	<0.001	<0.001	<0.001	1.96	<0.001	0.221	<0.0001	0.006	0.008	<0.01	<0.001	0.005	<0.01	0.021
9	DW7093W1	Pollux Lower Upper Seam	16-Dec-2019	<0.01	0.016	0.398	<0.001	0.49	<0.0001	<0.001	<0.001	<0.001	1.22	<0.001	0.421	<0.0001	0.005	0.009	<0.01	<0.001	0.005	<0.01	0.033
9	DW7093W1	Pollux Lower Upper Seam	29-Jan-2020	0.04	0.037	0.429	<0.001	0.44	<0.0001	0.003	<0.001	0.004	1.83	<0.001	0.256	<0.0001	0.002	0.01	<0.01	<0.001	0.004	<0.01	0.021
9	DW7093W1	Pollux Lower Upper Seam	19-Feb-2020	0.02	0.01	0.478	<0.001	0.43	<0.0001	0.002	<0.001	<0.001	<0.05	<0.001	0.099	<0.0001	0.004	0.002	<0.01	<0.001	0.007	<0.01	<0.005
9	DW7093W1	Pollux Lower Upper Seam	18-Mar-2020	0.04	0.029	0.628	<0.001	0.5	<0.0001	0.002	<0.001	<0.001	0.65	<0.001	0.177	<0.0001	0.002	0.007	<0.01	<0.001	0.003	<0.01	0.017
9	DW7093W1	Pollux Lower Upper Seam	29-Apr-2020	<0.01	0.015	0.826	<0.001	0.56	<0.0001	0.002	<0.001	<0.001	0.16	<0.001	0.131	<0.0001	0.003	0.008	<0.01	<0.001	0.003	<0.01	0.015
9	DW7093W1	Pollux Lower Upper Seam	19-May-2020	0.01	0.016	0.951	<0.001	0.62	<0.0001	0.002	<0.001	<0.001	0.06	<0.001	0.141	<0.0001	0.003	0.007	<0.01	<0.001	0.004	<0.01	<0.005
9	DW7093W1	Pollux Lower Upper Seam	15-Jun-2020	0.05	0.018	0.822	<0.001	0.44	<0.0001	0.003	<0.001	<0.001	0.37	<0.001	0.091	<0.0001	0.004	0.015	<0.01	<0.001	0.004	<0.01	0.024
9	DW7093W1	Pollux Lower Upper Seam	14-Jul-2020	0.06	0.012	1.19	<0.001	0.47	<0.0001	0.003	<0.001	<0.001	0.13	<0.001	0.113	<0.0001	0.003	0.007	<0.01	<0.001	0.002	<0.01	0.005
9	DW7093W1	Pollux Lower Upper Seam	19-Aug-2020	0.04	0.02	1.38	<0.001	0.44	<0.0001	0.006	<0.001	<0.001	0.06	<0.001	0.066	<0.0001	0.002	0.004	<0.01	<0.001	0.001	<0.01	0.007
9	DW7093W1	Pollux Lower Upper Seam	22-Sep-2020	0.04	0.033	1.73	<0.001	0.45	<0.0001	0.003	<0.001	<0.001	0.2	<0.001	0.057	<0.0001	0.002	0.004	<0.01	<0.001	0.001	<0.01	0.006
9	DW7093W1	Pollux Lower Upper Seam	20-Oct-2020	<0.01	0.004	2.46	<0.001	0.29	<0.0001	0.003	<0.001	<0.001	0.06	<0.001	0.047	<0.0001	0.002	0.003	<0.01	<0.001	0.001	<0.01	0.006
9	DW7093W2	Interburden	24-Sep-2019	<0.01	0.012	0.609	<0.001	0.56	<0.0001	0.002	<0.001	<0.001	1.43	<0.001	0.312	<0.0001	0.004	0.004	<0.01	<0.001	0.041	<0.01	0.011
9	DW7093W2	Interburden	24-Oct-2019	<0.01	0.012	0.561	<0.001	0.52	<0.0001	0.001	<0.001	<0.001	1.31	<0.001	0.274	<0.0001	0.004	0.003	<0.01	<0.001	0.033	<0.01	0.006
9	DW7093W2	Interburden	21-Nov-2019	<0.01	0.009	0.734	<0.001	0.55	<0.0001	0.001	<0.001	<0.001	0.91	<0.001	0.27	<0.0001	0.004	0.005	<0.01	<0.001	0.028	<0.01	0.007
9	DW7093W2	Interburden	16-Dec-2019	<0.01	0.007	0.79	<0.001	0.44	<0.0001	0.001	<0.001	<0.001	1.19	<0.001	0.353	<0.0001	0.003	0.005	<0.01	<0.001	0.029	<0.01	0.011
9	DW7093W2	Interburden	29-Jan-2020	0.04	0.02	0.952	<0.001	0.42	<0.0001	0.002	<0.001	<0.001	0.15	<0.001	0.299	<0.0001	<0.001	0.002	<0.01	<0.001	0.026	<0.01	<0.005
9	DW7093W2	Interburden	19-Feb-2020	0.01	0.027	1.2	<0.001	0.44	<0.0001	0.002	<0.001	0.001	0.68	<0.001	0.261	<0.0001	0.003	0.003	<0.01	<0.001	0.021	<0.01	<0.005
9	DW7093W2	Interburden	20-Mar-2020	0.02	0.008	1.52	<0.001	0.36	<0.0001	<0.001	<0.001	<0.001	0.17	<0.001	0.273	<0.0001	<0.001	0.003	<0.01	<0.001	0.017	<0.01	0.009
9	DW7093W2	Interburden	29-Apr-2020	0.01	0.006	1.95	<0.001	0.42	<0.0001	0.002	<0.001	<0.001	<0.05	<0.001	0.285	<0.0001	0.002	0.003	<0.01	<0.001	0.018	<0.01	<0.005
9	DW7093W2	Interburden	19-May-2020	0.06	0.012	2.36	<0.001	0.53	<0.0001	0.003	<0.001	0.003	0.1	<0.001	0.275	<0.0001	0.003	0.006	<0.01	<0.001	0.013	<0.01	0.011
9	DW7093W2	Interburden	15-Jun-2020	0.04	0.011	3.44	<0.001	0.39	<0.0001	0.003	<0.001	<0.001	<0.05	<0.001	0.27	<0.0001	0.001	0.004	<0.01	<0.001	0.014	<0.01	0.008
9	DW7093W2	Interburden	14-Jul-2020	0.04	0.006	3.79	<0.001	0.44	<0.0001	0.009	<0.001	<0.001	<0.05	<0.001	0.246	<0.0001	0.007	0.027	<0.01	<0.001	0.011	<0.01	<0.005
9	DW7093W2	Interburden	19-Aug-2020	0.02	0.006	4.15	<0.001	0.41	<0.0001	0.003	<0.001	<0.001	<0.05	<0.001	0.229	<0.0001	0.001	0.003	<0.01	<0.001	0.01	<0.01	0.008
9	DW7093W2	Interburden	22-Sep-2020	0.03	0.011	5.04	<0.001	0.43	<0.0001	0.002	<0.001	<0.001	0.05	<0.001	0.206	<0.0001	0.001	0.002	<0.01	<0.001	0.008	<0.01	0.007
9	DW7093W2	Interburden	20-Oct-2020	0.01	0.003	6.38	<0.001	0.33	<0.0001	0.001	<0.001	<0.001	<0.05	<0.001	0.226	<0.0001	0.001	0.002	<0.01	<0.001	0.008	<0.01	<0.005

Appendix C-2: Dissolved Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
9	DW7093W3	Pollux Lower Lower Seam	25-Sep-2019	<0.01	<0.001	0.616	<0.001	0.8	<0.0001	<0.001	<0.001	<0.001	1.15	<0.001	0.097	<0.0001	0.006	0.007	<0.01	<0.001	0.001	<0.01	0.006
9	DW7093W3	Pollux Lower Lower Seam	28-Oct-2019	<0.01	<0.001	0.537	<0.001	0.79	<0.0001	<0.001	<0.001	<0.001	1.45	<0.001	0.095	<0.0001	0.005	0.005	<0.01	<0.001	0.001	<0.01	<0.005
9	DW7093W3	Pollux Lower Lower Seam	21-Nov-2019	<0.01	0.002	0.522	<0.001	0.97	<0.0001	<0.001	<0.001	<0.001	1.61	<0.001	0.133	<0.0001	0.007	0.006	<0.01	<0.001	0.002	<0.01	0.008
9	DW7093W3	Pollux Lower Lower Seam	16-Dec-2019	<0.01	0.002	0.723	<0.001	0.66	<0.0001	<0.001	<0.001	<0.001	1.6	<0.001	0.229	<0.0001	0.003	0.004	<0.01	<0.001	0.006	<0.01	0.006
9	DW7093W3	Pollux Lower Lower Seam	29-Jan-2020	0.01	0.002	0.572	<0.001	0.62	<0.0001	<0.001	<0.001	<0.001	0.96	<0.001	0.12	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	<0.005
9	DW7093W3	Pollux Lower Lower Seam	19-Feb-2020	<0.01	0.003	0.506	<0.001	0.64	<0.0001	<0.001	<0.001	<0.001	0.81	<0.001	0.09	<0.0001	0.003	0.005	<0.01	<0.001	<0.001	<0.01	<0.005
9	DW7093W3	Pollux Lower Lower Seam	31-Mar-2020	0.02	<0.001	0.552	<0.001	0.75	<0.0001	<0.001	<0.001	<0.001	0.75	<0.001	0.102	<0.0001	0.001	0.013	<0.01	<0.001	<0.001	<0.01	<0.005
9	DW7093W3	Pollux Lower Lower Seam	29-Apr-2020	0.01	<0.001	0.711	<0.001	0.78	<0.0001	<0.001	<0.001	<0.001	0.49	<0.001	0.122	<0.0001	0.002	0.006	<0.01	<0.001	0.002	<0.01	<0.005
9	DW7093W3	Pollux Lower Lower Seam	19-May-2020	0.02	<0.001	0.498	<0.001	0.86	<0.0001	<0.001	<0.001	0.003	0.25	<0.001	0.098	<0.0001	0.002	0.004	<0.01	<0.001	<0.001	<0.01	0.007
9	DW7093W3	Pollux Lower Lower Seam	15-Jun-2020	0.02	<0.001	0.481	<0.001	0.84	<0.0001	<0.001	<0.001	<0.001	2.87	<0.001	0.088	<0.0001	0.004	0.013	<0.01	<0.001	<0.001	<0.01	<0.005
9	DW7093W3	Pollux Lower Lower Seam	14-Jul-2020	<0.01	<0.001	0.619	<0.001	0.87	<0.0001	<0.001	<0.001	<0.001	4.26	<0.001	0.086	<0.0001	0.004	0.012	<0.01	<0.001	<0.001	<0.01	0.006
9	DW7093W3	Pollux Lower Lower Seam	19-Aug-2020	<0.01	<0.001	0.59	<0.001	0.91	<0.0001	<0.001	<0.001	<0.001	2.83	<0.001	0.091	<0.0001	0.004	0.003	<0.01	<0.001	<0.001	<0.01	0.01
9	DW7093W3	Pollux Lower Lower Seam	22-Sep-2020	0.02	0.002	1.14	<0.001	0.95	<0.0001	0.001	<0.001	<0.001	1.73	<0.001	0.108	<0.0001	0.003	0.006	<0.01	<0.001	0.001	<0.01	<0.005
9	DW7093W3	Pollux Lower Lower Seam	20-Oct-2020	<0.01	<0.001	0.322	<0.001	0.71	<0.0001	<0.001	<0.001	<0.001	0.98	<0.001	0.074	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.026
10	DW7105W2	Pollux Lower Upper Seam	26-Sep-2019	0.08	0.005	0.026	<0.001	0.3	<0.0001	<0.001	<0.001	<0.001	0.05	<0.001	0.003	<0.0001	0.003	<0.001	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	24-Oct-2019	0.04	0.004	0.036	<0.001	0.29	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.005	<0.0001	0.021	0.001	<0.01	<0.001	0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	25-Nov-2019	0.03	0.003	0.024	<0.001	0.29	<0.0001	<0.001	<0.001	<0.001	0.06	<0.001	0.005	<0.0001	0.019	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	13-Dec-2019	0.04	0.003	0.035	<0.001	0.29	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.004	<0.0001	0.022	<0.001	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	31-Jan-2020	0.03	0.002	0.075	<0.001	0.2	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.006	<0.0001	0.011	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	19-Feb-2020	0.05	0.002	0.088	<0.001	0.27	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.005	<0.0001	0.011	<0.001	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	18-Mar-2020	0.02	0.002	0.052	<0.001	0.32	<0.0001	<0.001	<0.001	<0.001	0.09	<0.001	0.014	<0.0001	0.009	0.002	<0.01	<0.001	<0.001	<0.01	0.006
10	DW7105W2	Pollux Lower Upper Seam	28-Apr-2020	0.04	0.001	0.141	<0.001	0.26	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.012	<0.0001	0.01	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	20-May-2020	0.04	0.002	0.09	<0.001	0.3	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.005	<0.0001	0.008	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	16-Jun-2020	0.05	0.002	0.109	<0.001	0.3	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.004	<0.0001	0.008	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	14-Jul-2020	0.04	0.002	0.067	<0.001	0.34	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.004	<0.0001	0.008	0.001	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	18-Aug-2020	0.04	0.002	0.067	<0.001	0.3	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.003	<0.0001	0.007	0.001	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	22-Sep-2020	0.04	0.002	0.078	<0.001	0.25	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.005	<0.0001	0.005	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
10	DW7105W2	Pollux Lower Upper Seam	20-Oct-2020	0.04	0.001	0.138	<0.001	0.26	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.007	<0.0001	0.006	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
11	DW7178W1	Tertiary	27-Sep-2019	<0.01	<0.001	0.27	<0.001	1.43	<0.0001	0.003	0.002	<0.001	<0.05	<0.001	0.007	<0.0001	0.004	0.009	<0.01	<0.001	0.007	<0.01	0.018
11	DW7178W1	Tertiary	25-Oct-2019	<0.01	0.001	0.215	<0.001	1.27	<0.0001	<0.001	0.002	<0.001	<0.05	<0.001	0.018	<0.0001	0.005	0.009	<0.01	<0.001	0.007	<0.01	0.012
11	DW7178W1	Tertiary	26-Nov-2019	<0.01	<0.001	0.249	<0.001	1.36	<0.0001	<0.001	0.002	0.001	0.07	<0.001	0.007	<0.0001	0.003	0.011	<0.01	<0.001	0.008	<0.01	0.033
11	DW7178W1	Tertiary	18-Dec-2019	<0.01	<0.001	0.258	<0.001	1.37	<0.0001	<0.001	0.002	<0.001	<0.05	<0.001	0.017	<0.0001	0.004	0.008	<0.01	<0.001	0.009	<0.01	0.007
11	DW7178W1	Tertiary	29-Jan-2020	<0.01	<0.001	0.186	<0.001	1.26	<0.0001	<0.001	0.004	<0.001	2.28	<0.001	0.013	<0.0001	0.002	0.012	<0.01	<0.001	0.007	<0.01	0.061
11	DW7178W1	Tertiary	19-Feb-2020	<0.01	<0.001	0.25	<0.001	1.3	<0.0001	<0.001	0.001	<0.001	3.29	<0.001	0.016	<0.0001	0.003	0.017	<0.01	<0.001	0.006	<0.01	0.024
11	DW7178W1	Tertiary	20-Mar-2020	<0.01	<0.001	0.223	<0.001	1.25	<0.0001	<0.001	0.001	0.067	<0.05	<0.001	0.014	<0.0001	0.002	0.015	<0.01	<0.001	0.006	<0.01	0.092
11	DW7178W1	Tertiary	27-Apr-2020	<0.01	<0.001	0.223	<0.001	1.2	<0.0001	0.001	0.001	0.006	<0.05	<0.001	0.016	<0.0001	0.004	0.015	<0.01	<0.001	0.006	<0.01	0.027
11	DW7178W1	Tertiary	18-May-2020	<0.01	<0.001	0.218	<0.001	1.61	<0.0001	<0.001	0.002	0.002	0.06	<0.001	0.02	<0.0001	0.002	0.012	<0.01	<0.001	0.007	<0.01	0.076
11	DW7178W1	Tertiary	17-Jun-2020	<0.01	<0.001	0.152	<0.001	1.24	<0.0001	<0.001	0.001	0.002	0.06	<0.001	0.007	<0.0001	0.003	0.011	<0.01	<0.001	0.006	<0.01	0.079
11	DW7178W1	Tertiary	13-Jul-2020	<0.01	<0.001	0.17	<0.001	1.37	<0.0001	<0.001	0.001	<0.001	<0.05	<0.001	0.013	<0.0001	0.004	0.011	<0.01	<0.001	0.007	<0.01	0.057
11	DW7178W1	Tertiary	18-Aug-2020	<0.01	<0.001	0.176	<0.001	1.35	<0.0001	<0.001	0.002	0.003	0.08	<0.001	0.012	<0.0001	0.003	0.011	<0.01	<0.001	0.006	<0.01	0.076
11	DW7178W1	Tertiary	21-Sep-2020	<0.01	0.001	0.265	<0.001	1.51	<0.0001	0.001	<0.001	0.002	<0.05	<0.001	0.015	<0.0001	0.004	0.012	<0.01	<0.001	0.006	<0.01	0.028
11	DW7178W1	Tertiary	19-Oct-2020	<0.01	<0.001	0.238	<0.001	0.99	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.012	<0.0001	0.003	0.019	<0.01	<0.001	0.006	<0.01	0.033
11	DW7178W2	Pollux Lower Upper Seam	27-Sep-2019	<0.01	0.001	0.162	<0.001	1.42	<0.0001	<0.001	0.008	0.001	0.71	<0.001	0.202	<0.0001	0.001	0.01	<0.01	<0.001	0.001	<0.01	0.048
11	DW7178W2	Pollux Lower Upper Seam	25-Oct-2019	<0.01	0.003	0.16	<0.001	1.63	<0.0001	<0.001	0.012	0.001	0.82	<0.001	0.226	<0.0001	0.001	0.011	<0.01	<0.001	0.001	<0.01	0.042
11	DW7178W2	Pollux Lower Upper Seam	25-Nov-2019	<0.01	0.003	0.127	<0.001	1.4	<0.0001	<0.001	0.025	0.001	0.5	<0.001	0.308	<0.0001	<0.001	0.014	<0.01	<0.001	0.002	<0.01	0.045
11	DW7178W2	Pollux Lower Upper Seam	17-Dec-2019	<0.01	0.003	0.282	<0.001	1.52	<0.0001	<0.001	0.022	<0.001	1.03	<0.001	0.311	<0.0001	0.001	0.012	<0.01	<0.001	0.002	<0.01	0.029
11	DW7178W2	Pollux Lower Upper Seam	29-Jan-2020	<0.01	0.003	0.175	<0.001	1.37	<0.0001	<0.001	0.013	<0.001	3.29	<0.001	0.267	<0.0001	<0.001	0.014	<0.01	<0.001	0.001	<0.01	0.097
11	DW7178W2	Pollux Lower Upper Seam	18-Feb-2020	<0.01	0.003	0.184	<0.001	1.4	<0.0001	<0.001	0.02	0.005	0.68	<0.001	0.281	<0.0001	<0.001	0.017	<0.01	<0.001	0.002	<0.01	0.056
11	DW7178W2	Pollux Lower Upper Seam	20-Mar-2020	<0.05	<0.005	0.15	<0.005	1.35	<0.0005	<0.005	0.012	<0.005	2.62	<0.005	0.307	<0.0001	<0.005	0.012	<0.05	<0.005	<0.005	<0.05	<0.025
11	DW7178W2	Pollux Lower Upper Seam	27-Apr-2020	<0.05	<0.005	0.162	<0.005	1.88	<0.0005	<0.005	0.019	<0.005	0.73	<0.005	0.348	<0.0001	<0.005	0.024	<0.05	<0.005	<0.005	<0.05	0.14
11	DW7178W2	Pollux Lower Upper Seam	18-May-2020	<0.01	0.005	0.192	<0.001	1.65	<0.0001	<0.001	0.023	0.001	0.63	<0.001	0.334	<0.0001	0.001	0.016	<0.01	<0.001	0.002	<0.01	0.106
11	DW7178W2	Pollux Lower Upper Seam	17-Jun-2020	<0.01	0.003	0.193	<0.001	1.39	<0.0001	<0.001	0.014	<0.001	1.06	<0.001	0.262	<0.0001	0.001	0.015	<0.01	<0.001	0.001	<0.01	0.13
11	DW7178W2	Pollux Lower Upper Seam	13-Jul-2020	<0.01	0.003	0.252	<0.001	1.41	<0.0001	<0.001	0.018	<0.001	0.78	<0.001	0.328	<0.0001	0.001	0.016	<0.01	<0.001	0.002	<0.01	0.087
11	DW7178W2	Pollux Lower Upper Seam	18-Aug-2020	<0.01	0.003	0.204	<0.001	1.42	<0.0001	<0.001	0.018	0.001	0.89	<0.001	0.306	<0.0001	0.001	0.015	<0.01	<0.001	0.002	<0.01	0.115
11	DW7178W2	Pollux Lower Upper Seam	21-Sep-2020	<0.01	0.003	0.168	<0.001	1.63	0.0001	<0.001	0.014	0.008	0.68	<0.001	0.31	<0.0001	<0.001	0.011	<0.01	<0.001	0.002	<0.01	0.049
11	DW7178W2	Pollux Lower Upper Seam	19-Oct-2020	<0.01	0.003	0.173	<0.001	0.93	<0.0001	<0.001	0.013	0.003	0.88	<0.001	0.295	<0.0001	0.001	0.012	<0.01	0.002	0.002	<0.01	0.039
12	DW7220W1	Tertiary	25-Sep-2019	0.03	0.002	0.094	<0.001	0.16	<0.0001	0.002	0.002	<0.001	0.08	<0.001	0.128	<0.0001	0.028	0.008	<0.01	<0.001	<0.001	<0.01	0.026
12	DW7220W1	Tertiary	25-Oct-2019	<0.01	0.003	0.09	<0.001	0.16	<0.0001	0.002	0.003	<0.001	0.17	<0.001	0.139	<0.0001	0.023	0.01	<0.01	<0.001	<0.001	<0.01	0.027
12	DW7220W1	Tertiary	22-Nov-2019	0.08	0.003	0.1	<0.001	0.21	<0.0001	<0.001	0.003	<0.001	0.23	<0.001	0.148	<0.0001	0.018	0.012	<0.01	<0.001	0.001	<0.01	0.028
12	DW7220W1	Tertiary	17-Dec-2019	<0.01	0.003	0.101	<0.001	0.18	<0.0001	<0.001	0.004	<0.001	0.28	<0.001	0.172	<0.0001	0.012	0.009	<0.01	<0.001	0.001	<0.01	0.048

Appendix C-2: Dissolved Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
12	DW7220W1	Tertiary	31-Jan-2020	<0.01	0.002	0.114	<0.001	0.12	<0.0001	<0.001	0.005	0.006	0.3	<0.001	0.19	<0.0001	0.008	0.039	<0.01	<0.001	0.001	<0.01	0.235
12	DW7220W1	Tertiary	21-Feb-2020	0.02	0.002	0.121	<0.001	0.13	<0.0001	<0.001	0.004	<0.001	0.31	<0.001	0.21	<0.0001	0.009	0.013	<0.01	<0.001	0.001	<0.01	0.117
12	DW7220W1	Tertiary	18-Mar-2020	0.02	0.001	0.13	<0.001	0.21	<0.0001	<0.001	0.004	0.002	0.16	<0.001	0.206	<0.0001	0.007	0.014	<0.01	<0.001	0.001	<0.01	0.066
12	DW7220W1	Tertiary	30-Apr-2020	0.02	0.002	0.153	<0.001	0.14	<0.0001	<0.001	0.004	<0.001	0.37	<0.001	0.228	<0.0001	0.008	0.014	<0.01	<0.001	0.001	<0.01	0.096
12	DW7220W1	Tertiary	21-May-2020	0.02	0.002	0.13	<0.001	0.21	<0.0001	<0.001	0.004	<0.001	0.33	<0.001	0.19	<0.0001	0.005	0.013	<0.01	<0.001	<0.001	<0.01	0.154
12	DW7220W1	Tertiary	16-Jun-2020	0.02	0.002	0.145	<0.001	0.2	<0.0001	<0.001	0.004	<0.001	1.76	<0.001	0.182	<0.0001	0.005	0.02	<0.01	<0.001	<0.001	<0.01	0.158
12	DW7220W1	Tertiary	16-Jul-2020	0.01	0.001	0.148	<0.001	0.24	<0.0001	<0.001	0.004	<0.001	0.31	<0.001	0.182	<0.0001	0.005	0.012	<0.01	<0.001	<0.001	<0.01	0.082
12	DW7220W1	Tertiary	21-Aug-2020	0.01	0.002	0.15	<0.001	0.21	<0.0001	<0.001	0.005	<0.001	0.37	<0.001	0.19	<0.0001	0.004	0.016	<0.01	<0.001	<0.001	<0.01	0.147
12	DW7220W1	Tertiary	23-Sep-2020	0.02	0.001	0.142	<0.001	0.22	<0.0001	<0.001	0.004	<0.001	0.42	<0.001	0.173	<0.0001	0.004	0.015	<0.01	<0.001	<0.001	<0.01	0.091
12	DW7220W1	Tertiary	19-Oct-2020	0.03	0.001	0.221	<0.001	0.18	<0.0001	<0.001	0.004	0.062	0.12	<0.001	0.181	<0.0001	0.003	0.019	<0.01	<0.001	<0.001	<0.01	0.37
12	DW7220W2	Castor Seam	25-Sep-2019	<0.01	0.004	0.079	<0.001	0.17	<0.0001	<0.001	0.004	<0.001	0.74	<0.001	0.201	<0.0001	<0.001	0.013	<0.01	<0.001	<0.001	<0.01	0.072
12	DW7220W2	Castor Seam	25-Oct-2019	<0.01	0.005	0.051	<0.001	0.17	<0.0001	<0.001	0.005	<0.001	1.03	<0.001	0.218	<0.0001	<0.001	0.014	<0.01	<0.001	<0.001	<0.01	0.058
12	DW7220W2	Castor Seam	22-Nov-2019	<0.01	0.004	0.068	<0.001	0.18	<0.0001	<0.001	0.005	<0.001	1.16	<0.001	0.225	<0.0001	<0.001	0.013	<0.01	<0.001	<0.001	<0.01	0.082
12	DW7220W2	Castor Seam	17-Dec-2019	<0.01	0.005	0.052	<0.001	0.16	<0.0001	<0.001	0.005	<0.001	1.14	<0.001	0.22	<0.0001	<0.001	0.01	<0.01	<0.001	<0.001	<0.01	0.099
12	DW7220W2	Castor Seam	30-Jan-2020	<0.01	0.007	0.075	<0.001	0.13	<0.0001	<0.001	0.006	<0.001	1.15	<0.001	0.231	<0.0001	<0.001	0.02	<0.01	<0.001	<0.001	<0.01	0.167
12	DW7220W2	Castor Seam	21-Feb-2020	<0.01	0.007	0.083	<0.001	0.08	<0.0001	<0.001	0.005	0.002	1.3	<0.001	0.224	<0.0001	<0.001	0.017	<0.01	<0.001	<0.001	<0.01	0.239
12	DW7220W2	Castor Seam	18-Mar-2020	<0.01	0.008	0.059	<0.001	0.14	<0.0001	<0.001	0.005	<0.001	1.46	<0.001	0.236	<0.0001	<0.001	0.02	<0.01	<0.001	<0.001	<0.01	0.109
12	DW7220W2	Castor Seam	30-Apr-2020	<0.01	0.008	0.093	<0.001	0.12	<0.0001	<0.001	0.006	0.001	1.62	<0.001	0.25	<0.0001	<0.001	0.017	<0.01	<0.001	<0.001	<0.01	0.124
12	DW7220W2	Castor Seam	21-May-2020	<0.01	0.008	0.068	<0.001	0.18	<0.0001	<0.001	0.006	<0.001	1.66	<0.001	0.213	<0.0001	<0.001	0.014	<0.01	<0.001	<0.001	<0.01	0.152
12	DW7220W2	Castor Seam	16-Jun-2020	0.02	0.007	0.081	<0.001	0.16	<0.0001	0.001	0.005	<0.001	3.95	<0.001	0.207	<0.0001	<0.001	0.024	<0.01	<0.001	<0.001	<0.01	0.203
12	DW7220W2	Castor Seam	16-Jul-2020	<0.01	0.009	0.082	<0.001	0.19	<0.0001	0.002	0.006	<0.001	1.57	<0.001	0.204	<0.0001	0.002	0.019	<0.01	<0.001	<0.001	<0.01	0.092
12	DW7220W2	Castor Seam	21-Aug-2020	0.42	0.01	0.068	<0.001	0.17	<0.0001	<0.001	0.006	0.001	2.5	<0.001	0.224	<0.0001	<0.001	0.019	<0.01	<0.001	<0.001	<0.01	0.189
12	DW7220W2	Castor Seam	23-Sep-2020	0.01	0.008	0.08	<0.001	0.18	<0.0001	<0.001	0.005	<0.001	1.7	<0.001	0.192	<0.0001	<0.001	0.014	<0.01	<0.001	<0.001	<0.01	0.081
12	DW7220W2	Castor Seam	19-Oct-2020	<0.01	0.01	0.094	<0.001	0.18	<0.0001	<0.001	0.005	0.04	1.95	<0.001	0.198	<0.0001	<0.001	0.017	<0.01	<0.001	<0.001	<0.01	0.371
12	DW7220W3	Pollux Lower Upper Seam	25-Sep-2019	<0.01	0.001	0.259	<0.001	0.97	<0.0001	<0.001	<0.001	<0.001	1.53	<0.001	0.058	<0.0001	0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.027
12	DW7220W3	Pollux Lower Upper Seam	25-Oct-2019	<0.01	0.001	0.104	<0.001	0.8	<0.0001	<0.001	<0.001	<0.001	1.48	<0.001	0.117	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.017
12	DW7220W3	Pollux Lower Upper Seam	22-Nov-2019	<0.01	0.002	0.136	<0.001	1.06	<0.0001	<0.001	<0.001	<0.001	1.29	<0.001	0.08	<0.0001	0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.027
12	DW7220W3	Pollux Lower Upper Seam	17-Dec-2019	<0.01	<0.001	0.156	<0.001	1.02	<0.0001	<0.001	<0.001	<0.001	0.89	<0.001	0.128	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.056
12	DW7220W3	Pollux Lower Upper Seam	30-Jan-2020	<0.01	<0.001	0.073	<0.001	0.81	<0.0001	<0.001	<0.001	<0.001	1.38	<0.001	0.055	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.031
12	DW7220W3	Pollux Lower Upper Seam	21-Feb-2020	<0.01	<0.001	0.077	<0.001	0.69	<0.0001	<0.001	<0.001	<0.001	1.3	<0.001	0.047	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.05
12	DW7220W3	Pollux Lower Upper Seam	18-Mar-2020	<0.01	<0.001	0.087	<0.001	0.95	<0.0001	<0.001	<0.001	<0.001	1.26	<0.001	0.052	<0.0001	<0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.023
12	DW7220W3	Pollux Lower Upper Seam	30-Apr-2020	<0.01	<0.001	0.091	<0.001	1.06	<0.0001	<0.001	<0.001	<0.001	1.52	<0.001	0.055	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.044
12	DW7220W3	Pollux Lower Upper Seam	21-May-2020	<0.01	<0.001	0.077	<0.001	1.09	<0.0001	<0.001	<0.001	<0.001	1.3	<0.001	0.054	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.033
12	DW7220W3	Pollux Lower Upper Seam	16-Jun-2020	<0.01	<0.001	0.134	<0.001	0.87	<0.0001	<0.001	<0.001	<0.001	2.27	<0.001	0.043	<0.0001	<0.001	0.014	<0.01	<0.001	<0.001	<0.01	0.066
12	DW7220W3	Pollux Lower Upper Seam	16-Jul-2020	<0.01	<0.001	0.094	<0.001	0.88	<0.0001	<0.001	<0.001	<0.001	1.3	<0.001	0.048	<0.0001	0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.036
12	DW7220W3	Pollux Lower Upper Seam	20-Aug-2020	<0.01	<0.001	0.084	<0.001	0.91	<0.0001	<0.001	<0.001	<0.001	1.56	<0.001	0.059	<0.0001	0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.033
12	DW7220W3	Pollux Lower Upper Seam	23-Sep-2020	<0.01	0.001	0.1	<0.001	1.01	<0.0001	<0.001	<0.001	<0.001	1.39	<0.001	0.053	<0.0001	0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.03
12	DW7220W3	Pollux Lower Upper Seam	19-Oct-2020	<0.01	<0.001	0.094	<0.001	0.77	<0.0001	<0.001	<0.001	0.026	1.11	<0.001	0.044	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.102
13	DW7221W1	Aries 3 Seam	25-Sep-2019	<0.01	0.006	0.19	<0.001	0.24	<0.0001	<0.001	0.002	<0.001	6.9	<0.001	1.58	<0.0001	0.002	0.007	<0.01	<0.001	0.009	<0.01	0.007
13	DW7221W1	Aries 3 Seam	25-Oct-2019	0.02	0.003	0.184	<0.001	0.22	<0.0001	<0.001	0.001	<0.001	6.63	<0.001	1.55	<0.0001	<0.001	0.01	<0.01	<0.001	0.004	<0.01	0.028
13	DW7221W1	Aries 3 Seam	22-Nov-2019	<0.01	0.002	0.266	<0.001	0.23	<0.0001	<0.001	<0.001	<0.001	7.49	<0.001	1.54	<0.0001	0.001	0.008	<0.01	<0.001	0.003	<0.01	0.012
13	DW7221W1	Aries 3 Seam	16-Dec-2019	<0.01	0.002	0.342	<0.001	0.19	<0.0001	<0.001	<0.001	<0.001	18.5	<0.001	1.77	<0.0001	0.002	0.007	<0.01	<0.001	0.002	<0.01	0.044
13	DW7221W1	Aries 3 Seam	30-Jan-2020	<0.01	<0.001	0.189	<0.001	0.12	<0.0001	<0.001	<0.001	<0.001	6.26	<0.001	1.58	<0.0001	<0.001	0.013	<0.01	<0.001	0.001	<0.01	<0.005
13	DW7221W1	Aries 3 Seam	21-Feb-2020	<0.01	<0.001	0.179	<0.001	0.14	<0.0001	<0.001	<0.001	<0.001	6.9	<0.001	1.68	<0.0001	<0.001	0.011	<0.01	<0.001	0.001	<0.01	<0.005
13	DW7221W1	Aries 3 Seam	18-Mar-2020	<0.01	0.002	0.175	<0.001	0.18	<0.0001	<0.001	<0.001	<0.001	8.05	<0.001	1.48	<0.0001	<0.001	0.01	<0.01	<0.001	<0.001	<0.01	<0.005
13	DW7221W1	Aries 3 Seam	30-Apr-2020	<0.01	<0.001	0.215	<0.001	0.07	<0.0001	<0.001	<0.001	<0.001	5.84	<0.001	1.28	<0.0001	<0.001	0.012	<0.01	<0.001	<0.001	<0.01	<0.005
13	DW7221W1	Aries 3 Seam	21-May-2020	<0.01	<0.001	0.156	<0.001	0.22	<0.0001	<0.001	<0.001	<0.001	5.56	<0.001	1.48	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	<0.005
13	DW7221W1	Aries 3 Seam	17-Jun-2020	<0.01	<0.001	0.176	<0.001	0.17	<0.0001	<0.001	<0.001	<0.001	6.08	<0.001	1.55	<0.0001	<0.001	0.01	<0.01	<0.001	<0.001	<0.01	0.006
13	DW7221W1	Aries 3 Seam	16-Jul-2020	<0.01	<0.001	0.168	<0.001	0.21	<0.0001	<0.001	<0.001	<0.001	5.71	<0.001	1.47	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.064
13	DW7221W1	Aries 3 Seam	20-Aug-2020	<0.01	<0.001	0.169	<0.001	0.19	<0.0001	<0.001	<0.001	<0.001	5.68	<0.001	1.46	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.069
13	DW7221W1	Aries 3 Seam	23-Sep-2020	<0.01	<0.001	0.157	<0.001	0.2	<0.0001	<0.001	<0.001	<0.001	5.4	<0.001	1.48	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.026
13	DW7221W1	Aries 3 Seam	19-Oct-2020	<0.01	<0.001	0.248	<0.001	0.22	<0.0001	<0.001	0.001	<0.001	5.5	<0.001	1.35	<0.0001	<0.001	0.018	<0.01	<0.001	<0.001	<0.01	0.084
13	DW7221W2	Castor Seam	26-Sep-2019	<0.01	0.006	0.192	<0.001	0.46	<0.0001	<0.001	0.004	<0.001	3.29	<0.001	0.193	<0.0001	<0.001	0.007	<0.01	<0.001	0.001	<0.01	0.093
13	DW7221W2	Castor Seam	24-Oct-2019	<0.01	0.006	0.274	<0.001	0.41	<0.0001	<0.001	0.003	<0.001	4.02	<0.001	0.191	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.026
13	DW7221W2	Castor Seam	22-Nov-2019	<0.01	0.005	0.209	<0.001	0.46	<0.0001	<0.001	0.003	<0.001	4.87	<0.001	0.366	<0.0001	<0.001	0.009	<0.01	<0.001	<0.001	<0.01	0.041
13	DW7221W2	Castor Seam	16-Dec-2019	<0.01	0.004	0.253	<0.001	0.38	<0.0001	<0.001	0.002	<0.001	10.5	<0.001	0.418	<0.0001	0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.038
13	DW7221W2	Castor Seam	30-Jan-2020	<0.01	0.006	0.137	<0.001	0.35	<0.0001	<0.001	0.002	<0.001	4.55	<0.001	0.24	<0.0001	<0.001	0.011	<0.01	<0.001	<0.001	<0.01	0.027
13	DW7221W2	Castor Seam	21-Feb-2020	<0.01	0.005	0.206	<0.001	0.33	<0.0001	<0.001	0.001	<0.001	5.19	<0.001	0.222	<0.0001	<0.001	0.016	<0.01	<0.001	<0.001	<0.01	0.161
13	DW7221W2	Castor Seam	18-Mar-2020	<0.01	0.003	0.226	<0.001	0.54	<0.0001	<0.001	<0.001	<0.001	2.98	<0.001	0.172	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.028
13	DW7221W2	Castor Seam	30-Apr-2020	<0.01	0.002	0.203	<0.001	0.57	<0.0001	<0.001	<0.001	<0.001	3.06	<0.001	0.167	<0.0001	<0.001	0.012	<0.01	<0.001	<0.001	<0.01	0.039

Appendix C-2: Dissolved Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
13	DW7221W2	Castor Seam	21-May-2020	<0.01	0.002	0.167	<0.001	0.73	<0.0001	<0.001	<0.001	<0.001	2.54	<0.001	0.143	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.043
13	DW7221W2	Castor Seam	17-Jun-2020	<0.01	0.002	0.184	<0.001	0.63	<0.0001	<0.001	<0.001	<0.001	2.83	<0.001	0.103	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.051
13	DW7221W2	Castor Seam	16-Jul-2020	<0.01	0.002	0.185	<0.001	0.67	<0.0001	0.003	<0.001	<0.001	2.57	<0.001	0.125	<0.0001	0.004	0.016	<0.01	<0.001	<0.001	<0.01	0.034
13	DW7221W2	Castor Seam	20-Aug-2020	<0.01	0.002	0.181	<0.001	0.62	<0.0001	0.003	<0.001	<0.001	2.53	<0.001	0.13	<0.0001	0.004	0.018	<0.01	<0.001	<0.001	<0.01	0.043
13	DW7221W2	Castor Seam	24-Sep-2020	<0.01	0.002	0.169	<0.001	0.73	<0.0001	<0.001	<0.001	<0.001	2.04	<0.001	0.117	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.049
13	DW7221W2	Castor Seam	19-Oct-2020	0.02	0.001	0.184	<0.001	0.58	<0.0001	<0.001	<0.001	0.024	2	<0.001	0.09	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.125
14	DW7225W1	Tertiary	24-Sep-2019	<0.01	0.002	0.138	<0.001	0.62	<0.0001	<0.001	0.001	0.005	<0.05	<0.001	0.025	<0.0001	0.015	0.011	<0.01	<0.001	0.002	<0.01	0.085
14	DW7225W1	Tertiary	24-Oct-2019	<0.01	0.003	0.104	<0.001	0.56	<0.0001	<0.001	0.001	0.002	0.07	<0.001	0.024	<0.0001	0.011	0.006	<0.01	<0.001	0.001	<0.01	0.047
14	DW7225W1	Tertiary	21-Nov-2019	<0.01	0.003	0.134	<0.001	0.63	<0.0001	<0.001	0.002	<0.001	0.09	<0.001	0.043	<0.0001	0.009	0.01	<0.01	<0.001	0.002	<0.01	0.068
14	DW7225W1	Tertiary	13-Dec-2019	<0.01	<0.001	0.138	0.001	0.55	<0.0001	<0.001	0.001	0.035	<0.05	<0.001	0.046	<0.0001	<0.001	0.01	<0.01	<0.001	0.002	<0.01	0.117
14	DW7225W1	Tertiary	30-Jan-2020	<0.01	<0.001	0.142	<0.001	0.46	0.0001	<0.001	0.001	0.01	<0.05	<0.001	0.024	<0.0001	<0.001	0.015	<0.01	<0.001	0.002	<0.01	0.165
14	DW7225W1	Tertiary	18-Feb-2020	<0.01	<0.001	0.163	<0.001	0.52	<0.0001	<0.001	<0.001	0.009	0.05	<0.001	0.019	<0.0001	<0.001	0.015	<0.01	<0.001	0.002	<0.01	0.121
14	DW7225W1	Tertiary	17-Mar-2020	<0.01	<0.001	0.14	<0.001	0.54	<0.0001	<0.001	<0.001	0.053	<0.05	<0.001	0.015	<0.0001	<0.001	0.014	<0.01	<0.001	0.002	<0.01	0.215
14	DW7225W1	Tertiary	29-Apr-2020	<0.01	<0.001	0.155	<0.001	0.63	<0.0001	<0.001	<0.001	<0.001	0.21	<0.001	0.042	<0.0001	0.003	0.013	<0.01	<0.001	0.002	<0.01	0.104
14	DW7225W1	Tertiary	19-May-2020	<0.01	<0.001	0.18	<0.001	0.61	<0.0001	<0.001	0.001	<0.001	2.64	<0.001	0.029	<0.0001	<0.001	0.014	<0.01	<0.001	0.002	<0.01	0.011
14	DW7225W1	Tertiary	16-Jun-2020	<0.01	<0.001	0.191	<0.001	0.53	<0.0001	<0.001	<0.001	<0.001	5.27	<0.001	0.015	<0.0001	<0.001	0.019	<0.01	<0.001	0.002	<0.01	0.087
14	DW7225W1	Tertiary	14-Jul-2020	<0.01	<0.001	0.209	<0.001	0.58	<0.0001	<0.001	0.001	<0.001	5.71	<0.001	0.019	<0.0001	0.001	0.025	<0.01	<0.001	0.002	<0.01	0.048
14	DW7225W1	Tertiary	19-Aug-2020	<0.01	<0.001	0.214	<0.001	0.55	<0.0001	<0.001	<0.001	<0.001	3.78	<0.001	0.022	<0.0001	<0.001	0.011	<0.01	<0.001	0.002	<0.01	0.046
14	DW7225W1	Tertiary	22-Sep-2020	<0.01	<0.001	0.24	<0.001	0.59	<0.0001	<0.001	0.002	<0.001	5.22	<0.001	0.032	<0.0001	<0.001	0.019	<0.01	<0.001	0.002	<0.01	0.022
14	DW7225W1	Tertiary	20-Oct-2020	<0.01	<0.001	0.181	<0.001	0.51	<0.0001	<0.001	<0.001	0.034	<0.05	<0.001	0.014	<0.0001	<0.001	0.012	<0.01	<0.001	0.002	<0.01	0.175
14	DW7225W2	Aries 3 Seam	24-Sep-2019	<0.01	0.006	0.155	<0.001	0.62	0.0001	<0.001	0.003	0.007	0.18	<0.001	0.131	<0.0001	0.006	0.008	<0.01	<0.001	0.008	<0.01	0.043
14	DW7225W2	Aries 3 Seam	24-Oct-2019	<0.01	0.015	0.129	<0.001	0.63	<0.0001	<0.001	0.003	<0.001	0.92	<0.001	0.137	<0.0001	0.006	0.006	<0.01	<0.001	0.007	<0.01	0.026
14	DW7225W2	Aries 3 Seam	21-Nov-2019	<0.01	0.011	0.163	<0.001	0.65	<0.0001	<0.001	0.002	<0.001	0.95	<0.001	0.12	<0.0001	0.007	0.007	<0.01	<0.001	0.006	<0.01	0.035
14	DW7225W2	Aries 3 Seam	13-Dec-2019	<0.01	0.012	0.139	<0.001	0.54	<0.0001	<0.001	<0.001	0.066	0.54	<0.001	0.123	<0.0001	0.003	0.004	<0.01	<0.001	0.005	<0.01	0.04
14	DW7225W2	Aries 3 Seam	30-Jan-2020	<0.01	0.016	0.112	<0.001	0.5	<0.0001	<0.001	0.001	<0.001	1.48	<0.001	0.133	<0.0001	0.002	0.008	<0.01	<0.001	0.004	<0.01	0.007
14	DW7225W2	Aries 3 Seam	18-Feb-2020	<0.01	0.013	0.134	<0.001	0.49	<0.0001	<0.001	<0.001	<0.001	1.45	<0.001	0.111	<0.0001	0.002	0.009	<0.01	<0.001	0.004	<0.01	0.043
14	DW7225W2	Aries 3 Seam	17-Mar-2020	<0.01	0.014	0.117	<0.001	0.56	<0.0001	<0.001	<0.001	<0.001	2.89	<0.001	0.116	<0.0001	0.002	0.005	<0.01	<0.001	0.003	<0.01	0.045
14	DW7225W2	Aries 3 Seam	29-Apr-2020	<0.01	0.014	0.131	<0.001	0.64	<0.0001	<0.001	<0.001	<0.001	2.52	<0.001	0.116	<0.0001	0.002	0.006	<0.01	<0.001	0.003	<0.01	0.038
14	DW7225W2	Aries 3 Seam	19-May-2020	<0.01	0.011	0.133	<0.001	0.67	<0.0001	<0.001	<0.001	<0.001	2.54	<0.001	0.103	<0.0001	0.001	0.009	<0.01	<0.001	0.003	<0.01	<0.005
14	DW7225W2	Aries 3 Seam	16-Jun-2020	<0.01	0.012	0.134	<0.001	0.55	<0.0001	<0.001	<0.001	<0.001	2.64	<0.001	0.103	<0.0001	0.002	0.008	<0.01	<0.001	0.003	<0.01	0.032
14	DW7225W2	Aries 3 Seam	14-Jul-2020	<0.01	0.008	0.153	<0.001	0.59	<0.0001	0.006	<0.001	<0.001	2.53	<0.001	0.097	<0.0001	0.007	0.032	<0.01	<0.001	0.003	<0.01	0.031
14	DW7225W2	Aries 3 Seam	19-Aug-2020	<0.01	0.009	0.147	<0.001	0.56	<0.0001	<0.001	<0.001	<0.001	3.14	<0.001	0.103	<0.0001	0.002	0.006	<0.01	<0.001	0.002	<0.01	0.026
14	DW7225W2	Aries 3 Seam	22-Sep-2020	<0.01	0.008	0.156	<0.001	0.64	<0.0001	<0.001	<0.001	<0.001	2.69	<0.001	0.102	<0.0001	0.001	0.006	<0.01	<0.001	0.002	<0.01	0.018
14	DW7225W2	Aries 3 Seam	20-Oct-2020	<0.01	0.008	0.474	<0.001	0.51	<0.0001	<0.001	<0.001	<0.001	3.09	<0.001	0.122	<0.0001	0.001	0.006	<0.01	<0.001	0.002	<0.01	<0.005
14	DW7225W3	Castor Seam	25-Sep-2019	<0.01	0.002	1.26	<0.001	0.67	<0.0001	<0.001	0.001	<0.001	1.24	<0.001	0.124	<0.0001	0.003	0.012	<0.01	<0.001	0.003	<0.01	0.026
14	DW7225W3	Castor Seam	28-Oct-2019	<0.01	<0.001	1.22	<0.001	0.65	<0.0001	<0.001	<0.001	<0.001	3.15	<0.001	0.124	<0.0001	0.002	0.009	<0.01	<0.001	0.002	<0.01	0.009
14	DW7225W3	Castor Seam	21-Nov-2019	<0.01	0.003	1.03	<0.001	0.71	<0.0001	<0.001	<0.001	<0.001	1.66	<0.001	0.125	<0.0001	0.003	0.007	<0.01	<0.001	0.002	<0.01	0.008
14	DW7225W3	Castor Seam	13-Dec-2019	<0.01	0.003	1.09	<0.001	0.62	<0.0001	<0.001	<0.001	<0.001	3	<0.001	0.119	<0.0001	0.001	0.003	<0.01	<0.001	0.003	<0.01	0.022
14	DW7225W3	Castor Seam	30-Jan-2020	<0.01	0.002	1.17	<0.001	0.54	<0.0001	<0.001	<0.001	<0.001	3.34	<0.001	0.108	<0.0001	<0.001	0.007	<0.01	<0.001	0.002	<0.01	0.009
14	DW7225W3	Castor Seam	18-Feb-2020	<0.01	0.002	1.27	<0.001	0.59	<0.0001	<0.001	<0.001	<0.001	3.37	<0.001	0.102	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.026
14	DW7225W3	Castor Seam	17-Mar-2020	<0.01	0.002	1.32	<0.001	0.58	<0.0001	<0.001	<0.001	<0.001	4.55	<0.001	0.1	<0.0001	0.001	0.004	<0.01	<0.001	0.002	<0.01	0.009
14	DW7225W3	Castor Seam	29-Apr-2020	<0.01	0.002	1.33	<0.001	0.7	<0.0001	<0.001	<0.001	<0.001	4.12	<0.001	0.108	<0.0001	0.001	0.005	<0.01	<0.001	0.002	<0.01	0.016
14	DW7225W3	Castor Seam	19-May-2020	0.01	0.001	1.26	<0.001	0.78	<0.0001	<0.001	<0.001	<0.001	4.51	<0.001	0.095	<0.0001	0.001	0.008	<0.01	<0.001	0.002	<0.01	<0.005
14	DW7225W3	Castor Seam	16-Jun-2020	<0.01	<0.001	1.37	<0.001	0.58	<0.0001	<0.001	<0.001	<0.001	5.18	<0.001	0.104	<0.0001	<0.001	0.013	<0.01	<0.001	0.001	<0.01	0.029
14	DW7225W3	Castor Seam	15-Jul-2020	<0.01	0.001	1.38	<0.001	0.63	<0.0001	<0.001	<0.001	<0.001	3.3	<0.001	0.095	<0.0001	0.001	0.02	<0.01	<0.001	0.001	<0.01	0.046
14	DW7225W3	Castor Seam	20-Aug-2020	<0.01	0.001	1.36	<0.001	0.59	<0.0001	<0.001	<0.001	<0.001	3.5	<0.001	0.1	<0.0001	0.002	0.015	<0.01	<0.001	0.001	<0.01	0.064
14	DW7225W3	Castor Seam	22-Sep-2020	<0.01	0.001	1.43	<0.001	0.68	<0.0001	<0.001	<0.001	<0.001	3.7	<0.001	0.087	<0.0001	<0.001	0.005	<0.01	<0.001	0.001	<0.01	0.014
14	DW7225W3	Castor Seam	20-Oct-2020	<0.01	0.001	1.54	<0.001	0.54	<0.0001	<0.001	<0.001	<0.001	4.26	<0.001	0.091	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W2	Aries 1 Seam	27-Sep-2019	<0.01	0.001	0.21	<0.001	0.7	<0.0001	<0.001	<0.001	<0.001	1	<0.001	0.09	<0.0001	0.01	0.015	<0.01	<0.001	0.007	<0.01	0.01
15	DW7264W2	Aries 1 Seam	28-Oct-2019	<0.01	<0.001	0.134	<0.001	0.74	<0.0001	<0.001	<0.001	<0.001	1.68	<0.001	0.121	<0.0001	0.004	0.008	<0.01	<0.001	0.009	<0.01	<0.005
15	DW7264W2	Aries 1 Seam	26-Nov-2019	0.02	0.003	0.137	<0.001	0.66	<0.0001	<0.001	<0.001	<0.001	0.11	<0.001	0.039	<0.0001	0.023	0.003	<0.01	<0.001	0.003	<0.01	<0.005
15	DW7264W2	Aries 1 Seam	17-Dec-2019	<0.01	0.002	0.056	<0.001	0.72	<0.0001	<0.001	<0.001	<0.001	0.45	<0.001	0.026	<0.0001	0.012	0.002	<0.01	<0.001	0.002	<0.01	<0.005
15	DW7264W2	Aries 1 Seam	31-Mar-2020	<0.01	0.001	0.085	<0.001	0.72	<0.0001	<0.001	<0.001	<0.001	0.19	<0.001	0.053	<0.0001	0.004	0.014	<0.01	<0.001	0.002	<0.01	<0.005
15	DW7264W2	Aries 1 Seam	27-Apr-2020	<0.05	<0.005	0.092	<0.005	0.76	<0.0005	<0.005	<0.005	<0.005	0.72	<0.005	0.211	<0.0001	<0.005	0.017	<0.05	<0.005	<0.005	<0.05	<0.025
15	DW7264W2	Aries 1 Seam	18-May-2020	<0.01	<0.001	0.1	<0.001	0.81	<0.0001	<0.001	0.003	<0.001	0.43	<0.001	0.137	<0.0001	0.001	0.01	<0.01	<0.001	0.003	<0.01	<0.005
15	DW7264W2	Aries 1 Seam	17-Jun-2020	<0.01	<0.001	0.098	<0.001	0.62	<0.0001	<0.001	<0.001	<0.001	0.36	<0.001	0.106	<0.0001	<0.001	0.008	<0.01	<0.001	0.003	<0.01	0.005
15	DW7264W2	Aries 1 Seam	13-Jul-2020	<0.01	<0.001	0.129	<0.001	0.66	<0.0001	<0.001	<0.001	<0.001	1.89	<0.001	0.388	<0.0001	0.002	0.008	<0.01	0.001	0.003	<0.01	0.012
15	DW7264W2	Aries 1 Seam	18-Aug-2020	<0.01	0.001	0.15	<0.001	0.59	<0.0001	<0.001	<0.001	<0.001	1.39	<0.001	0.136	<0.0001	0.002	0.014	<0.01	<0.001	0.003	<0.01	0.019
15	DW7264W2	Aries 1 Seam	21-Sep-2020	<0.01	0.001	0.107	<0.001	0.69	<0.0001	<0.001	<0.001	0.002	0.51	<0.001	0.158	<0.0001	0.001	0.007	<0.01	<0.001	0.003	<0.01	0.027
15	DW7264W2	Aries 1 Seam	19-Oct-2020	<0.01	<0.001	0.108	<0.001	0.49	<0.0001	<0.001	<0.001	<0.001	0.76	<0.001	0.115	<0.0001	0.001	0.007	<0.01	<0.001	0.002	<0.01	<0.005

Appendix C-2: Dissolved Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	ANZECC 2000 - 95% Freshwater Species Protection			**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
15	DW7264W3	Aries 3 Seam	27-Sep-2019	<0.01	0.001	0.488	<0.001	0.47	<0.0001	<0.001	<0.001	<0.001	0.16	<0.001	0.04	<0.0001	0.013	0.008	<0.01	<0.001	<0.001	<0.01	0.012
15	DW7264W3	Aries 3 Seam	30-Oct-2019	<0.01	<0.001	0.602	<0.001	0.51	<0.0001	<0.001	<0.001	<0.001	0.27	<0.001	0.047	<0.0001	0.013	0.004	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	26-Nov-2019	0.01	<0.001	0.691	<0.001	0.42	<0.0001	0.003	<0.001	<0.001	0.21	<0.001	0.07	<0.0001	0.01	0.006	<0.01	<0.001	0.002	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	17-Dec-2019	<0.01	0.002	0.594	<0.001	0.48	<0.0001	<0.001	<0.001	<0.001	0.31	<0.001	0.042	<0.0001	0.01	0.002	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	31-Mar-2020	<0.01	0.001	0.952	<0.001	0.45	<0.0001	<0.001	<0.001	<0.001	0.24	<0.001	0.055	<0.0001	0.005	0.008	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	27-Apr-2020	<0.01	<0.001	1.2	<0.001	0.38	<0.0001	<0.001	<0.001	<0.001	0.32	<0.001	0.061	<0.0001	0.004	0.006	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	18-May-2020	<0.01	0.001	1.24	<0.001	0.45	<0.0001	<0.001	<0.001	<0.001	0.19	<0.001	0.074	<0.0001	0.003	0.006	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	17-Jun-2020	0.01	<0.001	1.52	<0.001	0.33	<0.0001	<0.001	<0.001	<0.001	0.2	<0.001	0.057	<0.0001	0.004	0.007	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	13-Jul-2020	<0.01	<0.001	1.46	<0.001	0.36	<0.0001	<0.001	<0.001	<0.001	0.1	<0.001	0.073	<0.0001	0.004	0.011	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	18-Aug-2020	<0.01	<0.001	1.56	<0.001	0.33	<0.0001	<0.001	<0.001	<0.001	0.21	<0.001	0.07	<0.0001	0.004	0.01	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	21-Sep-2020	<0.01	0.001	1.55	<0.001	0.38	<0.0001	<0.001	<0.001	0.002	0.23	<0.001	0.099	<0.0001	0.003	0.004	<0.01	<0.001	<0.001	<0.01	<0.005
15	DW7264W3	Aries 3 Seam	19-Oct-2020	<0.01	<0.001	1.76	<0.001	0.29	<0.0001	<0.001	<0.001	<0.001	0.32	<0.001	0.076	<0.0001	0.003	0.005	<0.01	<0.001	<0.001	<0.01	<0.005
16	DW7282W1	Overburden	26-Sep-2019	0.02	0.003	0.3	<0.001	1.5	<0.0001	<0.001	0.004	<0.001	0.2	<0.001	0.291	<0.0001	0.001	0.01	<0.01	<0.001	0.002	<0.01	0.023
16	DW7282W1	Overburden	28-Oct-2019	<0.01	0.003	0.148	<0.001	1.59	<0.0001	<0.001	0.004	<0.001	0.39	<0.001	0.284	<0.0001	0.001	0.009	<0.01	<0.001	0.002	<0.01	0.067
16	DW7282W1	Overburden	25-Nov-2019	<0.01	0.005	0.212	<0.001	1.5	<0.0001	<0.001	0.004	0.001	0.34	<0.001	0.232	<0.0001	0.002	0.012	<0.01	<0.001	0.001	<0.01	0.055
16	DW7282W1	Overburden	17-Dec-2019	<0.01	0.005	0.152	<0.001	1.72	<0.0001	<0.001	0.004	0.004	0.34	<0.001	0.275	<0.0001	0.002	0.01	<0.01	<0.001	0.001	<0.01	0.047
16	DW7282W1	Overburden	20-Feb-2020	<0.01	0.004	0.103	<0.001	1.33	<0.0001	<0.001	0.002	<0.001	0.78	<0.001	0.224	<0.0001	0.001	0.018	<0.01	<0.001	0.001	<0.01	0.053
16	DW7282W1	Overburden	20-Mar-2020	<0.05	<0.005	0.08	<0.005	1.59	<0.0005	<0.005	<0.005	<0.005	1.78	<0.005	0.246	<0.0001	<0.005	0.009	<0.05	<0.005	<0.005	<0.05	0.03
16	DW7282W1	Overburden	27-Apr-2020	<0.05	0.005	0.095	<0.005	2.01	<0.0005	<0.005	<0.005	<0.005	0.54	<0.005	0.262	<0.0001	<0.005	0.014	<0.05	<0.005	<0.005	<0.05	0.096
16	DW7282W1	Overburden	19-May-2020	<0.01	0.005	0.088	<0.001	1.7	<0.0001	<0.001	0.002	0.003	0.63	<0.001	0.233	<0.0001	0.002	0.008	<0.01	<0.001	0.001	<0.01	0.113
16	DW7282W1	Overburden	17-Jun-2020	<0.01	0.005	0.078	<0.001	1.42	<0.0001	<0.001	0.002	<0.001	0.79	<0.001	0.225	<0.0001	0.002	0.011	<0.01	<0.001	0.001	<0.01	0.067
16	DW7282W1	Overburden	14-Jul-2020	<0.05	<0.005	0.086	<0.005	1.8	<0.0005	<0.005	<0.005	0.008	0.7	<0.005	0.237	<0.0001	0.006	0.013	<0.05	<0.005	<0.005	<0.05	0.083
16	DW7282W1	Overburden	19-Aug-2020	<0.01	0.003	0.167	<0.001	1.36	<0.0001	<0.001	0.002	0.006	0.37	<0.001	0.224	<0.0001	0.002	0.012	<0.01	<0.001	0.001	<0.01	0.092
16	DW7282W1	Overburden	21-Sep-2020	<0.01	0.003	0.081	<0.001	1.59	<0.0001	<0.001	0.002	0.006	0.45	<0.001	0.231	<0.0001	0.001	0.007	<0.01	<0.001	0.001	<0.01	0.029
16	DW7282W1	Overburden	19-Oct-2020	<0.01	0.005	0.084	<0.001	1.06	<0.0001	<0.001	0.002	<0.001	0.91	<0.001	0.24	<0.0001	0.001	0.01	<0.01	<0.001	0.001	<0.01	0.029
16	DW7282W2	Aries 3 Seam	26-Sep-2019	<0.01	0.001	0.161	<0.001	0.74	<0.0001	<0.001	<0.001	<0.001	2.44	<0.001	0.096	<0.0001	0.002	0.008	<0.01	<0.001	0.002	<0.01	0.034
16	DW7282W2	Aries 3 Seam	28-Oct-2019	<0.01	<0.001	0.127	<0.001	0.76	<0.0001	<0.001	<0.001	<0.001	3.13	<0.001	0.09	<0.0001	0.002	0.005	<0.01	<0.001	0.003	<0.01	0.047
16	DW7282W2	Aries 3 Seam	25-Nov-2019	<0.01	0.002	0.187	<0.001	0.74	<0.0001	<0.001	0.001	0.002	2.82	<0.001	0.102	<0.0001	0.001	0.01	<0.01	<0.001	0.002	<0.01	<0.005
16	DW7282W2	Aries 3 Seam	17-Dec-2019	<0.05	<0.005	0.146	<0.005	1.19	<0.0005	<0.005	<0.005	<0.005	4.71	<0.005	0.144	<0.0001	<0.005	0.006	<0.05	<0.005	<0.005	<0.05	<0.025
16	DW7282W2	Aries 3 Seam	20-Feb-2020	<0.05	<0.005	0.125	<0.005	0.82	<0.0005	<0.005	<0.005	<0.005	3.87	<0.005	0.114	<0.0001	<0.005	0.01	<0.05	<0.005	<0.005	<0.05	<0.025
16	DW7282W2	Aries 3 Seam	20-Mar-2020	<0.05	0.005	0.108	<0.005	0.64	<0.0005	<0.005	<0.005	<0.005	5.23	<0.005	0.12	<0.0001	<0.005	0.007	<0.05	<0.005	<0.005	<0.05	<0.025
16	DW7282W2	Aries 3 Seam	27-Apr-2020	<0.05	<0.005	0.11	<0.005	0.78	<0.0005	<0.005	<0.005	<0.005	4.87	<0.005	0.131	<0.0001	<0.005	0.01	<0.05	<0.005	<0.005	<0.05	<0.025
16	DW7282W2	Aries 3 Seam	19-May-2020	<0.05	<0.005	0.115	<0.005	1.16	<0.0005	<0.005	<0.005	<0.005	3.77	<0.005	0.117	<0.0001	<0.005	0.005	<0.05	<0.005	<0.005	<0.05	0.059
16	DW7282W2	Aries 3 Seam	17-Jun-2020	<0.01	<0.001	0.118	<0.001	0.63	<0.0001	<0.001	<0.001	<0.001	3.95	<0.001	0.098	<0.0001	0.001	0.011	<0.01	<0.001	0.001	<0.01	0.076
16	DW7282W2	Aries 3 Seam	14-Jul-2020	<0.05	<0.005	0.112	<0.005	0.78	<0.0005	0.011	<0.005	<0.005	3.94	<0.005	0.118	<0.0001	0.011	0.046	<0.05	<0.005	<0.005	<0.05	0.076
16	DW7282W2	Aries 3 Seam	19-Aug-2020	<0.05	<0.005	0.126	<0.005	0.97	<0.0005	<0.005	<0.005	<0.005	3.83	<0.005	0.095	<0.0001	<0.005	0.007	<0.05	<0.005	<0.005	<0.05	0.083
16	DW7282W2	Aries 3 Seam	21-Sep-2020	<0.05	<0.005	0.111	<0.005	0.84	<0.0005	<0.005	<0.005	<0.005	3.66	<0.005	0.107	<0.0001	<0.005	0.005	<0.05	<0.005	<0.005	<0.05	0.039
16	DW7282W2	Aries 3 Seam	19-Oct-2020	<0.05	<0.005	0.106	<0.005	0.86	<0.0005	<0.005	<0.005	<0.005	3.72	<0.005	0.093	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.03
17	DW7292W1	Quaternary Alluvium	25-Sep-2019	<0.01	0.003	0.103	<0.001	0.83	<0.0001	<0.001	0.001	<0.001	0.08	<0.001	0.121	<0.0001	0.003	0.01	<0.01	<0.001	0.008	<0.01	0.021
17	DW7292W1	Quaternary Alluvium	28-Oct-2019	0.09	<0.001	0.079	<0.001	0.5	<0.0001	<0.001	0.001	<0.001	<0.05	<0.001	0.059	<0.0001	0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.063
17	DW7292W1	Quaternary Alluvium	25-Nov-2019	<0.01	0.002	0.122	<0.001	0.38	<0.0001	<0.001	0.002	<0.001	<0.05	<0.001	0.098	<0.0001	0.001	0.009	<0.01	<0.001	<0.001	<0.01	0.077
17	DW7292W1	Quaternary Alluvium	31-Mar-2020	<0.01	<0.001	0.052	<0.001	0.22	<0.0001	<0.001	0.002	0.042	<0.05	<0.001	0.06	<0.0001	0.002	0.083	<0.01	<0.001	<0.001	<0.01	0.341
17	DW7292W1	Quaternary Alluvium	27-Apr-2020	0.07	<0.001	0.055	<0.001	0.25	<0.0001	<0.001	0.001	0.014	<0.05	<0.001	0.096	<0.0001	0.002	0.071	<0.01	<0.001	<0.001	<0.01	0.461
17	DW7292W1	Quaternary Alluvium	18-May-2020	<0.01	0.001	0.054	<0.001	0.21	0.0003	<0.001	0.002	0.054	<0.05	<0.001	0.037	<0.0001	<0.001	0.027	<0.01	<0.001	<0.001	<0.01	0.533
17	DW7292W1	Quaternary Alluvium	17-Jun-2020	0.01	<0.001	0.046	<0.001	0.22	<0.0001	<0.001	<0.001	0.002	0.66	<0.001	0.04	<0.0001	<0.001	0.033	<0.01	<0.001	<0.001	<0.01	0.21
17	DW7292W1	Quaternary Alluvium	13-Jul-2020	<0.01	<0.001	0.076	<0.001	0.32	<0.0001	<0.001	<0.001	0.016	0.07	<0.001	0.155	<0.0001	<0.001	0.021	<0.01	<0.001	<0.001	<0.01	0.264
17	DW7292W1	Quaternary Alluvium	18-Aug-2020	<0.01	<0.001	0.113	<0.001	0.27	<0.0001	<0.001	0.001	0.058	<0.05	<0.001	0.05	<0.0001	0.001	0.029	<0.01	<0.001	<0.001	<0.01	0.26
17	DW7292W1	Quaternary Alluvium	21-Sep-2020	0.01	0.001	0.065	<0.001	0.22	<0.0001	<0.001	0.002	0.053	<0.05	<0.001	0.111	<0.0001	<0.001	0.03	<0.01	<0.001	<0.001	<0.01	0.287
17	DW7292W1	Quaternary Alluvium	19-Oct-2020	<0.01	<0.001	0.044	<0.001	0.19	<0.0001	<0.001	<0.001	0.273	<0.05	<0.001	0.055	<0.0001	<0.001	0.019	<0.01	<0.001	<0.001	<0.01	0.237

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Livestock Trigger - ANZECC 2000			**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
1	DW7065W	Aries 3 Seam	12-Dec-2018	0.33	0.022	0.082	<0.001	1.33	0.0002	<0.001	0.018	0.102	2.82	0.012	0.316	<0.0001	0.001	0.022	<0.01	<0.001	0.013	<0.01	0.19
1	DW7065W	Aries 3 Seam	07-Jan-2019	0.1	0.033	0.204	<0.001	1.58	0.0002	<0.001	0.012	0.057	3.24	0.002	0.264	<0.0001	0.003	0.015	<0.01	<0.001	0.011	<0.01	0.204
1	DW7065W	Aries 3 Seam	18-Feb-2019	0.11	0.025	0.12	<0.001	1.29	0.0002	<0.001	0.009	0.03	4.66	<0.001	0.238	<0.0001	0.001	0.016	<0.01	<0.001	0.007	<0.01	0.124
1	DW7065W	Aries 3 Seam	11-Mar-2019	0.28	0.017	0.094	<0.005	1.64	<0.0005	<0.005	0.01	0.045	5.39	<0.005	0.362	<0.0001	<0.005	0.014	<0.05	<0.005	0.006	<0.05	0.09
1	DW7065W	Aries 3 Seam	17-Apr-2019	0.06	0.017	0.106	<0.001	1.13	<0.0001	<0.001	0.006	0.031	3.37	<0.001	0.231	<0.0005	0.001	0.008	<0.01	<0.001	0.007	<0.01	0.1
1	DW7065W	Aries 3 Seam	13-May-2019	0.06	0.022	0.32	<0.001	1.37	<0.0001	<0.001	0.008	0.039	4.15	<0.001	0.35	<0.0001	0.001	0.014	<0.01	<0.001	0.008	<0.01	0.149
1	DW7065W	Aries 3 Seam	19-Jun-2019	0.04	0.018	0.178	<0.001	1.14	<0.0001	<0.001	0.006	0.006	3.87	<0.001	0.295	<0.0001	<0.001	0.011	<0.01	<0.001	0.008	<0.01	0.103
1	DW7065W	Aries 3 Seam	11-Jul-2019	0.12	0.008	0.284	<0.005	1.47	<0.0005	<0.005	0.006	0.01	2.12	<0.005	0.406	<0.0001	<0.005	0.011	<0.05	<0.005	0.006	<0.05	0.121
1	DW7065W	Aries 3 Seam	26-Aug-2019	0.17	0.019	0.474	<0.001	1.52	<0.0001	<0.001	0.006	0.008	4.39	0.001	0.279	<0.0001	<0.001	0.01	<0.01	<0.001	0.009	<0.01	0.42
1	DW7065W	Aries 3 Seam	23-Sep-2019	0.12	0.018	0.297	<0.001	1.35	<0.0001	<0.001	0.006	0.071	4.35	<0.001	0.323	<0.0001	0.002	0.01	<0.01	<0.001	0.007	<0.01	0.117
1	DW7065W	Aries 3 Seam	23-Oct-2019	0.06	0.013	0.135	<0.005	1.46	<0.0005	<0.005	<0.005	0.076	3.87	<0.005	0.297	<0.0001	<0.005	0.008	<0.05	<0.005	0.006	<0.05	0.075
1	DW7065W	Aries 3 Seam	20-Nov-2019	0.05	0.009	0.959	<0.001	1.2	<0.0001	<0.001	0.004	0.007	2.14	<0.001	0.569	<0.0001	0.001	0.01	<0.01	<0.001	0.007	<0.01	0.059
1	DW7065W	Aries 3 Seam	16-Mar-2020	<0.05	0.02	0.172	<0.005	1.27	<0.0005	<0.005	<0.005	0.103	4.69	<0.005	0.315	<0.0001	<0.005	0.03	<0.05	<0.005	0.005	<0.05	0.155
1	DW7065W	Aries 3 Seam	23-Apr-2020	0.59	0.015	0.096	<0.001	1.31	<0.0001	0.002	0.004	0.087	4.18	0.002	0.255	<0.0001	0.002	0.02	<0.01	<0.001	0.006	<0.01	0.179
1	DW7065W	Aries 3 Seam	25-May-2020	0.44	0.017	0.114	<0.001	1.2	<0.0001	0.002	0.005	0.013	4.22	0.002	0.263	<0.0001	0.002	0.02	<0.01	<0.001	0.006	<0.01	0.232
1	DW7065W	Aries 3 Seam	30-Jun-2020	0.28	0.015	0.109	<0.005	1.32	<0.0005	<0.005	<0.005	0.064	4.3	0.013	0.3	<0.0001	<0.005	0.028	<0.05	<0.005	0.006	<0.05	0.296
1	DW7065W	Aries 3 Seam	28-Jul-2020	0.24	0.006	0.091	<0.001	1.28	<0.0001	0.011	0.003	0.029	3.75	0.001	0.246	<0.0001	0.002	0.021	<0.01	<0.001	0.005	<0.01	0.119
1	DW7065W	Aries 3 Seam	31-Aug-2020	0.2	0.014	0.134	<0.001	1.28	0.0001	0.007	0.004	0.01	4.05	<0.001	0.291	<0.0001	0.001	0.017	<0.01	<0.001	0.008	<0.01	0.114
1	DW7065W	Aries 3 Seam	28-Sep-2020	0.16	0.01	0.098	0.004	1.18	<0.0001	0.003	0.004	0.02	4.32	0.004	0.263	<0.0001	0.005	0.018	<0.01	0.004	0.009	<0.01	0.075
1	DW7065W	Aries 3 Seam	21-Oct-2020	0.94	0.014	0.105	<0.001	1.27	<0.0001	0.002	0.003	0.007	5.03	0.001	0.276	<0.0001	0.001	0.013	<0.01	0.001	0.005	<0.01	0.057
2	DW7067W	Aries 3 Seam	12-Dec-2018	0.06	0.006	0.059	<0.001	1.44	<0.0001	<0.001	0.005	0.046	2.32	0.005	0.11	<0.0001	0.001	0.006	<0.01	<0.001	0.004	<0.01	0.111
2	DW7067W	Aries 3 Seam	07-Jan-2019	<0.05	0.012	0.089	<0.005	1.47	<0.0005	<0.005	<0.005	0.027	3.23	<0.005	0.122	<0.0001	<0.005	0.006	<0.05	<0.005	<0.005	<0.05	0.149
2	DW7067W	Aries 3 Seam	18-Feb-2019	0.01	0.013	0.077	<0.001	1.36	<0.0001	<0.001	0.002	0.021	4.31	<0.001	0.112	<0.0001	0.002	0.007	0.01	<0.001	0.002	<0.01	0.067
2	DW7067W	Aries 3 Seam	11-Mar-2019	<0.05	0.01	0.079	<0.005	1.76	<0.0005	<0.005	<0.005	0.014	3.88	<0.005	0.119	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.09
2	DW7067W	Aries 3 Seam	17-Apr-2019	0.02	0.008	0.069	<0.001	1.19	<0.0001	<0.001	0.001	0.012	3.38	<0.001	0.102	<0.0001	<0.001	0.002	<0.01	<0.001	0.002	<0.01	0.063
2	DW7067W	Aries 3 Seam	13-May-2019	0.01	0.008	0.156	<0.001	1.44	<0.0001	<0.001	0.001	0.022	3.34	<0.001	0.121	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.098
2	DW7067W	Aries 3 Seam	19-Jun-2019	0.02	0.004	0.11	<0.001	1.24	<0.0001	<0.001	0.002	0.007	0.52	<0.001	0.092	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.092
2	DW7067W	Aries 3 Seam	11-Jul-2019	<0.05	<0.005	0.134	<0.005	1.5	<0.0005	<0.005	<0.005	0.013	2.35	<0.005	0.154	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.148
2	DW7067W	Aries 3 Seam	26-Aug-2019	0.04	0.007	0.184	<0.001	1.6	<0.0001	<0.001	0.001	0.007	2.98	<0.001	0.107	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.06
2	DW7067W	Aries 3 Seam	23-Sep-2019	0.02	0.007	0.141	<0.001	1.4	<0.0001	<0.001	0.002	0.035	2.94	<0.001	0.126	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.078
2	DW7067W	Aries 3 Seam	23-Oct-2019	<0.05	<0.005	0.103	<0.005	1.58	<0.0005	<0.005	<0.005	0.018	0.74	<0.005	0.126	<0.0001	<0.005	0.007	<0.05	<0.005	<0.005	<0.05	0.075
2	DW7067W	Aries 3 Seam	20-Nov-2019	<0.01	0.003	0.275	<0.001	1.26	<0.0001	<0.001	0.002	0.003	0.34	<0.001	0.15	<0.0001	0.001	0.008	<0.01	<0.001	0.002	<0.01	0.079
2	DW7067W	Aries 3 Seam	16-Mar-2020	<0.05	0.006	0.098	<0.005	1.15	<0.0005	<0.005	<0.005	0.129	4.48	<0.005	0.121	<0.0001	<0.005	0.011	<0.05	<0.005	<0.005	<0.05	0.113
2	DW7067W	Aries 3 Seam	23-Apr-2020	0.01	0.006	0.081	<0.001	1.33	0.0002	0.006	<0.001	0.1	3.97	0.002	0.106	<0.0001	<0.001	0.019	<0.01	<0.001	<0.001	<0.01	0.17
2	DW7067W	Aries 3 Seam	25-May-2020	0.05	0.007	0.077	<0.001	1.25	<0.0001	<0.001	<0.001	0.002	3.91	0.001	0.114	<0.0001	0.001	0.008	<0.01	<0.001	0.001	<0.01	0.099
2	DW7067W	Aries 3 Seam	30-Jun-2020	<0.05	0.008	0.072	<0.005	1.55	0.0008	<0.005	<0.005	0.022	3.59	0.01	0.113	<0.0001	<0.005	0.016	<0.05	<0.005	<0.005	<0.05	0.134
2	DW7067W	Aries 3 Seam	28-Jul-2020	0.09	0.003	0.077	<0.001	1.23	<0.0001	0.004	<0.001	0.039	3.08	<0.001	0.104	<0.0005	0.001	0.01	<0.01	<0.001	<0.001	<0.01	0.193
2	DW7067W	Aries 3 Seam	31-Aug-2020	0.04	0.005	0.084	<0.001	1.15	<0.0001	0.001	<0.001	0.008	3.17	<0.001	0.13	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.066
2	DW7067W	Aries 3 Seam	28-Sep-2020	0.05	0.002	0.09	<0.001	1.22	<0.0001	0.004	<0.001	0.081	2.87	<0.001	0.139	<0.0001	<0.001	0.022	<0.01	<0.001	<0.001	<0.01	0.111
2	DW7067W	Aries 3 Seam	21-Oct-2020	0.07	0.002	0.09	<0.001	1.29	<0.0001	<0.001	<0.001	0.002	3.37	<0.001	0.12	<0.0001	<0.001	0.01	<0.01	<0.001	<0.001	<0.01	0.046
2	DW7068W	Tertiary sediments	12-Dec-2018	1.27	<0.001	0.186	<0.001	1.26	<0.0001	0.004	0.002	0.004	0.53	0.001	0.036	<0.0001	0.007	0.005	<0.01	<0.001	0.011	<0.01	0.019
2	DW7068W	Tertiary sediments	07-Jan-2019	1.82	<0.001	0.268	<0.001	1.48	0.0002	0.006	0.002	0.017	0.91	0.002	0.044	<0.0001	0.007	0.006	<0.01	<0.001	0.012	<0.01	0.106
2	DW7068W	Tertiary sediments	18-Feb-2019	4.11	0.002	0.234	<0.001	1.3	<0.0001	0.013	0.002	0.01	2.2	0.003	0.045	<0.0001	0.005	0.006	<0.01	<0.001	0.009	0.02	0.067
2	DW7068W	Tertiary sediments	11-Mar-2019	3.12	<0.005	0.214	<0.005	1.48	<0.0005	0.009	<0.005	0.007	1.5	<0.005	0.033	<0.0001	<0.005	0.006	<0.05	<0.005	0.012	<0.05	<0.026
2	DW7068W	Tertiary sediments	17-Apr-2019	2.43	<0.001	0.237	<0.001	1.16	<0.0001	0.008	0.002	0.008	1.55	0.002	0.041	<0.0001	0.005	0.006	<0.01	<0.001	0.01	<0.01	0.043
2	DW7068W	Tertiary sediments	13-May-2019	2.81	0.002	0.242	<0.001	1.4	<0.0001	0.01	0.002	0.028	2	0.003	0.054	<0.0001	0.005	0.009	<0.01	<0.001	0.011	<0.01	0.094
2	DW7068W	Tertiary sediments	11-Jul-2019	3.9	<0.005	0.22	<0.005	1.55	<0.0005	0.009	<0.005	0.007	1.24	<0.005	0.063	<0.0001	0.006	0.014	<0.05	<0.005	0.01	<0.05	0.126
2	DW7068W	Tertiary sediments	23-Sep-2019	2.17	<0.001	0.201	<0.001	1.4	<0.0001	0.006	0.002	0.012	1.18	0.002	0.05	<0.0001	0.004	0.009	<0.01	<0.001	0.009	<0.01	0.056
2	DW7068W	Tertiary sediments	20-Nov-2019	1.53	<0.001	0.192	<0.001	1.29	<0.0001	0.005	0.002	0.008	0.84	0.001	0.053	<0.0001	0.003	0.006	<0.01	<0.001	0.009	<0.01	0.039
2	DW7068W	Tertiary sediments	16-Mar-2020	4.34	<0.005	0.218	<0.005	1.13	<0.0005	0.008	<0.005	0.009	2.73	<0.005	0.069	<0.0001	<0.005	0.011	<0.05	<0.005	0.009	<0.05	0.041
2	DW7068W	Tertiary sediments	28-Jul-2020	2.65	<0.001	0.173	<0.001	1.31	<0.0001	0.008	0.002	0.013	1.26	0.002	0.039	<0.0001	0.002	0.009	<0.01	<0.001	0.009	<0.01	0.057
2	DW7068W	Tertiary sediments	31-Aug-2020	4.34	0.002	0.192	<0.001	1.27	<0.0001	0.013	0.002	0.014	2.64	0.003	0.047	<0.0001	0.002	0.009	<0.01	<0.001	0.009	0.02	0.051
2	DW7068W	Tertiary sediments	28-Sep-2020	1.63	0.001	0.181	<0.001	1.24	0.0001	0.018	0.002	0.02	0.96	0.002	0.034	<0.0001	0.002	0.008	<0.01	<0.001	0.008	<0.01	0.096

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Livestock Trigger - ANZECC 2000			**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
2	DW7068W	Tertiary sediments	21-Oct-2020	2.23	0.001	0.194	<0.001	1.31	<0.0001	0.006	0.002	0.007	1.26	0.002	0.066	<0.0001	0.002	0.009	<0.01	<0.001	0.009	<0.01	0.054
3	DW7069W	Pollux Upper Seam	12-Dec-2018	0.1	0.003	0.056	<0.001	1.37	0.0001	<0.001	0.002	0.06	2.4	0.005	0.174	<0.0001	0.001	0.004	<0.01	<0.001	0.002	<0.01	0.137
3	DW7069W	Pollux Upper Seam	07-Jan-2019	0.07	0.004	0.083	<0.001	1.41	0.0001	<0.001	<0.001	0.028	2.86	0.001	0.184	<0.0001	0.002	0.003	<0.01	<0.001	0.002	<0.01	0.144
3	DW7069W	Pollux Upper Seam	18-Feb-2019	0.09	0.003	0.072	<0.001	1.31	<0.0001	<0.001	<0.001	0.02	2.4	<0.001	0.158	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.089
3	DW7069W	Pollux Upper Seam	11-Mar-2019	0.08	<0.005	0.069	<0.005	1.73	<0.0005	<0.005	<0.005	0.014	2.48	<0.005	0.188	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.088
3	DW7069W	Pollux Upper Seam	17-Apr-2019	0.04	0.002	0.064	<0.001	1.14	<0.0001	<0.001	<0.001	0.01	2.42	<0.001	0.154	<0.0001	<0.001	0.002	<0.01	<0.001	<0.001	<0.01	0.064
3	DW7069W	Pollux Upper Seam	13-May-2019	0.03	0.004	0.117	<0.001	1.41	0.0002	<0.001	<0.001	0.02	2.64	<0.001	0.185	<0.0001	0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.082
3	DW7069W	Pollux Upper Seam	19-Jun-2019	0.02	0.002	0.084	<0.001	1.21	<0.0001	<0.001	<0.001	0.014	2.38	<0.001	0.153	<0.0001	<0.001	0.003	<0.01	<0.001	<0.001	<0.01	0.104
3	DW7069W	Pollux Upper Seam	11-Jul-2019	0.13	<0.005	0.087	<0.005	1.5	<0.0005	<0.005	<0.005	0.012	2.05	<0.005	0.168	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.133
3	DW7069W	Pollux Upper Seam	26-Aug-2019	0.12	0.003	0.113	<0.001	1.56	<0.0001	<0.001	<0.001	0.006	2.57	<0.001	0.147	<0.0001	0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.045
3	DW7069W	Pollux Upper Seam	23-Sep-2019	0.02	0.004	0.1	<0.001	1.38	<0.0001	<0.001	<0.001	0.021	2.16	<0.001	0.153	<0.0001	0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.065
3	DW7069W	Pollux Upper Seam	23-Oct-2019	<0.05	<0.005	0.077	<0.005	1.46	<0.0005	<0.005	<0.005	0.019	2.06	<0.005	0.167	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.053
3	DW7069W	Pollux Upper Seam	20-Nov-2019	0.02	0.002	0.175	<0.001	1.18	<0.0001	<0.001	<0.001	0.005	1.54	<0.001	0.191	<0.0001	0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.078
3	DW7069W	Pollux Upper Seam	16-Mar-2020	<0.05	<0.005	0.085	<0.005	1.03	<0.0005	<0.005	<0.005	0.122	2.72	<0.005	0.207	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.103
3	DW7069W	Pollux Upper Seam	23-Apr-2020	0.08	0.002	0.105	<0.001	1.32	0.0001	0.004	0.002	0.138	0.72	0.003	0.204	<0.0001	0.003	0.04	<0.01	<0.001	<0.001	<0.01	0.237
3	DW7069W	Pollux Upper Seam	25-May-2020	0.08	0.003	0.069	<0.001	1.18	<0.0001	0.001	<0.001	0.004	2.88	0.002	0.162	<0.0001	0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.095
3	DW7069W	Pollux Upper Seam	30-Jun-2020	0.03	0.002	0.082	<0.001	1.13	<0.0001	<0.001	<0.001	0.027	2.71	0.005	0.211	<0.0001	0.002	0.01	<0.01	<0.001	<0.001	<0.01	0.075
3	DW7069W	Pollux Upper Seam	28-Jul-2020	0.06	0.001	0.079	<0.001	1.17	<0.0001	0.003	<0.001	0.008	2.7	<0.001	0.201	<0.0001	0.002	0.011	<0.01	<0.001	<0.001	<0.01	0.064
3	DW7069W	Pollux Upper Seam	31-Aug-2020	0.04	0.002	0.071	<0.001	1.14	<0.0001	0.002	<0.001	0.006	2.3	<0.001	0.195	<0.0001	0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.044
3	DW7069W	Pollux Upper Seam	28-Sep-2020	0.1	0.002	0.076	<0.001	1.15	<0.0001	0.003	<0.001	0.009	2.14	<0.001	0.187	<0.0001	0.002	0.01	<0.01	<0.001	0.001	<0.01	0.05
3	DW7069W	Pollux Upper Seam	22-Oct-2020	0.11	0.002	0.075	<0.001	1.12	<0.0001	<0.001	<0.001	0.004	2.69	<0.001	0.183	<0.0001	0.001	0.009	<0.01	<0.001	<0.001	<0.01	0.049
4	DW7074W	Castor Upper Seams	13-Dec-2018	0.05	0.001	0.073	<0.001	1.45	<0.0001	<0.001	0.001	0.034	0.09	0.003	0.203	<0.0001	0.009	0.003	<0.01	<0.001	0.002	<0.01	0.078
4	DW7074W	Castor Upper Seams	07-Jan-2019	0.03	0.001	0.112	<0.001	1.52	0.0001	<0.001	0.002	0.016	0.22	0.001	0.274	<0.0001	0.012	0.003	<0.01	<0.001	0.003	<0.01	0.082
4	DW7074W	Castor Upper Seams	18-Feb-2019	0.02	0.003	0.087	<0.001	1.34	<0.0001	<0.001	0.002	0.019	0.43	<0.001	0.26	<0.0001	0.008	0.005	<0.01	<0.001	0.002	<0.01	0.071
4	DW7074W	Castor Upper Seams	11-Mar-2019	<0.05	<0.005	0.084	<0.005	1.64	<0.0005	<0.005	<0.005	0.012	1.63	<0.005	0.264	<0.0001	0.007	<0.005	<0.05	<0.005	<0.005	<0.05	<0.026
4	DW7074W	Castor Upper Seams	17-Apr-2019	0.03	0.005	0.078	<0.001	1.18	<0.0001	<0.001	<0.001	0.008	1.86	<0.001	0.227	<0.0001	0.006	0.003	<0.01	<0.001	0.002	<0.01	0.043
4	DW7074W	Castor Upper Seams	13-May-2019	0.06	0.006	0.117	<0.001	1.45	<0.0001	<0.001	<0.001	0.016	2.77	<0.001	0.27	<0.0001	0.005	0.005	<0.01	<0.001	0.003	<0.01	0.054
4	DW7074W	Castor Upper Seams	19-Jun-2019	0.02	0.004	0.088	<0.001	1.27	<0.0001	<0.001	<0.001	0.014	1.87	<0.001	0.227	<0.0001	0.005	0.004	<0.01	<0.001	0.002	<0.01	0.059
4	DW7074W	Castor Upper Seams	11-Jul-2019	0.07	<0.005	0.1	<0.005	1.53	<0.0005	<0.005	<0.005	0.006	1.11	<0.005	0.256	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.068
4	DW7074W	Castor Upper Seams	26-Aug-2019	0.21	0.003	0.119	<0.001	1.52	<0.0001	<0.001	<0.001	0.008	2.01	<0.001	0.245	<0.0001	0.004	0.005	<0.01	<0.001	0.002	<0.01	0.04
4	DW7074W	Castor Upper Seams	23-Sep-2019	0.03	0.004	0.099	<0.001	1.47	<0.0001	<0.001	<0.001	0.014	1.88	<0.001	0.231	<0.0001	0.004	0.006	<0.01	<0.001	0.001	<0.01	0.029
4	DW7074W	Castor Upper Seams	23-Oct-2019	<0.05	<0.005	0.089	<0.005	1.53	<0.0005	<0.005	<0.005	0.011	1.33	<0.005	0.259	<0.0001	<0.005	0.006	<0.05	<0.005	<0.005	<0.05	<0.026
4	DW7074W	Castor Upper Seams	20-Nov-2019	0.04	0.001	0.133	<0.001	1.19	<0.0001	<0.001	<0.001	0.005	0.88	<0.001	0.272	<0.0001	0.003	0.008	<0.01	<0.001	0.001	<0.01	0.053
4	DW7074W	Castor Upper Seams	16-Mar-2020	0.35	<0.005	0.118	<0.005	1.22	<0.0005	<0.005	<0.005	0.109	2.12	<0.005	0.309	<0.0001	<0.005	0.007	<0.05	<0.005	<0.005	<0.05	0.075
4	DW7074W	Castor Upper Seams	23-Apr-2020	<0.01	0.002	0.101	<0.001	1.4	<0.0001	<0.001	<0.001	0.12	1.51	0.001	0.286	<0.0001	0.002	0.018	<0.01	<0.001	0.001	<0.01	0.128
4	DW7074W	Castor Upper Seams	25-May-2020	0.04	0.002	0.083	<0.001	1.26	<0.0001	<0.001	<0.001	0.002	1.32	<0.001	0.241	<0.0001	0.002	0.008	<0.01	<0.001	<0.001	<0.01	0.061
4	DW7074W	Castor Upper Seams	30-Jun-2020	0.1	0.001	0.112	<0.001	1.22	<0.0001	0.004	<0.001	0.05	0.8	0.007	0.267	<0.0001	0.003	0.018	<0.01	<0.001	0.001	<0.01	0.092
4	DW7074W	Castor Upper Seams	28-Jul-2020	0.08	0.001	0.087	<0.001	1.15	<0.0001	0.004	0.001	0.011	0.37	<0.001	0.264	<0.0001	0.003	0.014	<0.01	<0.001	0.001	<0.01	0.105
4	DW7074W	Castor Upper Seams	31-Aug-2020	0.08	0.002	0.092	<0.001	1.1	<0.0001	0.003	0.001	0.006	0.48	<0.001	0.275	<0.0001	0.002	0.008	<0.01	<0.001	<0.001	<0.01	0.061
4	DW7074W	Castor Upper Seams	28-Sep-2020	0.03	0.001	0.091	<0.001	1.19	<0.0001	0.003	<0.001	0.006	0.51	<0.001	0.288	<0.0001	0.002	0.012	<0.01	<0.001	<0.001	<0.01	0.057
4	DW7074W	Castor Upper Seams	22-Oct-2020	0.98	0.003	0.101	<0.001	1.07	<0.0001	0.018	0.002	0.01	2.88	0.003	0.29	<0.0001	0.002	0.016	<0.01	<0.001	0.001	<0.01	0.073
4	DW7073W	Castor/ Pollux Seams	13-Dec-2018	0.3	0.001	0.108	<0.001	1.14	<0.0001	<0.001	<0.001	0.05	3.61	0.005	0.288	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.097
4	DW7073W	Castor/ Pollux Seams	07-Jan-2019	0.64	0.001	0.149	<0.001	1.26	0.0001	<0.001	<0.001	0.02	4.59	0.003	0.36	<0.0001	0.003	0.002	<0.01	<0.001	<0.001	<0.01	0.115
4	DW7073W	Castor/ Pollux Seams	18-Feb-2019	0.23	0.002	0.129	<0.001	1.08	0.0001	<0.001	<0.001	0.017	4.16	<0.001	0.35	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.104
4	DW7073W	Castor/ Pollux Seams	11-Mar-2019	0.23	<0.005	0.142	<0.005	1.39	<0.0005	<0.005	<0.005	0.011	5.2	<0.005	0.405	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.097
4	DW7073W	Castor/ Pollux Seams	17-Apr-2019	0.18	0.001	0.115	<0.001	0.94	<0.0001	<0.001	<0.001	0.009	4.31	<0.001	0.318	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.055
4	DW7073W	Castor/ Pollux Seams	13-May-2019	0.27	0.003	0.167	<0.001	1.1	<0.0001	<0.001	<0.001	0.015	4.66	<0.001	0.345	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.054
4	DW7073W	Castor/ Pollux Seams	19-Jun-2019	0.15	0.002	0.128	<0.001	1.02	<0.0001	<0.001	<0.001	0.015	4.2	<0.001	0.325	<0.0001	0.002	0.002	<0.01	<0.001	<0.001	<0.01	0.065
4	DW7073W	Castor/ Pollux Seams	11-Jul-2019	0.22	<0.005	0.133	<0.005	1.2	<0.0005	<0.005	<0.005	0.011	3.83	<0.005	0.347	<0.0001	<0.005	0.006	<0.05	<0.005	<0.005	<0.05	0.116
4	DW7073W	Castor/ Pollux Seams	26-Aug-2019	0.23	0.001	0.14	<0.001	1.21	<0.0001	<0.001	<0.001	0.006	4.01	<0.001	0.301	<0.0001	0.002	0.003	<0.01	<0.001	<0.001	<0.01	0.037
4	DW7073W	Castor/ Pollux Seams	23-Sep-2019	0.11	0.002	0.138	<0.001	1.06	<0.0001	<0.001	<0.001	0.02	3.58	<0.001	0.321	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.051
4	DW7073W	Castor/ Pollux Seams	23-Oct-2019	0.13	<0.005	0.123	<0.005	1.23	<0.0005	<0.005	<0.005	0.018	4.08	<0.005	0.342	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.04
4	DW7073W	Castor/ Pollux Seams	20-Nov-2019	0.1	0.001	0.175	<0.001	0.98	<0.0001	0.003	<0.001	0.005	3.01	<0.001	0.356	<0.0001	0.003	0.014	<0.01	<0.001	<0.001	<0.01	0.077

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Livestock Trigger - ANZECC 2000			**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
4	DW7073W	Castor/ Pollux Seams	16-Mar-2020	<0.05	<0.005	0.156	<0.005	0.62	<0.0005	<0.005	<0.005	1.47	4.56	<0.005	0.412	<0.0001	<0.005	0.01	<0.05	<0.005	<0.005	<0.05	0.132
4	DW7073W	Castor/ Pollux Seams	23-Apr-2020	0.03	<0.001	0.134	<0.001	1.05	<0.0001	<0.001	<0.001	0.154	4.12	0.002	0.376	<0.0001	0.002	0.021	<0.01	<0.001	<0.001	<0.01	0.187
4	DW7073W	Castor/ Pollux Seams	25-May-2020	0.08	0.001	0.126	<0.001	0.95	<0.0001	<0.001	<0.001	0.003	4.26	<0.001	0.37	<0.0001	0.002	0.007	<0.01	<0.001	<0.001	<0.01	0.065
4	DW7073W	Castor/ Pollux Seams	30-Jun-2020	0.06	<0.001	0.136	<0.001	1	<0.0001	<0.001	<0.001	0.024	3.31	0.006	0.364	<0.0001	0.002	0.01	<0.01	<0.001	<0.001	<0.01	0.086
4	DW7073W	Castor/ Pollux Seams	28-Jul-2020	0.21	<0.001	0.129	<0.001	0.94	<0.0001	0.004	<0.001	0.015	3.99	<0.001	0.382	<0.0001	0.004	0.016	<0.01	<0.001	<0.001	<0.01	0.075
4	DW7073W	Castor/ Pollux Seams	31-Aug-2020	0.11	0.002	0.129	<0.001	0.88	0.0001	0.001	<0.001	0.008	3.97	<0.001	0.38	<0.0001	0.002	0.006	<0.01	<0.001	<0.001	<0.01	0.058
4	DW7073W	Castor/ Pollux Seams	28-Sep-2020	0.08	0.002	0.131	<0.001	0.94	<0.0001	0.002	<0.001	0.006	3.99	<0.001	0.398	<0.0001	0.002	0.01	<0.01	<0.001	<0.001	<0.01	0.057
4	DW7073W	Castor/ Pollux Seams	22-Oct-2020	0.32	<0.001	0.139	<0.001	0.89	<0.0001	0.01	<0.001	0.008	3.81	<0.001	0.362	<0.0001	0.001	0.016	<0.01	<0.001	<0.001	<0.01	0.076
5	DW7076W	Quaternary Alluvium	12-Dec-2018	2.06	0.002	0.301	<0.001	3.87	<0.0001	0.001	0.005	0.002	0.89	0.001	0.17	<0.0001	0.002	0.005	<0.01	<0.001	0.062	<0.01	0.009
5	DW7076W	Quaternary Alluvium	07-Jan-2019	7.22	0.003	0.389	<0.001	4.43	<0.0001	0.011	0.007	0.098	2.93	0.005	0.291	<0.0001	0.004	0.007	<0.01	<0.001	0.073	0.04	0.05
5	DW7076W	Quaternary Alluvium	18-Feb-2019	2.86	0.002	0.352	<0.001	3.56	<0.0001	0.006	0.004	0.103	1.28	0.002	0.154	<0.0001	0.003	0.005	<0.01	<0.001	0.053	0.04	0.024
5	DW7076W	Quaternary Alluvium	11-Mar-2019	6.6	<0.005	0.331	<0.005	4.71	<0.0005	0.009	0.006	0.308	2.52	0.006	0.236	<0.0001	<0.005	0.006	<0.05	<0.005	0.065	<0.05	<0.026
5	DW7076W	Quaternary Alluvium	17-Apr-2019	3.88	0.002	0.31	<0.001	3.41	<0.0001	0.008	0.004	0.164	1.92	0.003	0.158	<0.0001	0.002	0.004	<0.01	<0.001	0.053	0.02	0.041
5	DW7076W	Quaternary Alluvium	13-May-2019	4.8	0.003	0.27	<0.001	4.2	0.0001	0.007	0.004	0.313	2.22	0.003	0.176	<0.0001	0.002	0.004	<0.01	<0.001	0.055	0.02	0.036
5	DW7076W	Quaternary Alluvium	19-Jun-2019	2.05	0.002	0.209	<0.001	3.82	<0.0001	0.005	0.004	0.232	1.24	0.002	0.144	<0.0001	0.002	0.005	<0.01	<0.001	0.05	0.02	0.035
5	DW7076W	Quaternary Alluvium	11-Jul-2019	4.96	<0.005	0.224	<0.005	4.61	<0.0005	0.006	<0.005	0.452	2.2	<0.005	0.154	<0.0001	<0.005	0.007	<0.05	<0.005	0.044	<0.05	0.058
5	DW7076W	Quaternary Alluvium	26-Aug-2019	20.1	0.004	0.318	0.004	4.57	<0.0001	0.02	0.008	0.37	6.91	0.02	0.29	<0.0001	0.001	0.013	<0.01	<0.001	0.046	0.04	0.124
5	DW7076W	Quaternary Alluvium	23-Sep-2019	6.98	0.002	0.196	<0.001	4.69	<0.0001	0.006	0.003	0.047	2	0.006	0.092	<0.0001	0.002	0.007	<0.01	<0.001	0.027	0.02	0.03
5	DW7076W	Quaternary Alluvium	23-Oct-2019	4.81	0.002	0.18	<0.001	4.65	<0.0001	0.004	0.002	0.015	1.19	0.003	0.066	<0.0001	0.002	0.005	<0.01	<0.001	0.043	0.02	0.014
5	DW7076W	Quaternary Alluvium	20-Nov-2019	7.44	0.002	0.177	<0.001	4.01	<0.0001	0.009	0.002	0.027	1.94	0.006	0.067	<0.0001	0.002	0.008	<0.01	<0.001	0.038	0.03	0.024
5	DW7076W	Quaternary Alluvium	31-Mar-2020	9.08	0.009	0.216	<0.001	3.92	<0.0001	0.014	0.008	0.399	2.86	0.009	0.18	<0.0001	0.002	0.012	<0.01	<0.001	0.038	0.02	0.059
5	DW7076W	Quaternary Alluvium	23-Apr-2020	4.68	0.005	0.206	<0.001	4.16	<0.0001	0.008	0.003	0.098	1.58	0.005	0.244	<0.0001	0.002	0.007	<0.01	<0.001	0.034	0.01	0.024
5	DW7076W	Quaternary Alluvium	25-May-2020	3.91	0.003	0.21	<0.001	4.44	<0.0001	0.005	0.002	0.033	1.14	0.003	0.274	<0.0001	0.002	0.005	<0.01	<0.001	0.036	0.01	0.012
5	DW7076W	Quaternary Alluvium	30-Jun-2020	16.3	0.004	0.292	0.002	3.89	<0.0001	0.014	0.005	0.088	5.62	0.014	0.321	<0.0001	0.002	0.012	0.01	<0.001	0.042	0.03	0.056
5	DW7076W	Quaternary Alluvium	28-Jul-2020	5.73	0.003	0.22	<0.001	4.33	<0.0001	0.009	0.004	0.065	1.61	0.006	0.263	<0.0001	0.003	0.013	<0.01	<0.001	0.036	0.01	0.022
5	DW7076W	Quaternary Alluvium	31-Aug-2020	8.43	0.004	0.212	<0.001	4.55	<0.0001	0.014	0.004	0.118	2.69	0.01	0.24	<0.0001	0.001	0.01	<0.01	<0.001	0.033	0.02	0.05
5	DW7076W	Quaternary Alluvium	28-Sep-2020	8.89	0.003	0.193	<0.001	4.08	<0.0001	0.01	0.004	0.051	2.39	0.007	0.18	<0.0001	0.002	0.009	<0.01	<0.001	0.032	0.02	0.037
5	DW7076W	Quaternary Alluvium	22-Oct-2020	3.89	0.003	0.184	<0.001	4.16	<0.0001	0.006	0.003	0.047	1.1	0.004	0.112	<0.0001	0.001	0.005	<0.01	<0.001	0.032	<0.01	0.02
6	DW7033W3	Interburden	26-Sep-2019	0.06	0.004	0.11	<0.001	1.08	<0.0001	<0.001	0.02	0.001	1.62	<0.001	0.578	<0.0001	0.009	0.024	<0.01	<0.001	0.036	<0.01	0.015
6	DW7033W3	Interburden	30-Oct-2019	0.14	0.004	0.144	<0.001	1.07	<0.0001	<0.001	0.007	0.002	2.8	<0.001	0.545	<0.0001	0.004	0.012	<0.01	<0.001	0.029	<0.01	0.018
6	DW7033W3	Interburden	26-Nov-2019	0.08	0.004	0.13	<0.001	0.99	<0.0001	<0.001	0.004	0.003	6.57	0.002	0.533	<0.0001	0.004	0.016	<0.01	<0.001	0.019	<0.01	0.032
6	DW7033W3	Interburden	18-Dec-2019	0.07	0.004	0.145	<0.001	0.96	<0.0001	<0.001	0.002	0.005	8.73	<0.001	0.504	<0.0001	0.002	0.009	<0.01	<0.001	0.012	<0.01	0.033
6	DW7033W3	Interburden	20-Feb-2020	0.05	0.002	0.121	<0.001	0.86	<0.0001	0.001	0.002	0.002	3.46	<0.001	0.543	<0.0001	0.002	0.013	<0.01	<0.001	0.01	<0.01	0.022
6	DW7033W3	Interburden	20-Mar-2020	0.05	0.002	0.334	<0.001	0.9	<0.0001	<0.001	0.001	0.001	2.15	<0.001	0.532	<0.0001	0.002	0.007	<0.01	<0.001	0.009	<0.01	0.015
6	DW7033W3	Interburden	28-Apr-2020	0.31	<0.001	0.149	<0.001	1.1	<0.0001	0.001	<0.001	0.003	1.49	<0.001	0.41	<0.0001	0.002	0.01	<0.01	<0.001	0.005	<0.01	0.033
6	DW7033W3	Interburden	20-May-2020	0.38	<0.001	0.135	<0.001	1.03	<0.0001	0.001	0.001	0.002	1.43	<0.001	0.41	<0.0001	0.002	0.009	<0.01	<0.001	0.005	<0.01	0.015
6	DW7033W3	Interburden	17-Jun-2020	0.04	0.001	0.229	<0.001	0.92	<0.0001	0.002	0.001	0.006	1.67	<0.001	0.391	<0.0001	0.001	0.016	<0.01	<0.001	0.005	<0.01	0.104
6	DW7033W3	Interburden	15-Jul-2020	0.3	<0.001	0.163	<0.001	1.03	<0.0001	<0.001	<0.001	0.002	1	<0.001	0.35	<0.0001	0.002	0.007	<0.01	<0.001	0.004	<0.01	0.026
6	DW7033W3	Interburden	21-Aug-2020	3.98	0.002	0.157	<0.001	0.99	<0.0001	0.015	0.002	0.006	3.41	0.001	0.325	<0.0001	0.001	0.012	<0.01	<0.001	0.005	0.01	0.028
6	DW7033W3	Interburden	24-Sep-2020	0.36	<0.001	0.132	<0.001	1.11	<0.0001	0.002	<0.001	0.004	1.37	<0.001	0.289	<0.0001	0.002	0.007	<0.01	<0.001	0.004	<0.01	0.03
6	DW7033W3	Interburden	21-Oct-2020	0.44	0.001	0.161	<0.001	0.78	<0.0001	0.003	<0.001	0.006	1.59	<0.001	0.317	<0.0001	0.001	0.007	<0.01	<0.001	0.003	<0.01	0.031
6	DW7033W2	Orion 5 Seam	26-Sep-2019	0.41	0.001	0.138	<0.001	0.75	<0.0001	<0.001	0.003	0.002	0.79	<0.001	0.253	<0.0001	<0.001	0.006	<0.01	<0.001	0.004	<0.01	0.01
6	DW7033W2	Orion 5 Seam	30-Oct-2019	0.48	0.001	0.188	<0.001	1.01	<0.0001	<0.001	<0.001	0.003	2.6	<0.001	0.278	0.0005	<0.001	0.004	<0.01	<0.001	0.008	<0.01	0.021
6	DW7033W2	Orion 5 Seam	26-Nov-2019	0.11	0.001	0.15	<0.001	0.98	<0.0001	<0.001	<0.001	0.002	2.93	0.001	0.316	<0.0001	<0.001	0.007	<0.01	<0.001	0.005	<0.01	0.017
6	DW7033W2	Orion 5 Seam	18-Dec-2019	0.06	0.002	0.156	<0.001	0.89	<0.0001	<0.001	<0.001	0.002	4.26	<0.001	0.307	<0.0001	<0.001	0.004	<0.01	<0.001	0.002	<0.01	0.01
6	DW7033W2	Orion 5 Seam	20-Feb-2020	0.16	<0.001	0.147	<0.001	0.86	<0.0001	<0.001	<0.001	0.002	1.49	<0.001	0.276	<0.0001	<0.001	0.009	<0.01	<0.001	0.003	<0.01	0.01
6	DW7033W2	Orion 5 Seam	20-Mar-2020	0.61	<0.001	0.155	<0.001	0.87	<0.0001	0.002	<0.001	0.094	1.09	0.002	0.275	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.091
6	DW7033W2	Orion 5 Seam	28-Apr-2020	1.56	<0.001	0.179	<0.001	0.94	<0.0001	0.005	<0.001	0.003	1.45	<0.001	0.246	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.047
6	DW7033W2	Orion 5 Seam	20-May-2020	0.81	<0.001	0.164	<0.001	0.94	<0.0001	0.002	<0.001	0.002	1.1	<0.001	0.264	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.023
6	DW7033W2	Orion 5 Seam	17-Jun-2020	0.09	<0.001	0.202	<0.001	0.84	<0.0001	0.002	<0.001	0.006	1.18	<0.001	0.287	<0.0001	<0.001	0.013	<0.01	<0.001	0.002	<0.01	0.097
6	DW7033W2	Orion 5 Seam	15-Jul-2020	1.01	<0.001	0.183	<0.001	0.88	<0.0001	0.003	<0.001	0.002	1.17	<0.001	0.251	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.03
6	DW7033W2	Orion 5 Seam	21-Aug-2020	0.7	<0.001	0.157	<0.001	0.94	<0.0001	0.003	<0.001	0.002	1.22	<0.001	0.268	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.021
6	DW7033W2	Orion 5 Seam	24-Sep-2020	0.4	<0.001	0.157	<0.001	0.96	<0.0001	<0.001	<0.001	0.001	0.99	<0.001	0.267	<0.0001	<0.001	0.006	<0.01	<0.001	0.002	<0.01	0.02

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Livestock Trigger - ANZECC 2000			**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
6	DW7033W2	Orion 5 Seam	21-Oct-2020	10.4	0.003	0.239	0.002	0.73	<0.0001	0.015	0.004	0.039	7.9	0.015	0.38	<0.0001	0.002	0.015	<0.01	0.002	0.006	0.01	0.131
6	DW7033W1	Tertiary	26-Sep-2019	10.4	0.002	0.156	0.001	0.9	<0.0001	0.039	0.002	0.007	2.29	0.002	0.036	0.0009	<0.001	0.01	<0.01	<0.001	0.011	0.02	0.018
6	DW7033W1	Tertiary	30-Oct-2019	3.02	<0.001	0.184	<0.001	0.88	<0.0001	0.009	<0.001	0.009	0.73	<0.001	0.014	0.0002	<0.001	0.005	<0.01	<0.001	0.008	<0.01	0.05
6	DW7033W1	Tertiary	26-Nov-2019	2.26	<0.001	0.155	<0.001	0.89	<0.0001	0.005	0.001	0.001	0.72	<0.001	0.035	<0.0001	<0.001	0.008	<0.01	<0.001	0.008	<0.01	0.008
6	DW7033W1	Tertiary	18-Dec-2019	2.99	<0.001	0.11	<0.001	0.78	<0.0001	0.009	0.001	0.004	1.02	<0.001	0.042	<0.0001	0.002	0.012	<0.01	<0.001	0.009	<0.01	0.008
6	DW7033W1	Tertiary	20-Feb-2020	2.83	<0.001	0.149	<0.001	0.74	<0.0001	0.009	<0.001	0.002	1.3	<0.001	0.015	0.0004	<0.001	0.01	<0.01	<0.001	0.008	<0.01	0.011
6	DW7033W1	Tertiary	20-Mar-2020	1.74	<0.001	0.153	<0.001	0.72	<0.0001	0.006	<0.001	0.16	0.43	<0.001	0.033	0.0009	0.001	0.02	<0.01	<0.001	0.007	<0.01	0.108
6	DW7033W1	Tertiary	28-Apr-2020	16.2	0.002	0.201	0.002	0.72	<0.0001	0.053	0.003	0.013	4.39	0.004	0.048	0.0006	<0.001	0.016	<0.01	<0.001	0.012	0.04	0.059
6	DW7033W1	Tertiary	20-May-2020	2.52	<0.001	0.147	<0.001	0.76	<0.0001	0.008	<0.001	0.001	0.68	<0.001	0.011	<0.0001	<0.001	0.009	<0.01	<0.001	0.007	<0.01	0.021
6	DW7033W1	Tertiary	17-Jun-2020	3.03	<0.001	0.165	<0.001	0.8	<0.0001	0.01	<0.001	0.003	0.67	<0.001	0.018	<0.0001	<0.001	0.013	<0.01	<0.001	0.008	<0.01	0.085
6	DW7033W1	Tertiary	15-Jul-2020	3.02	0.001	0.157	<0.001	0.87	<0.0001	0.008	<0.001	0.002	0.61	<0.001	0.015	<0.0001	<0.001	0.011	<0.01	<0.001	0.008	<0.01	0.019
6	DW7033W1	Tertiary	21-Aug-2020	27.4	0.002	0.219	0.002	0.69	<0.0001	0.106	0.003	0.012	8.68	0.009	0.044	<0.0005	<0.001	0.017	<0.01	<0.001	0.012	0.06	0.03
6	DW7033W1	Tertiary	24-Sep-2020	8.22	<0.001	0.131	<0.001	0.81	<0.0001	0.034	<0.001	0.004	2.04	0.002	0.02	0.0003	<0.001	0.013	<0.01	<0.001	0.008	0.02	0.02
6	DW7033W1	Tertiary	21-Oct-2020	3.74	<0.001	0.164	<0.001	0.72	<0.0001	0.014	<0.001	0.002	0.76	<0.001	0.011	<0.0001	<0.001	0.01	<0.01	<0.001	0.007	<0.01	0.019
7	DW7035W3	Orion 1 Seam	26-Sep-2019	0.58	0.001	0.158	<0.001	1.02	<0.0001	0.001	<0.001	0.001	0.55	<0.001	0.21	<0.0001	0.001	0.004	<0.01	<0.001	0.003	<0.01	0.023
7	DW7035W3	Orion 1 Seam	30-Oct-2019	0.3	0.001	0.131	<0.001	1.08	<0.0001	<0.001	<0.001	<0.001	1.2	<0.001	0.206	<0.0001	0.002	0.005	<0.01	<0.001	0.002	<0.01	0.024
7	DW7035W3	Orion 1 Seam	26-Nov-2019	0.36	0.001	0.168	<0.001	0.88	<0.0001	<0.001	0.001	0.003	1.53	0.001	0.195	<0.0001	0.002	0.009	<0.01	<0.001	0.001	<0.01	0.07
7	DW7035W3	Orion 1 Seam	18-Dec-2019	0.11	<0.001	0.152	<0.001	0.88	<0.0001	<0.001	0.001	0.153	0.38	<0.001	0.182	<0.0001	0.002	0.005	<0.01	<0.001	<0.001	<0.01	0.041
7	DW7035W3	Orion 1 Seam	31-Mar-2020	0.12	<0.001	0.152	<0.001	0.92	<0.0001	0.002	<0.001	0.002	2.04	<0.001	0.318	<0.0001	0.001	0.026	<0.01	<0.001	<0.001	<0.01	0.066
7	DW7035W3	Orion 1 Seam	28-Apr-2020	0.03	<0.001	0.121	<0.001	0.99	<0.0001	0.001	<0.001	0.003	1.12	<0.001	0.258	<0.0001	<0.001	0.012	<0.01	<0.001	<0.001	<0.01	0.075
7	DW7035W3	Orion 1 Seam	20-May-2020	0.02	<0.001	0.11	<0.001	0.9	<0.0001	<0.001	<0.001	<0.001	1.53	<0.001	0.248	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	<0.005
7	DW7035W3	Orion 1 Seam	17-Jun-2020	0.22	0.001	0.119	<0.001	0.84	<0.0001	0.001	<0.001	0.003	1.26	<0.001	0.186	<0.0001	<0.001	0.012	<0.01	<0.001	<0.001	<0.01	0.059
7	DW7035W3	Orion 1 Seam	15-Jul-2020	<0.01	0.002	0.105	<0.001	0.96	<0.0001	<0.001	<0.001	<0.001	1.86	<0.001	0.249	<0.0001	0.003	0.007	<0.01	<0.001	<0.001	<0.01	0.014
7	DW7035W3	Orion 1 Seam	21-Aug-2020	0.02	0.001	0.1	<0.001	0.97	<0.0001	<0.001	<0.001	<0.001	1.16	<0.001	0.234	<0.0001	0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.015
7	DW7035W3	Orion 1 Seam	24-Sep-2020	0.06	<0.001	0.085	<0.001	1.07	<0.0001	<0.001	<0.001	<0.001	1.33	<0.001	0.247	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.009
7	DW7035W3	Orion 1 Seam	21-Oct-2020	0.02	0.001	0.138	<0.001	0.72	<0.0001	<0.001	<0.001	0.001	1.39	<0.001	0.19	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.012
8	DW7082W1	Castor Lower Seam	24-Sep-2019	0.13	0.021	0.095	<0.001	0.78	0.0011	<0.001	0.011	0.025	0.63	0.001	0.21	<0.0001	2.91	0.015	<0.01	<0.001	0.004	<0.01	0.091
8	DW7082W1	Castor Lower Seam	24-Oct-2019	0.02	0.037	0.072	<0.001	0.74	0.0002	<0.001	0.007	0.017	1.13	<0.001	0.243	<0.0001	0.661	0.009	<0.01	<0.001	0.005	<0.01	0.033
8	DW7082W1	Castor Lower Seam	21-Nov-2019	0.02	0.027	0.107	<0.001	0.72	0.0002	<0.001	0.005	0.003	1.4	<0.001	0.257	<0.0001	0.252	0.01	<0.01	<0.001	0.004	<0.01	0.053
8	DW7082W1	Castor Lower Seam	13-Dec-2019	0.04	0.022	0.294	<0.001	0.72	<0.0001	<0.001	0.004	0.019	2.83	<0.001	0.23	<0.0001	0.154	0.007	<0.01	<0.001	0.003	<0.01	0.04
8	DW7082W1	Castor Lower Seam	19-Feb-2020	0.12	0.018	0.102	<0.001	0.58	<0.0001	<0.001	0.003	0.006	2.8	<0.001	0.248	<0.0001	0.107	0.011	<0.01	<0.001	0.002	<0.01	0.043
8	DW7082W1	Castor Lower Seam	17-Mar-2020	0.02	0.016	0.132	<0.001	0.67	<0.0001	<0.001	0.001	0.04	3.13	<0.001	0.201	<0.0001	0.191	0.006	<0.01	<0.001	0.002	<0.01	0.053
8	DW7082W1	Castor Lower Seam	29-Apr-2020	0.2	0.008	0.154	<0.001	0.73	<0.0001	<0.001	<0.001	0.002	2.43	<0.001	0.143	<0.0001	0.111	0.008	<0.01	<0.001	<0.001	<0.01	0.074
8	DW7082W1	Castor Lower Seam	20-May-2020	0.11	0.01	0.159	<0.001	0.69	<0.0001	<0.001	<0.001	0.002	3.91	<0.001	0.182	<0.0001	0.117	0.01	<0.01	<0.001	0.001	<0.01	0.047
8	DW7082W1	Castor Lower Seam	30-Jun-2020	0.02	0.008	0.089	<0.001	0.65	<0.0001	<0.001	<0.001	0.012	3.36	0.002	0.189	<0.0001	0.101	0.007	<0.01	<0.001	<0.001	<0.01	0.036
8	DW7082W1	Castor Lower Seam	15-Jul-2020	0.06	0.005	0.257	<0.001	0.67	<0.0001	0.002	<0.001	0.002	3.14	<0.001	0.16	<0.0001	0.11	0.016	<0.01	<0.001	<0.001	<0.01	0.053
8	DW7082W1	Castor Lower Seam	20-Aug-2020	0.02	0.005	0.152	<0.001	0.77	<0.0001	0.001	<0.001	0.001	3.81	<0.001	0.162	<0.0001	0.083	0.01	<0.01	<0.001	<0.001	<0.01	0.063
8	DW7082W1	Castor Lower Seam	23-Sep-2020	0.41	0.004	0.16	<0.001	0.72	<0.0001	0.003	<0.001	0.007	3.61	<0.001	0.165	<0.0001	0.06	0.009	<0.01	<0.001	<0.001	<0.01	0.049
8	DW7082W1	Castor Lower Seam	20-Oct-2020	0.03	0.004	0.17	<0.001	0.57	<0.0001	0.002	<0.001	0.001	3.52	<0.001	0.136	<0.0001	0.057	0.01	<0.01	<0.001	<0.001	<0.01	0.01
8	DW7082W2	Pollux Upper Seam	24-Sep-2019	0.07	0.006	0.081	<0.001	0.94	<0.0001	<0.001	0.006	0.013	0.69	<0.001	0.151	<0.0001	0.195	0.011	<0.01	<0.001	0.001	<0.01	0.05
8	DW7082W2	Pollux Upper Seam	24-Oct-2019	0.02	0.011	0.072	<0.001	0.88	<0.0001	<0.001	0.004	0.009	0.98	<0.001	0.161	<0.0001	0.173	0.006	<0.01	<0.001	0.001	<0.01	0.025
8	DW7082W2	Pollux Upper Seam	21-Nov-2019	0.02	0.008	0.097	<0.001	0.85	<0.0001	<0.001	0.003	0.001	1	<0.001	0.174	<0.0001	0.12	0.007	<0.01	<0.001	<0.001	<0.01	0.043
8	DW7082W2	Pollux Upper Seam	13-Dec-2019	0.02	0.008	0.116	<0.001	0.87	<0.0001	<0.001	0.003	0.004	1.37	<0.001	0.163	<0.0001	0.096	0.006	<0.01	<0.001	<0.001	<0.01	0.036
8	DW7082W2	Pollux Upper Seam	19-Feb-2020	0.02	0.013	0.081	<0.001	0.72	<0.0001	<0.001	0.002	0.004	2.6	<0.001	0.161	<0.0001	0.068	0.009	<0.01	<0.001	0.001	<0.01	0.038
8	DW7082W2	Pollux Upper Seam	17-Mar-2020	0.02	0.012	0.086	<0.001	0.87	<0.0001	<0.001	0.002	0.052	2.93	<0.001	0.154	<0.0001	0.06	0.006	<0.01	<0.001	<0.001	<0.01	0.056
8	DW7082W2	Pollux Upper Seam	29-Apr-2020	0.06	0.009	0.112	<0.001	0.88	<0.0001	<0.001	<0.001	0.002	2.6	<0.001	0.146	<0.0001	0.037	0.007	<0.01	<0.001	<0.001	<0.01	0.052
8	DW7082W2	Pollux Upper Seam	20-May-2020	0.02	0.007	0.098	<0.001	0.82	<0.0001	<0.001	<0.001	<0.001	2.44	<0.001	0.143	<0.0001	0.036	0.008	<0.01	<0.001	<0.001	<0.01	0.04
8	DW7082W2	Pollux Upper Seam	30-Jun-2020	0.02	0.009	0.073	<0.001	0.76	<0.0001	<0.001	0.001	0.011	2.3	0.001	0.148	<0.0001	0.044	0.008	<0.01	<0.001	<0.001	<0.01	0.041
8	DW7082W2	Pollux Upper Seam	15-Jul-2020	0.02	0.006	0.111	<0.001	0.8	<0.0001	<0.001	<0.001	<0.001	2.12	<0.001	0.137	<0.0001	0.045	0.007	<0.01	<0.001	<0.001	<0.01	0.044
8	DW7082W2	Pollux Upper Seam	20-Aug-2020	0.02	0.006	0.114	<0.001	0.96	<0.0001	<0.001	<0.001	<0.001	2.83	<0.001	0.153	<0.0001	0.04	0.012	<0.01	<0.001	<0.001	<0.01	0.069
8	DW7082W2	Pollux Upper Seam	23-Sep-2020	0.05	0.005	0.102	<0.001	0.94	<0.0001	<0.001	<0.001	0.001	2.32	<0.001	0.152	<0.0001	0.028	0.006	<0.01	<0.001	<0.001	<0.01	0.045
8	DW7082W2	Pollux Upper Seam	20-Oct-2020	0.01	0.004	0.11	<0.001	0.58	<0.0001	<0.001	<0.001	0.037	1.64	<0.001	0.139	<0.0001	0.019	0.009	<0.01	<0.001	<0.001	<0.01	0.085
9	DW7093W2	Interburden	24-Sep-2019	0.23	0.015	1.3	<0.001	0.59	<0.0001	0.005	<0.001	0.002	3.87	<0.001	0.31	<0.0001	0.017	0.005	<0.01	<0.001	0.048	<0.01	0.067

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Livestock Trigger - ANZECC 2000			**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
9	DW7093W2	Interburden	24-Oct-2019	0.27	0.013	2.39	<0.001	0.53	<0.0001	0.005	<0.001	0.003	4.4	<0.001	0.276	<0.0001	0.022	0.005	<0.01	<0.001	0.033	<0.01	0.047
9	DW7093W2	Interburden	21-Nov-2019	0.09	0.009	1.46	<0.001	0.5	<0.0001	0.003	<0.001	0.002	3.94	<0.001	0.28	<0.0001	0.012	0.006	<0.01	<0.001	0.029	<0.01	0.061
9	DW7093W2	Interburden	16-Dec-2019	0.04	0.007	0.933	<0.001	0.54	<0.0001	0.002	<0.001	0.007	2.65	<0.001	0.302	<0.0001	0.005	0.006	<0.01	<0.001	0.028	<0.01	0.071
9	DW7093W2	Interburden	29-Jan-2020	0.05	0.022	1.04	<0.001	0.49	<0.0001	0.003	<0.001	0.003	1.64	<0.001	0.317	<0.0001	0.003	0.006	<0.01	<0.001	0.027	<0.01	0.037
9	DW7093W2	Interburden	19-Feb-2020	0.04	0.026	1.23	<0.001	0.41	<0.0001	0.002	<0.001	0.005	2.92	<0.001	0.284	<0.0001	0.008	0.007	<0.01	<0.001	0.022	<0.01	0.036
9	DW7093W2	Interburden	20-Mar-2020	0.13	0.009	2.11	<0.001	0.39	<0.0001	0.004	<0.001	0.004	1.8	<0.001	0.303	<0.0001	0.007	0.005	<0.01	<0.001	0.02	<0.01	0.042
9	DW7093W2	Interburden	29-Apr-2020	0.13	0.006	2.92	<0.001	0.5	<0.0001	0.004	<0.001	0.004	1.23	<0.001	0.301	<0.0001	0.008	0.009	<0.01	<0.001	0.019	<0.01	0.053
9	DW7093W2	Interburden	19-May-2020	0.08	0.012	2.69	<0.001	0.49	<0.0001	0.004	<0.001	0.005	1.35	0.001	0.286	<0.0001	0.004	0.006	<0.01	<0.001	0.015	<0.01	0.082
9	DW7093W2	Interburden	15-Jun-2020	0.09	0.012	3.74	<0.001	0.38	<0.0001	0.003	<0.001	0.004	0.67	<0.001	0.27	<0.0001	0.003	0.011	<0.01	<0.001	0.016	<0.01	0.043
9	DW7093W2	Interburden	14-Jul-2020	0.13	0.006	5.04	<0.001	0.43	<0.0001	0.003	<0.001	0.005	0.81	<0.001	0.243	<0.0001	0.007	0.005	<0.01	<0.001	0.013	<0.01	0.041
9	DW7093W2	Interburden	19-Aug-2020	0.07	0.005	4.56	<0.001	0.5	<0.0001	0.004	<0.001	0.003	0.46	<0.001	0.235	<0.0001	0.003	0.007	<0.01	<0.001	0.011	<0.01	0.034
9	DW7093W2	Interburden	22-Sep-2020	0.11	0.012	5.32	<0.001	0.46	<0.0001	0.004	<0.001	0.005	0.75	<0.001	0.231	<0.0001	0.003	0.005	<0.01	<0.001	0.009	<0.01	0.04
9	DW7093W2	Interburden	20-Oct-2020	0.11	0.004	6.98	<0.001	0.31	<0.0001	0.003	<0.001	0.008	0.6	<0.001	0.241	<0.0001	0.003	0.004	<0.01	<0.001	0.009	<0.01	0.034
9	DW7093W3	Pollux Lower Lower Seam	25-Sep-2019	0.29	0.002	0.712	<0.001	0.76	<0.0001	0.002	<0.001	0.015	2.18	0.001	0.109	<0.0001	0.009	0.011	<0.01	<0.001	0.001	<0.01	0.032
9	DW7093W3	Pollux Lower Lower Seam	28-Oct-2019	0.22	0.002	0.675	<0.001	0.8	<0.0001	0.002	<0.001	0.005	2.49	<0.001	0.106	<0.0001	0.006	0.006	<0.01	<0.001	0.001	<0.01	0.034
9	DW7093W3	Pollux Lower Lower Seam	21-Nov-2019	0.37	0.002	0.694	<0.001	0.9	<0.0001	0.004	<0.001	0.005	3.5	<0.001	0.143	<0.0001	0.009	0.007	<0.01	<0.001	0.002	<0.01	0.036
9	DW7093W3	Pollux Lower Lower Seam	16-Dec-2019	0.04	0.002	0.754	<0.001	0.78	<0.0001	<0.001	<0.001	0.002	2.6	<0.001	0.211	<0.0001	0.004	0.005	<0.01	<0.001	0.005	<0.01	0.016
9	DW7093W3	Pollux Lower Lower Seam	29-Jan-2020	0.05	0.003	0.605	<0.001	0.65	<0.0001	<0.001	<0.001	0.002	1.95	<0.001	0.128	<0.0001	0.003	0.007	<0.01	<0.001	0.003	<0.01	0.013
9	DW7093W3	Pollux Lower Lower Seam	19-Feb-2020	0.04	0.003	0.525	<0.001	0.62	<0.0001	<0.001	<0.001	0.002	1.59	<0.001	0.105	<0.0001	0.005	0.006	<0.01	<0.001	0.001	<0.01	0.014
9	DW7093W3	Pollux Lower Lower Seam	31-Mar-2020	0.08	<0.001	0.615	<0.001	0.62	<0.0001	0.002	<0.001	0.01	1.2	0.001	0.098	<0.0001	0.003	0.015	<0.01	<0.001	<0.001	<0.01	0.056
9	DW7093W3	Pollux Lower Lower Seam	29-Apr-2020	0.2	0.001	0.872	<0.001	0.73	<0.0001	0.002	<0.001	0.002	1.76	<0.001	0.134	<0.0001	0.005	0.008	<0.01	<0.001	0.002	<0.01	0.016
9	DW7093W3	Pollux Lower Lower Seam	19-May-2020	0.09	<0.001	0.52	<0.001	0.74	<0.0001	<0.001	<0.001	0.002	0.81	<0.001	0.101	<0.0001	0.004	0.003	<0.01	<0.001	<0.001	<0.01	0.022
9	DW7093W3	Pollux Lower Lower Seam	15-Jun-2020	0.07	0.001	0.503	<0.001	0.81	<0.0001	0.001	<0.001	0.019	3.19	<0.001	0.092	<0.0001	0.005	0.013	<0.01	<0.001	<0.001	<0.01	0.052
9	DW7093W3	Pollux Lower Lower Seam	14-Jul-2020	0.08	<0.001	0.696	<0.001	0.88	<0.0001	<0.001	<0.001	0.009	4.74	<0.001	0.09	<0.0001	0.005	0.013	<0.01	<0.001	<0.001	<0.01	0.03
9	DW7093W3	Pollux Lower Lower Seam	19-Aug-2020	0.03	0.001	0.596	<0.001	1.04	<0.0001	0.002	<0.001	0.012	3.16	<0.001	0.09	<0.0001	0.004	0.003	<0.01	<0.001	<0.001	<0.01	0.048
9	DW7093W3	Pollux Lower Lower Seam	22-Sep-2020	0.05	0.002	1.13	<0.001	1.05	<0.0001	0.002	<0.001	0.002	2.15	0.001	0.113	<0.0001	0.004	0.008	<0.01	<0.001	0.001	<0.01	0.017
9	DW7093W3	Pollux Lower Lower Seam	20-Oct-2020	0.03	<0.001	0.354	<0.001	0.72	<0.0001	<0.001	<0.001	0.058	1.23	0.001	0.082	<0.0001	0.003	0.007	<0.01	<0.001	<0.001	<0.01	0.082
9	DW7093W1	Pollux Lower Upper Seam	24-Sep-2019	0.46	0.006	2.92	<0.001	0.48	<0.0001	<0.001	<0.001	0.002	1.54	<0.001	0.078	<0.0001	0.005	0.004	<0.01	<0.001	0.012	<0.01	0.026
9	DW7093W1	Pollux Lower Upper Seam	24-Oct-2019	0.32	0.017	1.48	<0.001	0.54	<0.0001	<0.001	<0.001	0.003	2.5	<0.001	0.184	<0.0001	0.003	0.003	<0.01	<0.001	0.008	<0.01	0.017
9	DW7093W1	Pollux Lower Upper Seam	21-Nov-2019	0.07	0.019	1.22	<0.001	0.54	<0.0001	<0.001	<0.001	0.002	4.38	<0.001	0.228	<0.0001	0.004	0.008	<0.01	<0.001	0.005	<0.01	0.064
9	DW7093W1	Pollux Lower Upper Seam	16-Dec-2019	0.09	0.018	0.983	<0.001	0.6	<0.0001	0.002	0.001	0.002	2.72	<0.001	0.425	0.0001	0.002	0.011	<0.01	<0.001	0.005	<0.01	0.095
9	DW7093W1	Pollux Lower Upper Seam	29-Jan-2020	0.11	0.039	1.14	<0.001	0.59	<0.0001	0.004	0.001	0.012	3.67	<0.001	0.264	<0.0001	0.003	0.013	<0.01	<0.001	0.004	<0.01	0.072
9	DW7093W1	Pollux Lower Upper Seam	19-Feb-2020	0.33	0.01	2.56	<0.001	0.28	<0.0001	0.005	<0.001	0.013	1.84	<0.001	0.111	<0.0001	0.005	0.007	<0.01	<0.001	0.007	<0.01	0.044
9	DW7093W1	Pollux Lower Upper Seam	18-Mar-2020	0.15	0.028	1.66	<0.001	0.5	<0.0001	0.002	<0.001	0.003	2.51	<0.001	0.194	<0.0001	0.005	0.01	<0.01	<0.001	0.004	<0.01	0.073
9	DW7093W1	Pollux Lower Upper Seam	29-Apr-2020	0.15	0.017	1.76	<0.001	0.57	<0.0001	0.003	<0.001	0.005	1.45	<0.001	0.138	<0.0001	0.006	0.014	<0.01	<0.001	0.003	<0.01	0.091
9	DW7093W1	Pollux Lower Upper Seam	19-May-2020	0.11	0.015	1.73	<0.001	0.52	<0.0001	0.003	<0.001	0.003	0.68	0.001	0.152	<0.0001	0.006	0.011	<0.01	<0.001	0.004	<0.01	0.054
9	DW7093W1	Pollux Lower Upper Seam	15-Jun-2020	0.11	0.018	1.23	<0.001	0.43	<0.0001	0.004	0.001	0.004	1.44	<0.001	0.092	<0.0001	0.007	0.024	<0.01	<0.001	0.005	<0.01	0.082
9	DW7093W1	Pollux Lower Upper Seam	14-Jul-2020	0.17	0.012	1.91	<0.001	0.46	<0.0001	0.003	<0.001	0.005	1.31	<0.001	0.114	<0.0001	0.006	0.01	<0.01	<0.001	0.002	<0.01	0.052
9	DW7093W1	Pollux Lower Upper Seam	19-Aug-2020	0.13	0.025	1.99	<0.001	0.53	<0.0001	0.007	<0.001	0.005	1.43	<0.001	0.07	0.0002	0.006	0.01	<0.01	<0.001	0.001	<0.01	0.063
9	DW7093W1	Pollux Lower Upper Seam	22-Sep-2020	0.11	0.038	2.31	<0.001	0.53	<0.0001	0.004	<0.001	0.006	1.92	<0.001	0.067	<0.0001	0.005	0.009	<0.01	<0.001	0.002	<0.01	0.043
9	DW7093W1	Pollux Lower Upper Seam	20-Oct-2020	0.12	0.005	3.1	<0.001	0.31	<0.0001	0.005	<0.001	0.008	0.78	<0.001	0.051	<0.0001	0.005	0.006	<0.01	<0.001	0.001	<0.01	0.041
10	DW7105W2	Pollux Lower Upper Seam	26-Sep-2019	0.8	0.005	0.034	<0.001	0.33	<0.0001	<0.001	<0.001	0.004	0.6	0.002	0.008	<0.0001	0.003	0.002	<0.01	<0.001	<0.001	<0.01	0.026
10	DW7105W2	Pollux Lower Upper Seam	24-Oct-2019	0.38	0.004	0.06	<0.001	0.33	<0.0001	<0.001	<0.001	0.007	0.25	<0.001	0.008	<0.0001	0.024	0.002	<0.01	<0.001	0.002	<0.01	0.007
10	DW7105W2	Pollux Lower Upper Seam	25-Nov-2019	0.27	0.004	0.03	<0.001	0.31	<0.0001	<0.001	<0.001	0.002	0.19	<0.001	0.006	<0.0001	0.025	0.003	<0.01	<0.001	<0.001	<0.01	0.009
10	DW7105W2	Pollux Lower Upper Seam	13-Dec-2019	0.24	0.003	0.034	<0.001	0.31	<0.0001	<0.001	<0.001	0.006	0.2	<0.001	0.005	<0.0001	0.023	0.001	<0.01	<0.001	<0.001	<0.01	0.014
10	DW7105W2	Pollux Lower Upper Seam	31-Jan-2020	0.36	0.002	0.079	<0.001	0.22	<0.0001	<0.001	<0.001	0.007	0.34	<0.001	0.008	<0.0001	0.016	0.004	<0.01	<0.001	<0.001	<0.01	0.018
10	DW7105W2	Pollux Lower Upper Seam	19-Feb-2020	0.3	0.002	0.096	<0.001	0.23	<0.0001	<0.001	<0.001	0.003	0.24	<0.001	0.008	<0.0001	0.016	0.002	<0.01	<0.001	<0.001	<0.01	0.009
10	DW7105W2	Pollux Lower Upper Seam	18-Mar-2020	0.18	0.002	0.056	<0.001	0.26	<0.0001	<0.001	<0.001	0.003	0.29	<0.001	0.017	<0.0001	0.013	0.002	<0.01	<0.001	<0.001	<0.01	0.016
10	DW7105W2	Pollux Lower Upper Seam	28-Apr-2020	0.6	0.002	0.146	<0.001	0.28	0.0002	0.002	<0.001	0.004	0.33	<0.001	0.015	<0.0001	0.012	0.003	<0.01	<0.001	<0.001	<0.01	0.028
10	DW7105W2	Pollux Lower Upper Seam	20-May-2020	0.42	0.002	0.089	<0.001	0.37	<0.0001	<0.001	<0.001	0.004	0.36	0.002	0.007	<0.0001	0.011	0.002	<0.01	<0.001	<0.001	<0.01	0.014
10	DW7105W2	Pollux Lower Upper Seam	16-Jun-2020	0.22	0.002	0.115	<0.001	0.29	<0.0001	<0.001	<0.001	0.004	0.2	<0.001	0.006	<0.0001	0.01	0.003	<0.01	<0.001	<0.001	<0.01	0.015
10	DW7105W2	Pollux Lower Upper Seam	14-Jul-2020	0.24	0.002	0.075	<0.001	0.34	<0.0001	<0.001	<0.001	0.005	0.17	<0.001	0.005	<0.0001	0.009	0.002	<0.01	<0.001	<0.001	<0.01	0.014
10	DW7105W2	Pollux Lower Upper Seam	18-Aug-2020	0.17	0.002	0.074	<0.001	0.35	<0.0001	<0.001	<0.001	0.005	0.14	<0.001	0.004	<0.0001	0.008	0.002	<0.01	<0.001	<0.001	<0.01	0.013

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Livestock Trigger - ANZECC 2000			**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
10	DW7105W2	Pollux Lower Upper Seam	22-Sep-2020	0.15	0.002	0.085	<0.001	0.29	<0.0001	0.001	<0.001	0.005	0.14	<0.001	0.006	<0.0001	0.007	0.002	<0.01	<0.001	<0.001	<0.01	0.012
10	DW7105W2	Pollux Lower Upper Seam	20-Oct-2020	0.24	0.001	0.157	<0.001	0.25	<0.0001	<0.001	<0.001	0.004	0.29	<0.001	0.009	<0.0001	0.007	0.003	<0.01	<0.001	<0.001	<0.01	0.015
11	DW7178W2	Pollux Lower Upper Seam	27-Sep-2019	2.41	0.004	0.18	<0.001	1.74	<0.0001	0.005	0.009	0.012	5.2	0.002	0.226	<0.0001	<0.001	0.019	<0.01	<0.001	0.002	<0.01	0.051
11	DW7178W2	Pollux Lower Upper Seam	25-Oct-2019	0.69	0.003	0.177	<0.001	1.58	<0.0001	0.001	0.01	0.007	2.2	0.001	0.25	<0.0001	0.002	0.011	<0.01	<0.001	0.002	<0.01	0.041
11	DW7178W2	Pollux Lower Upper Seam	25-Nov-2019	3.01	0.006	0.149	<0.001	1.37	<0.0001	0.006	0.029	0.015	5.8	0.003	0.347	0.0002	<0.001	0.03	<0.01	<0.001	0.002	0.01	0.08
11	DW7178W2	Pollux Lower Upper Seam	17-Dec-2019	2.22	0.004	0.314	<0.001	1.5	<0.0001	0.004	0.019	0.011	5.47	0.002	0.329	<0.0001	<0.001	0.018	<0.01	<0.001	0.002	<0.01	0.046
11	DW7178W2	Pollux Lower Upper Seam	29-Jan-2020	1.37	0.004	0.198	<0.001	1.51	<0.0001	0.003	0.016	0.011	7.02	0.002	0.291	<0.0001	<0.001	0.022	<0.01	<0.001	0.002	<0.01	0.132
11	DW7178W2	Pollux Lower Upper Seam	18-Feb-2020	0.6	0.003	0.19	<0.001	1.35	<0.0001	0.001	0.017	0.013	2.23	<0.001	0.323	<0.0001	<0.001	0.019	<0.01	<0.001	0.002	<0.01	0.06
11	DW7178W2	Pollux Lower Upper Seam	20-Mar-2020	1.57	0.006	0.173	<0.005	1.53	<0.0005	<0.005	0.016	0.012	7.53	<0.005	0.342	<0.0001	<0.005	0.02	<0.05	<0.005	<0.005	<0.05	0.036
11	DW7178W2	Pollux Lower Upper Seam	27-Apr-2020	5.88	0.008	0.2	<0.005	2.1	<0.0005	0.013	0.032	0.043	14.1	0.006	0.388	0.0003	<0.005	0.055	<0.05	<0.005	<0.005	<0.05	0.206
11	DW7178W2	Pollux Lower Upper Seam	18-May-2020	3.48	0.005	0.218	<0.001	1.51	<0.0001	0.012	0.028	0.023	7.52	0.003	0.37	<0.0001	<0.001	0.031	<0.01	<0.001	0.002	0.02	0.138
11	DW7178W2	Pollux Lower Upper Seam	17-Jun-2020	2.5	0.004	0.207	<0.001	1.32	<0.0001	0.006	0.018	0.029	7.11	0.007	0.271	<0.0001	0.001	0.029	<0.01	<0.001	0.002	0.01	0.154
11	DW7178W2	Pollux Lower Upper Seam	13-Jul-2020	4.02	0.006	0.278	<0.001	1.36	<0.0001	0.008	0.024	0.021	8.31	0.004	0.333	<0.0001	0.001	0.033	<0.01	<0.001	0.003	0.02	0.119
11	DW7178W2	Pollux Lower Upper Seam	18-Aug-2020	2.04	0.005	0.224	<0.001	1.67	<0.0001	0.008	0.021	0.014	5.5	0.002	0.319	<0.0001	0.001	0.025	<0.01	<0.001	0.002	<0.01	0.143
11	DW7178W2	Pollux Lower Upper Seam	21-Sep-2020	5.54	0.006	0.165	0.001	1.67	<0.0001	0.016	0.023	0.04	17	0.005	0.316	0.0002	0.001	0.038	<0.01	<0.001	0.003	0.03	0.091
11	DW7178W2	Pollux Lower Upper Seam	19-Oct-2020	6.15	0.008	0.196	<0.001	1.07	<0.0001	0.014	0.024	0.034	16.4	0.006	0.326	0.0003	<0.001	0.04	<0.01	<0.001	0.002	0.03	0.084
11	DW7178W1	Tertiary	27-Sep-2019	4.8	0.002	0.331	<0.001	1.6	<0.0001	0.014	0.003	0.007	3.21	0.002	0.011	<0.0001	0.002	0.014	<0.01	<0.001	0.009	0.01	0.024
11	DW7178W1	Tertiary	25-Oct-2019	2.02	0.002	0.237	<0.001	1.47	<0.0001	0.005	0.002	0.002	1.18	<0.001	0.022	<0.0001	0.004	0.01	<0.01	<0.001	0.008	<0.01	0.014
11	DW7178W1	Tertiary	26-Nov-2019	3.16	0.001	0.267	<0.001	1.33	<0.0001	0.008	0.002	0.003	1.7	<0.001	0.008	<0.0001	0.002	0.016	<0.01	<0.001	0.009	<0.01	0.039
11	DW7178W1	Tertiary	18-Dec-2019	3.52	0.002	0.278	<0.001	1.38	<0.0001	0.009	0.002	0.004	2.47	<0.001	0.019	<0.0001	0.003	0.01	<0.01	<0.001	0.009	<0.01	0.014
11	DW7178W1	Tertiary	29-Jan-2020	4.16	0.002	0.193	<0.001	1.39	<0.0001	0.013	0.005	0.006	6.14	0.001	0.014	<0.0001	0.002	0.018	<0.01	<0.001	0.007	0.01	0.081
11	DW7178W1	Tertiary	19-Feb-2020	4.94	0.002	0.274	<0.001	1.33	<0.0001	0.017	0.002	0.006	8.86	0.001	0.021	<0.0001	0.002	0.023	<0.01	<0.001	0.007	0.02	0.038
11	DW7178W1	Tertiary	20-Mar-2020	2.19	0.001	0.24	<0.001	1.33	<0.0001	0.007	0.001	0.071	1.56	<0.001	0.017	<0.0001	0.003	0.015	<0.01	<0.001	0.007	<0.01	0.088
11	DW7178W1	Tertiary	27-Apr-2020	3.58	0.001	0.229	<0.001	1.52	<0.0001	0.011	0.002	0.017	3.02	0.001	0.018	<0.0001	0.004	0.02	<0.01	<0.001	0.008	0.01	0.04
11	DW7178W1	Tertiary	18-May-2020	1.66	<0.001	0.229	<0.001	1.52	<0.0001	0.006	0.002	0.004	1.11	<0.001	0.022	<0.0001	0.002	0.013	<0.01	<0.001	0.007	<0.01	0.078
11	DW7178W1	Tertiary	17-Jun-2020	2.28	0.001	0.161	<0.001	1.22	<0.0001	0.008	0.002	0.013	1.85	0.004	0.008	<0.0001	0.003	0.015	<0.01	<0.001	0.007	<0.01	0.09
11	DW7178W1	Tertiary	13-Jul-2020	4.39	0.002	0.183	<0.001	1.3	<0.0001	0.012	0.002	0.008	2.6	0.001	0.014	<0.0001	0.003	0.017	<0.01	<0.001	0.008	0.01	0.068
11	DW7178W1	Tertiary	18-Aug-2020	1.78	0.001	0.189	<0.001	1.53	<0.0001	0.008	0.002	0.008	1.23	<0.001	0.013	0.0001	0.003	0.016	<0.01	<0.001	0.007	<0.01	0.089
11	DW7178W1	Tertiary	21-Sep-2020	5	0.002	0.281	<0.001	1.47	<0.0001	0.028	0.002	0.012	4.98	0.001	0.018	0.0001	0.004	0.023	<0.01	<0.001	0.008	0.02	0.045
11	DW7178W1	Tertiary	19-Oct-2020	3.58	0.002	0.25	<0.001	1.02	<0.0001	0.015	0.001	0.01	3.26	<0.001	0.014	<0.0001	0.002	0.024	<0.01	<0.001	0.007	0.01	0.045
12	DW7220W2	Castor Seam	25-Sep-2019	3.82	0.005	0.15	<0.001	0.17	<0.0001	0.002	0.006	0.019	2.46	0.005	0.214	<0.0001	<0.001	0.015	<0.01	<0.001	<0.001	<0.01	0.081
12	DW7220W2	Castor Seam	25-Oct-2019	1.75	0.005	0.076	<0.001	0.18	<0.0001	0.001	0.005	0.008	1.84	0.002	0.228	<0.0001	<0.001	0.015	<0.01	<0.001	<0.001	<0.01	0.059
12	DW7220W2	Castor Seam	22-Nov-2019	3.38	0.004	0.122	<0.001	0.16	<0.0001	0.002	0.005	0.017	2.92	0.005	0.215	<0.0001	<0.001	0.015	<0.01	<0.001	<0.001	<0.01	0.085
12	DW7220W2	Castor Seam	17-Dec-2019	1.78	0.006	0.078	<0.001	0.17	<0.0001	0.001	0.005	0.009	1.78	0.001	0.23	<0.0001	<0.001	0.013	<0.01	<0.001	<0.001	<0.01	0.103
12	DW7220W2	Castor Seam	30-Jan-2020	5.31	0.008	0.173	<0.001	0.14	<0.0001	0.004	0.008	0.027	3.64	0.007	0.257	0.0002	<0.001	0.028	<0.01	<0.001	0.001	<0.01	0.222
12	DW7220W2	Castor Seam	21-Feb-2020	3.04	0.007	0.126	<0.001	0.1	<0.0001	0.002	0.006	0.016	2.64	0.006	0.236	<0.0001	<0.001	0.018	<0.01	<0.001	<0.001	<0.01	0.246
12	DW7220W2	Castor Seam	18-Mar-2020	1.97	0.008	0.089	<0.001	0.13	<0.0001	<0.001	0.006	0.01	2.44	0.002	0.26	<0.0001	<0.001	0.023	<0.01	<0.001	<0.001	<0.01	0.12
12	DW7220W2	Castor Seam	30-Apr-2020	9.98	0.009	0.318	0.002	0.12	<0.0001	0.007	0.009	0.045	6.38	0.014	0.29	0.0002	<0.001	0.032	<0.01	<0.001	0.002	0.02	0.196
12	DW7220W2	Castor Seam	21-May-2020	2.04	0.006	0.088	<0.001	0.16	<0.0001	0.001	0.005	0.011	2.48	0.003	0.196	<0.0001	<0.001	0.013	<0.01	<0.001	<0.001	<0.01	0.141
12	DW7220W2	Castor Seam	16-Jun-2020	1.03	0.008	0.098	<0.001	0.16	<0.0001	0.002	0.005	0.005	4.28	0.001	0.213	<0.0001	<0.001	0.025	<0.01	<0.001	<0.001	<0.01	0.214
12	DW7220W2	Castor Seam	16-Jul-2020	3.98	0.008	0.16	<0.001	0.17	<0.0001	0.003	0.007	0.022	2.83	0.005	0.214	<0.0001	<0.001	0.018	<0.01	<0.001	<0.001	<0.01	0.114
12	DW7220W2	Castor Seam	21-Aug-2020	2.01	0.009	0.092	<0.001	0.19	<0.0001	0.002	0.006	0.01	2.63	0.002	0.22	0.0003	<0.001	0.02	<0.01	<0.001	<0.001	<0.01	0.177
12	DW7220W2	Castor Seam	23-Sep-2020	2.88	0.008	0.125	<0.001	0.2	<0.0001	0.006	0.006	0.016	2.8	0.003	0.205	0.0001	<0.001	0.019	<0.01	<0.001	<0.001	<0.01	0.095
12	DW7220W2	Castor Seam	19-Oct-2020	1.72	0.01	0.134	<0.001	0.15	<0.0001	0.001	0.006	0.072	2.83	0.004	0.213	<0.0001	<0.001	0.019	<0.01	<0.001	<0.001	<0.01	0.394
12	DW7220W3	Pollux Lower Upper Seam	25-Sep-2019	0.32	0.001	0.263	<0.001	1.1	<0.0001	<0.001	<0.001	0.003	2.14	<0.001	0.066	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.028
12	DW7220W3	Pollux Lower Upper Seam	25-Oct-2019	0.16	0.002	0.114	<0.001	1.05	<0.0001	<0.001	<0.001	0.002	1.92	<0.001	0.13	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.016
12	DW7220W3	Pollux Lower Upper Seam	22-Nov-2019	0.11	0.002	0.135	<0.001	0.92	<0.0001	<0.001	<0.001	<0.001	1.64	<0.001	0.083	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.023
12	DW7220W3	Pollux Lower Upper Seam	17-Dec-2019	0.1	<0.001	0.161	<0.001	0.92	<0.0001	0.001	<0.001	0.006	1.09	<0.001	0.132	<0.0001	0.002	0.009	<0.01	<0.001	<0.001	<0.01	0.05
12	DW7220W3	Pollux Lower Upper Seam	30-Jan-2020	0.09	<0.001	0.077	<0.001	0.9	<0.0001	<0.001	<0.001	0.002	1.68	<0.001	0.056	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.038
12	DW7220W3	Pollux Lower Upper Seam	21-Feb-2020	0.1	<0.001	0.083	<0.001	0.98	<0.0001	0.002	<0.001	0.084	1.48	0.002	0.048	<0.0001	0.003	0.015	<0.01	<0.001	<0.001	<0.01	0.076
12	DW7220W3	Pollux Lower Upper Seam	18-Mar-2020	0.08	<0.001	0.084	<0.001	0.94	<0.0001	<0.001	<0.001	0.001	1.73	<0.001	0.059	<0.0001	<0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.028
12	DW7220W3	Pollux Lower Upper Seam	30-Apr-2020	0.31	<0.001	0.104	<0.001	1.05	<0.0001	<0.001	<0.001	0.003	1.76	<0.001	0.057	<0.0001	0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.055
12	DW7220W3	Pollux Lower Upper Seam	21-May-2020	0.07	<0.001	0.079	<0.001	0.97	<0.0001	<0.001	<0.001	<0.001	1.55	<0.001	0.058	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.041

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Livestock Trigger - ANZECC 2000				**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
12	DW7220W3	Pollux Lower Upper Seam	16-Jun-2020	0.04	<0.001	0.137	<0.001	0.89	<0.0001	<0.001	<0.001	<0.001	2.31	<0.001	0.043	<0.0001	<0.001	0.014	<0.01	<0.001	<0.001	<0.01	0.07
12	DW7220W3	Pollux Lower Upper Seam	16-Jul-2020	0.1	0.001	0.098	<0.001	0.92	<0.0001	<0.001	<0.001	0.001	1.29	<0.001	0.048	<0.0001	0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.04
12	DW7220W3	Pollux Lower Upper Seam	20-Aug-2020	0.03	<0.001	0.084	<0.001	1.1	<0.0001	<0.001	<0.001	<0.001	1.64	<0.001	0.06	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.039
12	DW7220W3	Pollux Lower Upper Seam	23-Sep-2020	0.07	0.001	0.101	<0.001	1.05	<0.0001	<0.001	<0.001	0.002	1.57	<0.001	0.056	<0.0001	0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.038
12	DW7220W3	Pollux Lower Upper Seam	19-Oct-2020	0.03	<0.001	0.1	<0.001	0.72	<0.0001	<0.001	<0.001	0.048	1.4	0.001	0.046	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.111
12	DW7220W1	Tertiary	25-Sep-2019	0.32	0.002	0.103	<0.001	0.15	<0.0001	0.004	0.002	0.005	0.19	<0.001	0.148	<0.0001	0.031	0.007	<0.01	<0.001	<0.001	<0.01	0.028
12	DW7220W1	Tertiary	25-Oct-2019	0.28	0.003	0.102	<0.001	0.18	<0.0001	0.007	0.003	0.005	0.27	<0.001	0.15	<0.0001	0.028	0.01	<0.01	<0.001	<0.001	<0.01	0.032
12	DW7220W1	Tertiary	22-Nov-2019	1.94	0.003	0.136	<0.001	0.19	0.0002	0.012	0.004	0.018	1.34	0.002	0.175	<0.0001	0.019	0.013	<0.01	<0.001	0.001	<0.01	0.054
12	DW7220W1	Tertiary	17-Dec-2019	0.41	0.003	0.11	<0.001	0.19	<0.0001	0.003	0.003	0.005	0.52	<0.001	0.181	<0.0001	0.016	0.01	<0.01	<0.001	0.001	<0.01	0.052
12	DW7220W1	Tertiary	31-Jan-2020	0.12	0.002	0.115	<0.001	0.15	<0.0001	0.005	0.005	0.013	0.54	<0.001	0.195	<0.0001	0.011	0.041	<0.01	<0.001	0.001	<0.01	0.242
12	DW7220W1	Tertiary	21-Feb-2020	0.29	0.003	0.138	<0.001	0.12	<0.0001	0.002	0.004	0.008	0.45	0.004	0.215	<0.0001	0.01	0.015	<0.01	<0.001	0.001	<0.01	0.129
12	DW7220W1	Tertiary	18-Mar-2020	0.97	0.003	0.133	<0.001	0.16	0.0001	0.006	0.005	0.025	1.06	0.002	0.232	<0.0001	0.01	0.018	<0.01	<0.001	0.001	<0.01	0.086
12	DW7220W1	Tertiary	30-Apr-2020	0.59	0.003	0.183	<0.001	0.18	<0.0001	0.003	0.005	0.007	0.74	<0.001	0.243	<0.0001	0.01	0.017	<0.01	<0.001	0.001	<0.01	0.117
12	DW7220W1	Tertiary	21-May-2020	0.7	0.002	0.135	<0.001	0.19	<0.0001	0.003	0.005	0.011	0.79	0.001	0.21	<0.0001	0.007	0.014	<0.01	<0.001	<0.001	<0.01	0.16
12	DW7220W1	Tertiary	16-Jun-2020	0.25	0.002	0.153	<0.001	0.23	<0.0001	0.002	0.004	0.003	1.9	<0.001	0.182	<0.0001	0.006	0.021	<0.01	<0.001	<0.001	<0.01	0.162
12	DW7220W1	Tertiary	16-Jul-2020	0.37	0.002	0.162	<0.001	0.18	<0.0001	0.002	0.004	0.004	0.5	<0.001	0.18	<0.0001	0.005	0.012	<0.01	<0.001	<0.001	<0.01	0.089
12	DW7220W1	Tertiary	21-Aug-2020	0.14	0.002	0.146	<0.001	0.22	<0.0001	0.002	0.004	0.002	0.44	<0.001	0.182	0.0001	0.004	0.016	<0.01	<0.001	<0.001	<0.01	0.129
12	DW7220W1	Tertiary	23-Sep-2020	0.09	0.002	0.139	<0.001	0.22	<0.0001	0.004	0.004	0.002	0.54	<0.001	0.175	<0.0001	0.004	0.016	<0.01	<0.001	<0.001	<0.01	0.095
12	DW7220W1	Tertiary	19-Oct-2020	1	0.002	0.248	<0.001	0.2	0.0001	0.004	0.005	0.081	0.79	0.003	0.19	<0.0001	0.003	0.021	<0.01	<0.001	<0.001	<0.01	0.426
13	DW7221W1	Aries 3 Seam	25-Sep-2019	0.06	0.007	0.204	<0.001	0.22	<0.0001	<0.001	0.002	0.001	7.81	<0.001	1.79	<0.0001	0.001	0.006	<0.01	<0.001	0.009	<0.01	0.029
13	DW7221W1	Aries 3 Seam	25-Oct-2019	0.25	0.004	0.197	<0.001	0.23	<0.0001	<0.001	0.001	0.006	7.23	<0.001	1.71	<0.0001	0.001	0.009	<0.01	<0.001	0.004	<0.01	0.04
13	DW7221W1	Aries 3 Seam	22-Nov-2019	0.67	0.003	0.315	<0.001	0.21	<0.0001	<0.001	0.001	0.003	8.89	0.002	1.8	<0.0001	0.002	0.009	<0.01	<0.001	0.003	<0.01	0.065
13	DW7221W1	Aries 3 Seam	16-Dec-2019	0.08	0.002	0.356	<0.001	0.19	<0.0001	<0.001	<0.001	0.002	18.2	<0.001	1.84	<0.0001	0.001	0.006	<0.01	<0.001	0.002	<0.01	0.062
13	DW7221W1	Aries 3 Seam	30-Jan-2020	0.04	0.001	0.194	<0.001	0.16	<0.0001	<0.001	<0.001	0.004	7.76	<0.001	1.64	<0.0001	<0.001	0.015	<0.01	<0.001	0.001	<0.01	0.094
13	DW7221W1	Aries 3 Seam	21-Feb-2020	0.21	0.001	0.177	<0.001	0.16	<0.0001	0.001	<0.001	0.002	6.83	<0.001	1.5	<0.0001	0.002	0.013	<0.01	<0.001	0.001	<0.01	0.049
13	DW7221W1	Aries 3 Seam	18-Mar-2020	0.04	0.002	0.187	<0.001	0.18	<0.0001	<0.001	<0.001	0.002	9.23	<0.001	1.75	<0.0001	<0.001	0.012	<0.01	<0.001	<0.001	<0.01	0.04
13	DW7221W1	Aries 3 Seam	30-Apr-2020	0.1	<0.001	0.254	<0.001	0.14	<0.0001	<0.001	<0.001	<0.001	7.69	<0.001	1.9	<0.0001	<0.001	0.013	<0.01	<0.001	<0.001	<0.01	0.035
13	DW7221W1	Aries 3 Seam	21-May-2020	0.3	<0.001	0.162	<0.001	0.16	<0.0001	<0.001	<0.001	0.001	6.59	<0.001	1.58	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.05
13	DW7221W1	Aries 3 Seam	17-Jun-2020	0.02	<0.001	0.186	<0.001	0.15	<0.0001	<0.001	<0.001	0.002	6.1	<0.001	1.53	<0.0001	<0.001	0.011	<0.01	<0.001	<0.001	<0.01	0.12
13	DW7221W1	Aries 3 Seam	16-Jul-2020	0.35	<0.001	0.176	<0.001	0.2	<0.0001	<0.001	<0.001	0.001	5.44	<0.001	1.46	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.07
13	DW7221W1	Aries 3 Seam	20-Aug-2020	0.03	<0.001	0.174	<0.001	0.23	<0.0001	<0.001	<0.001	<0.001	5.87	<0.001	1.44	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.071
13	DW7221W1	Aries 3 Seam	23-Sep-2020	0.02	<0.001	0.157	<0.001	0.18	<0.0001	<0.001	<0.001	<0.001	5.7	<0.001	1.46	<0.0001	<0.001	0.006	<0.01	<0.001	<0.001	<0.01	0.03
13	DW7221W1	Aries 3 Seam	19-Oct-2020	0.05	<0.001	0.264	<0.001	0.2	<0.0001	<0.001	0.001	0.08	5.79	0.001	1.38	<0.0001	<0.001	0.018	<0.01	<0.001	<0.001	<0.01	0.325
13	DW7221W2	Castor Seam	26-Sep-2019	0.47	0.006	0.189	<0.001	0.49	<0.0001	<0.001	0.004	0.003	4.24	<0.001	0.207	<0.0001	<0.001	0.007	<0.01	<0.001	0.001	<0.01	0.079
13	DW7221W2	Castor Seam	24-Oct-2019	0.17	0.008	0.293	<0.001	0.46	<0.0001	<0.001	0.002	0.001	4.71	<0.001	0.201	<0.0001	0.002	0.007	<0.01	<0.001	<0.001	<0.01	0.025
13	DW7221W2	Castor Seam	22-Nov-2019	0.09	0.005	0.215	<0.001	0.38	<0.0001	<0.001	0.002	0.001	5.37	<0.001	0.384	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.034
13	DW7221W2	Castor Seam	16-Dec-2019	0.09	0.004	0.249	<0.001	0.42	<0.0001	<0.001	0.002	0.001	10.6	<0.001	0.403	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.044
13	DW7221W2	Castor Seam	30-Jan-2020	0.07	0.008	0.138	<0.001	0.38	<0.0001	<0.001	0.002	<0.001	5.37	<0.001	0.247	<0.0001	<0.001	0.012	<0.01	<0.001	<0.001	<0.01	0.048
13	DW7221W2	Castor Seam	21-Feb-2020	0.09	0.004	0.188	<0.001	0.42	<0.0001	<0.001	0.001	0.047	4.76	0.001	0.198	<0.0001	<0.001	0.014	<0.01	<0.001	<0.001	<0.01	0.157
13	DW7221W2	Castor Seam	18-Mar-2020	0.02	0.003	0.226	<0.001	0.59	<0.0001	<0.001	<0.001	<0.001	3.96	<0.001	0.186	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.03
13	DW7221W2	Castor Seam	30-Apr-2020	0.06	0.002	0.235	<0.001	0.69	<0.0001	<0.001	<0.001	0.001	3.32	<0.001	0.177	<0.0001	<0.001	0.014	<0.01	<0.001	<0.001	<0.01	0.051
13	DW7221W2	Castor Seam	21-May-2020	0.06	0.001	0.185	<0.001	0.64	<0.0001	<0.001	<0.001	<0.001	2.47	<0.001	0.128	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.039
13	DW7221W2	Castor Seam	17-Jun-2020	0.18	0.003	0.191	<0.001	0.6	<0.0001	<0.001	<0.001	0.003	3.17	0.001	0.104	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.058
13	DW7221W2	Castor Seam	16-Jul-2020	0.06	0.002	0.195	<0.001	0.68	<0.0001	<0.001	<0.001	<0.001	2.46	<0.001	0.123	<0.0001	<0.001	0.004	<0.01	<0.001	<0.001	<0.01	0.037
13	DW7221W2	Castor Seam	20-Aug-2020	<0.01	0.002	0.181	<0.001	0.75	<0.0001	<0.001	<0.001	<0.001	2.62	<0.001	0.131	<0.0001	<0.001	0.005	<0.01	<0.001	<0.001	<0.01	0.046
13	DW7221W2	Castor Seam	24-Sep-2020	0.02	0.001	0.162	<0.001	0.68	<0.0001	<0.001	<0.001	0.002	2.18	<0.001	0.119	<0.0001	<0.001	0.008	<0.01	<0.001	<0.001	<0.01	0.054
13	DW7221W2	Castor Seam	19-Oct-2020	0.02	0.001	0.192	<0.001	0.59	<0.0001	<0.001	<0.001	0.043	2.23	0.001	0.094	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.131
14	DW7225W2	Aries 3 Seam	24-Sep-2019	0.61	0.007	0.145	<0.001	0.68	0.0001	<0.001	0.003	0.008	0.34	<0.001	0.123	<0.0001	0.007	0.009	<0.01	<0.001	0.009	<0.01	0.041
14	DW7225W2	Aries 3 Seam	24-Oct-2019	0.91	0.013	0.133	<0.001	0.63	<0.0001	0.002	0.002	0.007	1.35	<0.001	0.141	<0.0001	0.007	0.006	<0.01	<0.001	0.007	<0.01	0.024
14	DW7225W2	Aries 3 Seam	21-Nov-2019	0.04	0.01	0.155	<0.001	0.56	<0.0001	<0.001	0.001	0.001	1.11	<0.001	0.121	<0.0001	0.007	0.006	<0.01	<0.001	0.006	<0.01	0.03
14	DW7225W2	Aries 3 Seam	13-Dec-2019	0.06	0.012	0.137	<0.001	0.61	<0.0001	<0.001	<0.001	0.177	0.88	<0.001	0.12	<0.0001	0.003	0.004	<0.01	<0.001	0.005	<0.01	0.047
14	DW7225W2	Aries 3 Seam	30-Jan-2020	0.1	0.017	0.119	<0.001	0.52	<0.0001	<0.001	0.001	0.007	1.78	<0.001	0.133	<0.0001	0.002	0.009	<0.01	<0.001	0.004	<0.01	0.05
14	DW7225W2	Aries 3 Seam	18-Feb-2020	0.05	0.014	0.136	<0.001	0.46	<0.0001	<0.001	<0.001	0.004	1.81	<0.001	0.123	<0.0001	0.002	0.009	<0.01	<0.001	0.004	<0.01	0.046

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Livestock Trigger - ANZECC 2000			**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
14	DW7225W2	Aries 3 Seam	17-Mar-2020	0.06	0.015	0.116	<0.001	0.42	<0.0001	<0.001	<0.001	0.07	2.73	<0.001	0.116	<0.0001	0.002	0.005	<0.01	<0.001	0.003	<0.01	0.068
14	DW7225W2	Aries 3 Seam	29-Apr-2020	0.27	0.014	0.141	<0.001	0.59	<0.0001	<0.001	<0.001	<0.001	2.66	<0.001	0.116	<0.0001	0.002	0.006	<0.01	<0.001	0.003	<0.01	0.049
14	DW7225W2	Aries 3 Seam	19-May-2020	0.4	0.011	0.138	<0.001	0.62	<0.0001	<0.001	<0.001	<0.001	3.08	<0.001	0.11	<0.0001	0.002	0.009	<0.01	<0.001	0.003	<0.01	0.009
14	DW7225W2	Aries 3 Seam	16-Jun-2020	0.06	0.012	0.136	<0.001	0.53	<0.0001	<0.001	<0.001	<0.001	2.7	<0.001	0.104	<0.0001	0.002	0.008	<0.01	<0.001	0.003	<0.01	0.034
14	DW7225W2	Aries 3 Seam	14-Jul-2020	0.41	0.008	0.161	<0.001	0.58	<0.0001	<0.001	<0.001	<0.001	2.6	<0.001	0.099	<0.0001	0.002	0.008	<0.01	<0.001	0.003	<0.01	0.04
14	DW7225W2	Aries 3 Seam	19-Aug-2020	0.04	0.01	0.154	<0.001	0.68	<0.0001	<0.001	<0.001	<0.001	3.35	<0.001	0.102	<0.0001	0.002	0.008	<0.01	<0.001	0.002	<0.01	0.03
14	DW7225W2	Aries 3 Seam	22-Sep-2020	0.44	0.009	0.159	<0.001	0.67	<0.0001	0.002	<0.001	0.003	3.52	<0.001	0.112	<0.0001	0.002	0.008	<0.01	<0.001	0.002	<0.01	0.024
14	DW7225W2	Aries 3 Seam	20-Oct-2020	0.06	0.009	0.524	<0.001	0.47	<0.0001	<0.001	<0.001	0.001	3.3	<0.001	0.127	<0.0001	0.001	0.005	<0.01	<0.001	0.002	<0.01	0.008
14	DW7225W3	Castor Seam	25-Sep-2019	1.1	0.003	1.29	<0.001	0.77	0.0003	0.003	0.002	0.03	3.08	0.002	0.14	<0.0001	0.002	0.012	<0.01	<0.001	0.004	<0.01	0.107
14	DW7225W3	Castor Seam	28-Oct-2019	0.36	0.002	1.41	<0.001	0.68	0.0001	0.002	0.001	0.02	4.27	<0.001	0.137	<0.0001	0.002	0.008	<0.01	<0.001	0.003	<0.01	0.122
14	DW7225W3	Castor Seam	21-Nov-2019	0.33	0.004	1.07	<0.001	0.59	0.0001	0.001	0.001	0.005	2.84	<0.001	0.13	<0.0001	0.003	0.008	<0.01	<0.001	0.003	<0.01	0.087
14	DW7225W3	Castor Seam	13-Dec-2019	0.08	0.004	1.12	<0.001	0.7	<0.0001	<0.001	<0.001	0.168	3.19	<0.001	0.109	<0.0001	0.002	0.003	<0.01	<0.001	0.002	<0.01	0.066
14	DW7225W3	Castor Seam	30-Jan-2020	0.1	0.003	1.18	<0.001	0.6	<0.0001	<0.001	<0.001	0.017	4.58	<0.001	0.113	<0.0001	0.001	0.008	<0.01	<0.001	0.002	<0.01	0.072
14	DW7225W3	Castor Seam	18-Feb-2020	0.05	0.002	1.31	<0.001	0.5	<0.0001	<0.001	<0.001	0.004	4.54	<0.001	0.116	<0.0001	<0.001	0.007	<0.01	<0.001	0.002	<0.01	0.056
14	DW7225W3	Castor Seam	17-Mar-2020	0.05	0.002	1.38	<0.001	0.64	<0.0001	<0.001	<0.001	0.057	5.02	<0.001	0.106	<0.0001	0.001	0.004	<0.01	<0.001	0.002	<0.01	0.074
14	DW7225W3	Castor Seam	29-Apr-2020	0.22	0.003	1.42	<0.001	0.68	<0.0001	0.002	<0.001	0.004	4.72	<0.001	0.112	<0.0001	0.002	0.009	<0.01	0.002	0.002	<0.01	0.092
14	DW7225W3	Castor Seam	19-May-2020	0.16	0.002	1.29	<0.001	0.63	<0.0001	<0.001	<0.001	0.002	5.62	<0.001	0.104	<0.0001	<0.001	0.008	<0.01	<0.001	0.002	<0.01	0.039
14	DW7225W3	Castor Seam	16-Jun-2020	0.11	0.001	1.38	<0.001	0.61	0.0001	<0.001	<0.001	0.03	5.46	<0.001	0.105	<0.0001	0.001	0.014	<0.01	<0.001	0.001	<0.01	0.132
14	DW7225W3	Castor Seam	15-Jul-2020	0.18	0.001	1.42	<0.001	0.63	<0.0001	<0.001	<0.001	0.01	3.37	<0.001	0.098	<0.0001	0.001	0.02	<0.01	<0.001	0.002	<0.01	0.094
14	DW7225W3	Castor Seam	20-Aug-2020	0.04	0.001	1.37	<0.001	0.72	<0.0001	0.003	<0.001	0.002	3.86	<0.001	0.1	0.0002	0.001	0.014	<0.01	<0.001	0.001	<0.01	0.087
14	DW7225W3	Castor Seam	22-Sep-2020	0.1	0.001	1.42	<0.001	0.72	<0.0001	<0.001	<0.001	0.001	4.54	<0.001	0.095	<0.0001	0.001	0.006	<0.01	<0.001	0.001	<0.01	0.027
14	DW7225W3	Castor Seam	20-Oct-2020	0.03	0.001	1.59	<0.001	0.51	<0.0001	<0.001	<0.001	0.001	4.41	<0.001	0.09	<0.0001	<0.001	0.007	<0.01	<0.001	<0.001	<0.01	0.012
14	DW7225W1	Tertiary	24-Sep-2019	10.6	0.004	0.159	<0.001	0.66	<0.0001	0.016	0.002	0.009	2.08	0.002	0.032	<0.0001	0.013	0.015	<0.01	<0.001	0.003	<0.01	0.101
14	DW7225W1	Tertiary	24-Oct-2019	5.6	0.004	0.117	<0.001	0.61	<0.0001	0.014	0.002	0.03	2.58	0.002	0.032	<0.0001	0.012	0.008	<0.01	<0.001	0.002	0.01	0.056
14	DW7225W1	Tertiary	21-Nov-2019	5.36	0.003	0.139	<0.001	0.55	<0.0001	0.014	0.002	0.004	2.13	0.001	0.049	<0.0001	0.007	0.011	<0.01	<0.001	0.002	0.01	0.078
14	DW7225W1	Tertiary	13-Dec-2019	2.18	<0.001	0.127	<0.001	0.6	<0.0001	0.006	0.001	0.042	0.83	<0.001	0.044	<0.0001	<0.001	0.01	<0.01	<0.001	0.002	<0.01	0.133
14	DW7225W1	Tertiary	30-Jan-2020	4.61	0.001	0.15	<0.001	0.5	0.0001	0.012	0.002	0.018	1.64	0.001	0.03	<0.0001	<0.001	0.017	<0.01	<0.001	0.002	<0.01	0.19
14	DW7225W1	Tertiary	18-Feb-2020	2.21	<0.001	0.167	<0.001	0.4	<0.0001	0.006	0.001	0.014	1.14	<0.001	0.026	<0.0001	<0.001	0.016	<0.01	<0.001	0.002	<0.01	0.125
14	DW7225W1	Tertiary	17-Mar-2020	2.8	<0.001	0.149	<0.001	0.56	<0.0001	0.009	<0.001	0.067	1.23	0.002	0.021	<0.0001	0.002	0.015	<0.01	<0.001	0.002	<0.01	0.228
14	DW7225W1	Tertiary	29-Apr-2020	3.81	0.001	0.171	<0.001	0.55	<0.0001	0.01	0.001	0.003	1.84	0.001	0.044	<0.0001	0.003	0.016	<0.01	<0.001	0.002	<0.01	0.128
14	DW7225W1	Tertiary	19-May-2020	3.93	0.002	0.206	<0.001	0.56	<0.0001	0.013	0.001	0.003	4.85	0.001	0.035	<0.0001	<0.001	0.017	<0.01	<0.001	0.002	<0.01	0.031
14	DW7225W1	Tertiary	16-Jun-2020	2.4	<0.001	0.204	<0.001	0.52	<0.0001	0.009	<0.001	0.004	6.4	<0.001	0.023	<0.0001	<0.001	0.022	<0.01	<0.001	0.002	<0.01	0.098
14	DW7225W1	Tertiary	14-Jul-2020	4.72	<0.001	0.225	<0.001	0.56	<0.0001	0.013	0.002	0.003	6.98	0.001	0.024	<0.0001	<0.001	0.024	<0.01	<0.001	0.002	0.01	0.062
14	DW7225W1	Tertiary	19-Aug-2020	1.64	<0.001	0.222	<0.001	0.66	<0.0001	0.005	<0.001	0.003	4.66	<0.001	0.025	<0.0001	<0.001	0.014	<0.01	<0.001	0.002	<0.01	0.05
14	DW7225W1	Tertiary	22-Sep-2020	3.27	<0.001	0.223	<0.001	0.56	<0.0001	0.012	0.002	0.005	6.81	0.001	0.033	<0.0001	<0.001	0.019	<0.01	<0.001	0.002	<0.01	0.03
14	DW7225W1	Tertiary	20-Oct-2020	1.69	<0.001	0.211	<0.001	0.52	<0.0001	0.004	0.001	0.047	0.69	0.002	0.017	<0.0001	<0.001	0.013	<0.01	<0.001	0.002	<0.01	0.187
15	DW7264W2	Aries 1 Seam	27-Sep-2019	0.88	0.002	0.324	<0.001	0.78	<0.0001	0.022	<0.001	0.015	2.38	0.002	0.126	<0.0001	0.012	0.014	<0.01	<0.001	0.008	<0.01	0.043
15	DW7264W2	Aries 1 Seam	28-Oct-2019	0.77	0.001	0.141	<0.001	0.74	<0.0001	0.005	<0.001	0.01	2.71	0.001	0.123	<0.0001	0.005	0.008	<0.01	<0.001	0.009	<0.01	0.058
15	DW7264W2	Aries 1 Seam	26-Nov-2019	0.1	0.003	0.199	<0.001	0.66	<0.0001	0.005	<0.001	0.002	0.41	0.002	0.042	<0.0001	0.03	0.005	<0.01	<0.001	0.004	<0.01	0.015
15	DW7264W2	Aries 1 Seam	17-Dec-2019	0.04	0.002	0.065	<0.001	0.61	<0.0001	0.004	<0.001	0.004	0.94	<0.001	0.028	<0.0001	0.018	0.002	<0.01	<0.001	0.002	<0.01	0.015
15	DW7264W2	Aries 1 Seam	31-Mar-2020	0.07	0.002	0.099	<0.001	0.61	<0.0001	0.005	<0.001	0.003	0.74	<0.001	0.053	<0.0001	0.008	0.023	<0.01	<0.001	0.003	<0.01	0.026
15	DW7264W2	Aries 1 Seam	27-Apr-2020	0.09	<0.005	0.095	<0.005	1.03	<0.0005	<0.005	<0.005	0.008	0.96	<0.005	0.215	<0.0001	<0.005	0.019	<0.05	<0.005	<0.005	<0.05	0.041
15	DW7264W2	Aries 1 Seam	18-May-2020	0.09	0.001	0.11	<0.001	0.7	<0.0001	0.005	0.003	0.014	0.66	<0.001	0.149	<0.0001	0.002	0.011	<0.01	<0.001	0.004	<0.01	0.066
15	DW7264W2	Aries 1 Seam	17-Jun-2020	0.06	<0.001	0.101	<0.001	0.61	<0.0001	0.003	<0.001	0.004	0.44	<0.001	0.11	<0.0001	0.002	0.008	<0.01	<0.001	0.004	<0.01	0.024
15	DW7264W2	Aries 1 Seam	13-Jul-2020	0.1	<0.001	0.15	<0.001	0.62	<0.0001	0.007	0.001	0.003	1.98	<0.001	0.385	<0.0001	0.003	0.01	<0.01	<0.001	0.006	<0.01	0.06
15	DW7264W2	Aries 1 Seam	18-Aug-2020	0.03	0.001	0.157	<0.001	0.76	<0.0001	0.004	<0.001	0.007	1.55	<0.001	0.14	<0.0001	0.002	0.016	<0.01	<0.001	0.004	<0.01	0.094
15	DW7264W2	Aries 1 Seam	21-Sep-2020	0.07	0.001	0.111	<0.001	0.69	<0.0001	0.005	<0.001	0.025	0.71	<0.001	0.166	<0.0001	0.002	0.007	<0.01	<0.001	0.004	<0.01	0.053
15	DW7264W2	Aries 1 Seam	19-Oct-2020	0.06	<0.001	0.114	<0.001	0.46	<0.0001	<0.001	<0.001	0.008	0.88	<0.001	0.113	<0.0001	0.002	0.008	<0.01	0.003	0.003	<0.01	0.032
15	DW7264W3	Aries 3 Seam	27-Sep-2019	0.6	0.002	3.99	<0.001	0.56	0.0002	0.006	0.001	0.01	1.41	0.002	0.066	<0.0001	0.014	0.008	<0.01	<0.001	0.002	<0.01	0.021
15	DW7264W3	Aries 3 Seam	30-Oct-2019	0.04	0.001	2.07	<0.001	0.49	<0.0001	0.001	<0.001	0.001	0.53	<0.001	0.049	<0.0001	0.014	0.003	<0.01	<0.001	0.001	<0.01	0.011
15	DW7264W3	Aries 3 Seam	26-Nov-2019	0.08	0.001	1.34	<0.001	0.45	<0.0001	0.002	<0.001	0.002	0.41	<0.001	0.073	<0.0001	0.012	0.008	<0.01	<0.001	0.002	<0.01	0.022
15	DW7264W3	Aries 3 Seam	17-Dec-2019	0.05	0.002	1.4	<0.001	0.43	<0.0001	0.002	<0.001	0.002	0.71	<0.001	0.046	<0.0001	0.011	0.003	<0.01	<0.001	<0.001	<0.01	0.015
15	DW7264W3	Aries 3 Seam	31-Mar-2020	0.05	0.002	1.25	<0.001	0.34	<0.0001	0.002	<0.001	0.002	0.54	<0.001	0.055	<0.0001	0.008	0.012	<0.01	<0.001	<0.001	<0.01	0.009

Appendix C3: Total Metals/ Metalloid Data

Site No.	Bore No.	Groundwater Unit	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Livestock Trigger - ANZECC 2000			**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
15	DW7264W3	Aries 3 Seam	27-Apr-2020	0.11	0.002	1.76	<0.001	0.4	<0.0001	0.002	<0.001	0.01	0.69	<0.001	0.066	<0.0001	0.006	0.007	<0.01	<0.001	<0.001	<0.01	0.024
15	DW7264W3	Aries 3 Seam	18-May-2020	0.1	<0.001	1.76	<0.001	0.37	<0.0001	0.002	<0.001	0.006	0.48	<0.001	0.081	<0.0001	0.005	0.007	<0.01	<0.001	<0.001	<0.01	0.03
15	DW7264W3	Aries 3 Seam	17-Jun-2020	0.08	<0.001	2.42	<0.001	0.33	<0.0001	<0.001	<0.001	0.005	0.47	<0.001	0.063	<0.0001	0.005	0.008	<0.01	<0.001	<0.001	<0.01	0.024
15	DW7264W3	Aries 3 Seam	13-Jul-2020	0.07	<0.001	2.06	<0.001	0.35	<0.0001	0.001	<0.001	0.005	0.33	<0.001	0.076	<0.0001	0.006	0.014	<0.01	<0.001	<0.001	<0.01	0.041
15	DW7264W3	Aries 3 Seam	18-Aug-2020	0.05	<0.001	1.67	<0.001	0.42	<0.0001	0.002	<0.001	0.006	0.51	<0.001	0.076	<0.0001	0.006	0.012	<0.01	<0.001	<0.001	<0.01	0.043
15	DW7264W3	Aries 3 Seam	21-Sep-2020	0.07	0.001	1.64	<0.001	0.41	<0.0001	0.002	<0.001	0.004	0.61	<0.001	0.104	<0.0001	0.004	0.005	<0.01	<0.001	<0.001	<0.01	0.022
15	DW7264W3	Aries 3 Seam	19-Oct-2020	0.06	<0.001	1.96	<0.001	0.25	<0.0001	<0.001	<0.001	0.004	0.57	<0.001	0.082	<0.0001	0.003	0.005	<0.01	<0.001	<0.001	<0.01	0.012
16	DW7282W2	Aries 3 Seam	26-Sep-2019	0.32	<0.005	0.173	<0.005	0.91	<0.0005	<0.005	<0.005	<0.005	3.57	<0.005	0.103	<0.0001	<0.005	0.006	<0.05	<0.005	<0.005	<0.05	0.039
16	DW7282W2	Aries 3 Seam	28-Oct-2019	0.18	<0.001	0.132	<0.001	0.74	<0.0001	<0.001	<0.001	0.007	3.96	<0.001	0.097	<0.0001	0.002	0.004	<0.01	<0.001	0.003	<0.01	0.055
16	DW7282W2	Aries 3 Seam	25-Nov-2019	0.17	0.002	0.208	<0.001	0.75	<0.0001	<0.001	<0.001	0.003	3.35	<0.001	0.112	<0.0001	0.002	0.011	<0.01	<0.001	0.002	<0.01	0.073
16	DW7282W2	Aries 3 Seam	17-Dec-2019	0.25	<0.005	0.16	<0.005	1.24	<0.0005	<0.005	<0.005	0.007	5.21	<0.005	0.146	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.044
16	DW7282W2	Aries 3 Seam	20-Feb-2020	0.18	<0.005	0.125	<0.005	0.81	0.0013	<0.005	<0.005	<0.005	4.92	<0.005	0.124	<0.0001	0.006	0.013	<0.05	<0.005	<0.005	<0.05	0.112
16	DW7282W2	Aries 3 Seam	20-Mar-2020	0.22	<0.005	0.119	<0.005	0.68	<0.0005	<0.005	<0.005	0.122	6.38	<0.005	0.134	<0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.081
16	DW7282W2	Aries 3 Seam	27-Apr-2020	0.17	<0.005	0.118	<0.005	1.03	<0.0005	<0.005	<0.005	0.021	4.92	<0.005	0.131	<0.0001	0.008	0.01	<0.05	<0.005	<0.005	<0.05	0.098
16	DW7282W2	Aries 3 Seam	19-May-2020	0.15	<0.005	0.109	<0.005	1.04	<0.0005	<0.005	<0.005	0.008	4.76	<0.005	0.118	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.112
16	DW7282W2	Aries 3 Seam	17-Jun-2020	0.06	<0.001	0.125	<0.001	0.58	<0.0001	<0.001	<0.001	0.005	4.02	<0.001	0.1	<0.0001	<0.001	0.012	<0.01	<0.001	0.002	<0.01	0.096
16	DW7282W2	Aries 3 Seam	14-Jul-2020	0.13	<0.005	0.117	<0.005	0.76	<0.0005	0.006	<0.005	0.02	4.36	<0.005	0.122	<0.0001	<0.005	<0.005	<0.05	<0.005	<0.005	<0.05	0.09
16	DW7282W2	Aries 3 Seam	19-Aug-2020	<0.05	<0.005	0.116	<0.005	0.97	<0.0005	<0.005	<0.005	0.008	4.14	<0.005	0.094	0.0001	<0.005	0.008	<0.05	<0.005	<0.005	<0.05	0.1
16	DW7282W2	Aries 3 Seam	21-Sep-2020	0.08	<0.005	0.125	<0.005	0.97	<0.0005	<0.005	<0.005	0.007	4.66	<0.005	0.123	<0.0001	<0.005	0.007	<0.05	<0.005	<0.005	<0.05	0.054
16	DW7282W2	Aries 3 Seam	19-Oct-2020	0.22	<0.005	0.112	<0.005	0.98	<0.0005	<0.005	<0.005	0.008	3.72	<0.005	0.09	<0.0001	<0.005	0.011	<0.05	<0.005	<0.005	<0.05	0.042
16	DW7282W1	Overburden	26-Sep-2019	4.4	0.008	0.316	<0.001	1.62	<0.0001	0.009	0.006	0.019	8.38	0.008	0.412	<0.0001	0.001	0.021	<0.01	<0.001	0.002	0.01	0.066
16	DW7282W1	Overburden	28-Oct-2019	1.34	0.005	0.166	<0.001	1.57	<0.0001	0.003	0.003	0.011	2.58	0.003	0.312	<0.0001	0.002	0.011	<0.01	<0.001	0.002	<0.01	0.076
16	DW7282W1	Overburden	25-Nov-2019	3.16	0.007	0.25	<0.001	1.46	<0.0001	0.007	0.005	0.011	5.22	0.005	0.281	<0.0001	0.002	0.025	<0.01	<0.001	0.001	<0.01	0.101
16	DW7282W1	Overburden	17-Dec-2019	2.26	0.006	0.171	<0.001	1.59	0.0001	0.004	0.004	0.016	3.5	0.003	0.297	<0.0001	0.003	0.014	<0.01	<0.001	0.001	<0.01	0.058
16	DW7282W1	Overburden	20-Feb-2020	2.88	0.004	0.148	<0.001	1.39	<0.0001	0.009	0.004	0.011	6.18	0.003	0.282	<0.0001	0.002	0.027	<0.01	<0.001	0.001	<0.01	0.081
16	DW7282W1	Overburden	20-Mar-2020	2.07	0.008	0.118	<0.005	1.65	<0.0005	0.006	<0.005	0.009	6.25	<0.005	0.289	<0.0001	<0.005	0.018	<0.05	<0.005	<0.005	<0.05	0.059
16	DW7282W1	Overburden	27-Apr-2020	3.44	0.006	0.154	<0.005	1.97	<0.0005	0.01	<0.005	0.031	6.04	<0.005	0.283	<0.0001	<0.005	0.028	<0.05	<0.005	<0.005	<0.05	0.112
16	DW7282W1	Overburden	19-May-2020	2.67	0.005	0.132	<0.001	1.51	<0.0001	0.007	0.004	0.034	4.8	0.003	0.268	<0.0001	0.002	0.016	<0.01	<0.001	0.001	<0.01	0.136
16	DW7282W1	Overburden	17-Jun-2020	1.66	0.005	0.114	<0.001	1.4	<0.0001	0.004	0.003	0.008	3.42	0.002	0.238	<0.0001	0.002	0.017	<0.01	<0.001	0.001	<0.01	0.088
16	DW7282W1	Overburden	14-Jul-2020	1.79	<0.005	0.124	<0.005	1.96	<0.0005	<0.005	<0.005	0.056	3.79	<0.005	0.268	<0.0001	<0.005	0.018	<0.05	<0.005	<0.005	<0.05	0.115
16	DW7282W1	Overburden	19-Aug-2020	0.62	0.003	0.171	<0.001	1.67	<0.0001	0.004	0.002	0.026	1.24	0.001	0.228	0.0005	0.002	0.016	<0.01	<0.001	0.001	<0.01	0.109
16	DW7282W1	Overburden	21-Sep-2020	1.98	0.003	0.124	<0.001	1.76	<0.0001	0.009	0.003	0.019	4.11	0.002	0.256	<0.0001	0.002	0.016	<0.01	<0.001	0.002	<0.01	0.049
16	DW7282W1	Overburden	19-Oct-2020	2.48	0.007	0.154	<0.001	0.96	<0.0001	0.005	0.003	0.013	5.17	0.002	0.266	<0.0001	0.001	0.019	<0.01	<0.001	0.001	<0.01	0.051
17	DW7292W1	Quaternary Alluvium	25-Sep-2019	11.1	0.004	0.146	<0.001	0.97	<0.0001	0.028	0.004	0.018	14	0.01	0.164	<0.0001	0.002	0.018	<0.01	<0.001	0.013	0.05	0.341
17	DW7292W1	Quaternary Alluvium	28-Oct-2019	17.8	0.003	0.158	0.002	0.47	<0.0001	0.046	0.004	0.026	21	0.013	0.113	0.0002	0.001	0.019	<0.01	<0.001	0.005	0.09	0.207
17	DW7292W1	Quaternary Alluvium	25-Nov-2019	5.6	0.003	0.161	<0.001	0.42	<0.0001	0.016	0.003	0.008	5.6	0.003	0.112	0.0001	<0.001	0.014	<0.01	<0.001	0.002	0.03	0.123
17	DW7292W1	Quaternary Alluvium	31-Mar-2020	3.19	<0.001	0.068	<0.001	0.18	<0.0001	0.031	0.003	0.098	3.23	0.006	0.075	<0.0001	0.002	0.097	<0.01	<0.001	<0.001	0.01	0.409
17	DW7292W1	Quaternary Alluvium	27-Apr-2020	6.06	0.002	0.076	<0.001	0.22	<0.0001	0.029	0.002	0.067	7.36	0.008	0.117	<0.0001	0.002	0.085	<0.01	<0.001	0.002	0.03	0.5
17	DW7292W1	Quaternary Alluvium	18-May-2020	3.26	0.002	0.072	<0.001	0.17	0.0002	0.02	0.003	0.098	3.67	0.002	0.049	<0.0001	<0.001	0.035	<0.01	<0.001	<0.001	0.02	0.57
17	DW7292W1	Quaternary Alluvium	17-Jun-2020	0.96	0.001	0.052	<0.001	0.19	<0.0001	0.006	<0.001	0.045	1.71	0.002	0.044	<0.0001	<0.001	0.036	<0.01	<0.001	<0.001	<0.01	0.218
17	DW7292W1	Quaternary Alluvium	13-Jul-2020	3.76	<0.001	0.099	<0.001	0.31	<0.0001	0.013	0.002	0.07	3.55	0.003	0.17	<0.0001	<0.001	0.026	<0.01	<0.001	0.001	0.02	0.31
17	DW7292W1	Quaternary Alluvium	18-Aug-2020	1.91	<0.001	0.124	<0.001	0.36	<0.0001	0.019	0.001	0.096	1.98	0.001	0.059	0.0003	<0.001	0.034	<0.01	<0.001	<0.001	<0.01	0.267
17	DW7292W1	Quaternary Alluvium	21-Sep-2020	1.9	0.002	0.076	<0.001	0.22	<0.0001	0.03	0.002	0.111	2.57	0.001	0.131	0.0001	<0.001	0.038	<0.01	<0.001	<0.001	0.01	0.315
17	DW7292W1	Quaternary Alluvium	19-Oct-2020	1.45	<0.001	0.055	<0.001	0.16	<0.0001	0.01	0.001	0.328	1.46	<0.001	0.064	<0.0001	<0.001	0.02	<0.01	<0.001	<0.001	<0.01	0.266

Appendix C-4: Summary Statistics for pH, EC, TDS, Major Ion Data

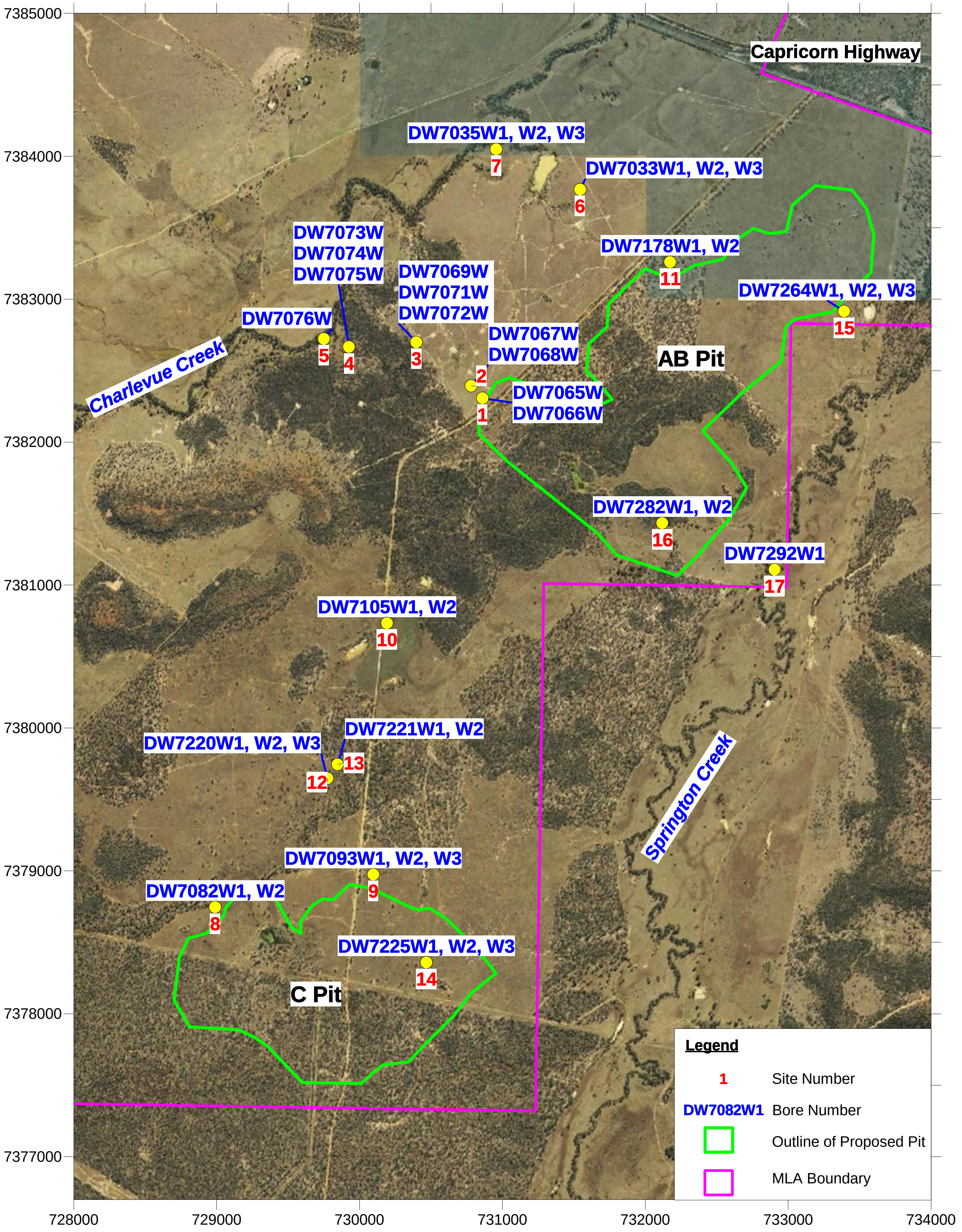
Site	Groundwater Unit	pH		Electrical Conductivity		TDS	Major Ions									
		Lab	Field	Lab	Field	Total Dissolved Solids (TDS)	Na	Ca	Mg	K	Cl	SO4	Carbonate Alkalinity	Bicarbonate Alkalinity	Hydroxide Alkalinity	Total Alkalinity
Major Ion, pH, EC, TPH Statistics																
Quaternary Alluvium	Total No. of Samples	29	30	29	30	29	31	31	31	31	31	31	31	31	31	31
	No. Samples >LOR	29	30	29	30	29	31	31	31	25	31	31	1	31	0	31
	% >LOR	100	100	100	100	100	100	100	100	81	100	100	3	100	0	100
	Min	6.04	5.53	1560	1594	932	267	5	20	1	501	10	562	54	0	54
	Max	8.51	7.49	16600	17106	11300	3760	73	407	17	4290	249	562	3680	0	3680
	Mean	7.42	6.77	10211	10437	6655	2229	33	211	12	2731	140	562	2054		2072
	Median	7.72	7.21	14300	14479	9340	3050	33	277	14	3630	184	562	2960		2980
	80th Percentile	8.00	7.34	15340	15149	10040	3410	47	329	16	4040	209	562	3480		3480
	95th Percentile	8.07	7.38	16200	16209	10560	3665	66	376	16	4180	226	562	3610		3610
	Standard Deviation	0.68	0.70	6299	6302	4182	1395	19	138	6	1554	86		1521		1535
Tertiary Sediments	Total No. of Samples	66	68	66	68	66	69	69	69	69	69	69	69	69	69	69
	No. Samples >LOR	66	68	66	68	66	69	69	69	69	69	69	1	69	0	69
	% >LOR	100	100	100	100	100	100	100	100	100	100	100	1	100	0	100
	Min	6.22	5.77	1400	1415	823	181	63	10	3	288	25	8	243	0	243
	Max	8.29	7.47	22600	22783	16400	4540	259	709	101	8160	635	8	740	0	740
	Mean	7.21	6.50	12413	12262	8151	2168	135	314	26	4194	170	8	519		519
	Median	7.26	6.56	9880	10003	6285	1740	122	238	10	3310	146	8	552		552
	80th Percentile	7.57	6.75	21300	21380	14300	3790	189	551	51	7474	271	8	655		655
	95th Percentile	7.84	6.94	22050	22362	14875	3986	232	592	73	7836	346	8	719		719
	Standard Deviation	0.42	0.34	7870	7913	5438	1454	54	218	26	2923	118		141		141
Coal Measures	Total No. of Samples	347	363	347	363	347	368	368	368	368	368	368	368	368	368	368
	No. Samples >LOR	347	363	347	363	347	368	368	368	368	368	368	15	368	0	368
	% >LOR	100	100	100	100	100	100	100	100	100	100	100	4	100	0	100
	Min	6.02	5.56	959	949	606	237	4	4	2	70	2	9	214	0	214
	Max	8.70	8.50	32800	33343	25600	6060	1050	998	43	11500	841	41	1130	0	1130
	Mean	7.37	6.66	18173	18272	12134	3334	262	400	16	6262	384	24	595		596
	Median	7.31	6.55	17900	17757	11000	3580	249	373	13	6055	348	23	593		594
	80th Percentile	7.78	6.94	25880	26066	17600	4666	376	641	23	9032	619	31	715		715
	95th Percentile	8.21	7.53	28400	28692	19900	5383	508	792	28	9897	766	37	878		878
	Standard Deviation	0.48	0.48	8001	8115	5849	1481	159	247	9	2930	229	9	168		167

Appendix C-4: Summary Statistics for Dissolved Metals/ Metalloid Data

Site	Groundwater Unit	Unit Type	Date	Al (diss)	As (diss)	Ba (diss)	Be (diss)	B (diss)	Cd (diss)	Cr (diss)	Co (diss)	Cu (diss)	Fe (diss)	Pb (diss)	Mn (diss)	Hg (diss)	Mo (diss)	Ni (diss)	Se (diss)	Ag (diss)	U (diss)	V (diss)	Zn (diss)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ANZECC 2000 - 95% Freshwater Species Protection				**0.055**	**0.013**			**0.37**	**0.0002**	**0.001**		**0.0014**		**0.0034**	**1.9**	**0.0006**		**0.011**	**0.011**	**0.00005**			**0.008**
Dissolved Metals Statistics																							
Quaternary Alluvium	Total No. of Samples			31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	No. Samples >LOR			18	22	31	0	31	1	3	24	20	16	0	31	0	23	29	0	0	21	9	21
	% >LOR			58	71	100	0	100	3	10	77	65	52	0	100	0	74	94	0	0	68	29	68
	Min			0.010	0.001	0.044	0.000	0.190	0.000	0.001	0.001	0.001	0.050	0.000	0.030	0.000	0.001	0.001	0.000	0.000	0.008	0.010	0.007
	Max			0.090	0.003	0.344	0.000	4.810	0.000	0.001	0.004	0.273	0.660	0.000	0.289	0.000	0.009	0.083	0.000	0.000	0.058	0.030	0.533
	Mean			0.042	0.002	0.158		2.479	0.000	0.001	0.002	0.031	0.128		0.105		0.002	0.014			0.033	0.016	0.138
	Median			0.045	0.002	0.167		3.300	0.000	0.001	0.002	0.015	0.090		0.077		0.002	0.005			0.033	0.010	0.028
	80th Percentile			0.060	0.003	0.217		4.380	0.000	0.001	0.002	0.044	0.130		0.138		0.003	0.023			0.051	0.020	0.264
	95th Percentile			0.090	0.003	0.269		4.660	0.000	0.001	0.004	0.069	0.278		0.227		0.004	0.056			0.058	0.026	0.461
	Standard Deviation			0.027	0.001	0.076		1.884		0.000	0.001	0.060	0.145		0.067		0.002	0.020			0.017	0.007	0.166
Tertiary Sediments	Total No. of Samples			69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
	No. Samples >LOR			13	22	69	1	69	1	6	47	29	42	0	69	1	49	68	0	2	61	0	67
	% >LOR			19	32	100	1	100	1	9	68	42	61	0	100	1	71	99	0	3	88	0	97
	Min			0.010	0.001	0.090	0.001	0.120	0.000	0.001	0.001	0.001	0.050	0.000	0.007	0.000	0.001	0.002	0.000	0.001	0.001	0.000	0.007
	Max			0.080	0.003	0.270	0.001	1.610	0.000	0.003	0.005	0.147	5.710	0.000	0.228	0.000	0.028	0.039	0.000	0.001	0.012	0.000	0.370
	Mean			0.024	0.002	0.170		0.826		0.002	0.002	0.017	0.855		0.057		0.006	0.012			0.006		0.068
	Median			0.020	0.002	0.161		0.820		0.002	0.002	0.003	0.190		0.028		0.004	0.011			0.006		0.047
	80th Percentile			0.026	0.003	0.211		1.282		0.003	0.004	0.022	0.412		0.087		0.008	0.015			0.008		0.096
	95th Percentile			0.050	0.003	0.250		1.460		0.003	0.004	0.065	5.148		0.190		0.017	0.020			0.010		0.172
	Standard Deviation			0.018	0.001	0.044		0.446		0.001	0.001	0.031	1.552		0.065		0.005	0.006			0.003		0.064
Coal Measures	Total No. of Samples			368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368
	No. Samples >LOR			52	260	368	1	368	6	35	103	110	350	8	368	0	235	357	0	5	190	0	285
	% >LOR			14	71	100	0	100	2	10	28	30	95	2	100	0	64	97	0	1	52	0	77
	Min			0.010	0.001	0.024	0.001	0.070	0.000	0.001	0.001	0.001	0.050	0.002	0.003	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.005
	Max			0.420	0.039	6.380	0.001	2.010	0.001	0.011	0.025	0.131	18.500	0.007	1.770	0.000	2.850	0.046	0.000	0.007	0.041	0.000	0.371
	Mean			0.036	0.006	0.341		0.835	0.000	0.003	0.006	0.017	2.143	0.004	0.242		0.026	0.009			0.005		0.059
	Median			0.020	0.004	0.134		0.815	0.000	0.002	0.004	0.006	1.790	0.004	0.192		0.002	0.007			0.003		0.047
	80th Percentile			0.040	0.011	0.282		1.226	0.000	0.003	0.008	0.016	3.342	0.004	0.293		0.007	0.012			0.007		0.092
	95th Percentile			0.060	0.019	1.377		1.420	0.001	0.007	0.019	0.083	5.090	0.006	0.468		0.081	0.020			0.018		0.150
	Standard Deviation			0.057	0.007	0.644		0.394	0.000	0.002	0.006	0.027	1.843	0.002	0.276		0.192	0.006			0.006		0.049

Appendix C-4: Summary Statistics for Total Metals/ Metalloid Data

Site	Groundwater Unit	Unit Type	Date	Al (tot)	As (tot)	Ba (tot)	Be (tot)	B (tot)	Cd (tot)	Cr (tot)	Co (tot)	Cu (tot)	Fe (tot)	Pb (tot)	Mn (tot)	Hg (tot)	Mo (tot)	Ni (tot)	Se (tot)	Ag (tot)	U (tot)	V (tot)	Zn (tot)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Livestock Trigger - ANZECC 2000				**5**	**0.5**	**n/a**	**n/a**	**5**	**0.01**	**1**	**1**	**1**	**n/a**	**0.1**	**n/a**	**0.002**	**0.15**	**1**	**0.02**	**n/a**	**0.2**	**n/a**	**20**
Total Metals Statistics																							
Quaternary Alluvium	Total No. of Samples			31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	No. Samples >LOR			31	25	31	3	31	2	31	29	31	31	29	31	4	22	31	1	0	25	24	30
	% >LOR			100	81	100	10	100	6	100	94	100	100	94	100	13	71	100	3	0	81	77	97
	Min			0.960	0.001	0.052	0.002	0.160	0.000	0.001	0.001	0.002	0.890	0.001	0.044	0.000	0.001	0.004	0.010	0.000	0.001	0.010	0.009
	Max			20.100	0.009	0.389	0.004	4.710	0.000	0.046	0.008	0.452	21.000	0.020	0.321	0.000	0.004	0.097	0.010	0.000	0.073	0.090	0.570
	Mean			6.183	0.003	0.196	0.003	2.830		0.014	0.004	0.129	3.625	0.006	0.158		0.002	0.018			0.037	0.026	0.142
	Median			4.810	0.003	0.196	0.002	3.890		0.010	0.004	0.096	2.220	0.005	0.154		0.002	0.010			0.038	0.020	0.053
	80th Percentile			8.430	0.004	0.292	0.003	4.440		0.020	0.004	0.232	3.670	0.008	0.240		0.002	0.026			0.053	0.034	0.276
	95th Percentile			17.050	0.005	0.342	0.004	4.670		0.031	0.008	0.385	10.680	0.014	0.291		0.003	0.062			0.064	0.049	0.459
	Standard Deviation			4.683	0.002	0.093	0.001	1.911		0.010	0.002	0.127	4.151	0.004	0.079		0.001	0.022			0.020	0.017	0.160
Tertiary Sediments	Total No. of Samples			69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
	No. Samples >LOR			69	42	69	3	69	6	69	55	69	69	37	69	9	47	69	0	0	61	16	68
	% >LOR			100	61	100	4	100	9	100	80	100	100	54	100	13	68	100	0	0	88	23	99
	Min			0.090	0.001	0.102	0.001	0.120	0.0001	0.002	0.001	0.001	0.190	0.001	0.008	0.000	0.001	0.005	0.000	0.000	0.001	0.010	0.008
	Max			27.400	0.004	0.331	0.002	1.600	0.0002	0.106	0.005	0.160	8.860	0.009	0.243	0.001	0.031	0.041	0.000	0.000	0.012	0.060	0.426
	Mean			3.407	0.002	0.186		0.850	0.0001	0.012	0.002	0.014	2.061	0.002	0.063	0.000	0.006	0.014			0.006	0.019	0.079
	Median			2.650	0.002	0.183		0.780	0.0001	0.008	0.002	0.007	1.260	0.002	0.035	0.000	0.004	0.013			0.008	0.015	0.058
	80th Percentile			4.340	0.003	0.229		1.330	0.0002	0.013	0.004	0.015	2.676	0.003	0.101	0.001	0.009	0.017			0.009	0.020	0.113
	95th Percentile			9.528	0.003	0.272		1.520	0.0002	0.032	0.005	0.059	6.646	0.004	0.204	0.001	0.018	0.023			0.012	0.045	0.189
	Standard Deviation			3.931	0.001	0.050		0.474	0.0001	0.014	0.001	0.024	1.982	0.001	0.067	0.000	0.006	0.006			0.004	0.014	0.067
Coal Measures	Total No. of Samples			368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368	368
	No. Samples >LOR			351	291	368	4	368	26	151	120	341	368	92	368	14	246	359	1	5	197	10	365
	% >LOR			95	79	100	1	100	7	41	33	93	100	25	100	4	67	98	0	1	54	3	99
	Min			0.010	0.001	0.030	0.001	0.100	0.000	0.001	0.001	0.001	0.090	0.001	0.004	0.000	0.001	0.001	0.010	0.001	0.001	0.010	0.007
	Max			10.400	0.039	6.980	0.004	2.100	0.001	0.022	0.032	1.470	18.200	0.015	1.900	0.001	2.910	0.055	0.010	0.004	0.048	0.030	0.420
	Mean			0.522	0.006	0.440		0.872	0.000	0.004	0.006	0.022	2.989	0.003	0.255		0.028	0.010			0.005		0.069
	Median			0.110	0.004	0.145		0.880	0.000	0.003	0.004	0.007	2.610	0.002	0.197		0.003	0.008			0.003		0.055
	80th Percentile			0.410	0.010	0.322		1.266	0.000	0.005	0.007	0.021	4.306	0.005	0.305		0.009	0.014			0.007		0.097
	95th Percentile			2.880	0.020	1.943		1.577	0.001	0.012	0.021	0.081	6.954	0.009	0.533		0.100	0.024			0.019		0.157
	Standard Deviation			1.208	0.007	0.815		0.425	0.000	0.004	0.007	0.084	2.361	0.003	0.296		0.192	0.007			0.007		0.054



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A4

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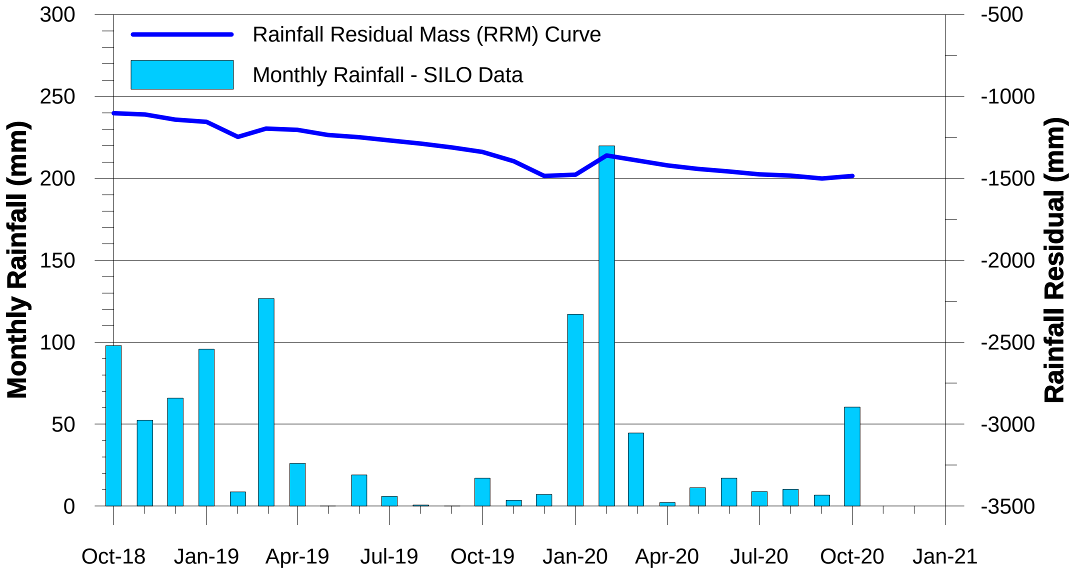
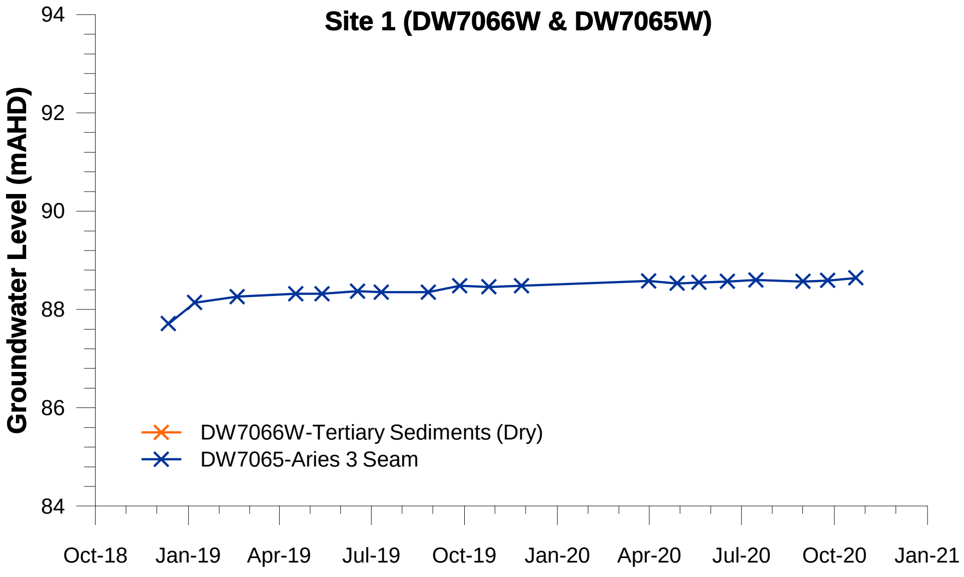
FIGURE No. 1

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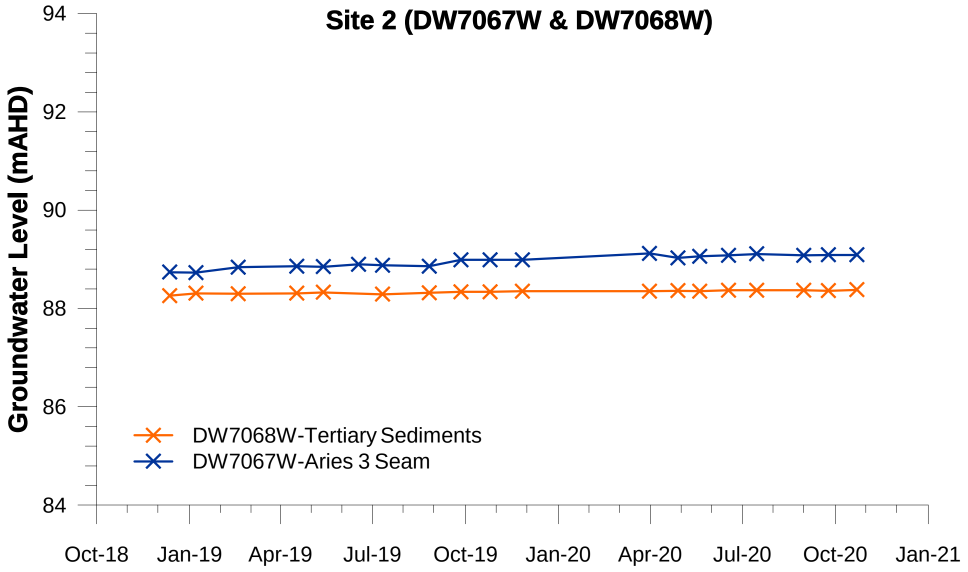
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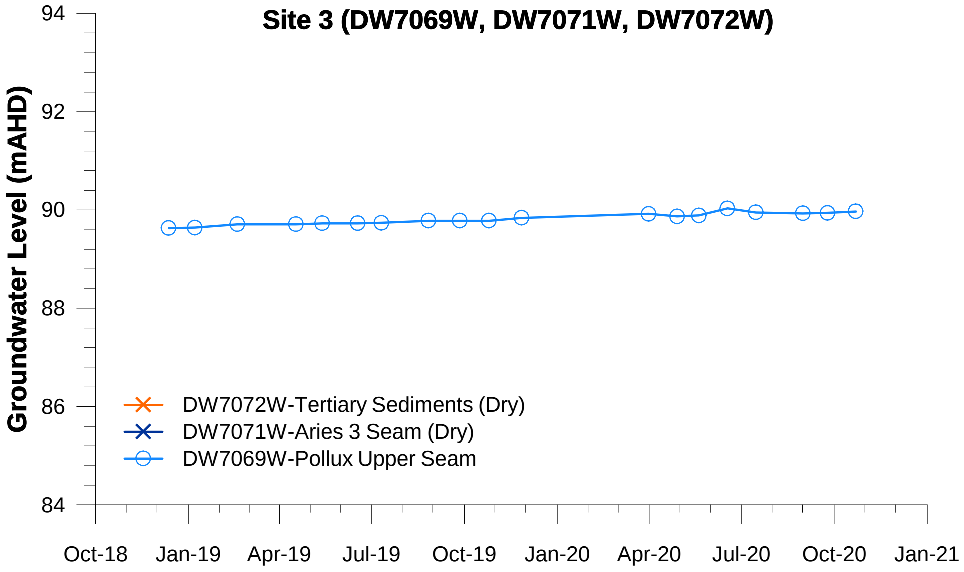
Site 3 (DW7069W, DW7071W, DW7072W)

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TITLE **Groundwater Level Data**
Monitoring Bores at Sites 1, 2 & 3
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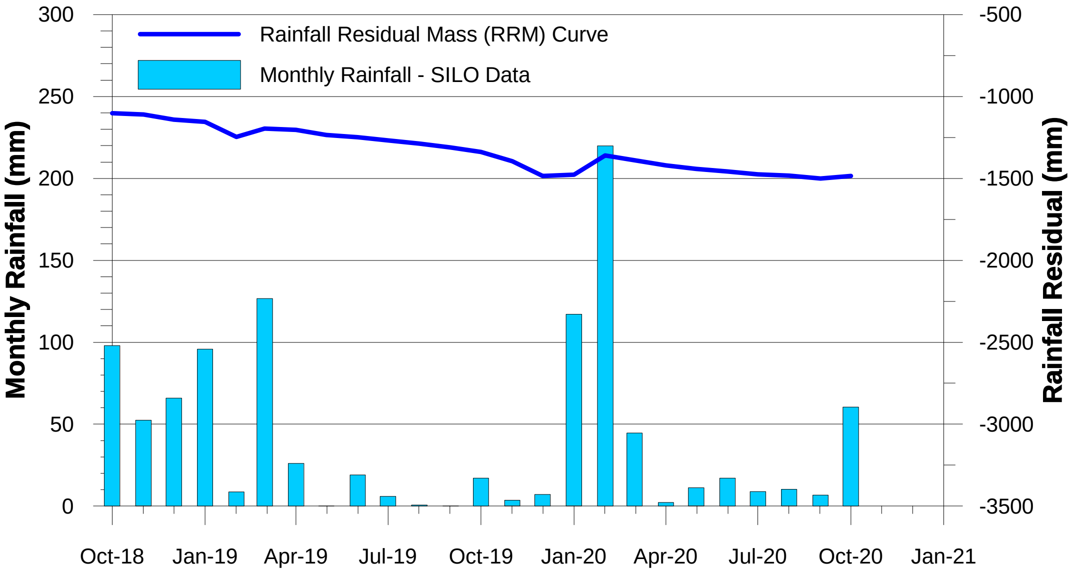
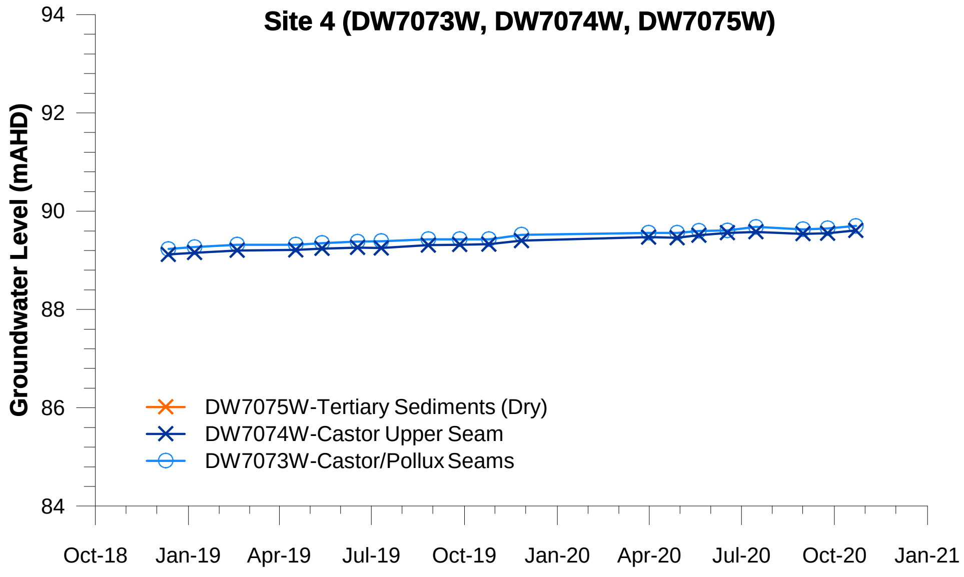
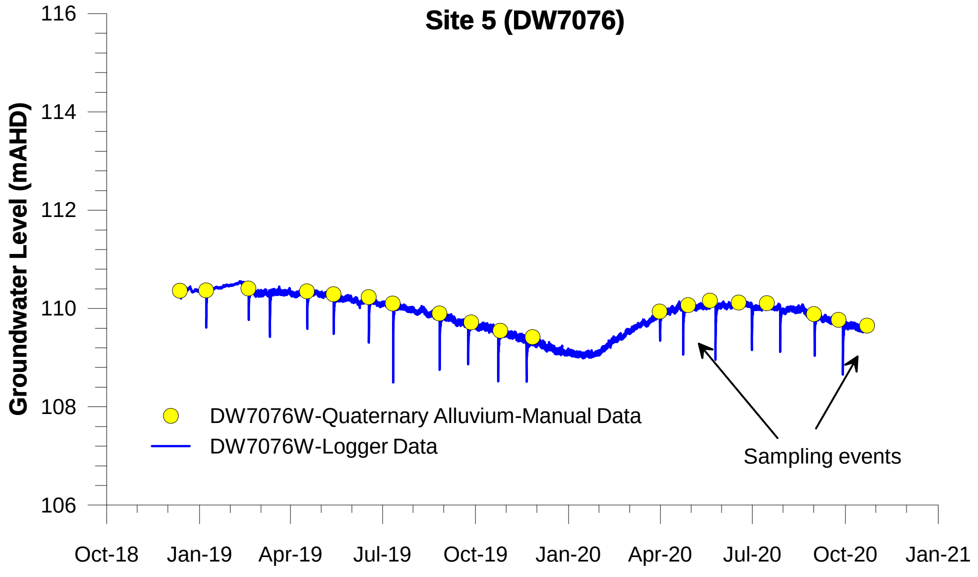
PROJECT No. JBT01-071-005
FIGURE No. **2**





Site 4 (DW7073W, DW7074W, DW7075W)



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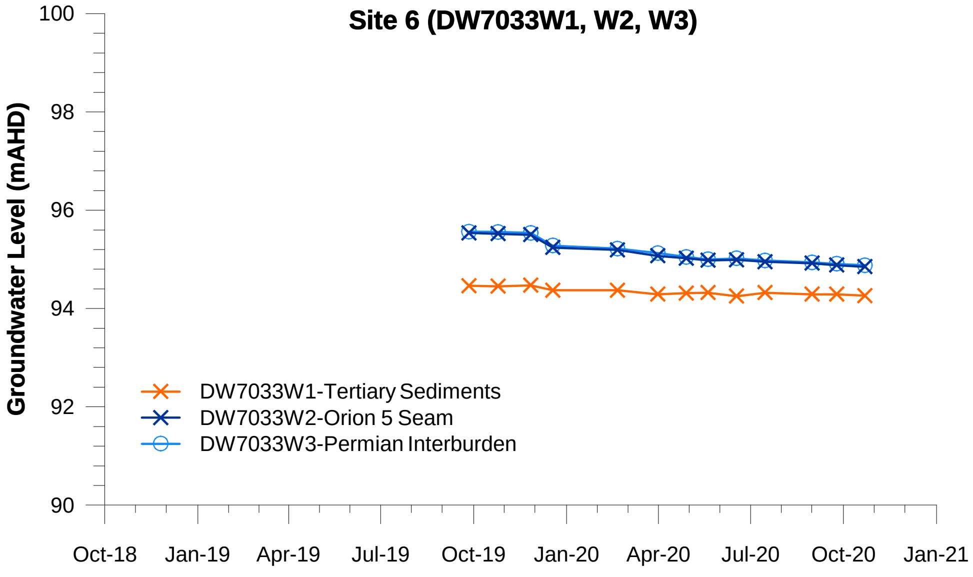

Site 6 (DW7033W1, W2, W3)

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Groundwater Level Data
Monitoring Bores at Sites 4, 5 & 6

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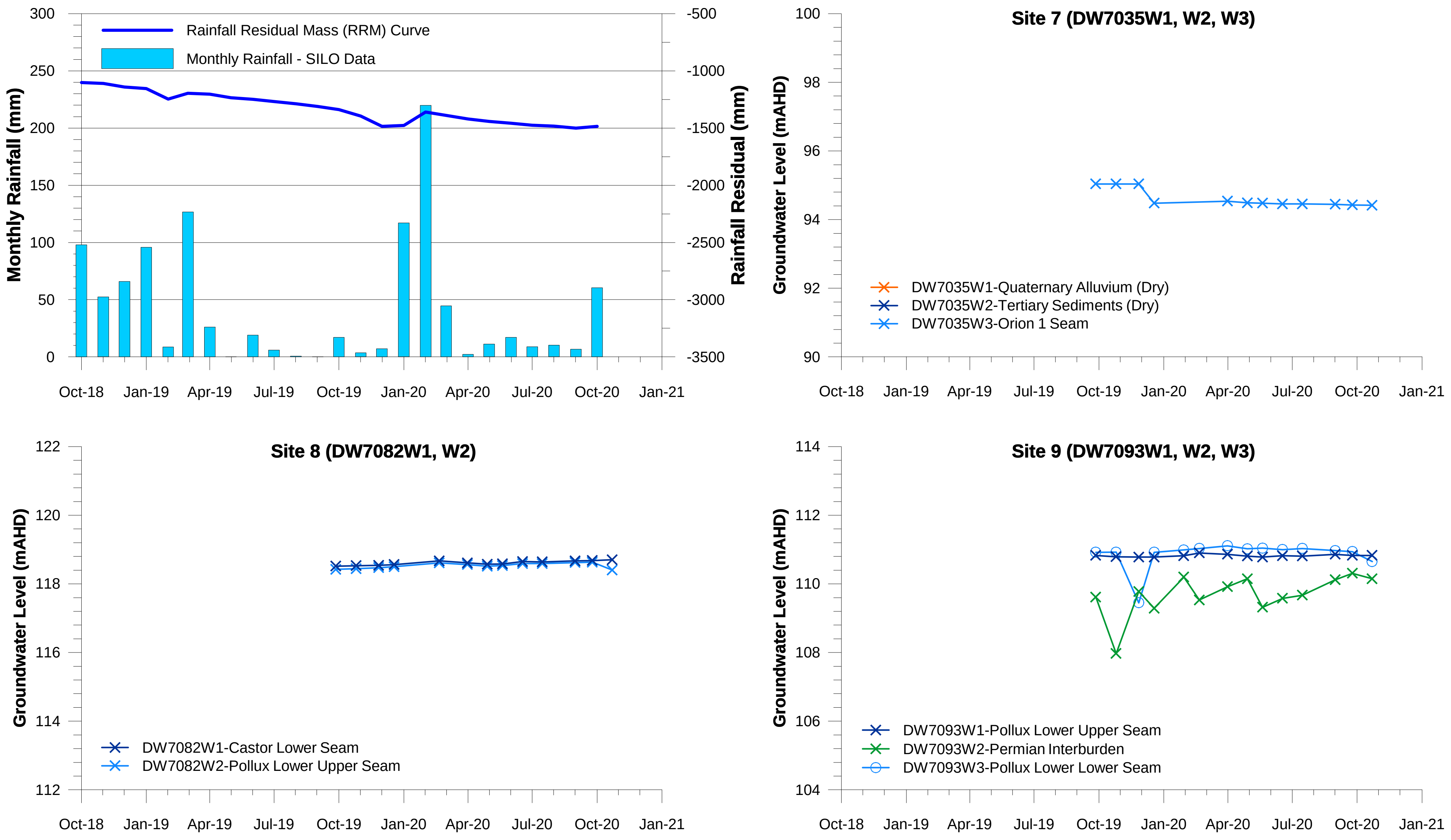
FIGURE No. **3**



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Groundwater Level Data
Monitoring Bores at Sites 7, 8 & 9

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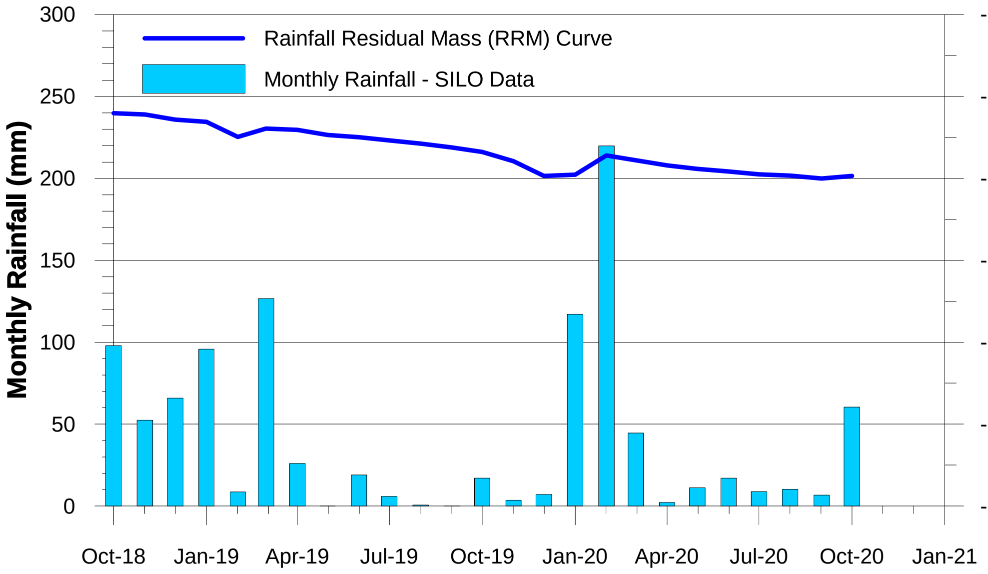
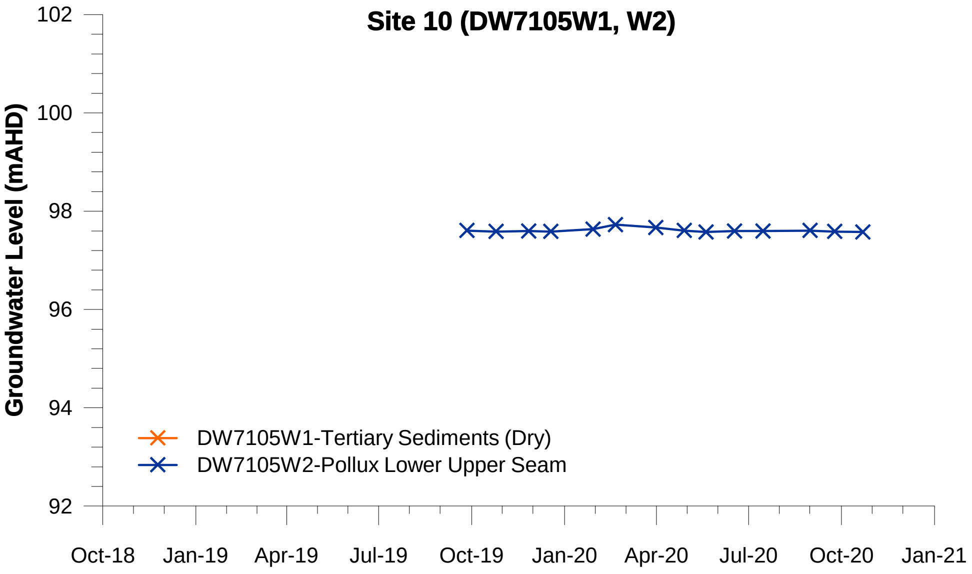
PROJECT No. JBT01-071-005

FIGURE No. **4**

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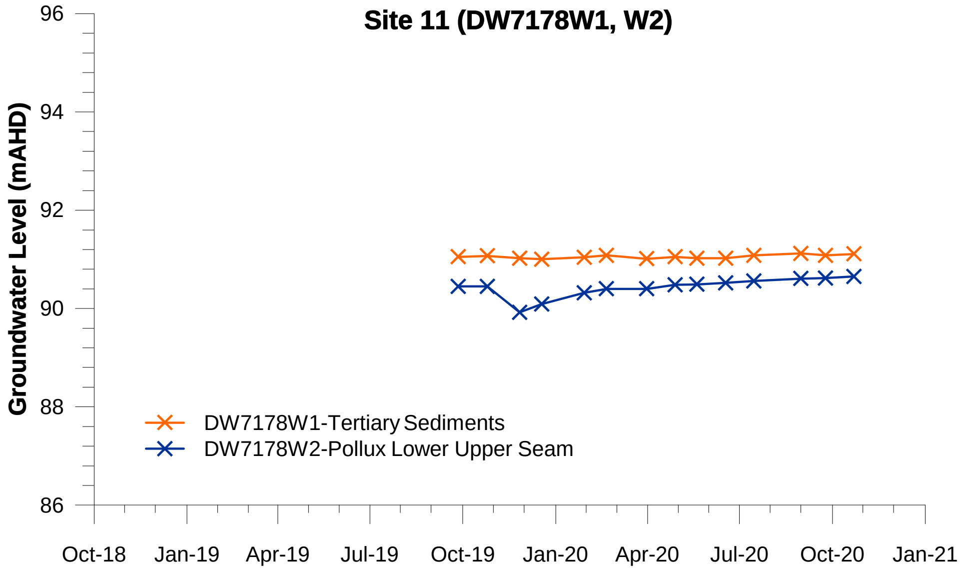
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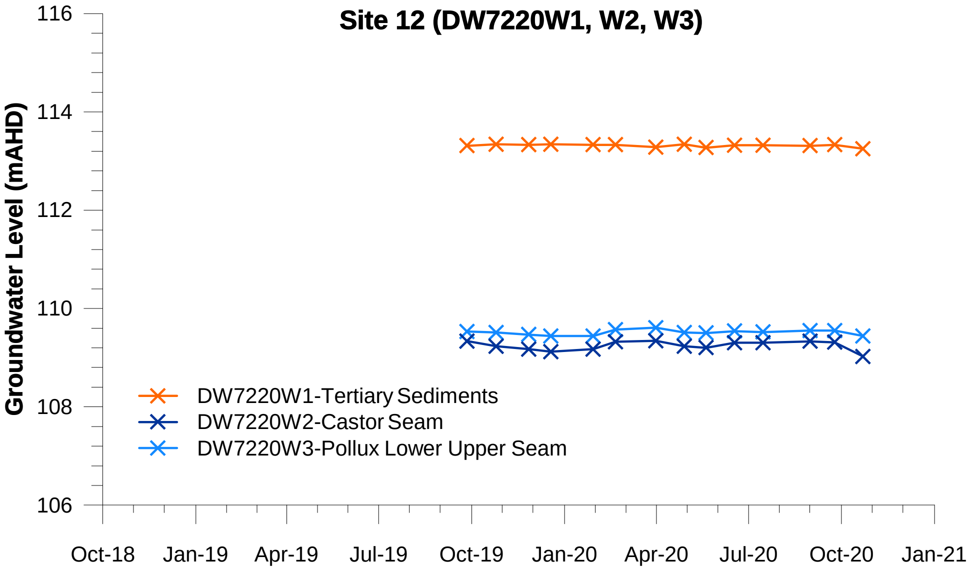
Site 12 (DW7220W1, W2, W3)

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TITLE **Groundwater Level Data**
Monitoring Bores at Sites 10, 11 & 12
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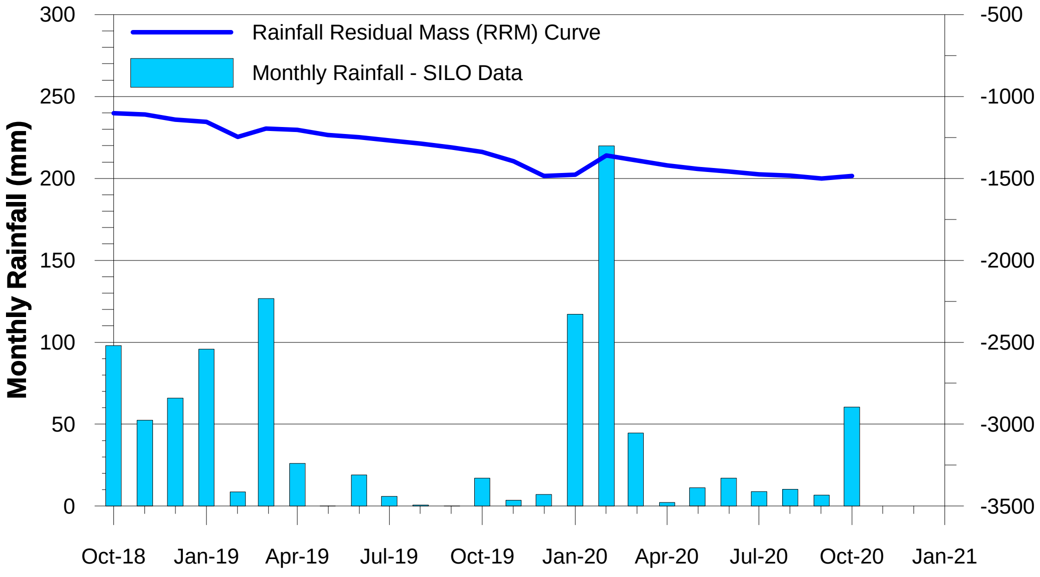
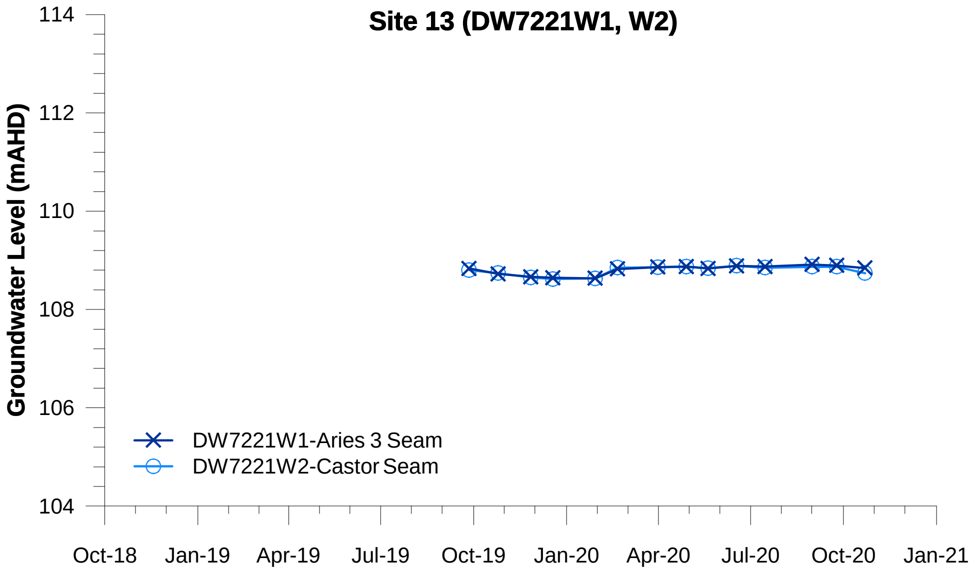
PROJECT No. JBT01-071-005
FIGURE No. **5**

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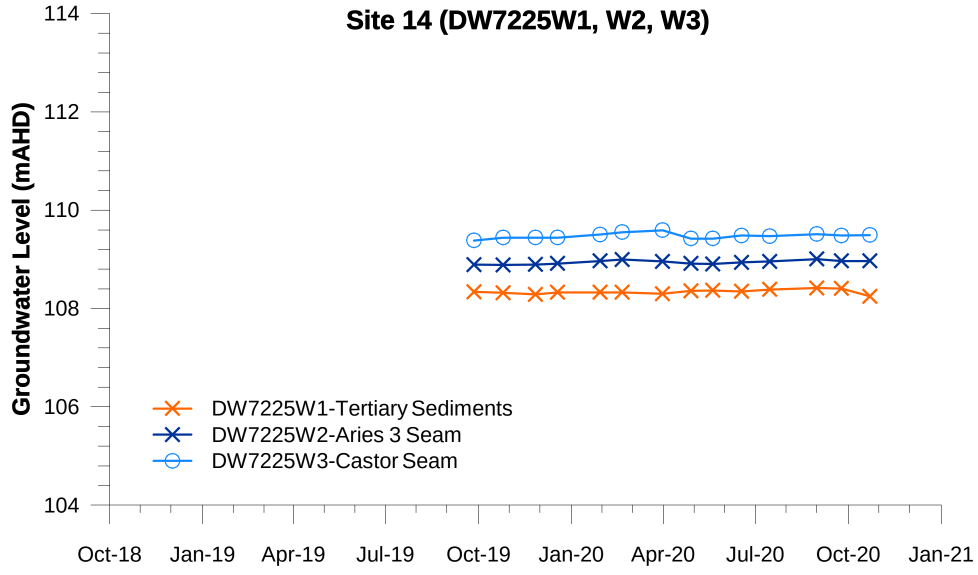
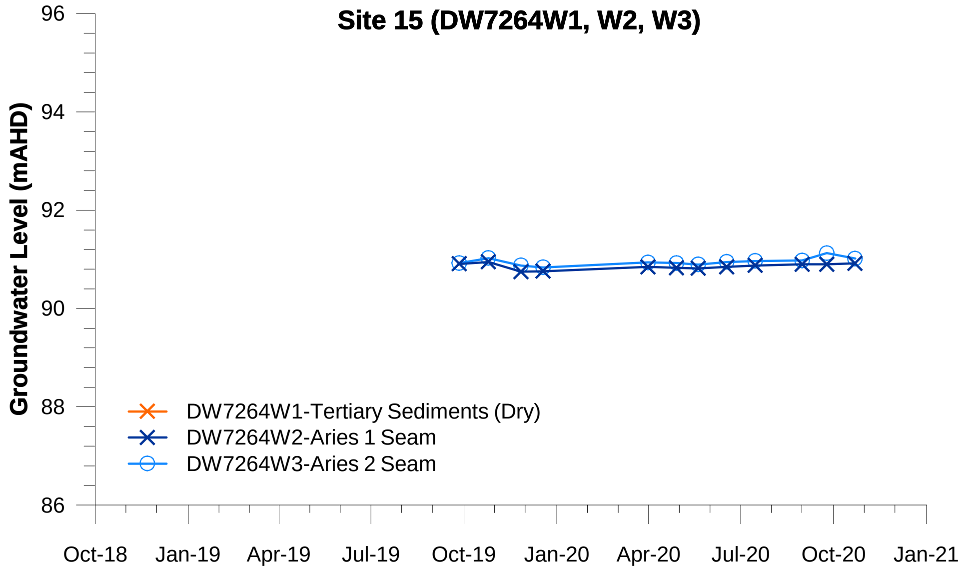
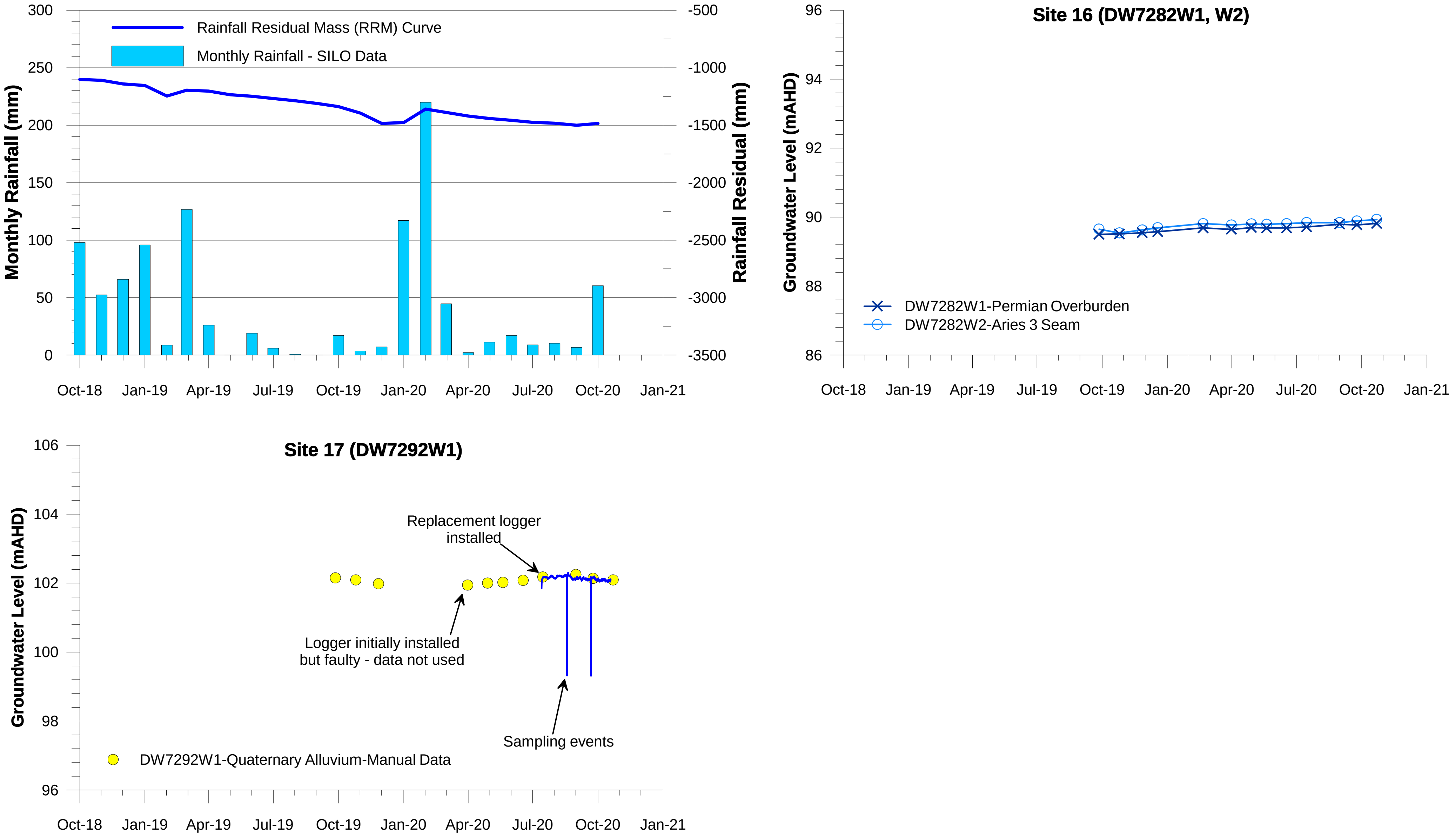
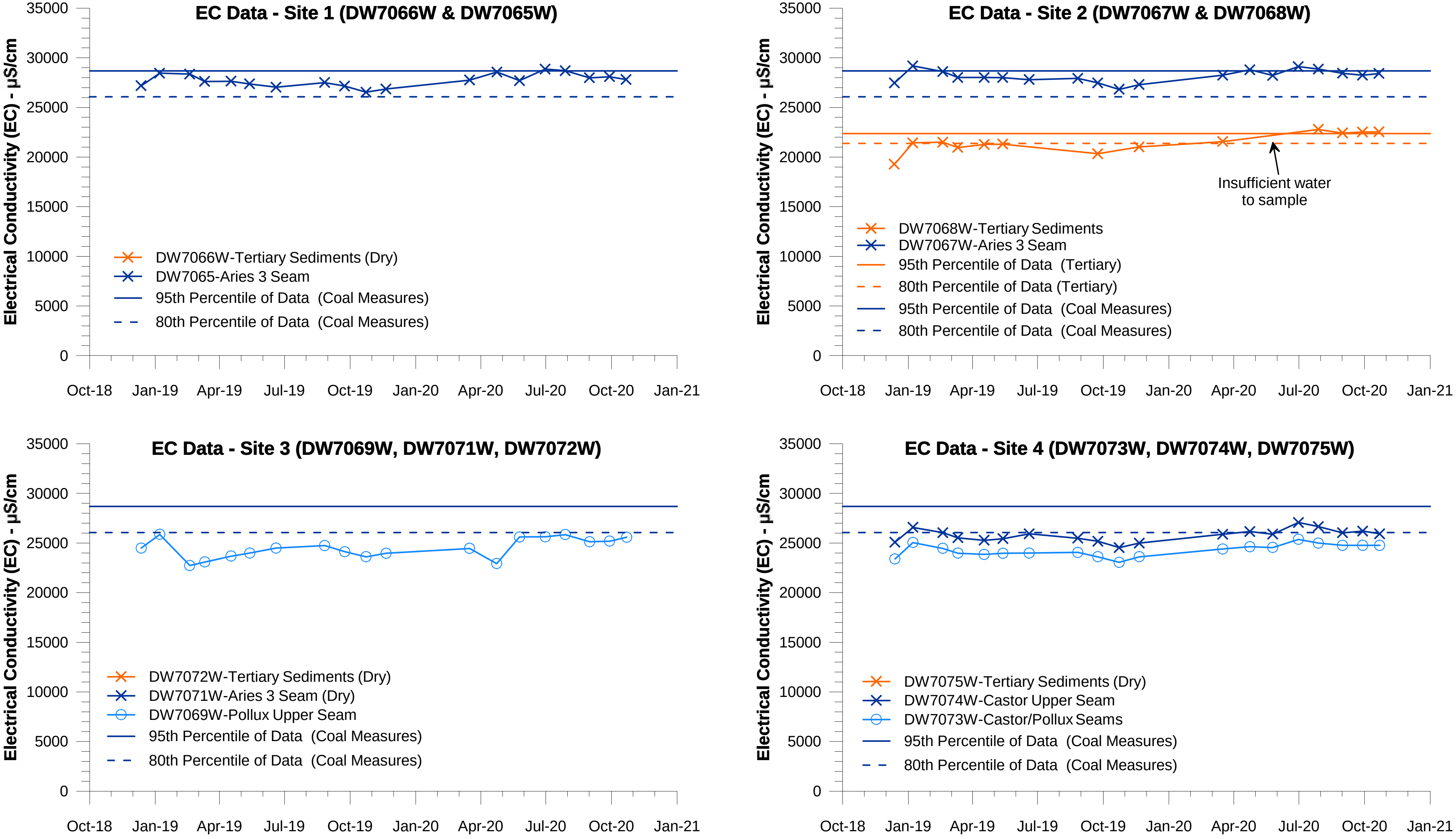

Site 14 (DW7225W1, W2, W3)


Site 15 (DW7264W1, W2, W3)

CLIENT Magnetic South
PROJECT Gemini Project
DRAWN JWB
DATE Nov 2020
CHECKED
DATE
TITLE **Groundwater Level Data**
Monitoring Bores at Sites 13, 14, & 15
SCALE As Shown
A4
PROJECT No. JBT01-071-005
FIGURE No. **6**



CLIENT	Magnetic South	PROJECT	Gemini Project
DRAWN JWB	DATE Nov 2020	TITLE	**Groundwater Level Data** **Monitoring Bores at Sites 16 & 17**
CHECKED	DATE		
SCALE As Shown	**A4**	PROJECT No. JBT01-071-005	FIGURE No. **7**

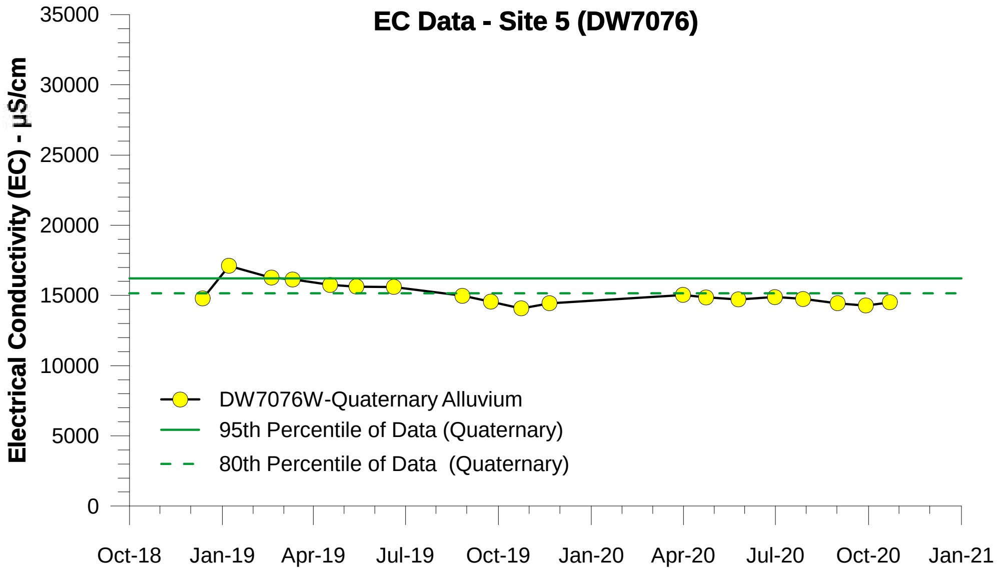

EC Data - Site 1 (DW7066W & DW7065W)

EC Data - Site 2 (DW7067W & DW7068W)

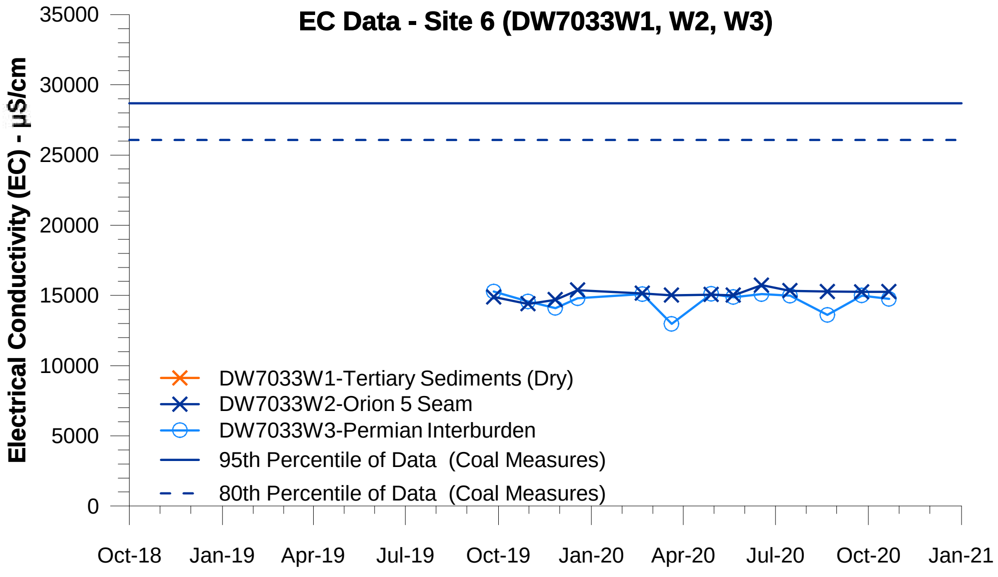
EC Data - Site 3 (DW7069W, DW7071W, DW7072W)

EC Data - Site 4 (DW7073W, DW7074W, DW7075W)

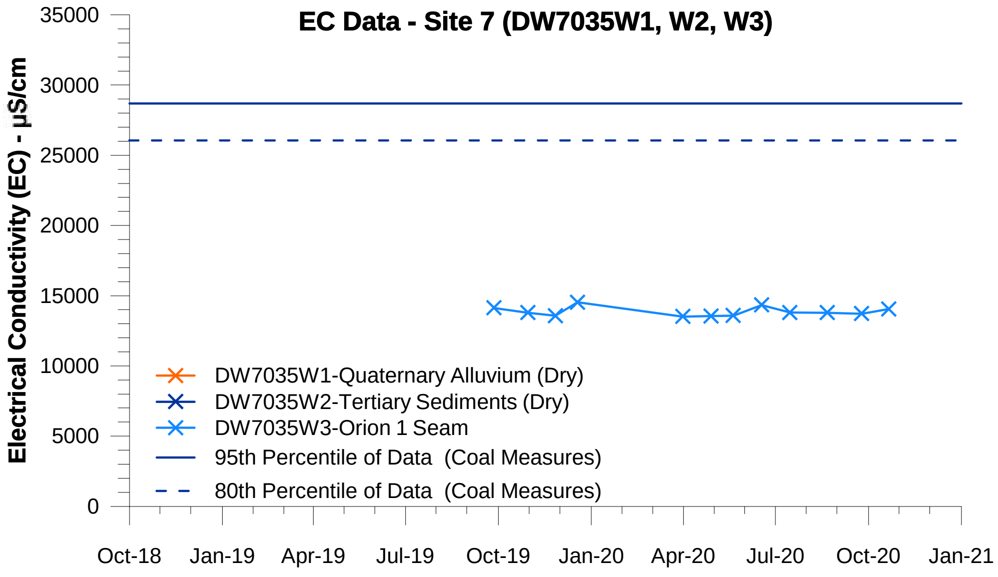
CLIENT Magnetic South		PROJECT Gemini Project	
DRAWN JWB	DATE Nov 2020	TITLE **Electrical Conductivity (EC) Data Monitoring Bores at Sites 1, 2, 3 & 4**	
CHECKED	DATE		
SCALE As Shown	A4	PROJECT No. JBT01-071-005	FIGURE No. 8



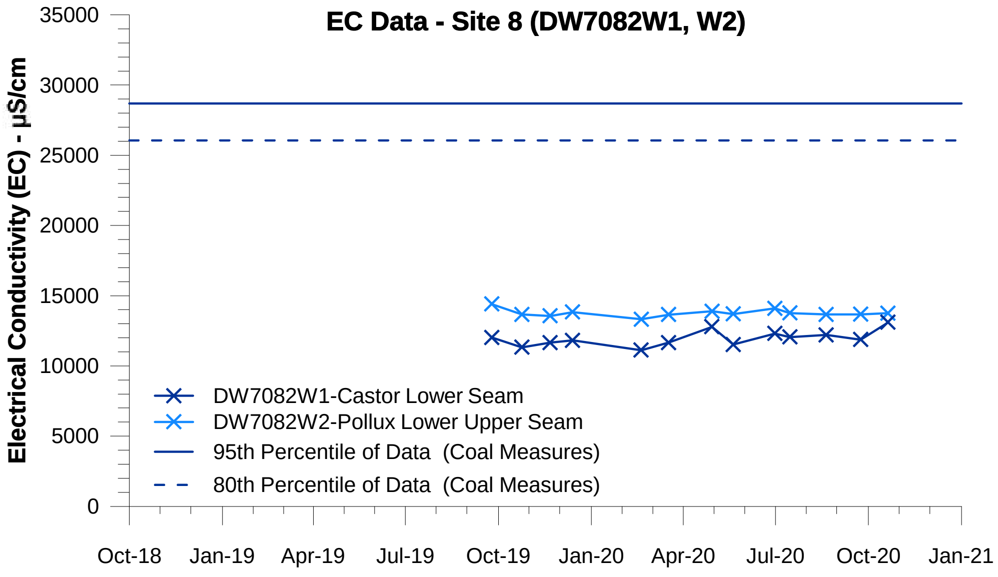
EC Data - Site 5 (DW7076)



EC Data - Site 6 (DW7033W1, W2, W3)



EC Data - Site 7 (DW7035W1, W2, W3)



EC Data - Site 8 (DW7082W1, W2)

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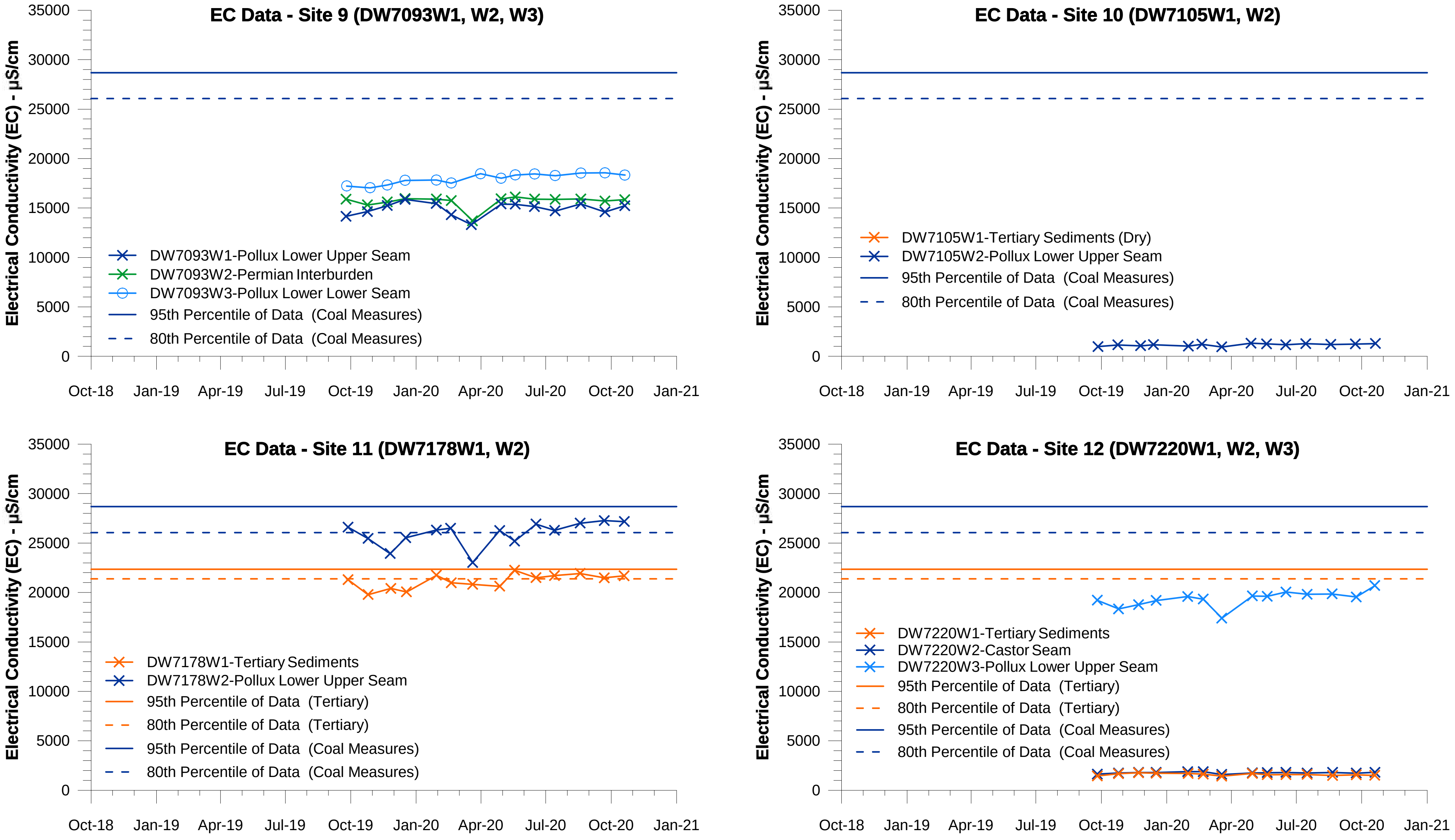
CLIENT Magnetic South
PROJECT Gemini Project
DRAWN JWB
DATE Nov 2020
CHECKED
DATE
TITLE **Electrical Conductivity (EC) Data**
Monitoring Bores at Sites 5, 6, 7 & 8
SCALE As Shown
A4
PROJECT No. JBT01-071-005
FIGURE No. **9**



CLIENT Magnetic South		PROJECT Gemini Project	
DRAWN JWB	DATE Nov 2020	TITLE **Electrical Conductivity (EC) Data Monitoring Bores at Sites 9, 10, 11 & 12**	
CHECKED	DATE		
SCALE As Shown	**A4**	PROJECT No. JBT01-071-005	FIGURE No. **10**

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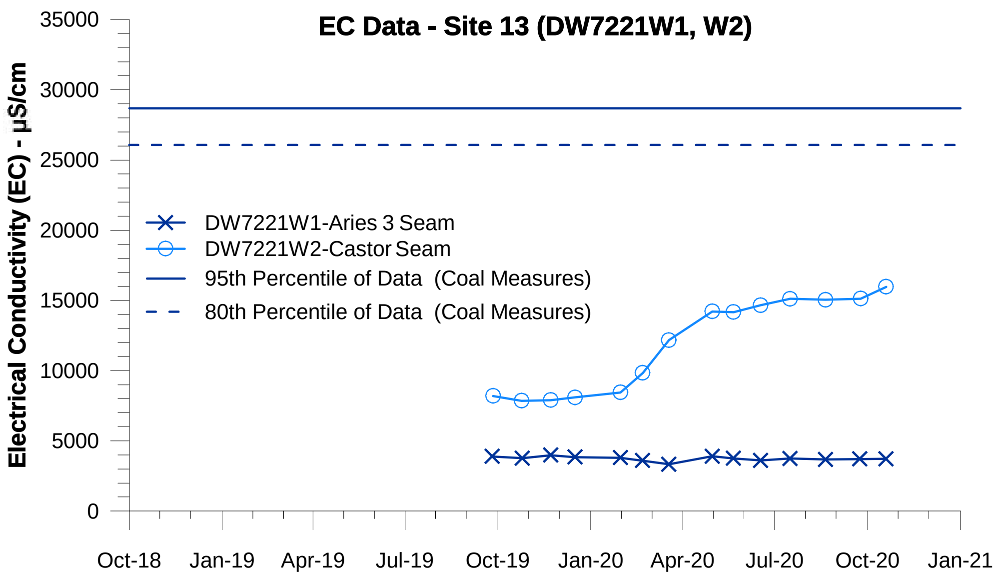
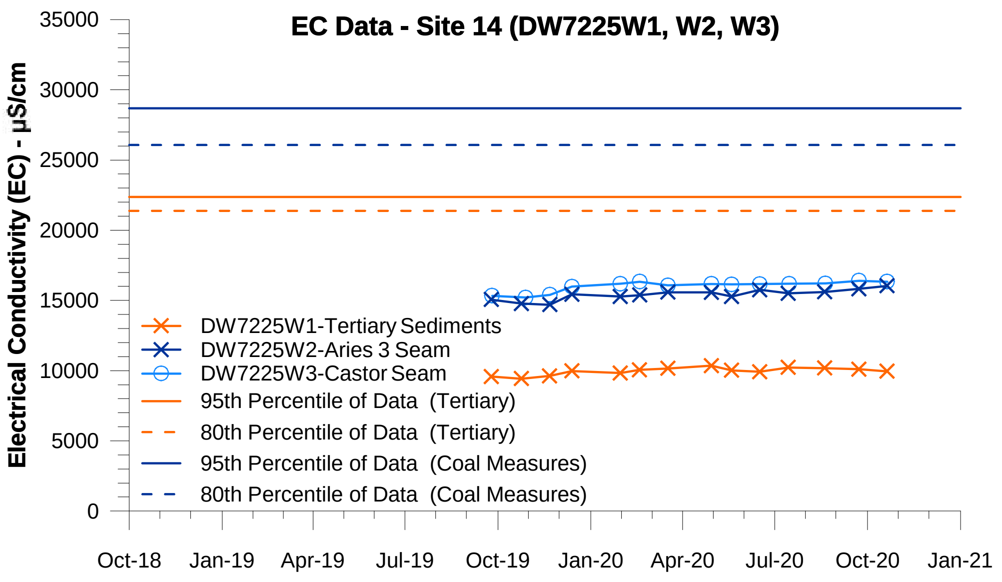
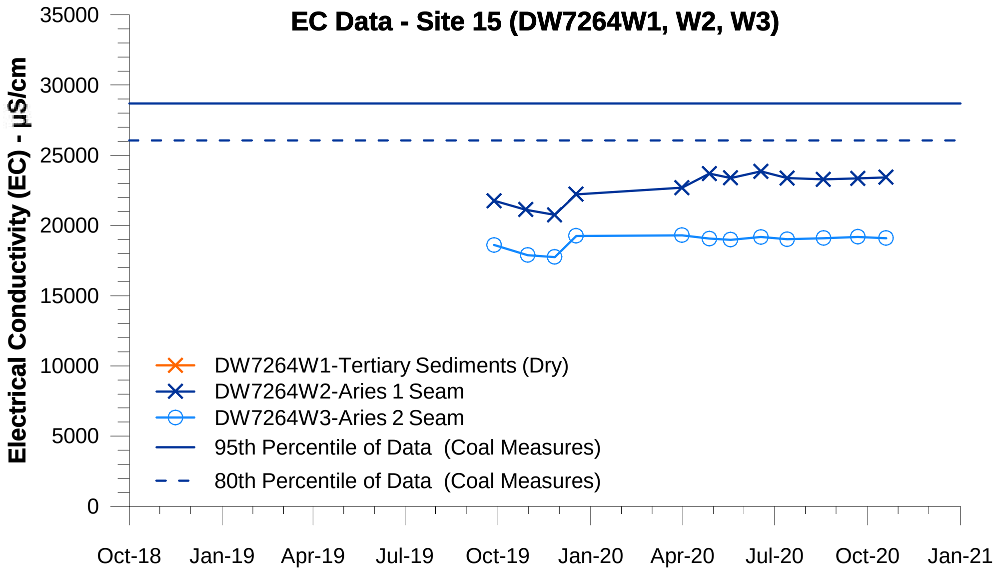
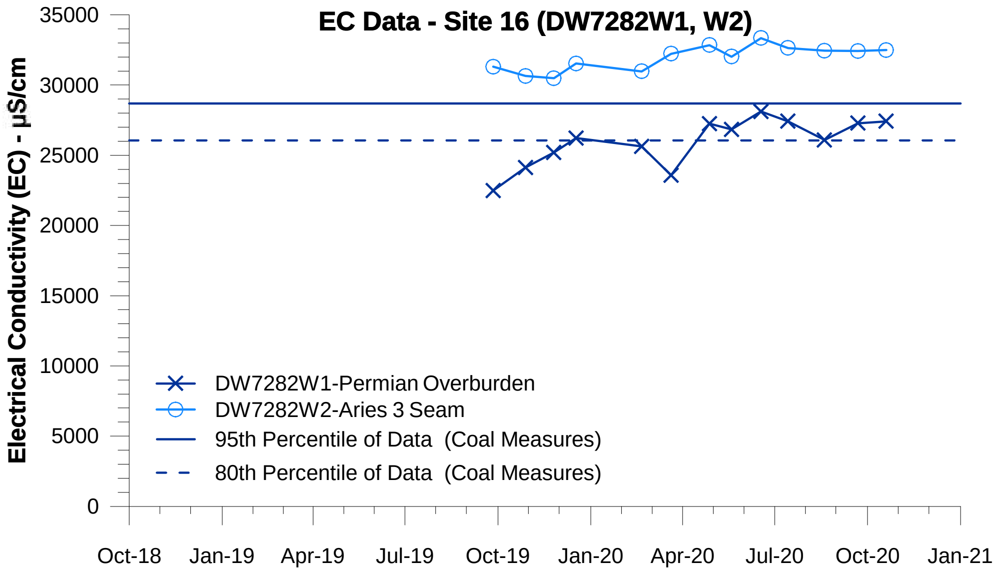
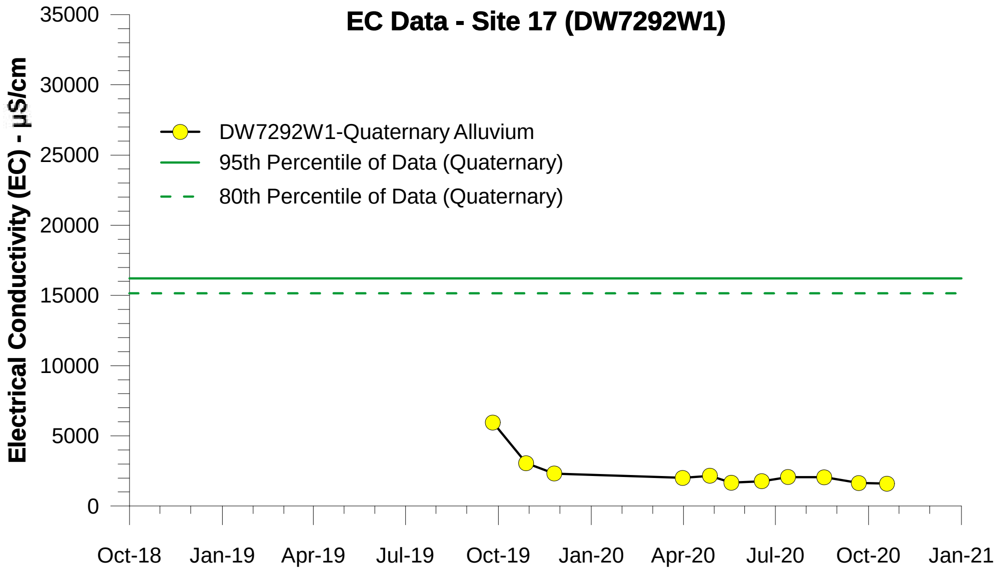

EC Data - Site 13 (DW7221W1, W2)


EC Data - Site 14 (DW7225W1, W2, W3)

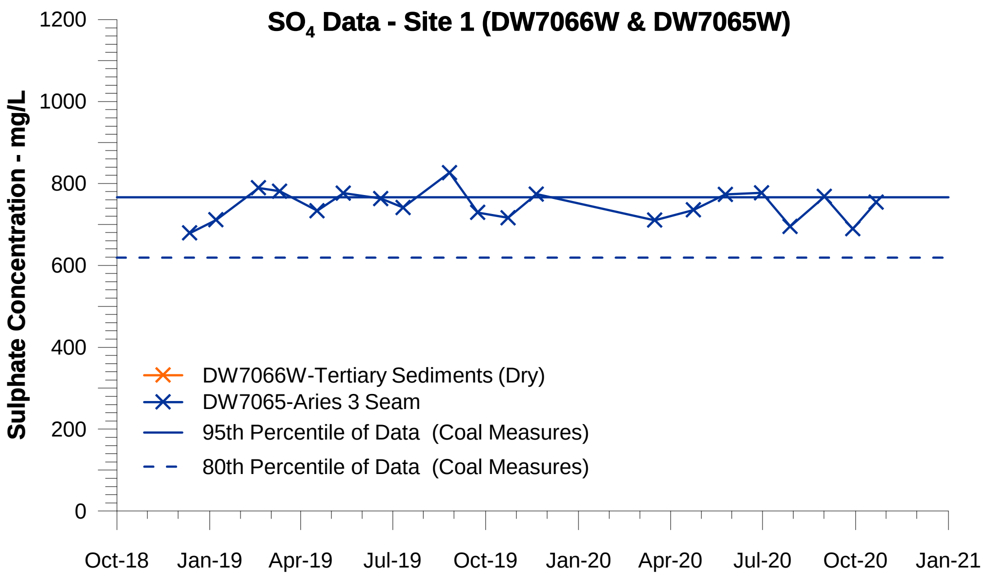

EC Data - Site 15 (DW7264W1, W2, W3)

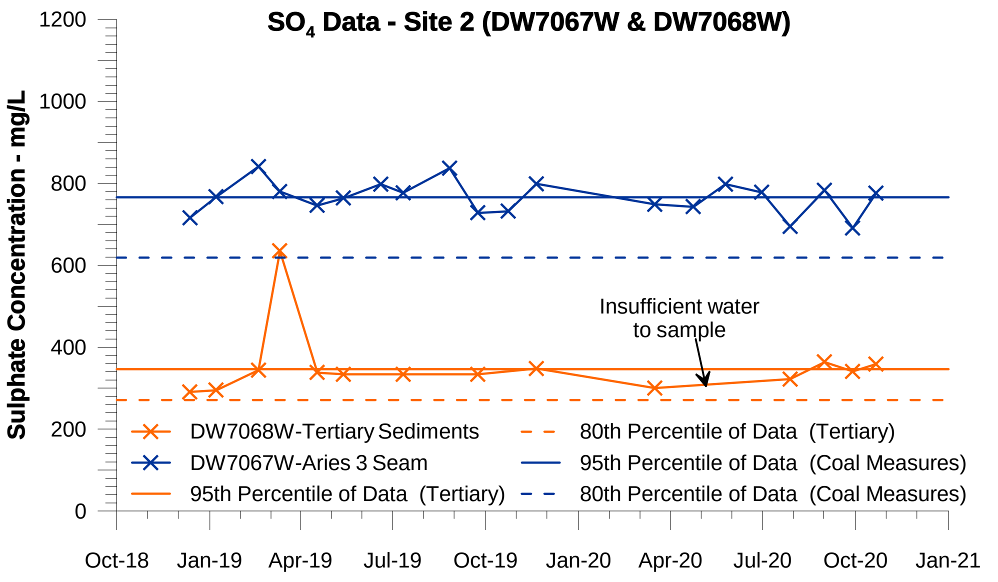

EC Data - Site 16 (DW7282W1, W2)

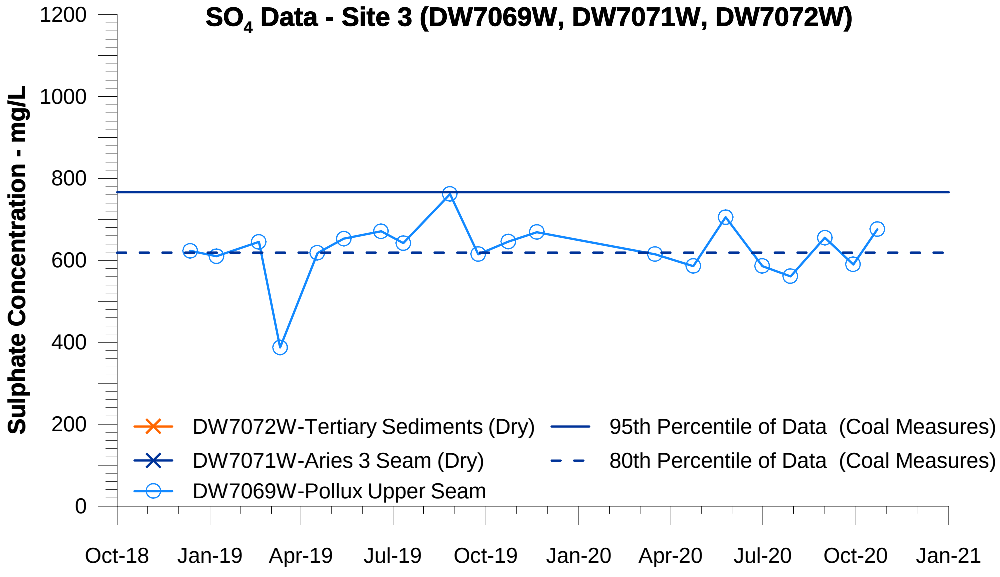
CLIENT	Magnetic South		PROJECT	Gemini Project	
DRAWN	JWB	DATE Nov 2020	TITLE	**Electrical Conductivity (EC) Data Monitoring Bores at Sites 13, 14, 15 & 16**	
CHECKED		DATE			
SCALE	As Shown	A4	PROJECT No.	JBT01-071-005	FIGURE No. **11**

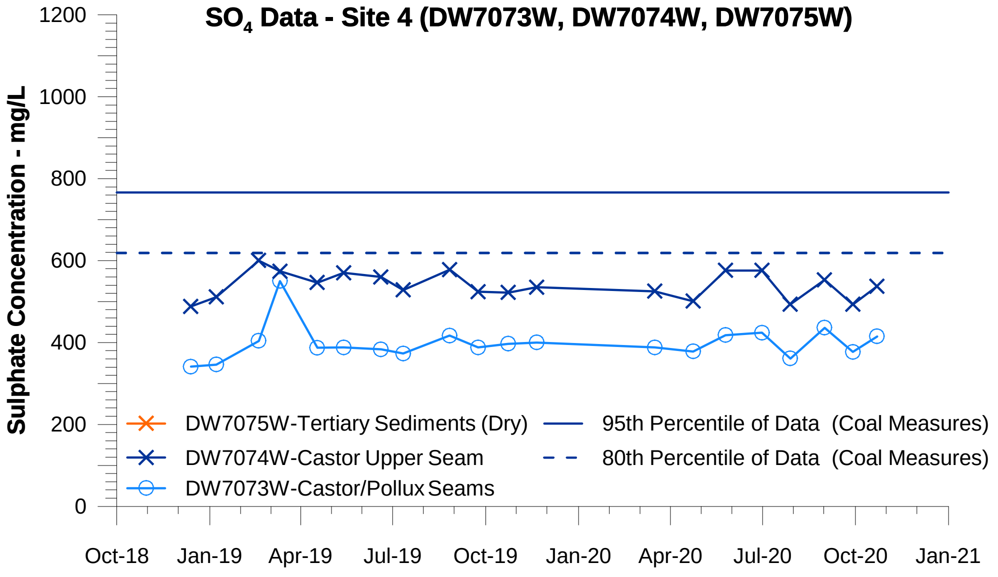


CLIENT	Magnetic South			PROJECT	Gemini Project	
DRAWN	JWB	DATE	Nov 2020	TITLE	**Electrical Conductivity (EC) Data Monitoring Bores at Site 17**	
CHECKED		DATE				
SCALE	As Shown		**A4**	PROJECT No. JBT01-071-005	FIGURE No.	**12**

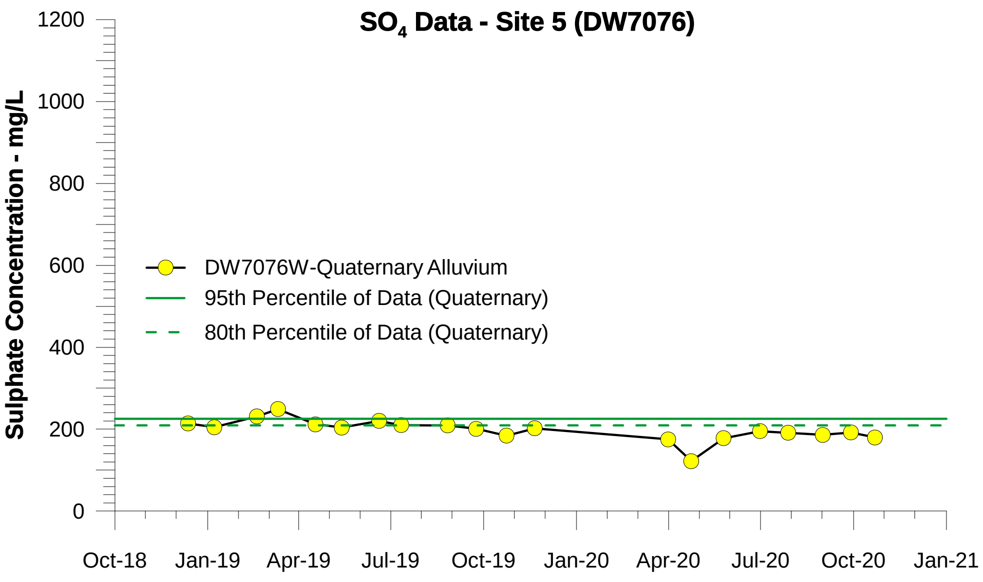




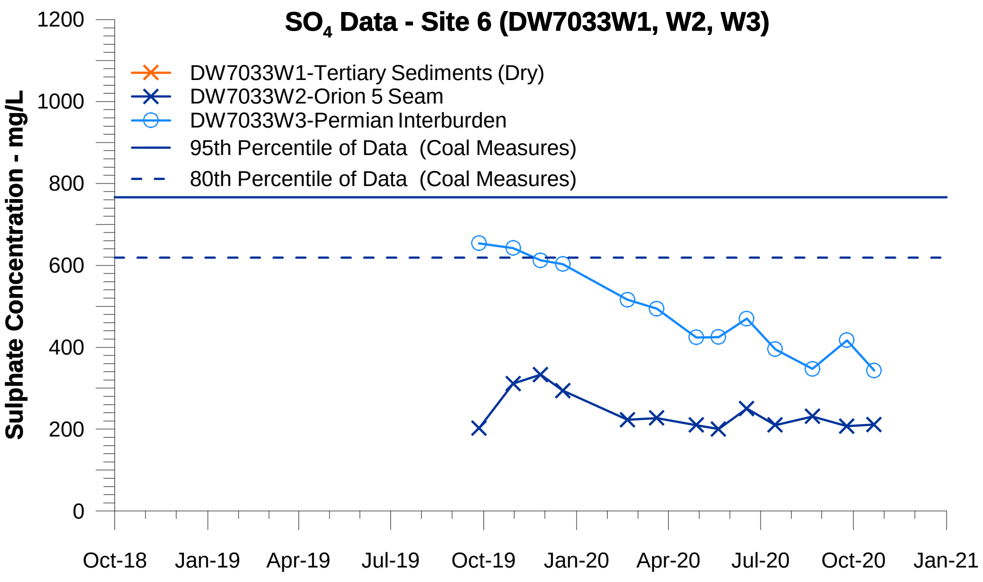




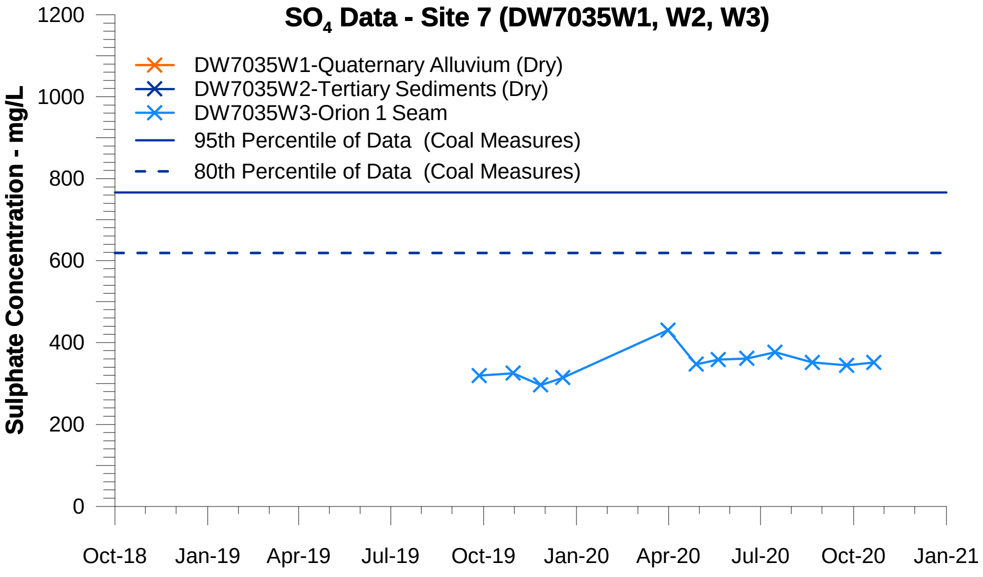
CLIENT	Magnetic South	PROJECT	Gemini Project
DRAWN	JWB	DATE	Nov 2020
CHECKED		DATE	
TITLE	**Sulphate (SO_4) Data Monitoring Bores at Sites 1, 2, 3 & 4**		
SCALE	As Shown	A4	
PROJECT No.	JBT01-071-005	FIGURE No.	**13**



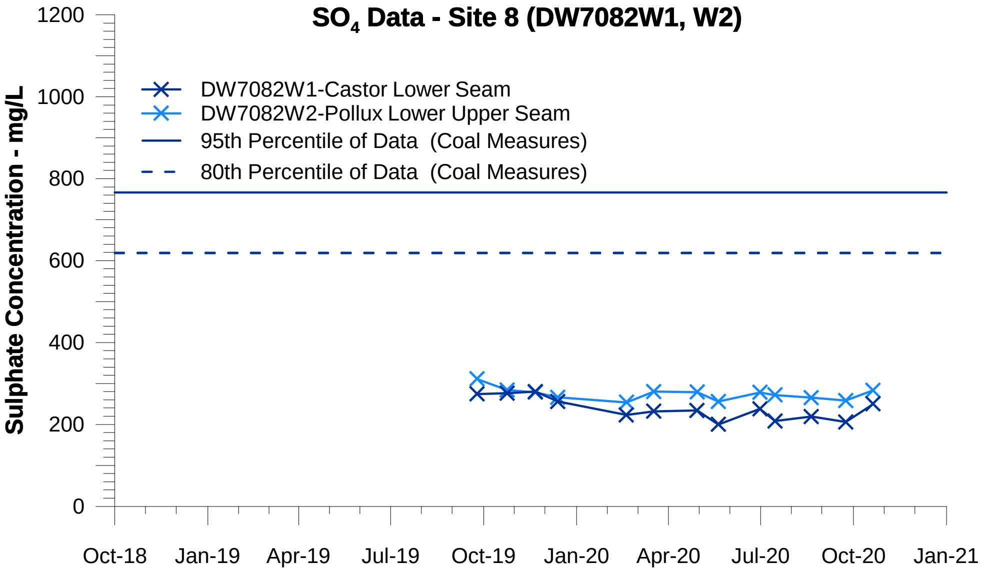
SO_4 Data - Site 5 (DW7076)



SO_4 Data - Site 6 (DW7033W1, W2, W3)



SO_4 Data - Site 7 (DW7035W1, W2, W3)



SO_4 Data - Site 8 (DW7082W1, W2)

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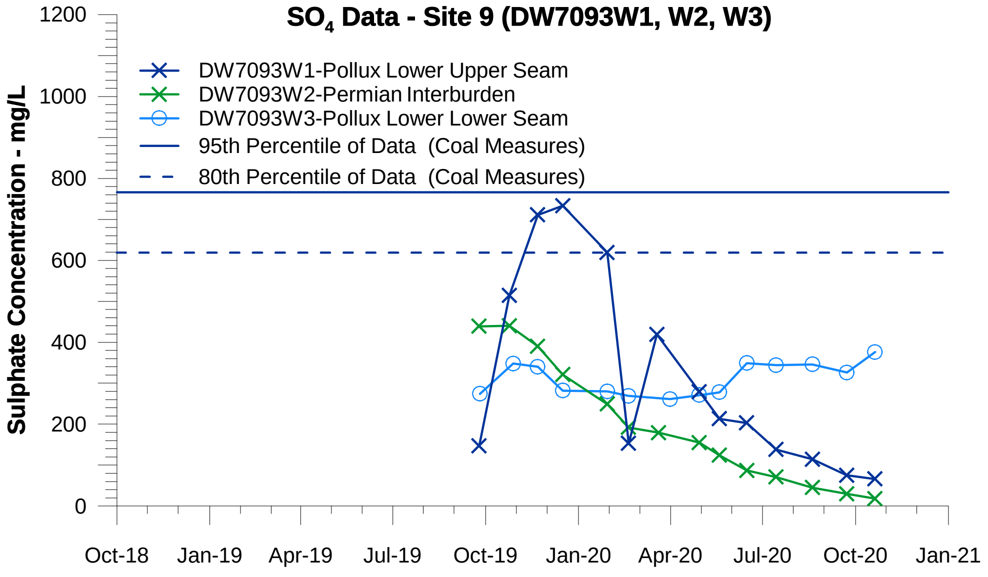
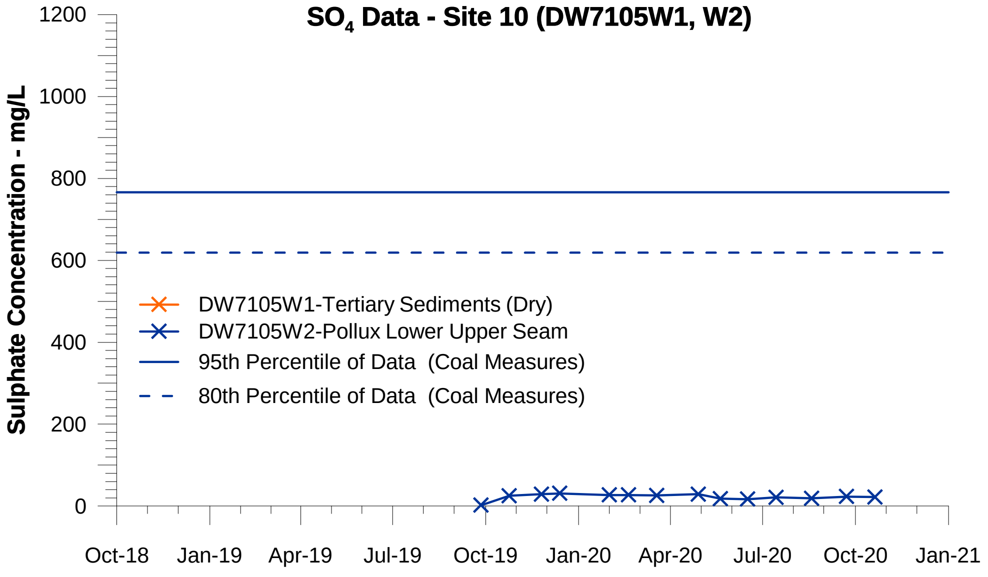
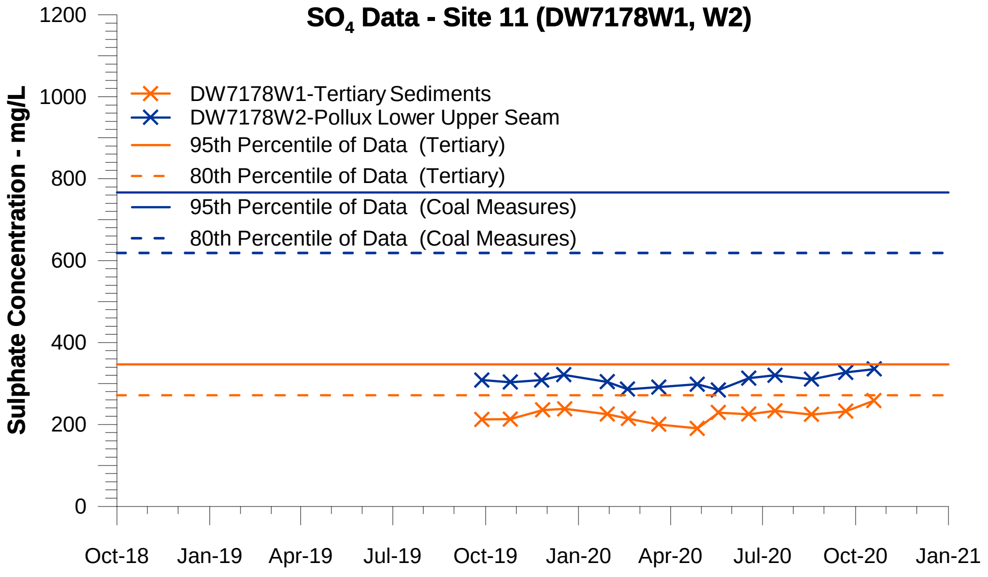
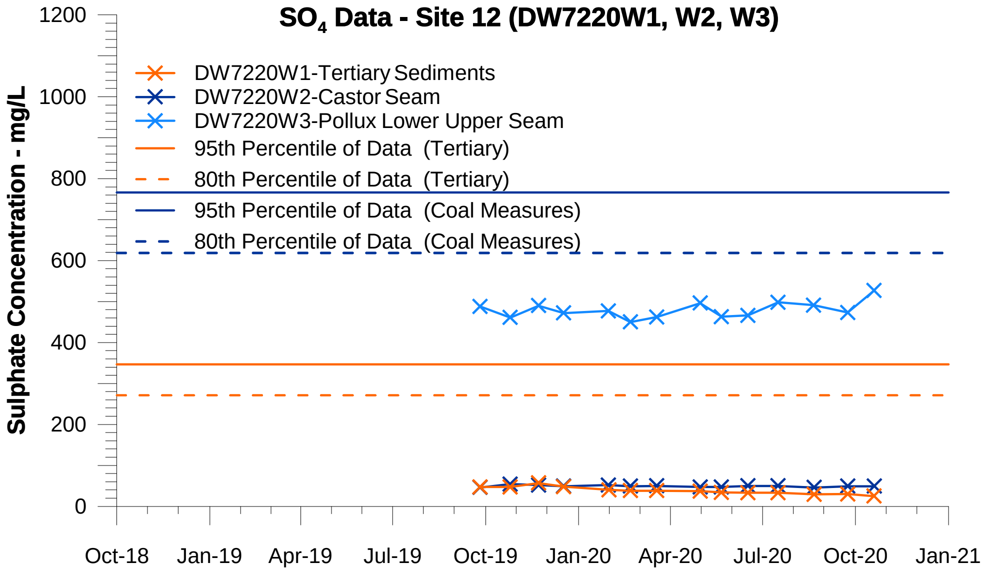
CLIENT Magnetic South		PROJECT Gemini Project	
DRAWN JWB	DATE Nov 2020	TITLE **Sulphate (SO_4) Data Monitoring Bores at Sites 5, 6, 7 & 8**	
CHECKED	DATE		
SCALE As Shown	**A4**	PROJECT No. JBT01-071-005	FIGURE No. **14**

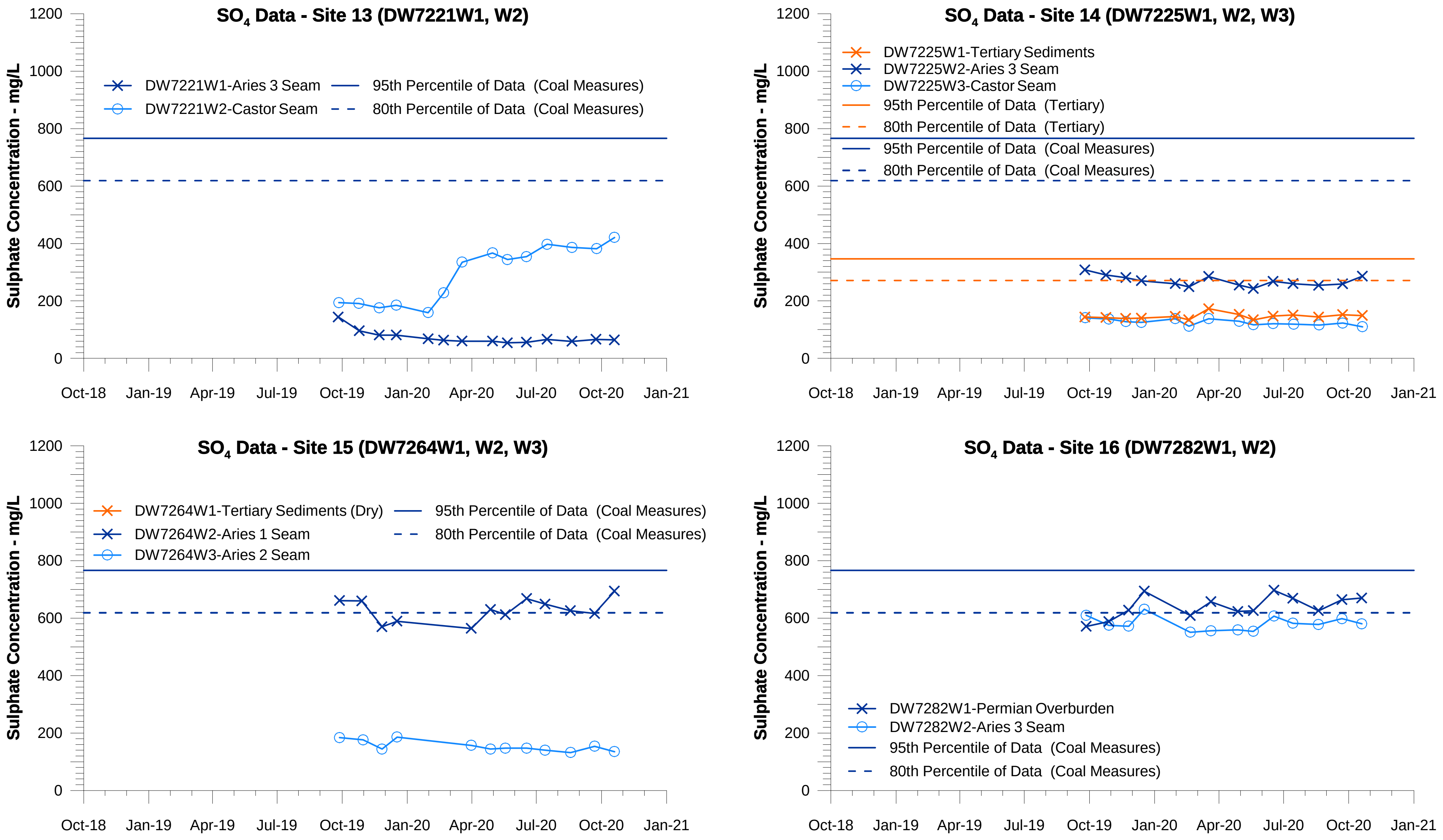

SO$_4$ Data - Site 9 (DW7093W1, W2, W3)


SO$_4$ Data - Site 10 (DW7105W1, W2)

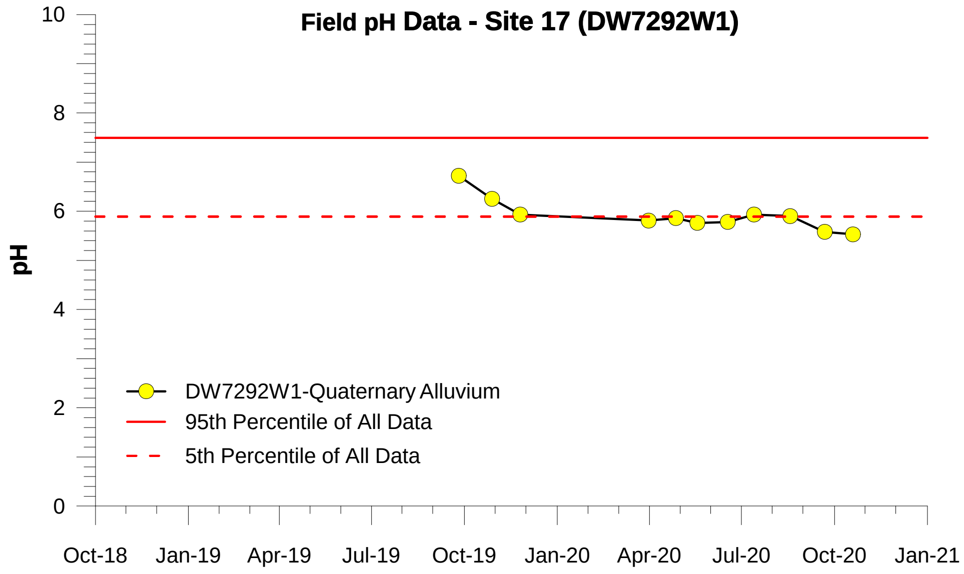

SO$_4$ Data - Site 11 (DW7178W1, W2)


SO$_4$ Data - Site 12 (DW7220W1, W2, W3)

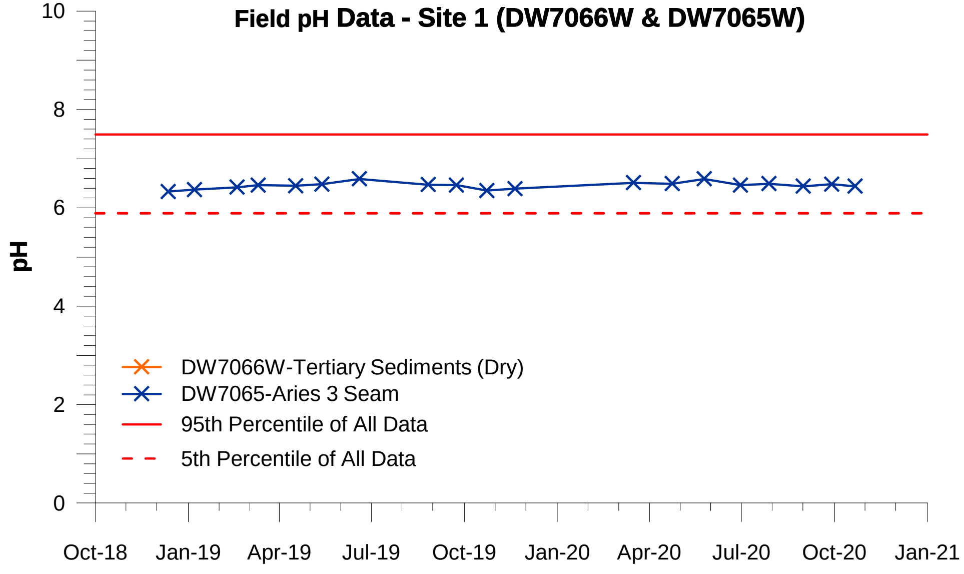
CLIENT Magnetic South
DRAWN JWB
DATE Nov 2020
CHECKED
DATE
SCALE As Shown
A4
PROJECT Gemini Project
TITLE **Sulphate (SO$_4$) Data**
Monitoring Bores at Sites 9, 10, 11 & 12
PROJECT No. JBT01-071-005
FIGURE No. **15**

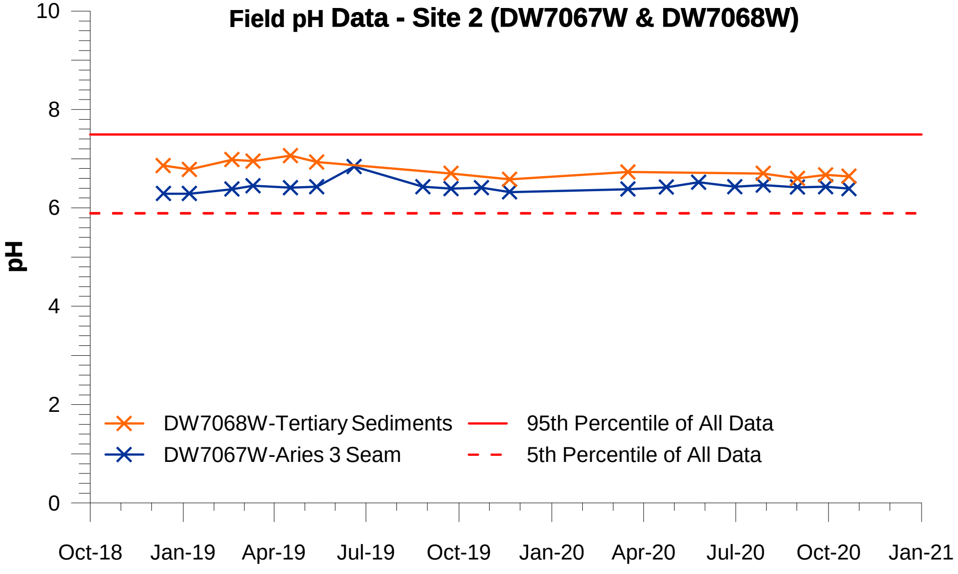


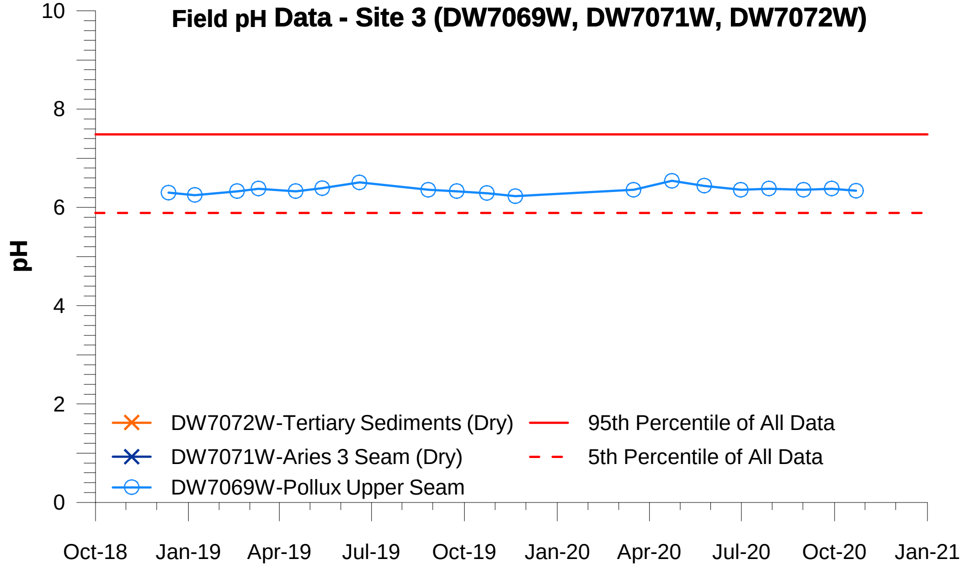
CLIENT	Magnetic South		PROJECT	Gemini Project
DRAWN	JWB	DATE Nov 2020	TITLE	**Sulphate (SO$_4$) Data** **Monitoring Bores at Sites 13, 14, 15 & 16**
CHECKED		DATE		
SCALE	As Shown	**A4**	PROJECT No. JBT01-071-005	FIGURE No. **16**

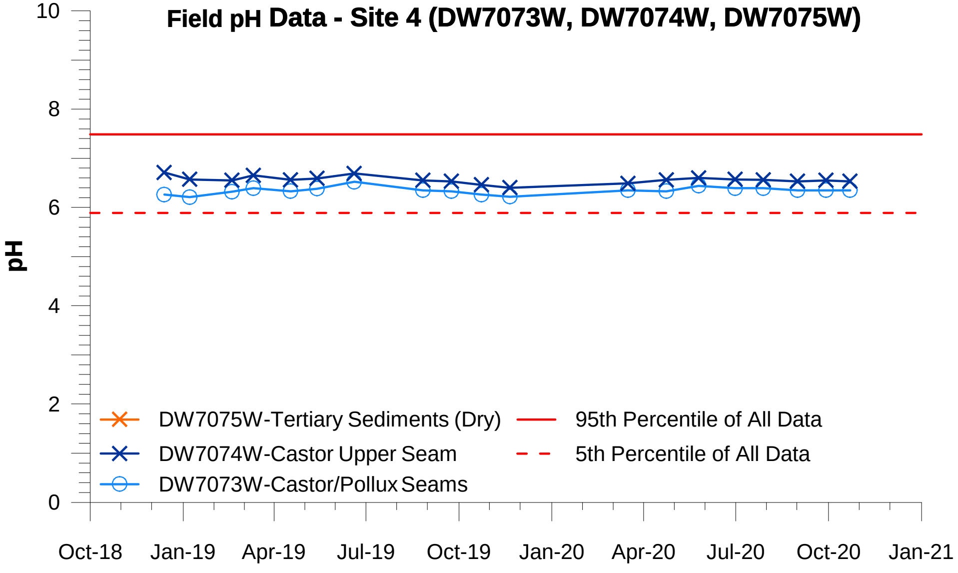


CLIENT Magnetic South			PROJECT Gemini Project	
DRAWN JWB	DATE Nov 2020		TITLE **Field pH Data Monitoring Bores at Site 17**	
CHECKED	DATE			
SCALE As Shown		**A4**	PROJECT No. JBT01-071-005	FIGURE No. **17**

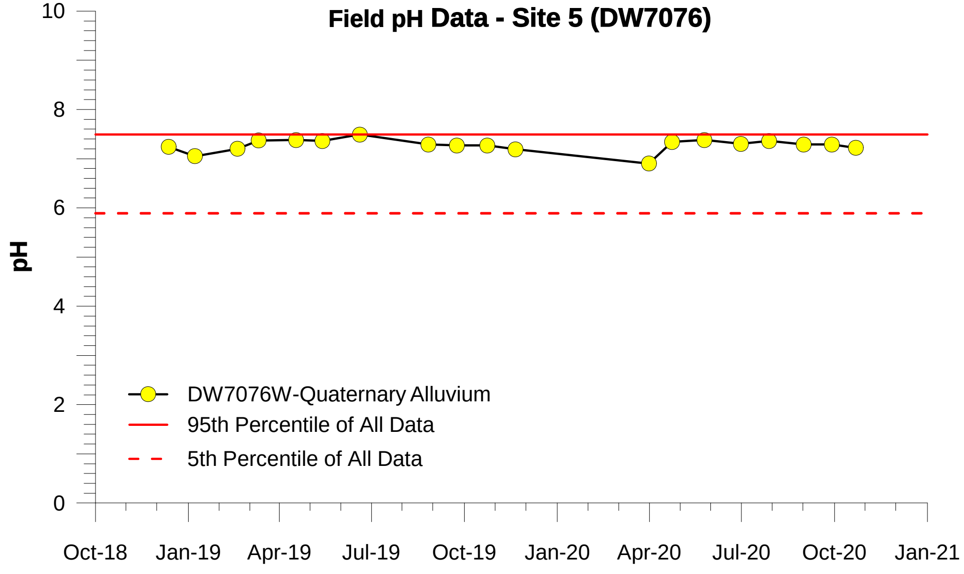


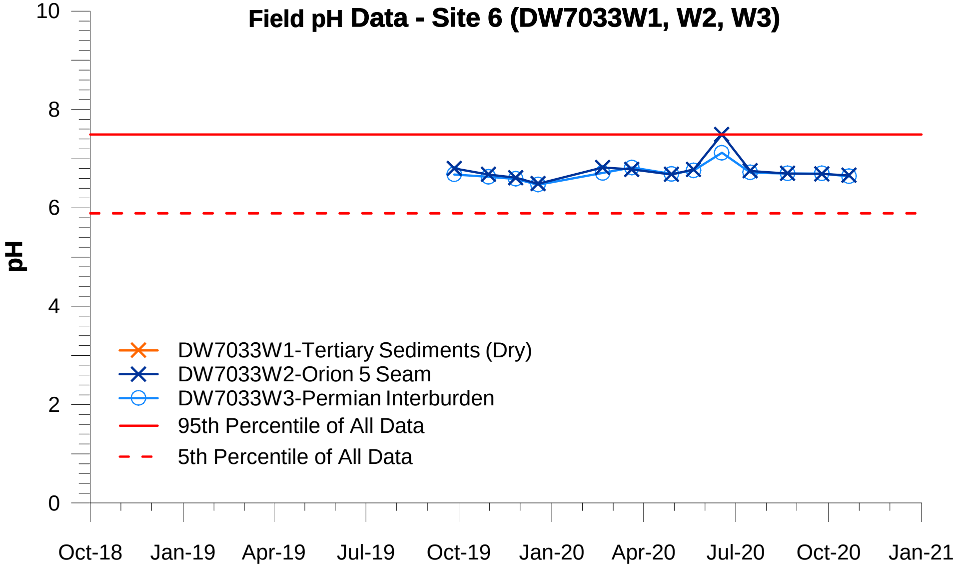


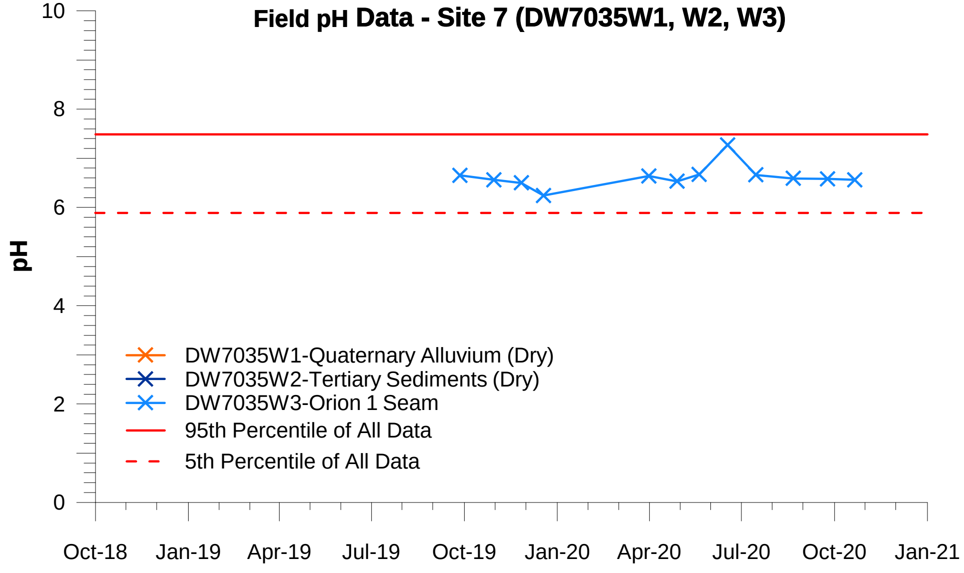


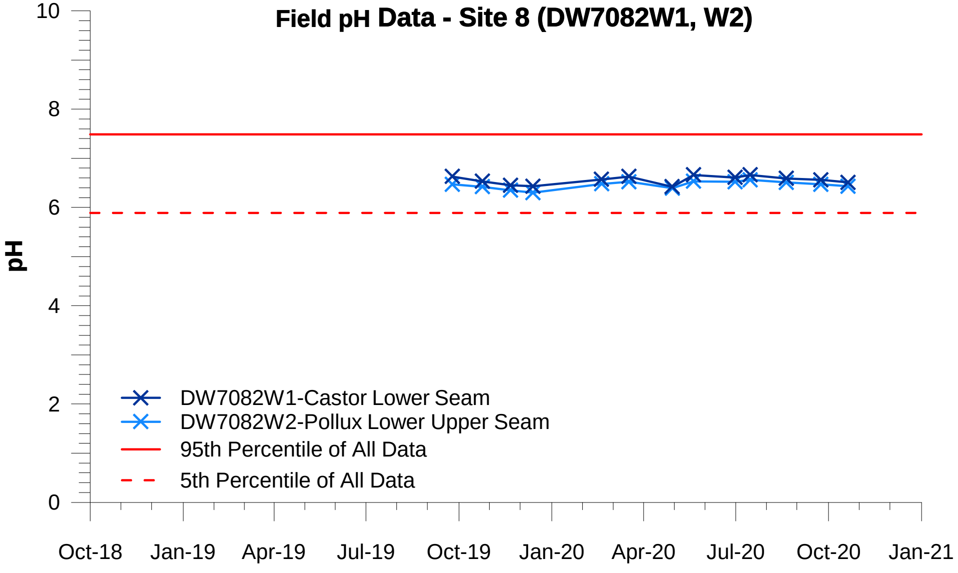


CLIENT	Magnetic South		PROJECT	Gemini Project
DRAWN	JWB	DATE Nov 2020	TITLE	**Field pH Data Monitoring Bores at Sites 1, 2, 3 & 4**
CHECKED		DATE		
SCALE	As Shown	**A4**	PROJECT No. JBT01-071-005	FIGURE No. **18**


Field pH Data - Site 5 (DW7076)


Field pH Data - Site 6 (DW7033W1, W2, W3)


Field pH Data - Site 7 (DW7035W1, W2, W3)


Field pH Data - Site 8 (DW7082W1, W2)

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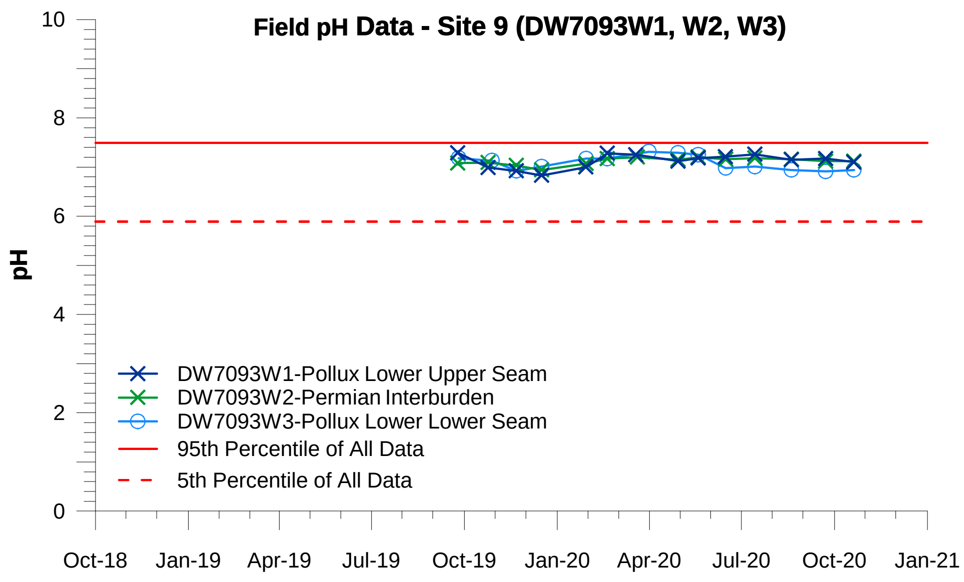
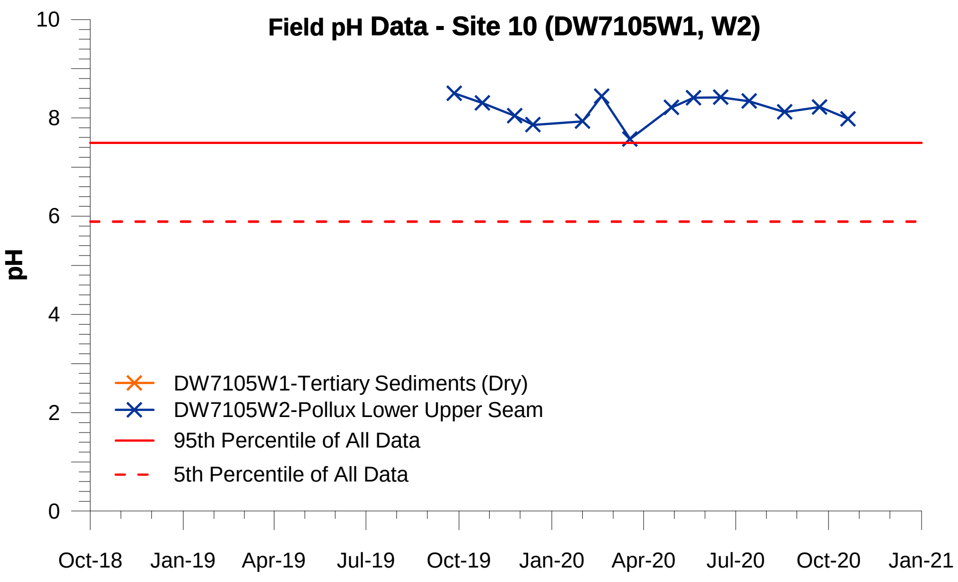
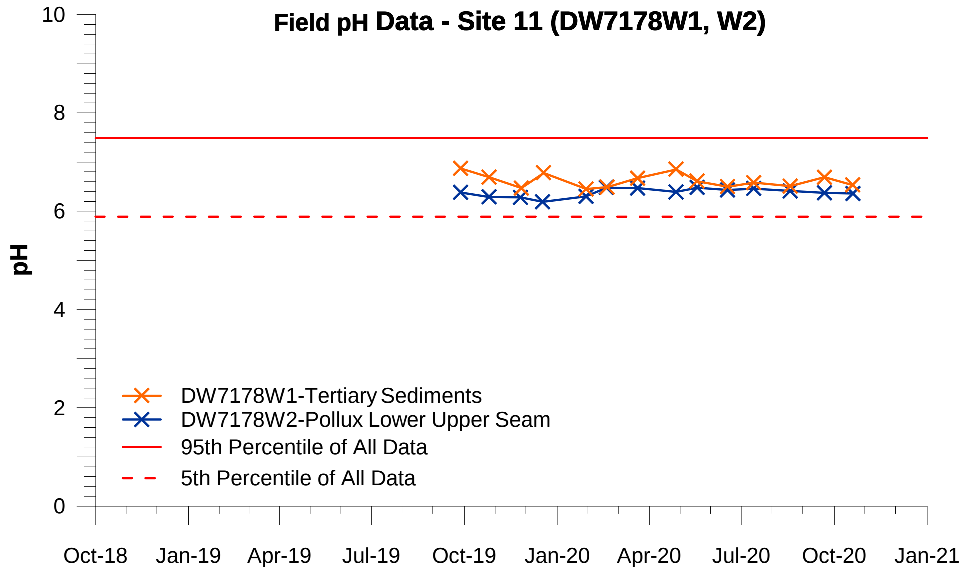
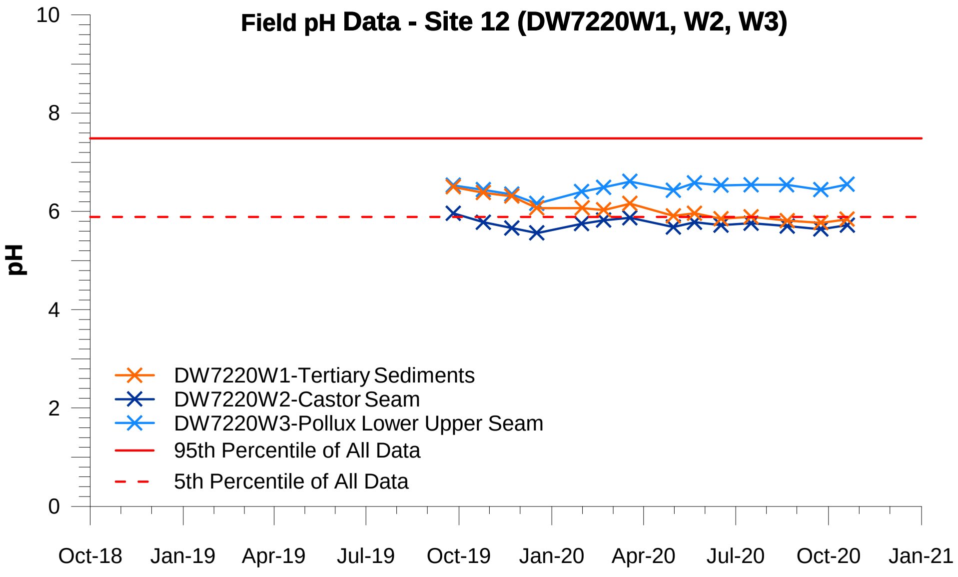
CLIENT Magnetic South
PROJECT Gemini Project
DRAWN JWB
DATE Nov 2020
CHECKED
DATE
TITLE **Field pH Data**
Monitoring Bores at Sites 5, 6, 7 & 8
SCALE As Shown
A4
PROJECT No. JBT01-071-005
FIGURE No. **19**


Field pH Data - Site 9 (DW7093W1, W2, W3)


Field pH Data - Site 10 (DW7105W1, W2)


Field pH Data - Site 11 (DW7178W1, W2)


Field pH Data - Site 12 (DW7220W1, W2, W3)

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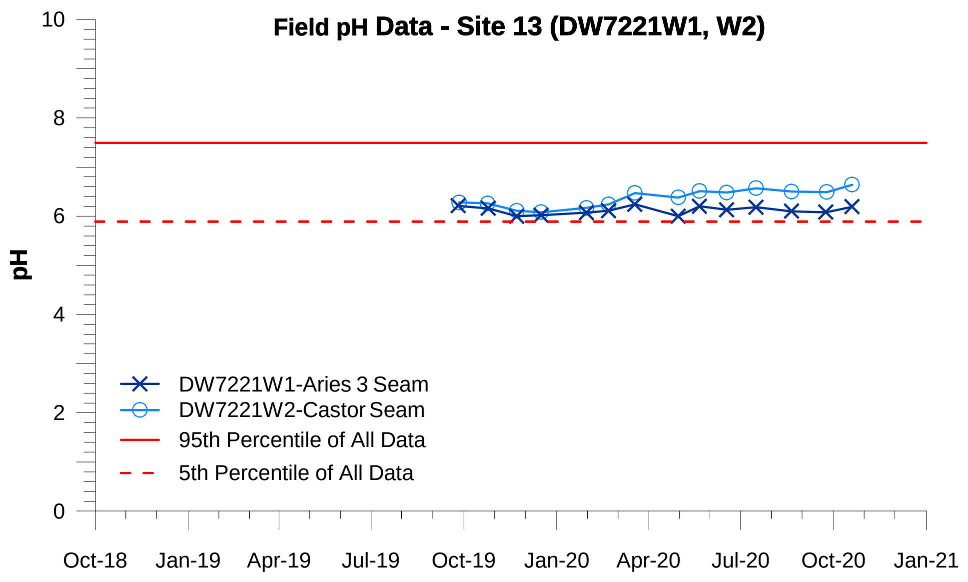
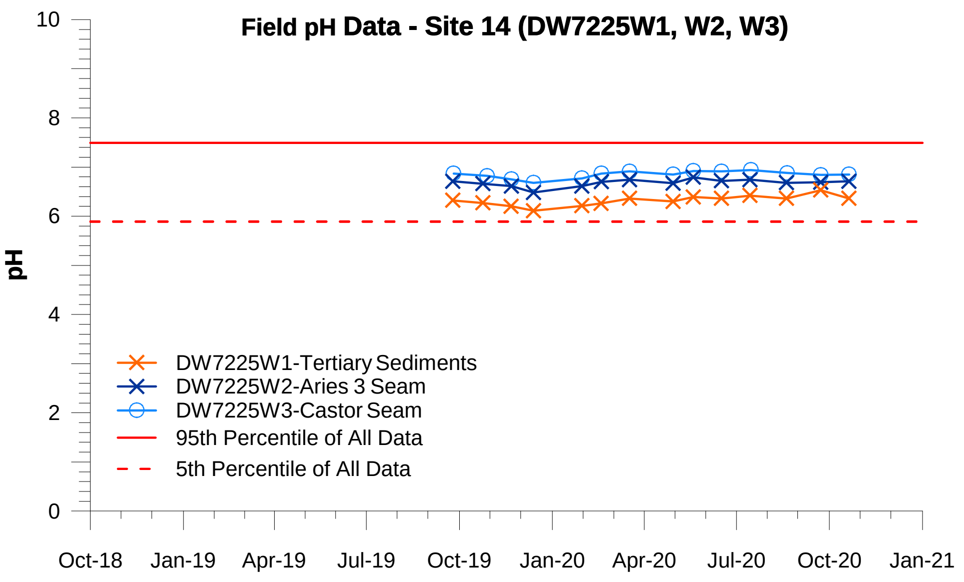
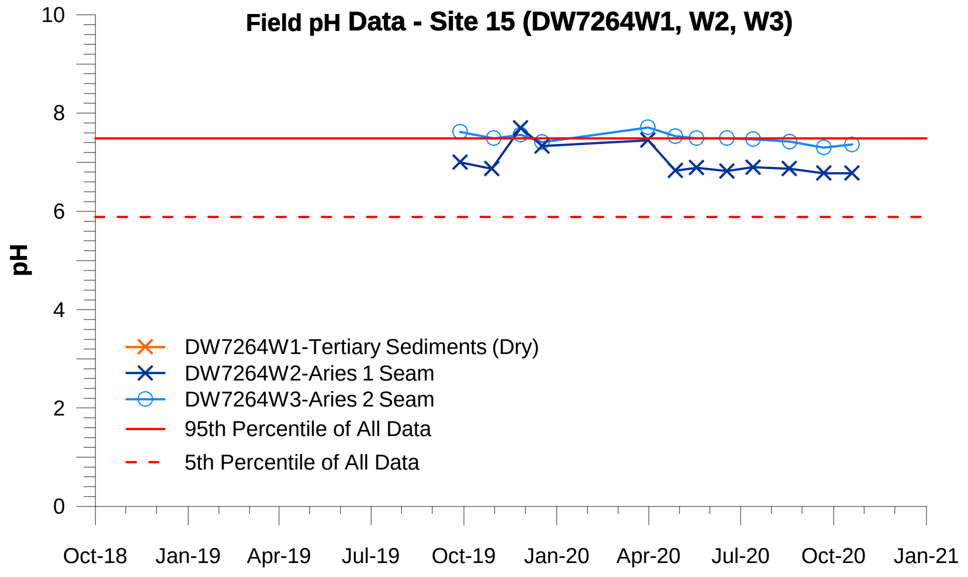
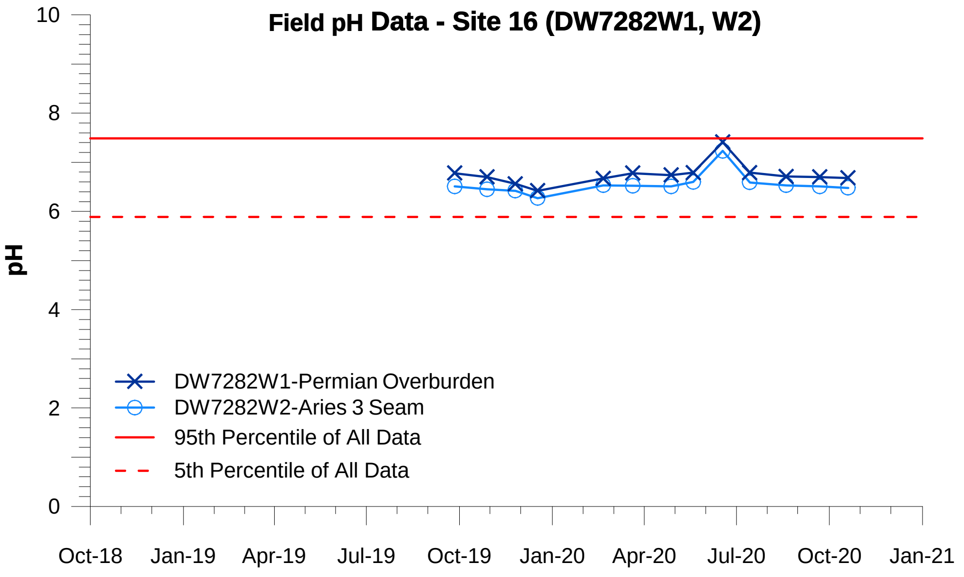
CLIENT Magnetic South
PROJECT Gemini Project
DRAWN JWB
DATE Nov 2020
CHECKED
DATE
TITLE **Field pH Data**
Monitoring Bores at Sites 9, 10, 11 & 12
SCALE As Shown
A4
PROJECT No. JBT01-071-005
FIGURE No. **20**









CLIENT Magnetic South

PROJECT Gemini Project

DRAWN JWB

DATE Nov 2020

TITLE **Field pH Data**
Monitoring Bores at Sites 13, 14, 15 & 16

CHECKED

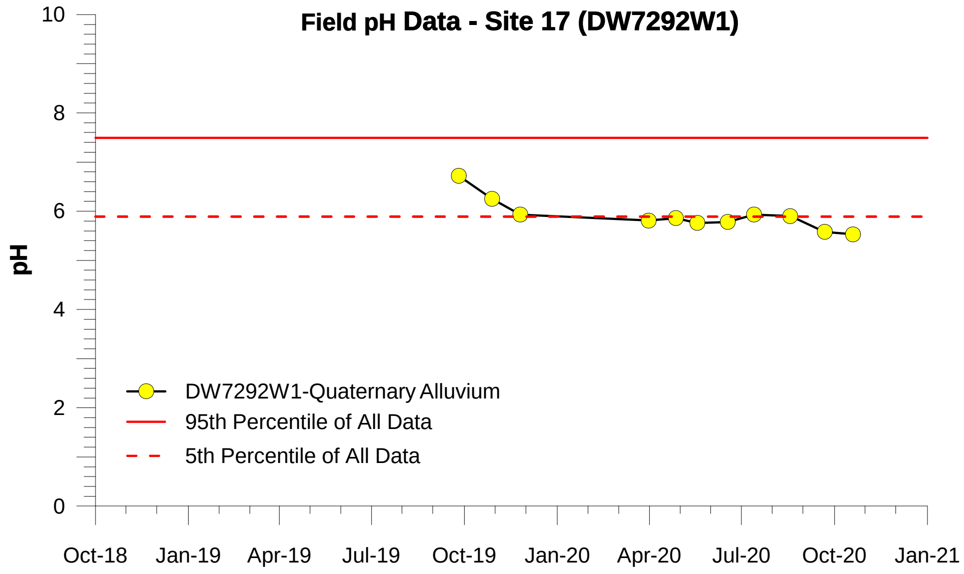
DATE

SCALE As Shown

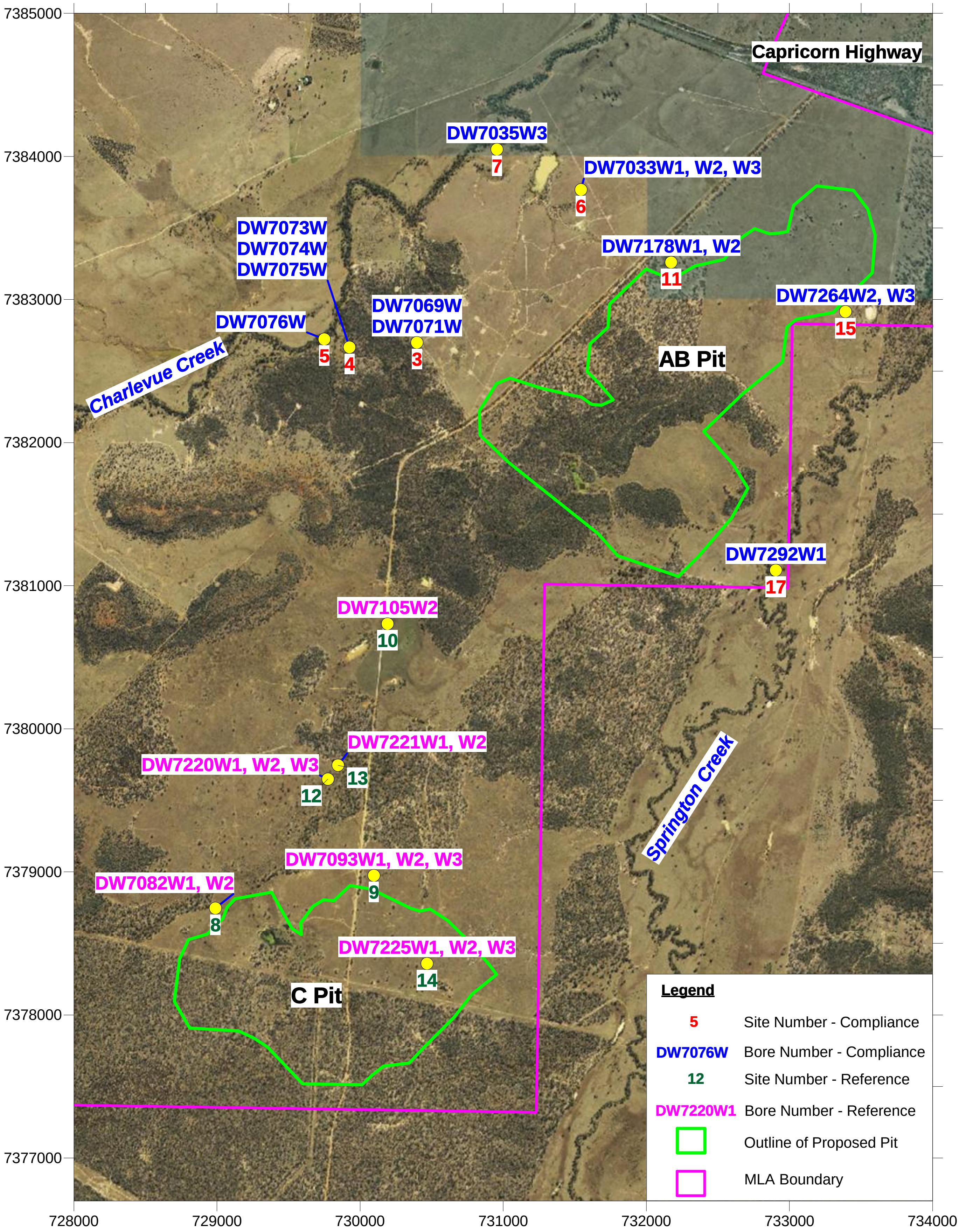
A4

PROJECT No. JBT01-071-005

FIGURE No. **21**



CLIENT Magnetic South			PROJECT Gemini Project	
DRAWN JWB	DATE Nov 2020		TITLE **Field pH Data** **Monitoring Bores at Site 17**	
CHECKED	DATE			
SCALE As Shown		**A4**	PROJECT No. JBT01-071-005	FIGURE No. **22**



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CLIENT Magnetic South

PROJECT Gemini Project

DRAWN JWB

DATE Nov 2020

CHECKED

DATE

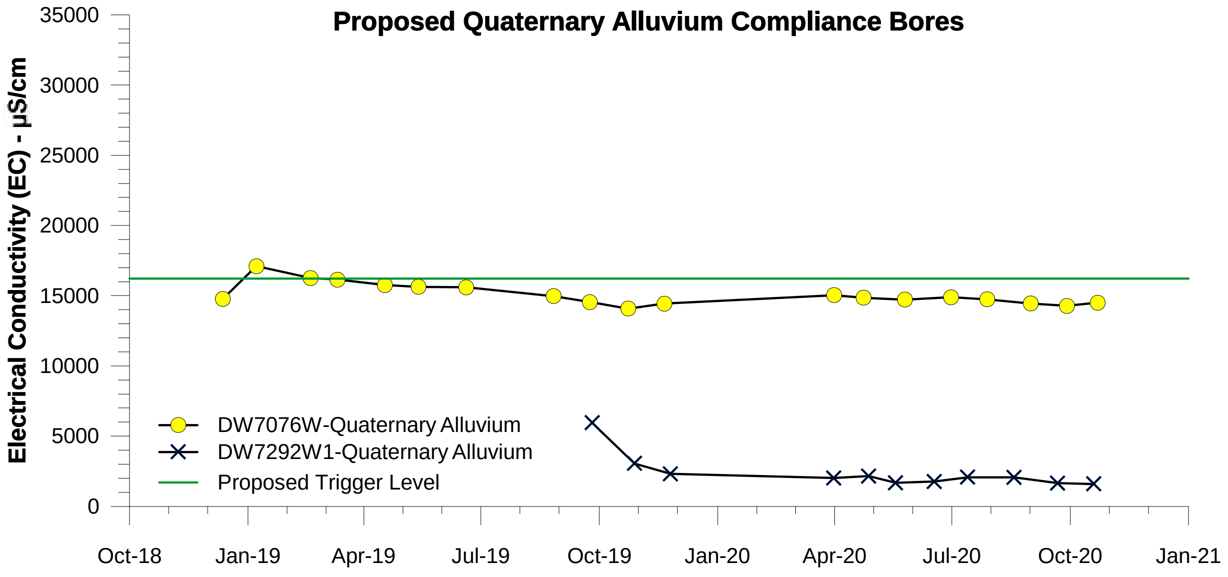
TITLE **Proposed Groundwater Compliance and Reference Bores**

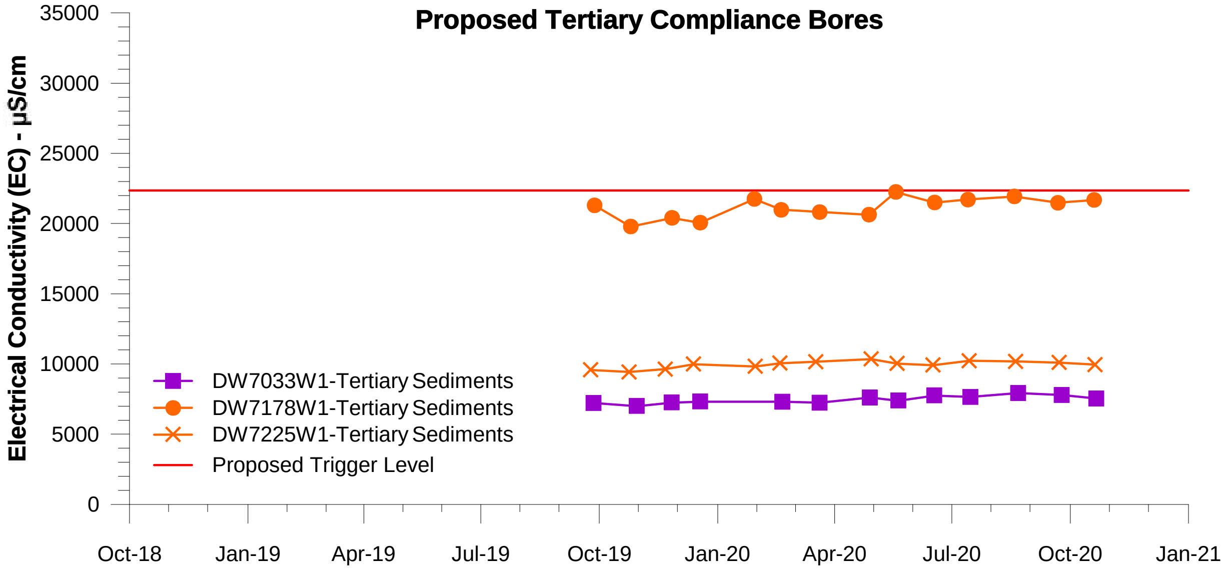
SCALE As Shown

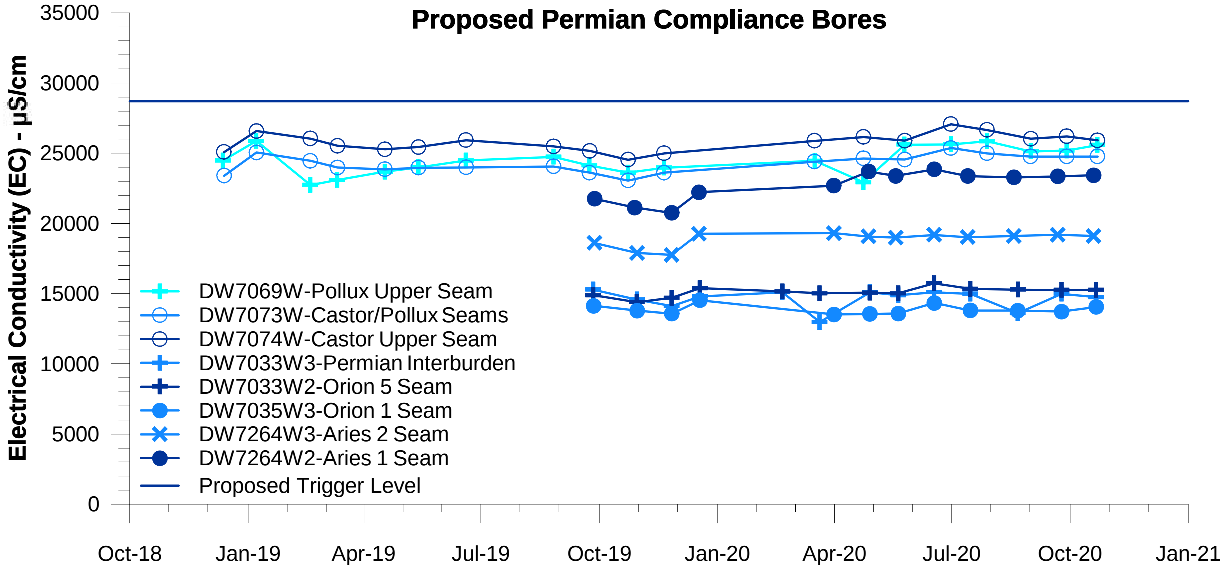
A4

PROJECT No JBT01-071-005

FIGURE No. **23**







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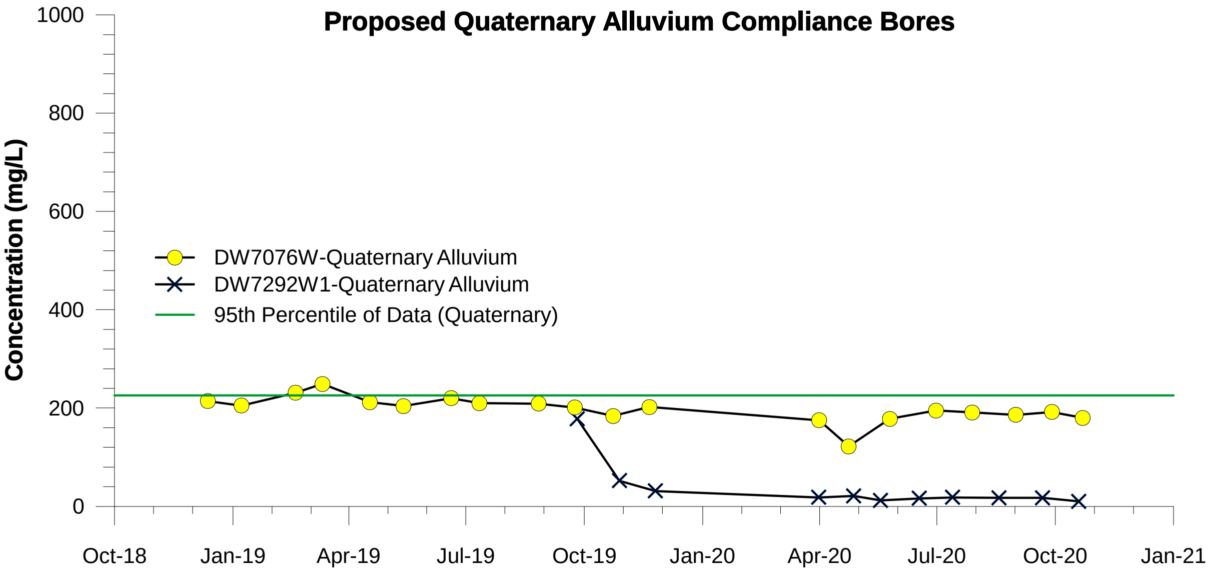
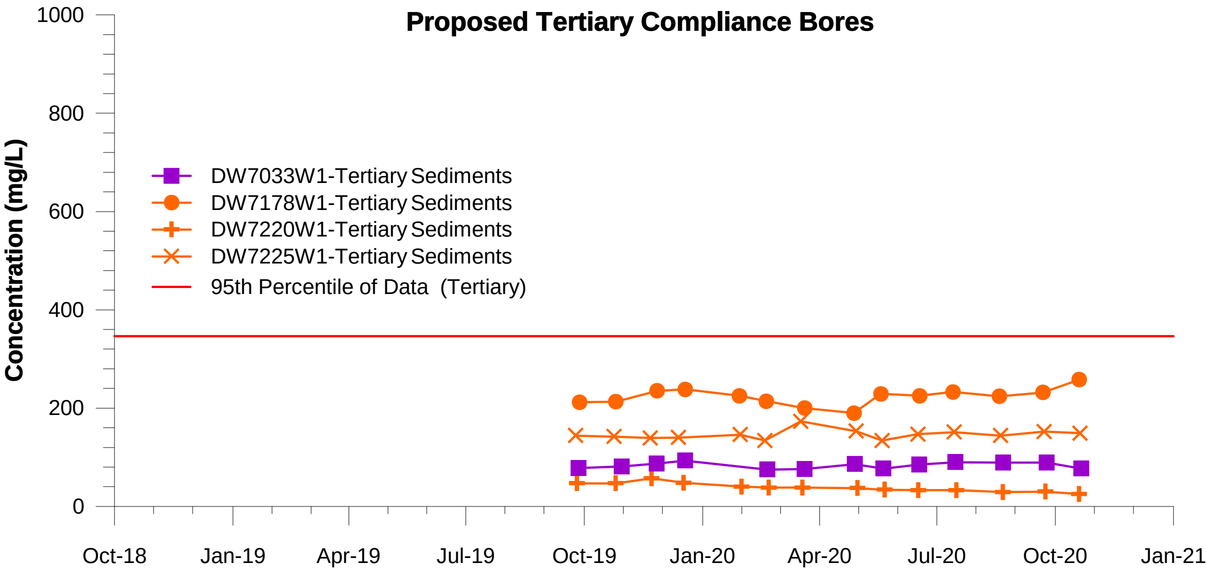
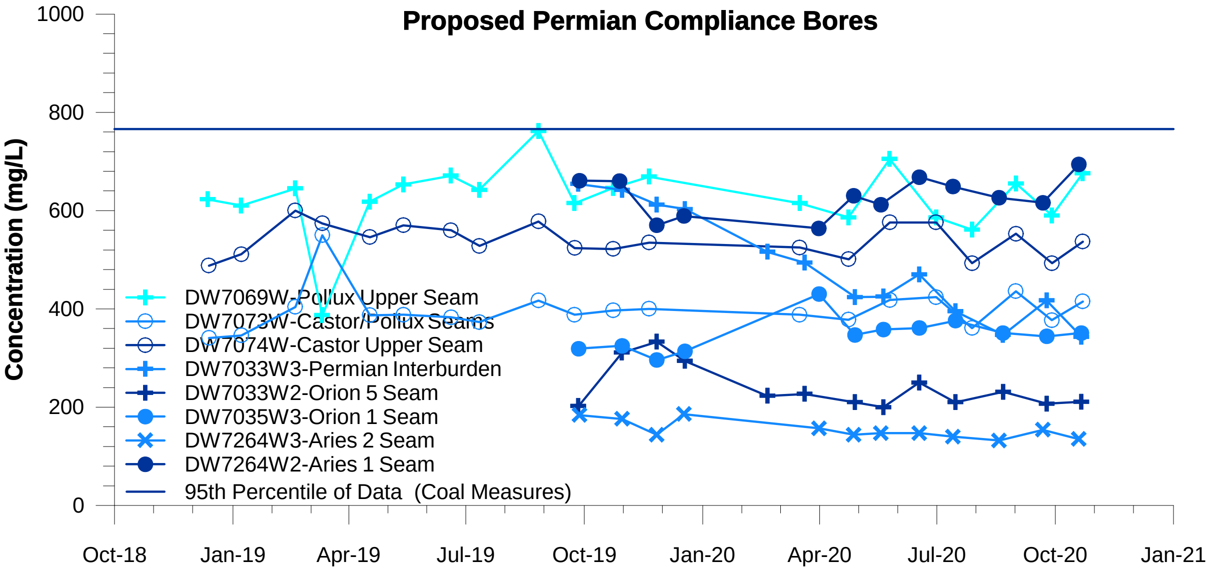
CLIENT Magnetic South
PROJECT Gemini Project
DRAWN JWB
DATE Nov 2020
CHECKED
DATE
TITLE **Field Electrical Conductivity (EC) Data**
Proposed Compliance Bores
SCALE As Shown
A4
PROJECT No. JBT01-071-005
FIGURE No. **24**


Proposed Quaternary Alluvium Compliance Bores


Proposed Tertiary Compliance Bores


Proposed Permian Compliance Bores

JBT consulting

CLIENT Magnetic South

PROJECT Gemini Project

DRAWN JWB

DATE Nov 2020

CHECKED

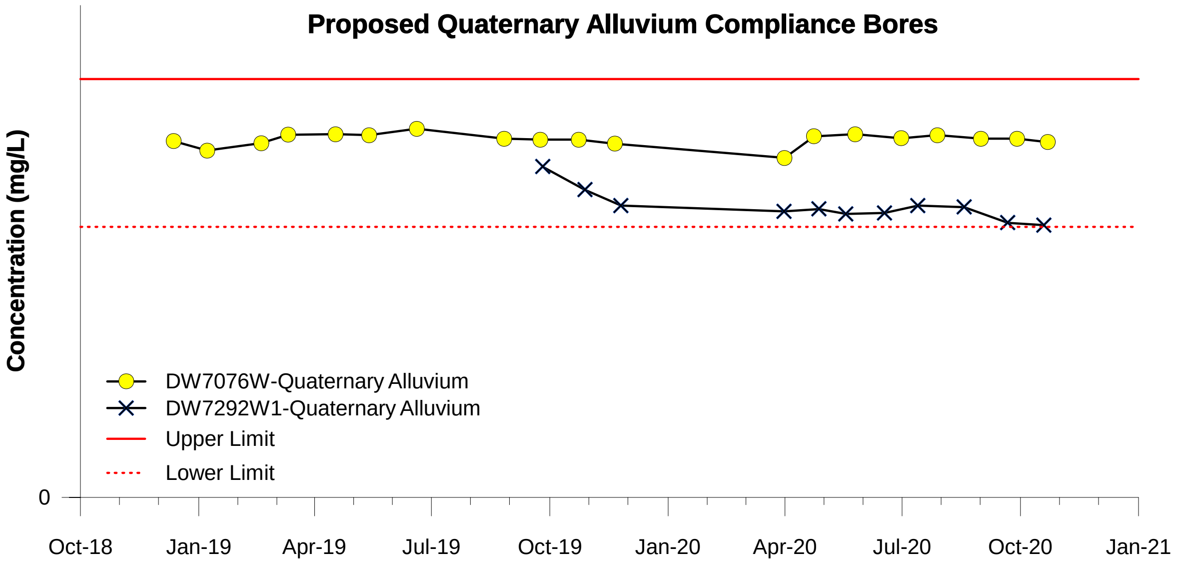
DATE

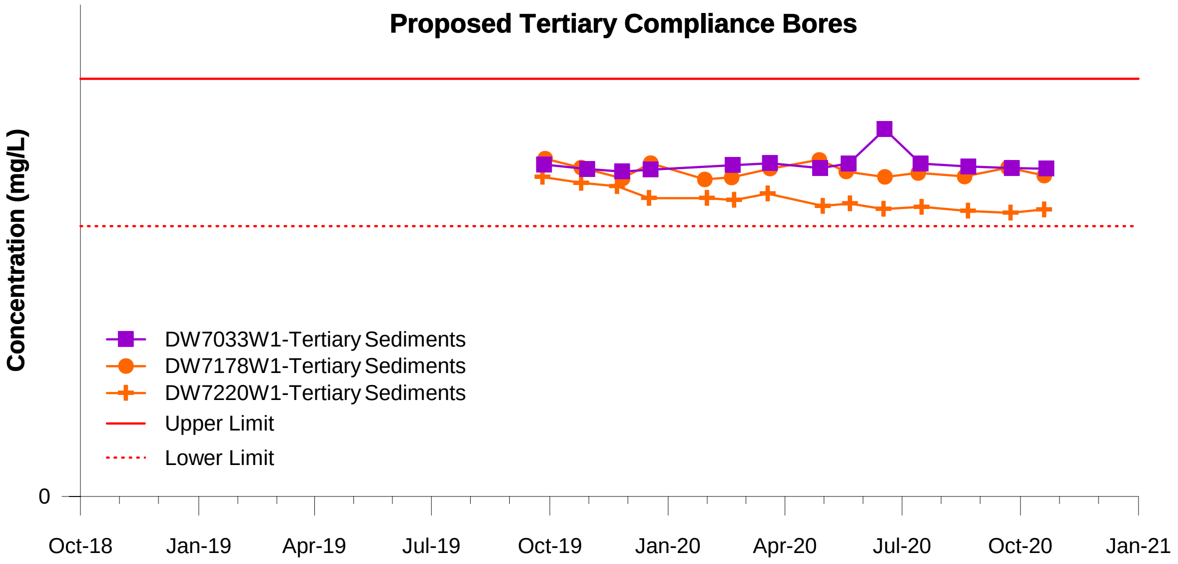
TITLE **Sulphate (SO_4) Data**
Proposed Compliance Bores

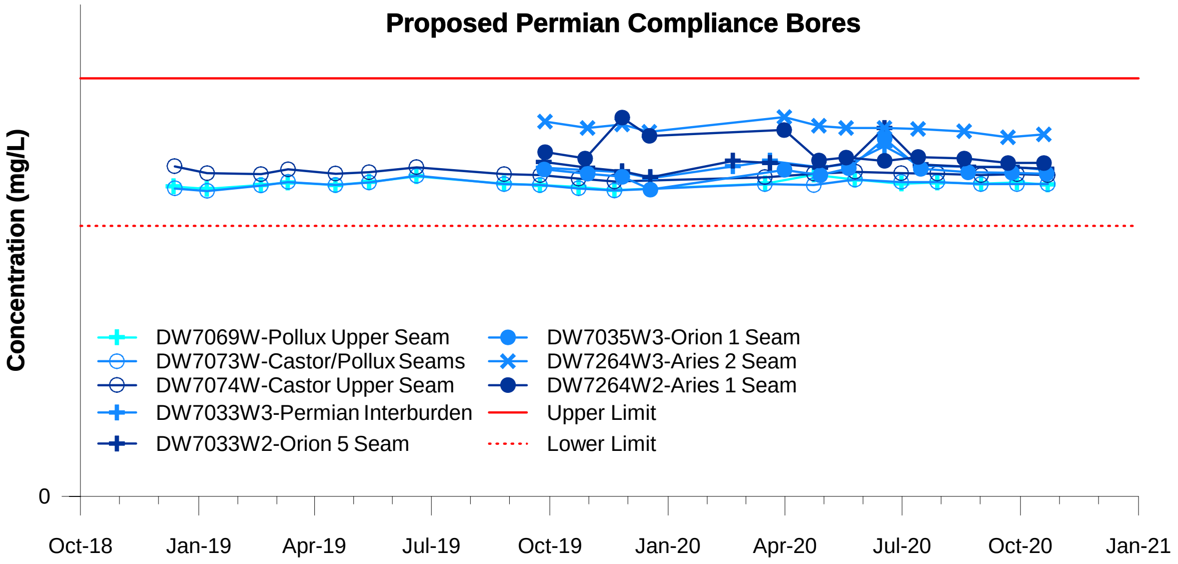
SCALE As Shown **A4**

PROJECT No. JBT01-071-005

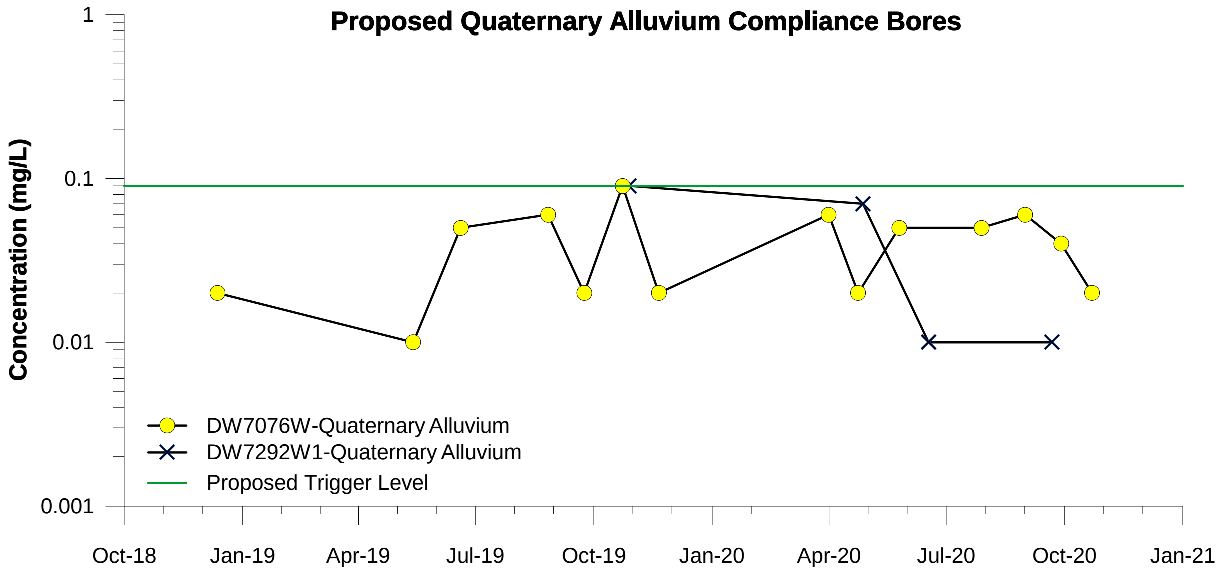
FIGURE No. **25**

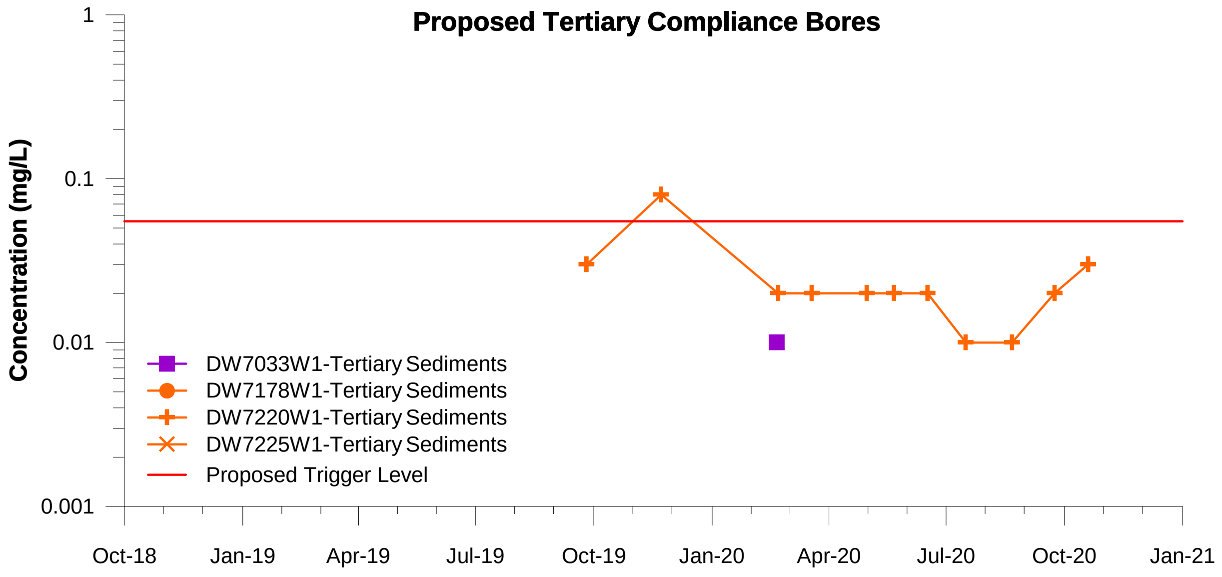


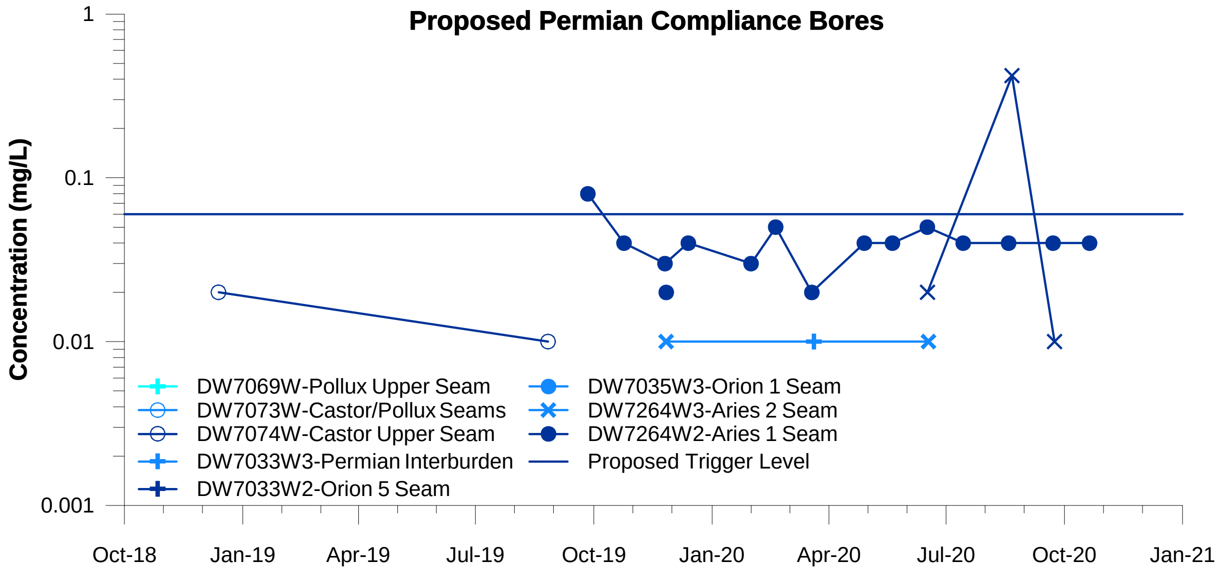




CLIENT Magnetic South		PROJECT Gemini Project	
DRAWN JWB	DATE Nov 2020	TITLE **Field pH Data** **Proposed Compliance Bores**	
CHECKED	DATE		
SCALE As Shown	**A4**	PROJECT No. JBT01-071-005	FIGURE No. **26**







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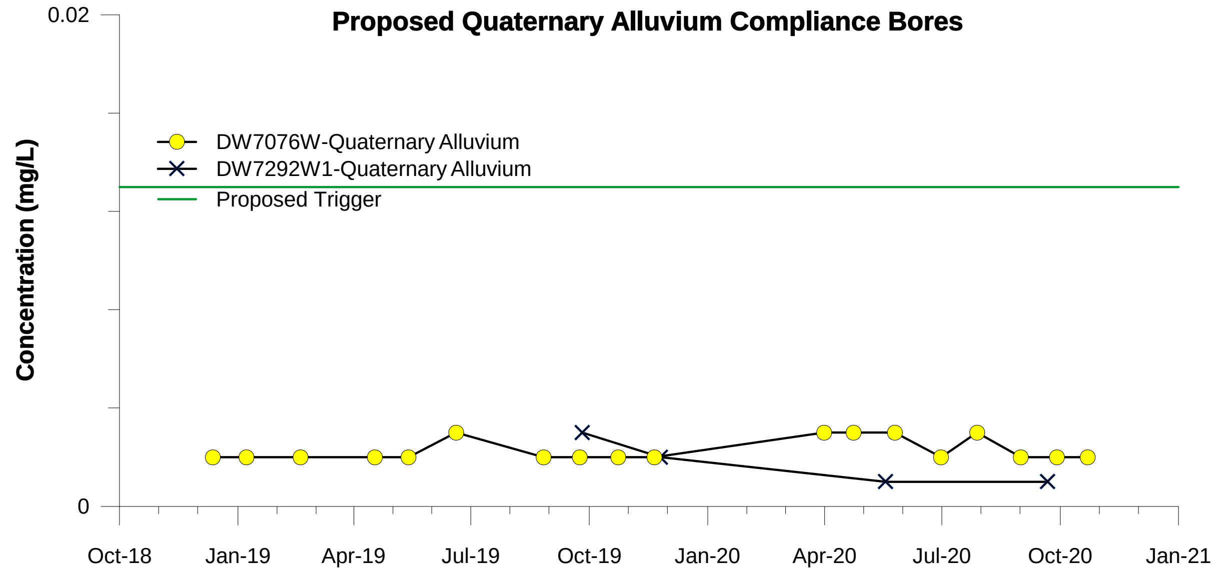
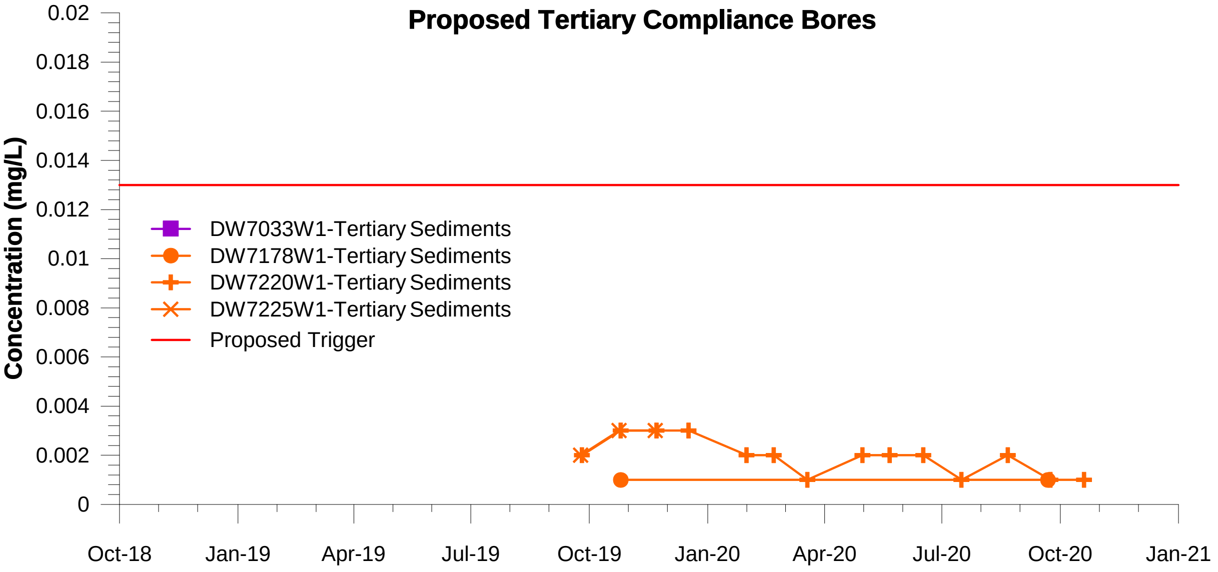
TITLE **Dissolved Aluminium (Al) Data**
Proposed Compliance Bores

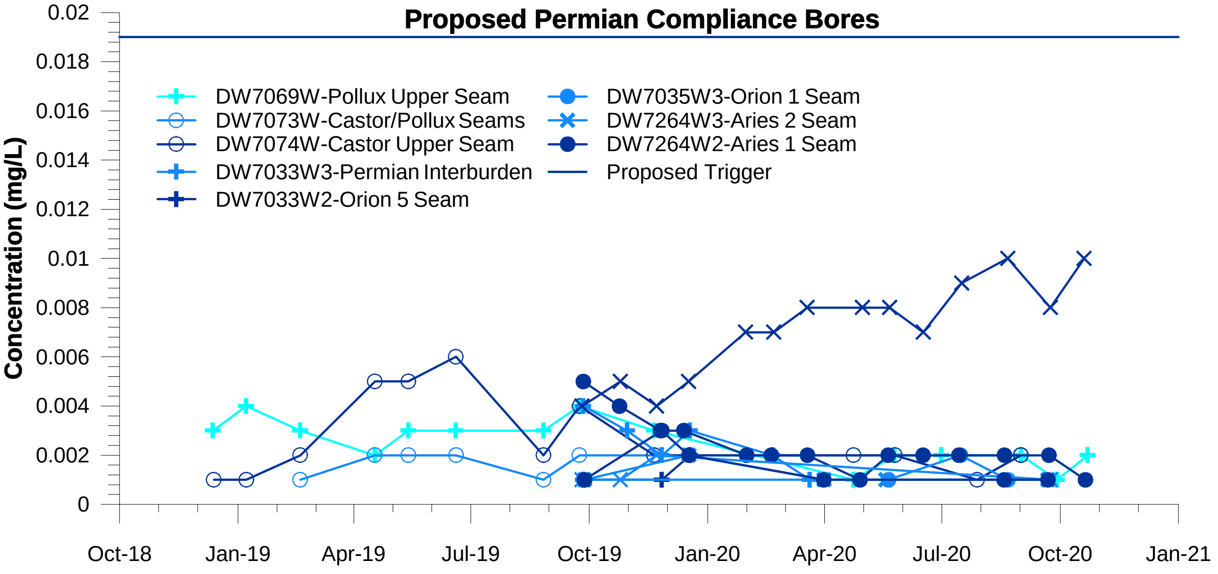
SCALE As Shown **A4**

PROJECT No. JBT01-071-005

FIGURE No. **27**







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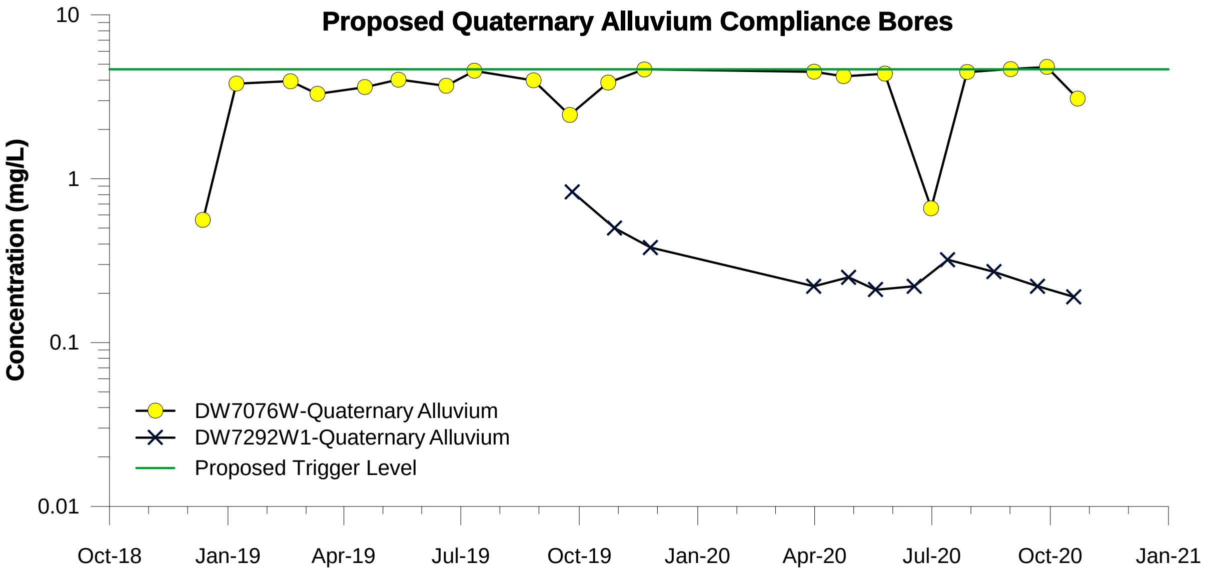
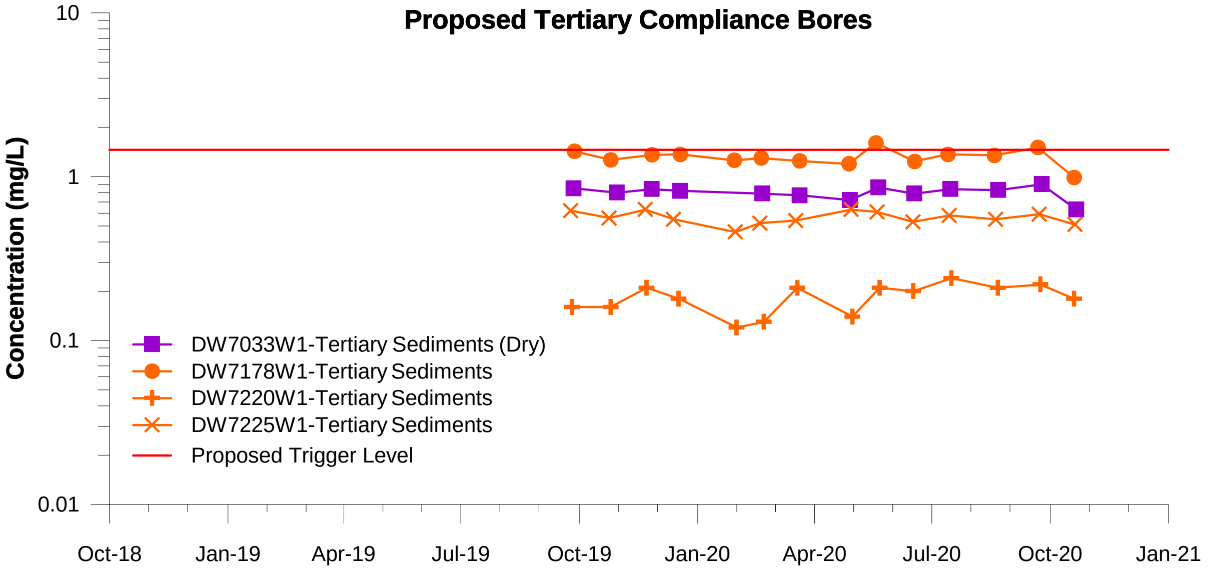
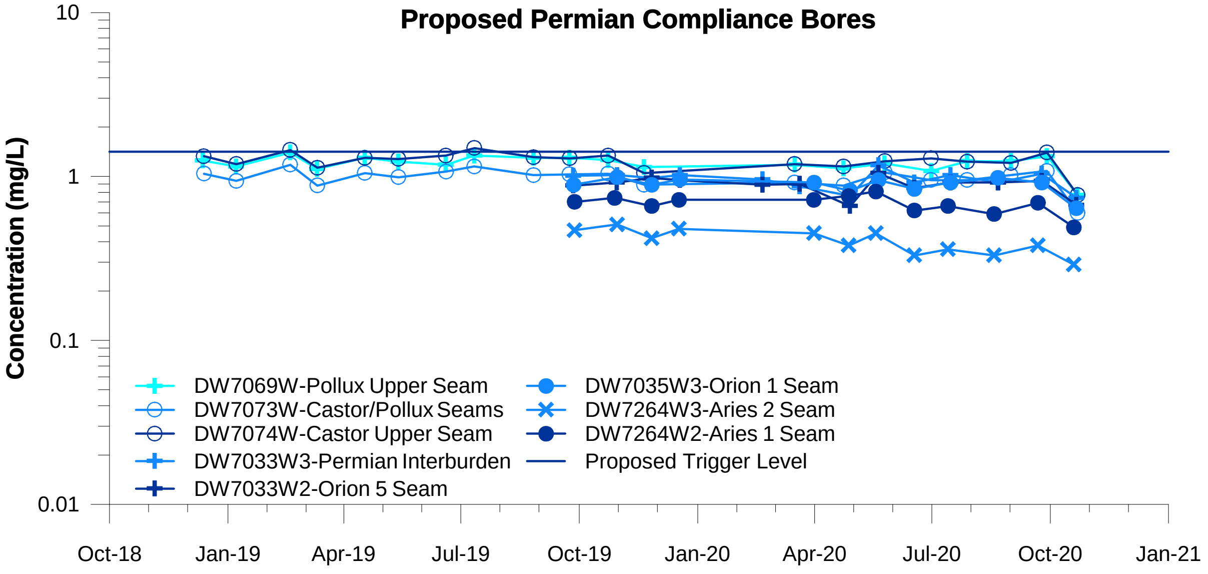
TITLE **Dissolved Arsenic (As) Data**
Proposed Compliance Bores

SCALE As Shown **A4**
PROJECT No. JBT01-071-005
FIGURE No. **28**







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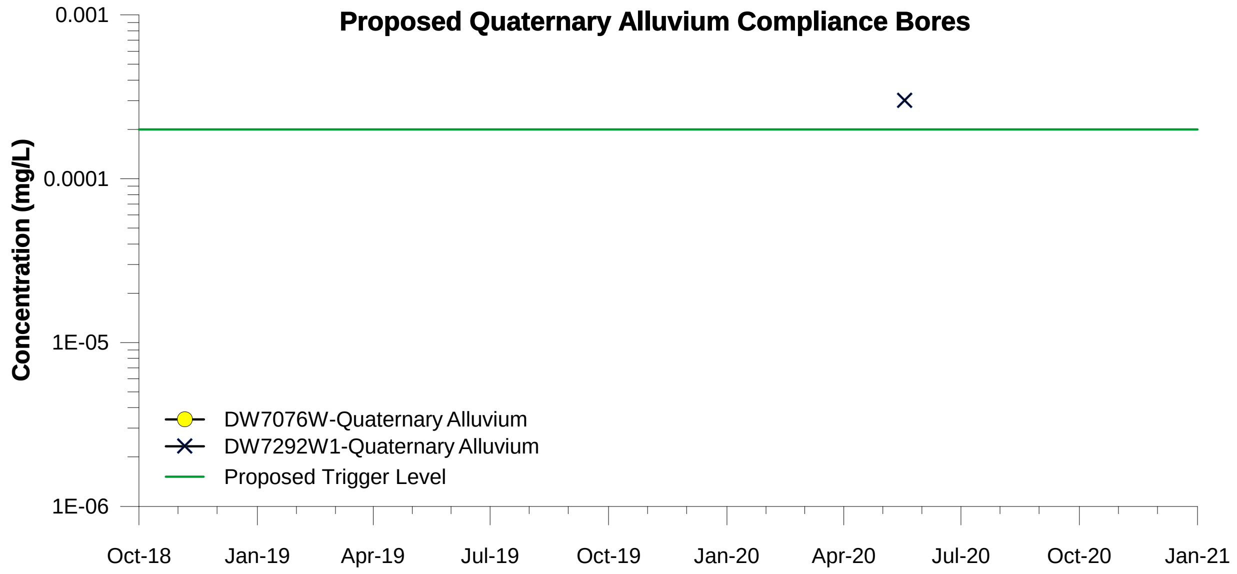

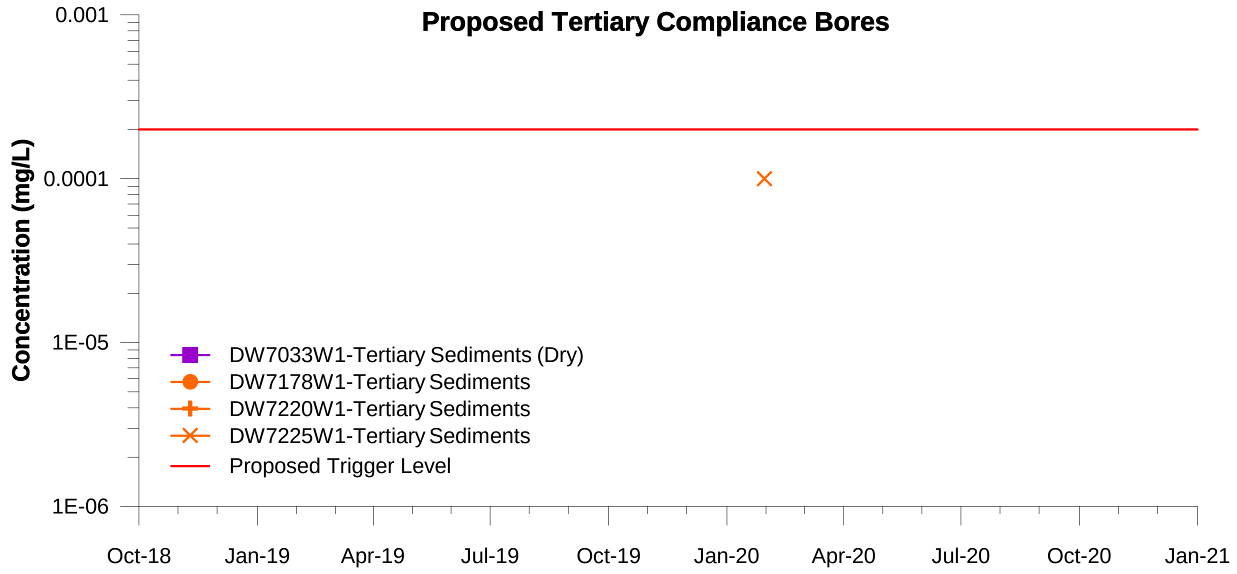

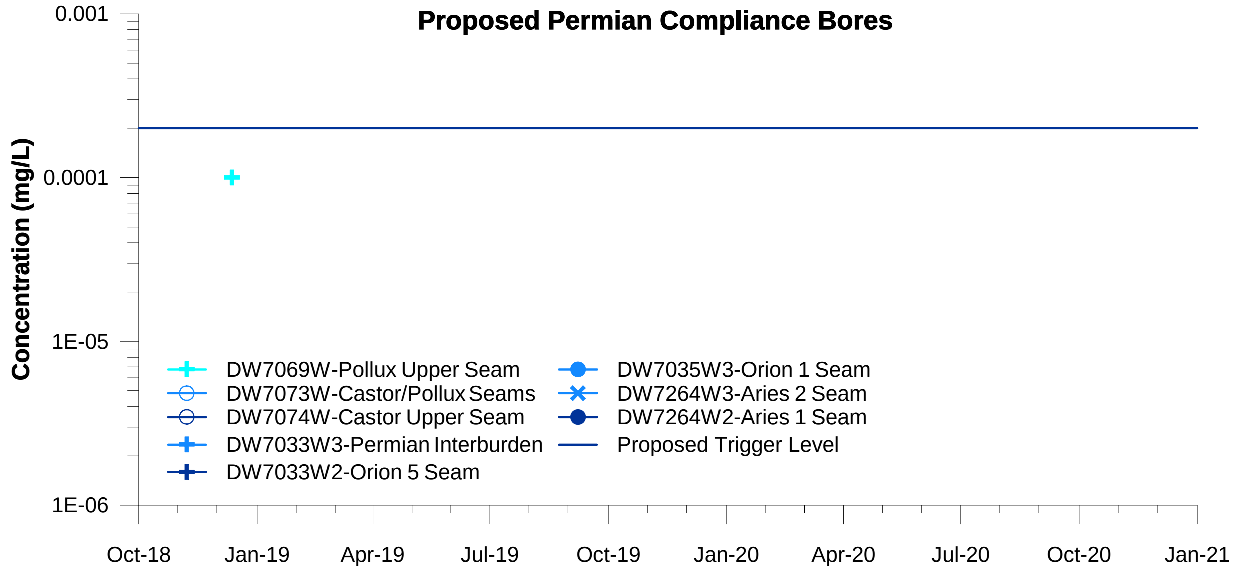

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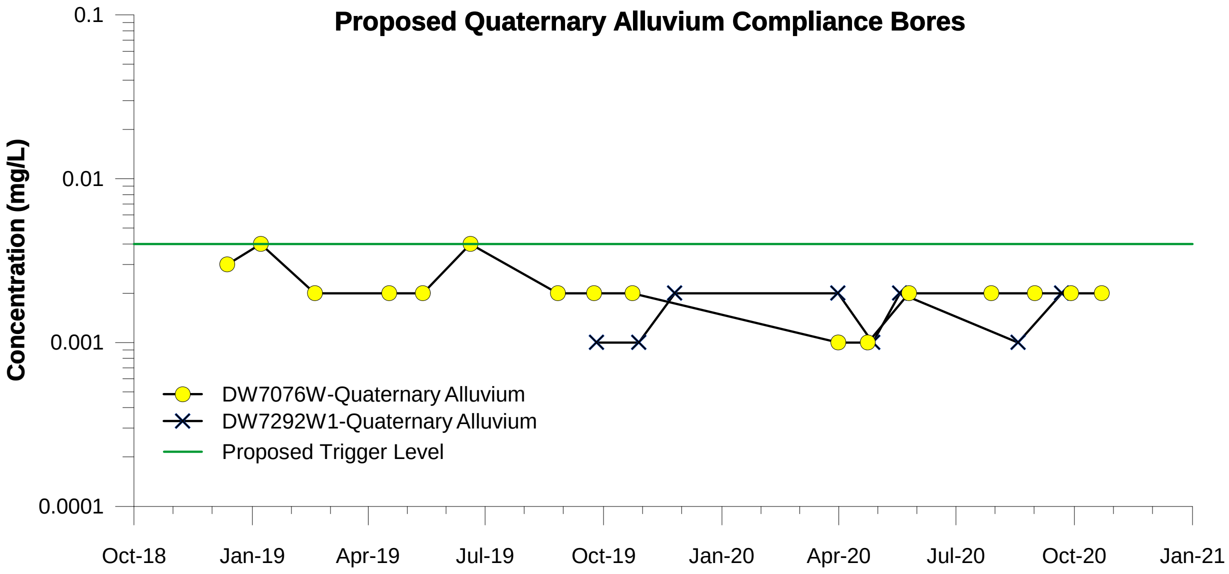
TITLE **Dissolved Cadmium (Cd) Data**
Proposed Compliance Bores
SCALE As Shown
A4
PROJECT No. JBT01-071-005
FIGURE No. 30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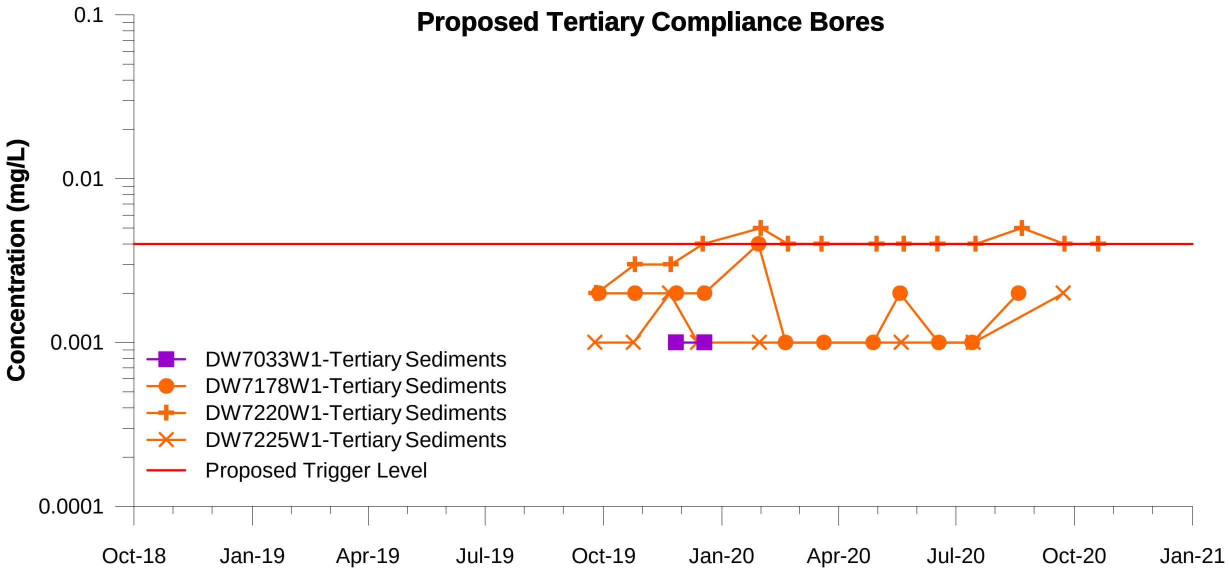
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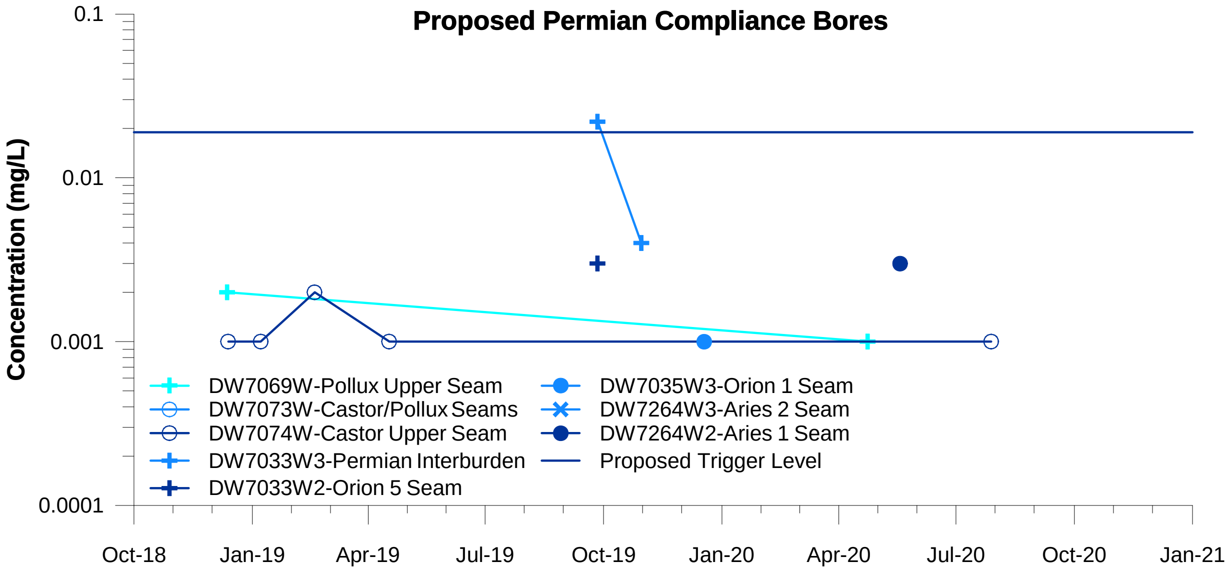
Proposed Permian Compliance Bores

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TITLE **Dissolved Cobalt (Co) Data**
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DATE
SCALE As Shown
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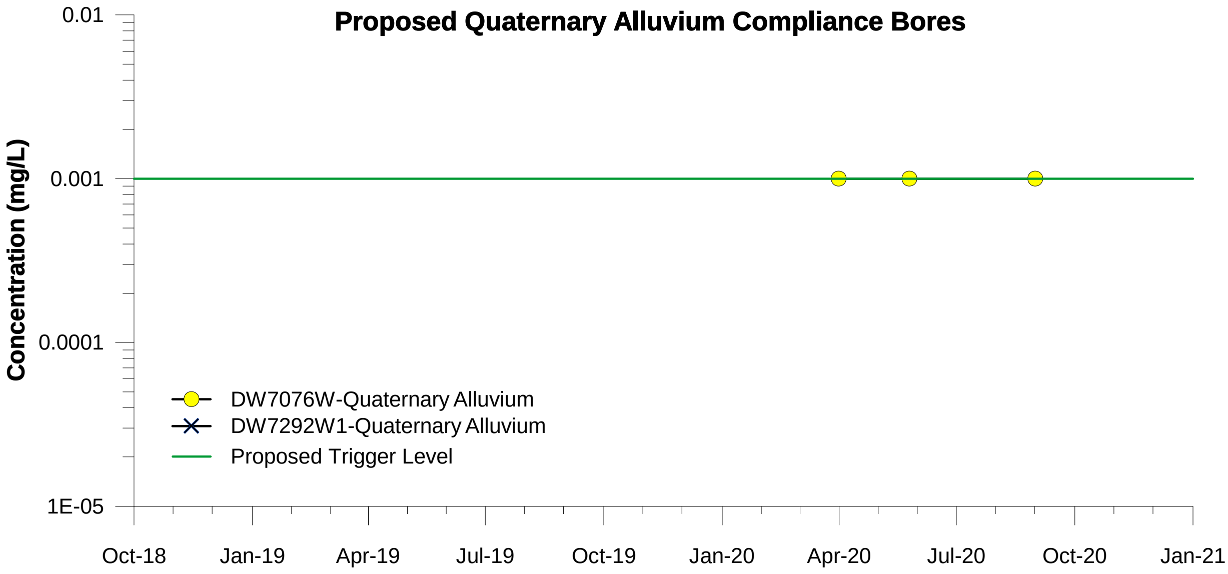
PROJECT No. JBT01-071-005
FIGURE No. **31**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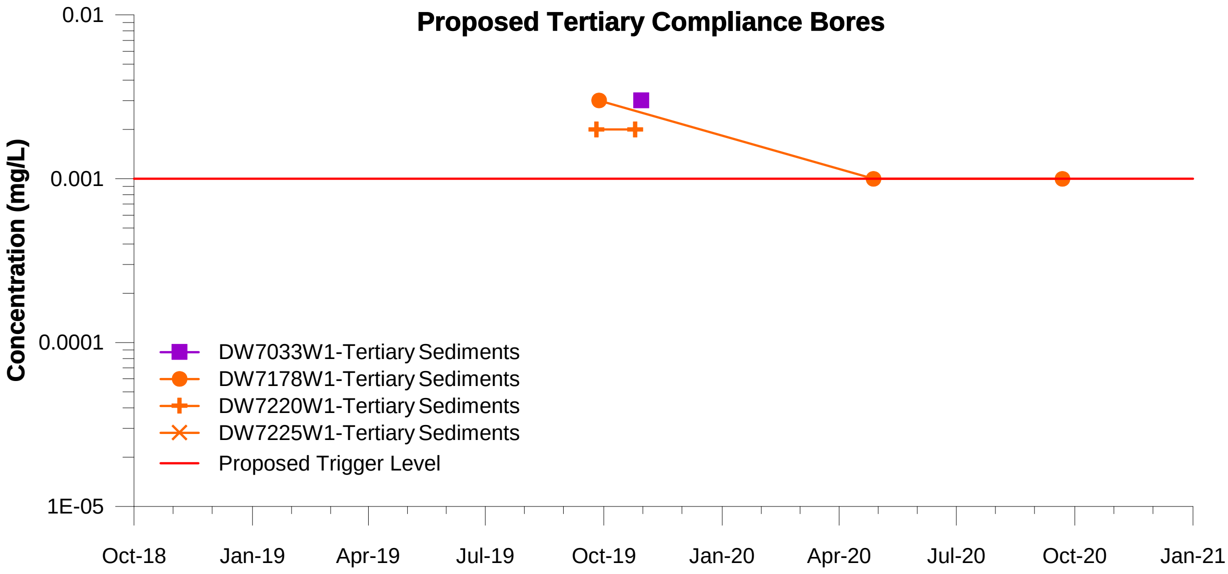
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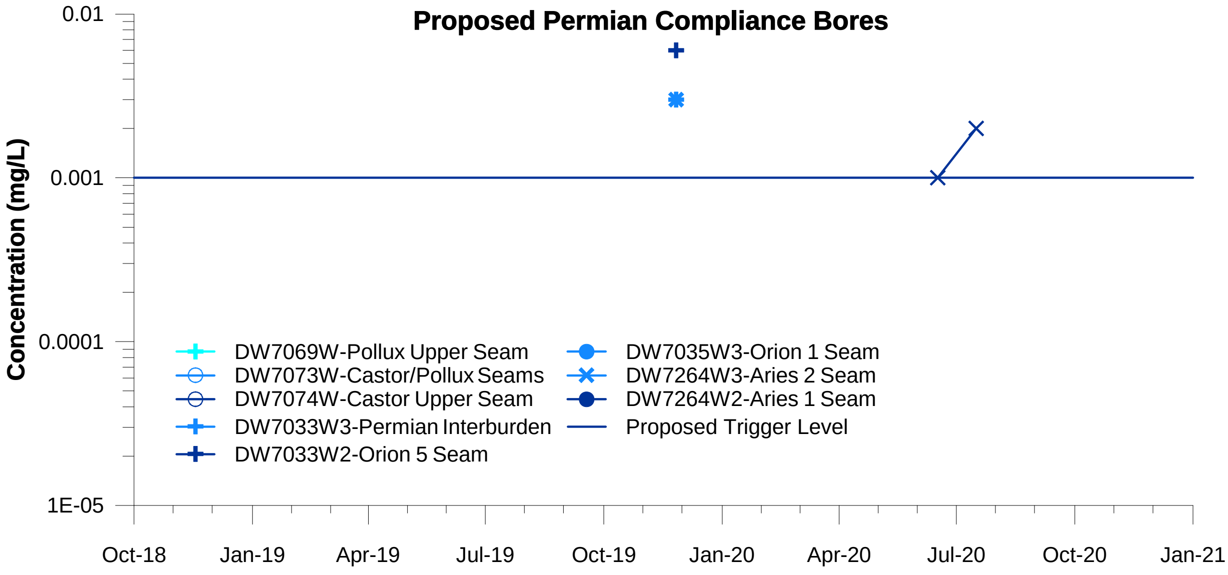
Proposed Permian Compliance Bores

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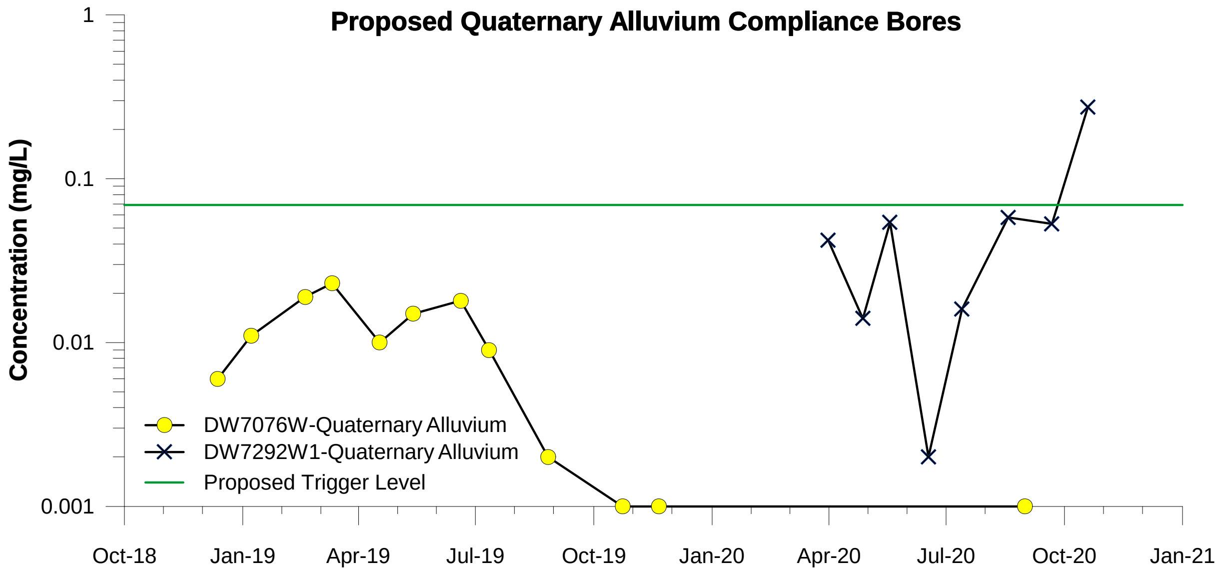
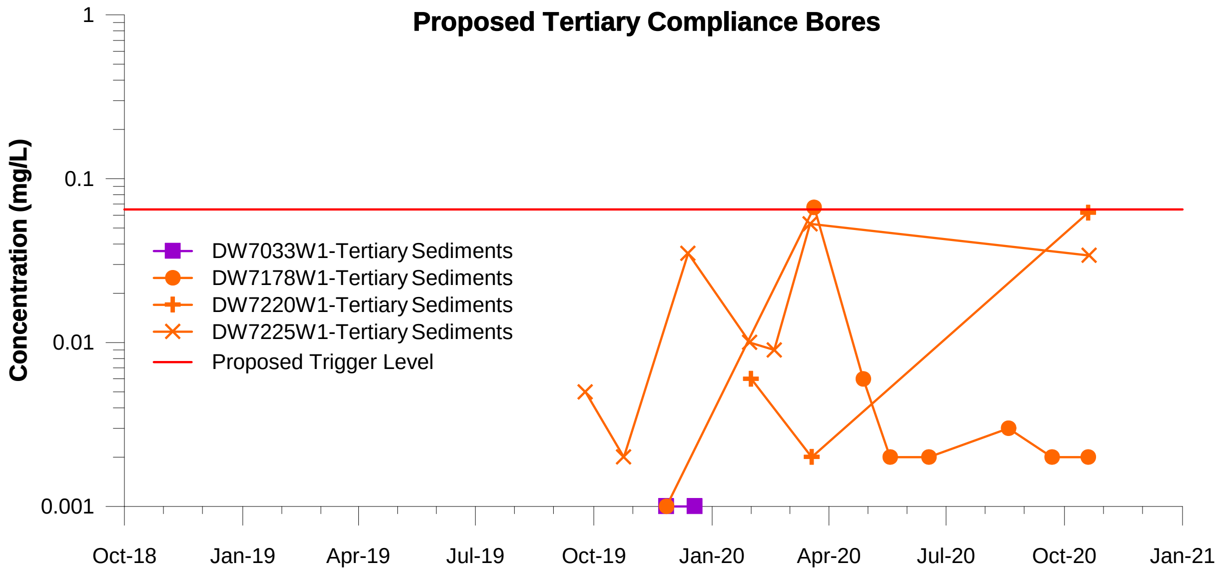
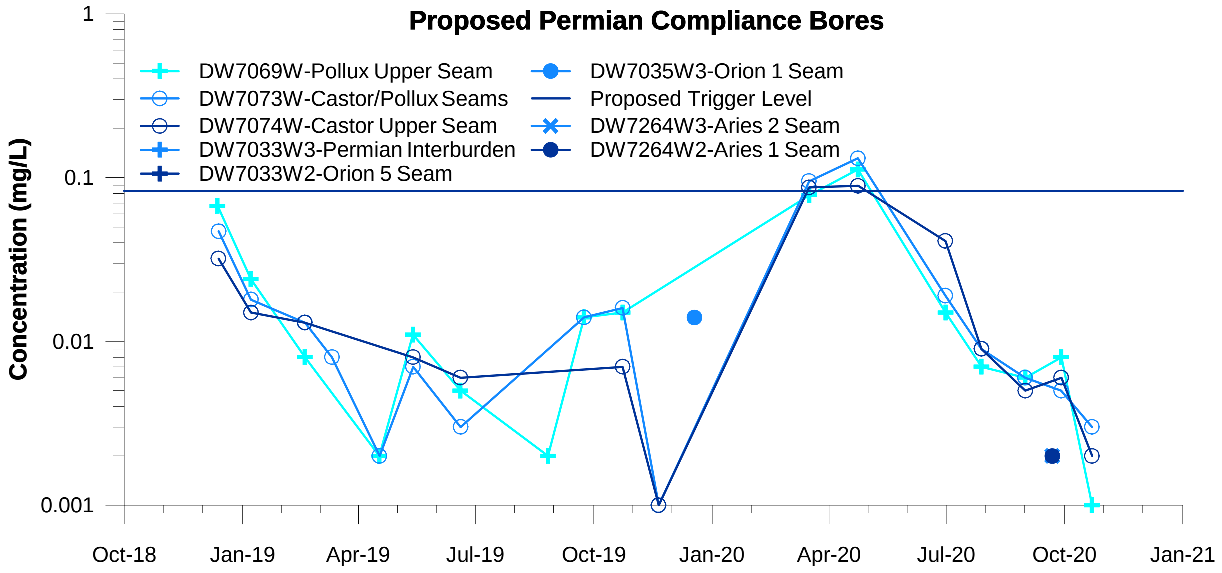
DATE
TITLE **Dissolved Chromium (Cr) Data**
Proposed Compliance Bores
SCALE As Shown **A4**
PROJECT No. JBT01-071-005
FIGURE No. **32**







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TITLE **Dissolved Copper (Cu) Data**
Proposed Compliance Bores
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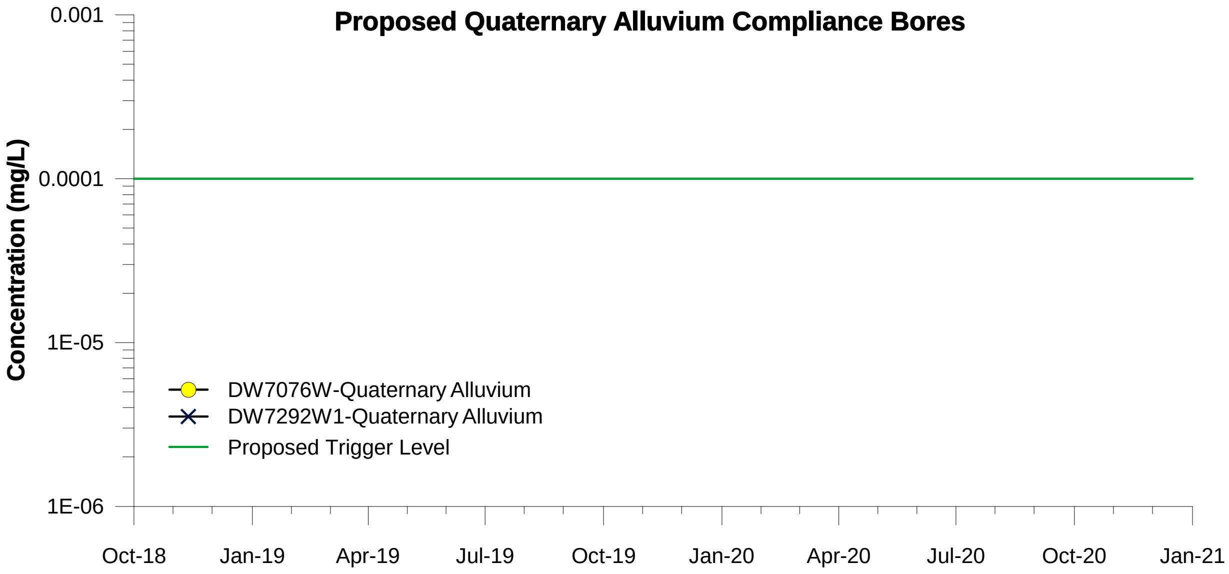
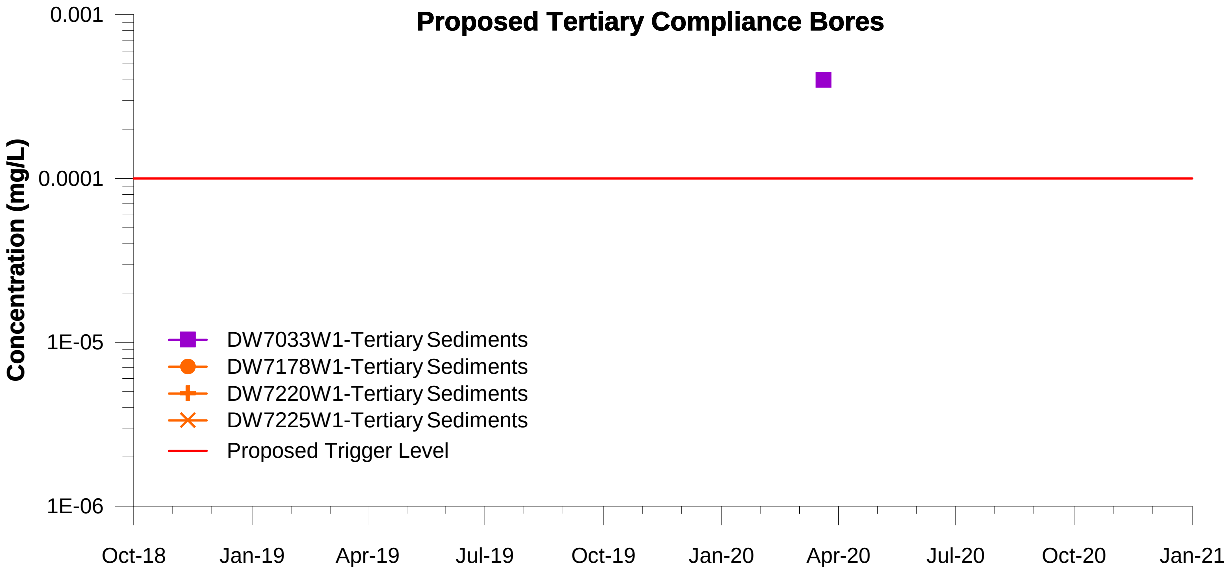
A4
PROJECT No. JBT01-071-005
FIGURE No. **33**



Proposed Quaternary Alluvium Compliance Bores



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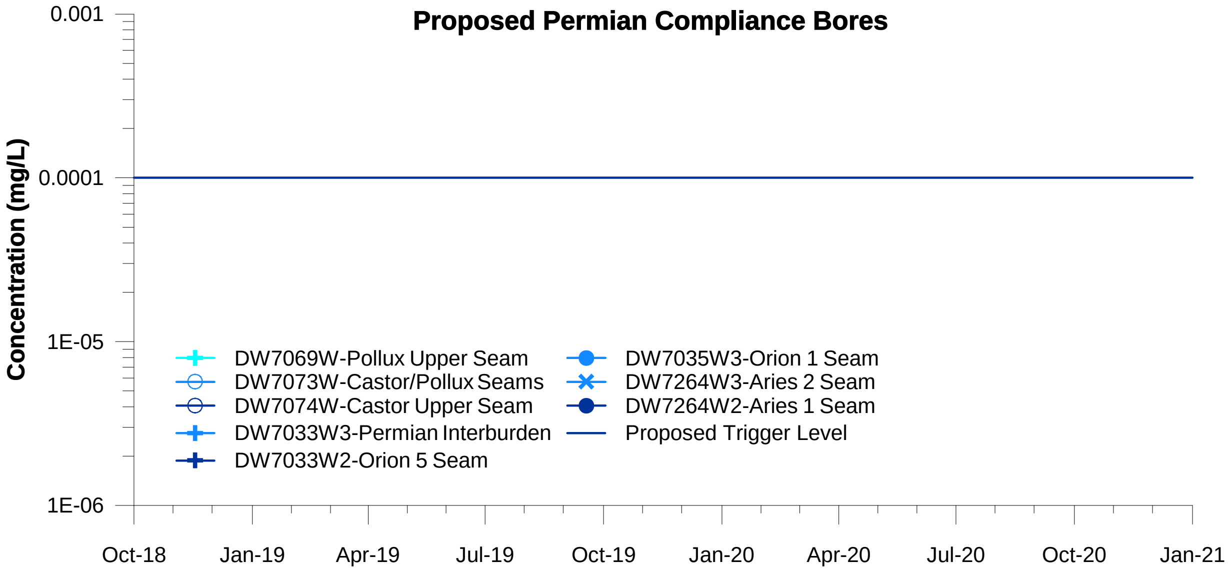

Proposed Permian Compliance Bores

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TITLE **Dissolved Mercury (Hg) Data Proposed Compliance Bores**

SCALE As Shown

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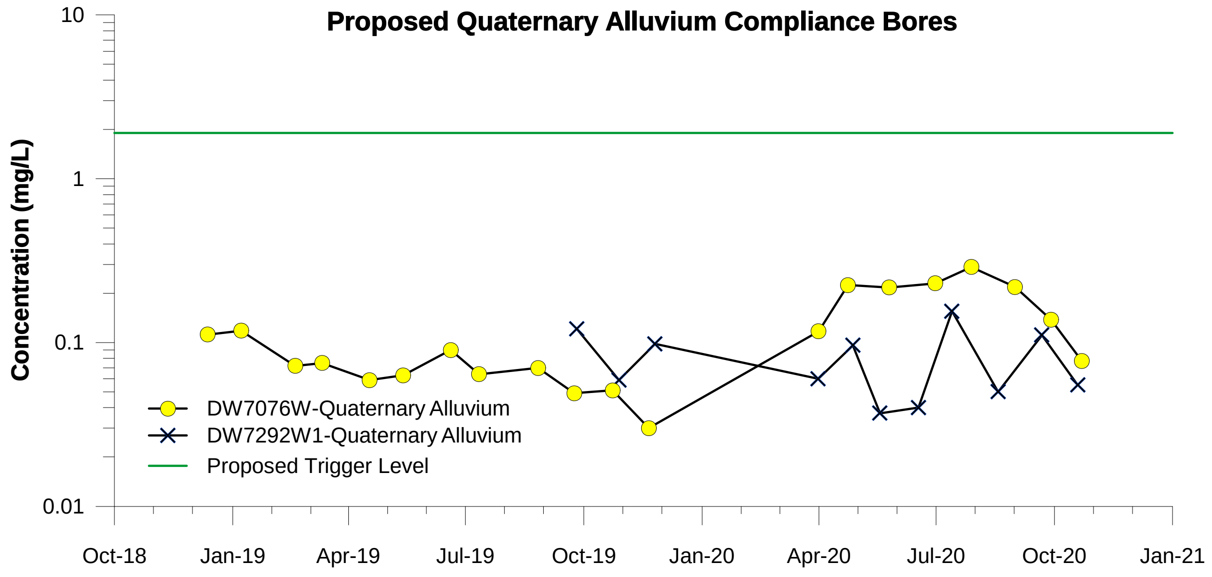
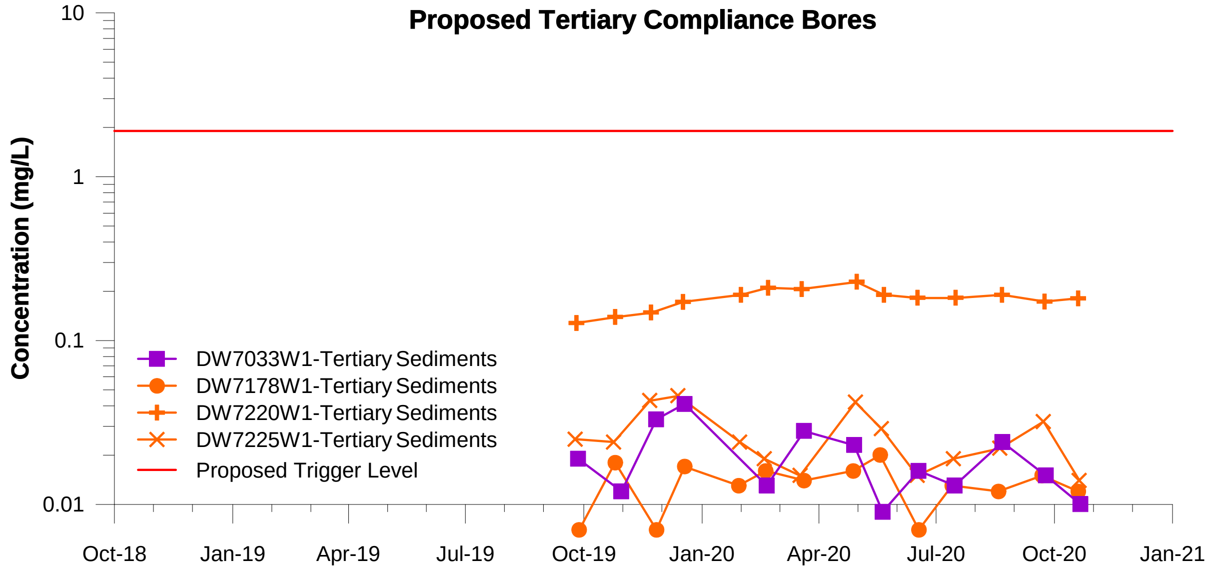
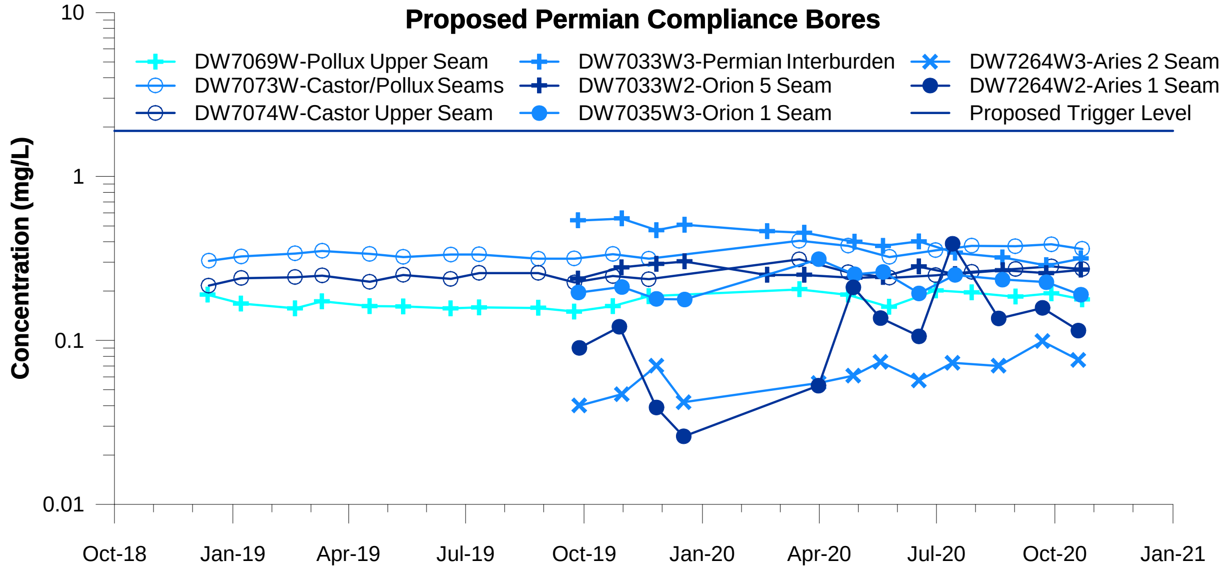
PROJECT No. JBT01-071-005

FIGURE No. 34







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TITLE **Dissolved Manganese (Mn) Data**
Proposed Compliance Bores
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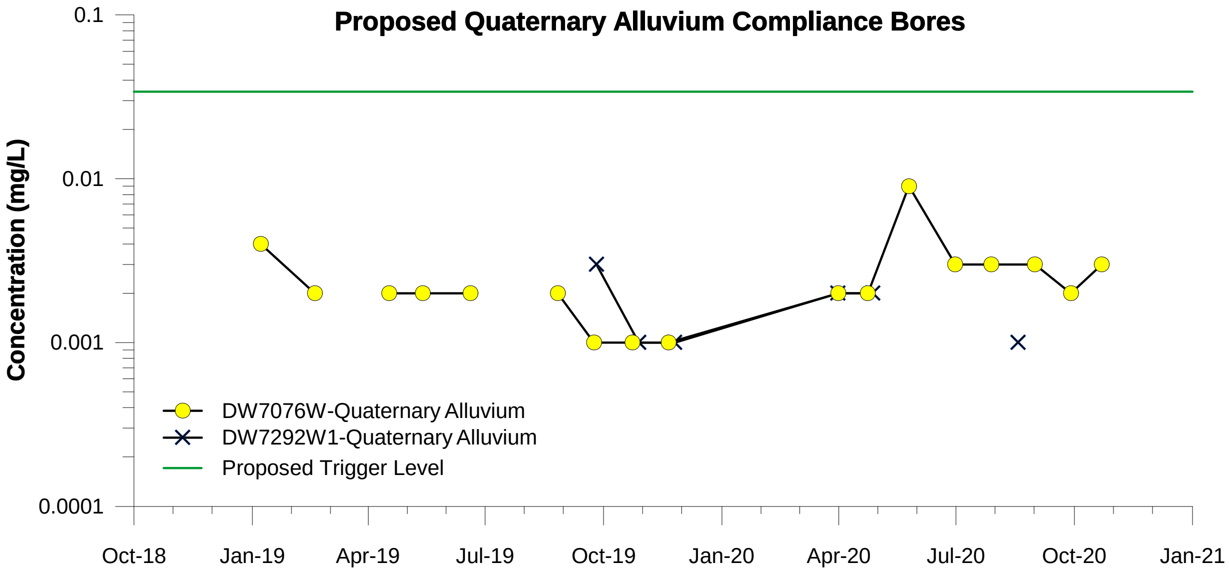
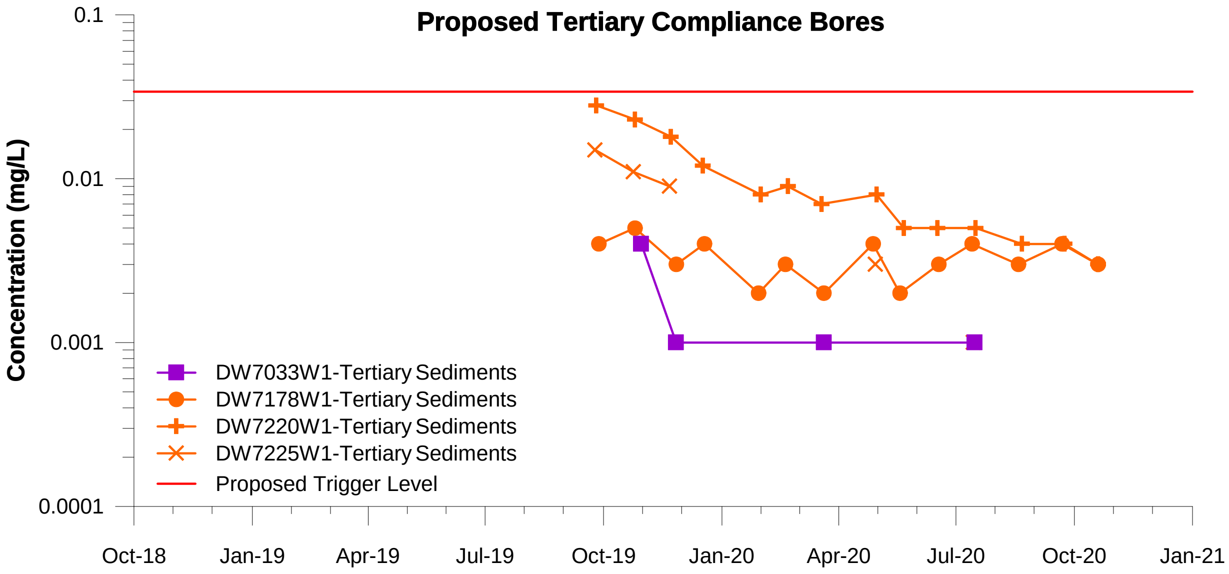
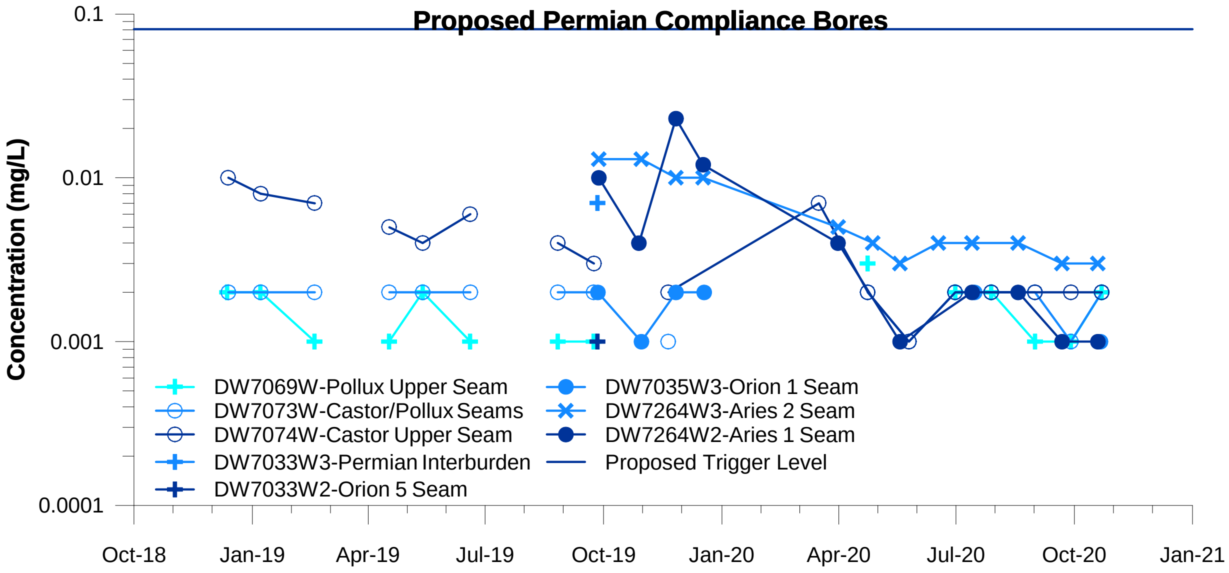
PROJECT No. JBT01-071-005
FIGURE No. **35**







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TITLE **Dissolved Molybdenum (Mo) Data**
Proposed Compliance Bores

SCALE As Shown **A4**

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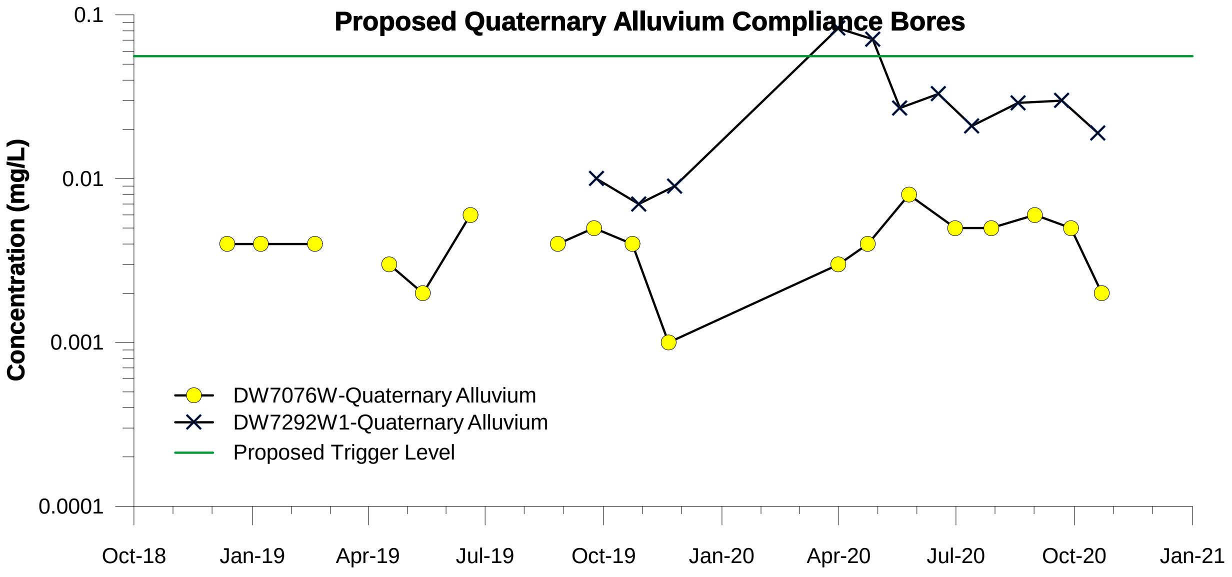
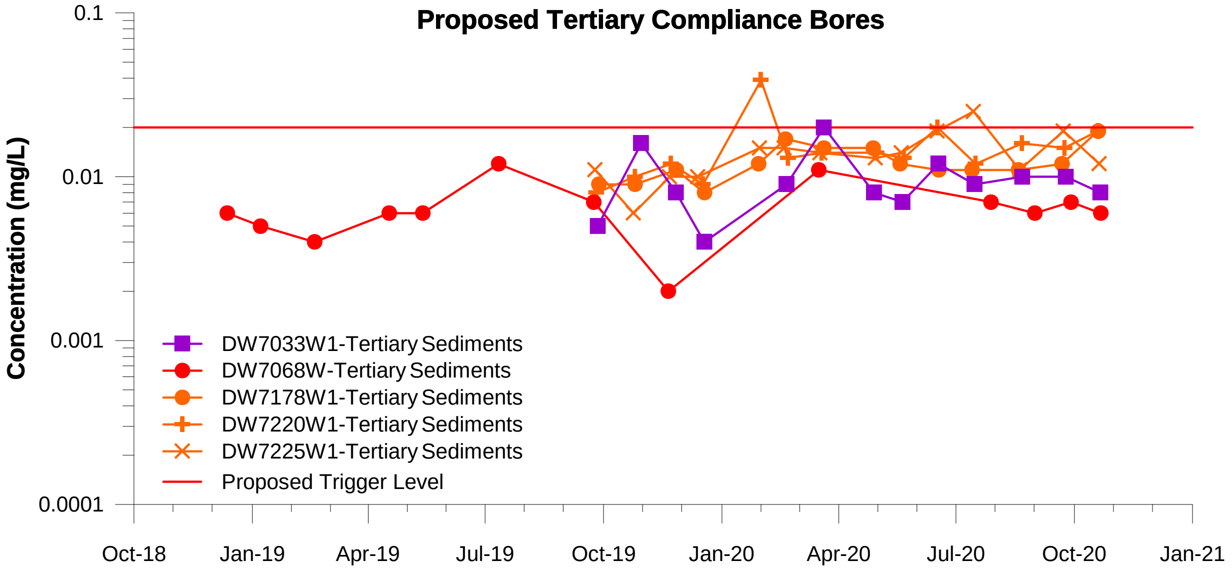
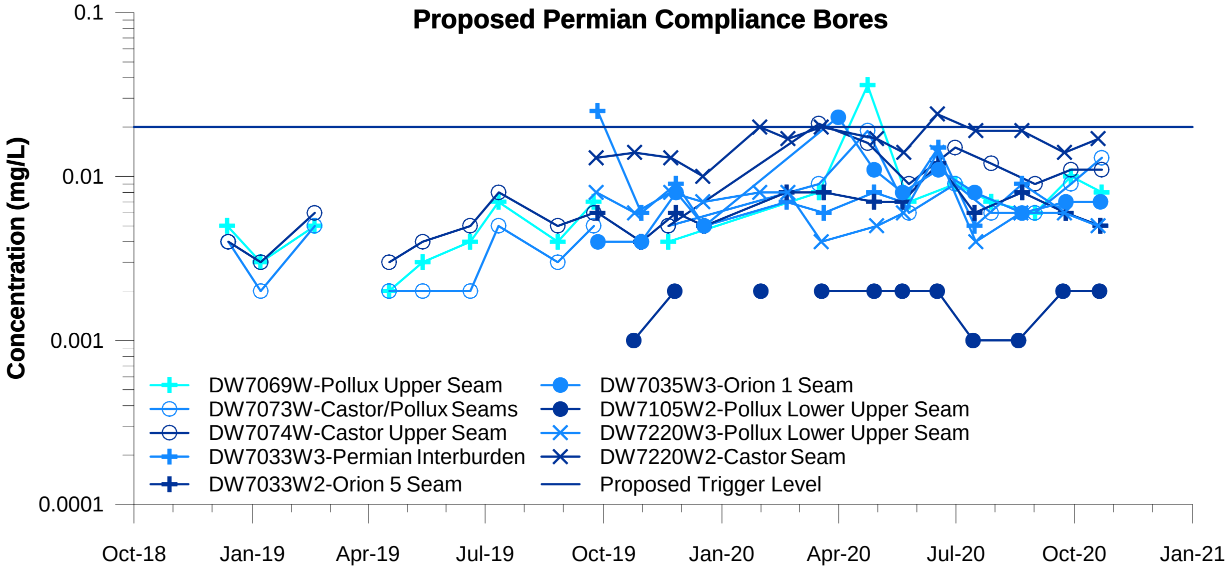
FIGURE No. **36**







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CLIENT Magnetic South		PROJECT Gemini Project	
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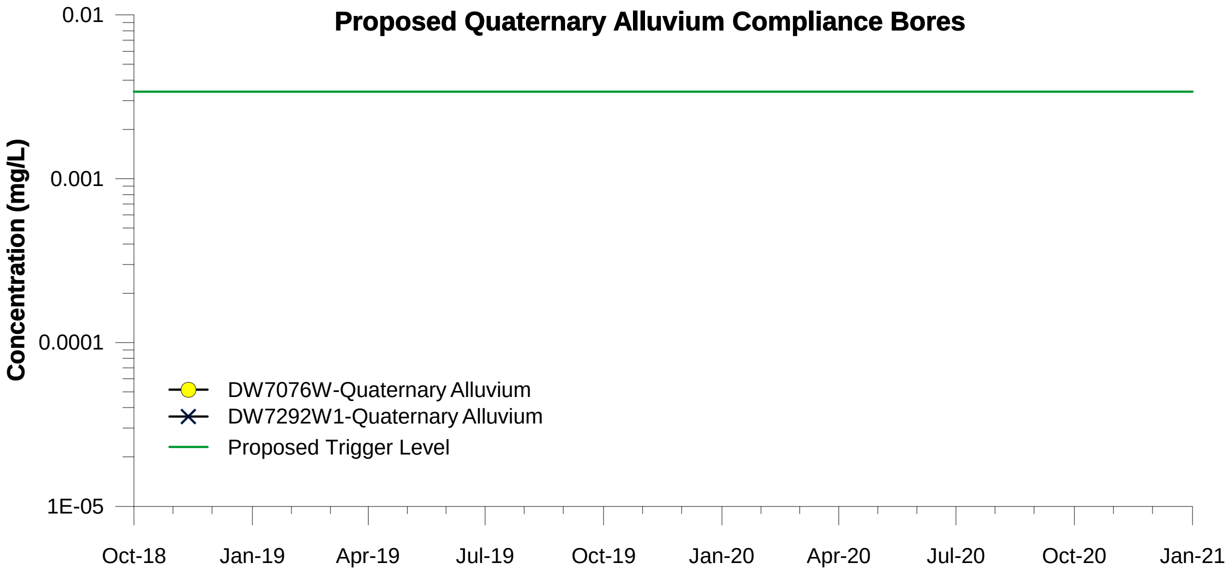
CHECKED	DATE		
SCALE As Shown	**A4**	PROJECT No. JBT01-071-005	FIGURE No. **37**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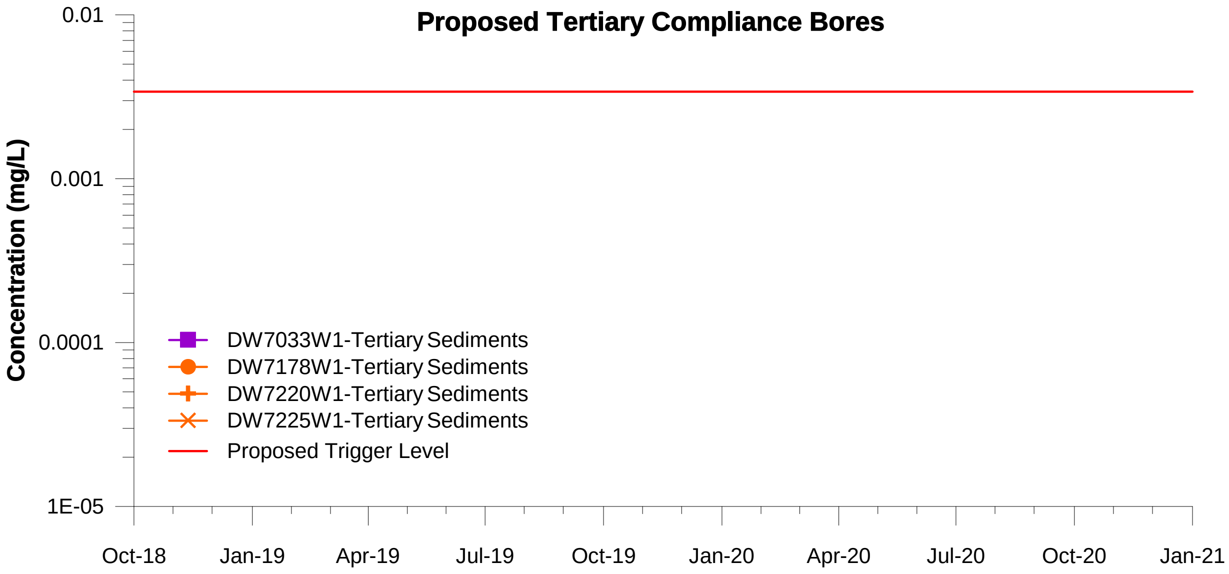
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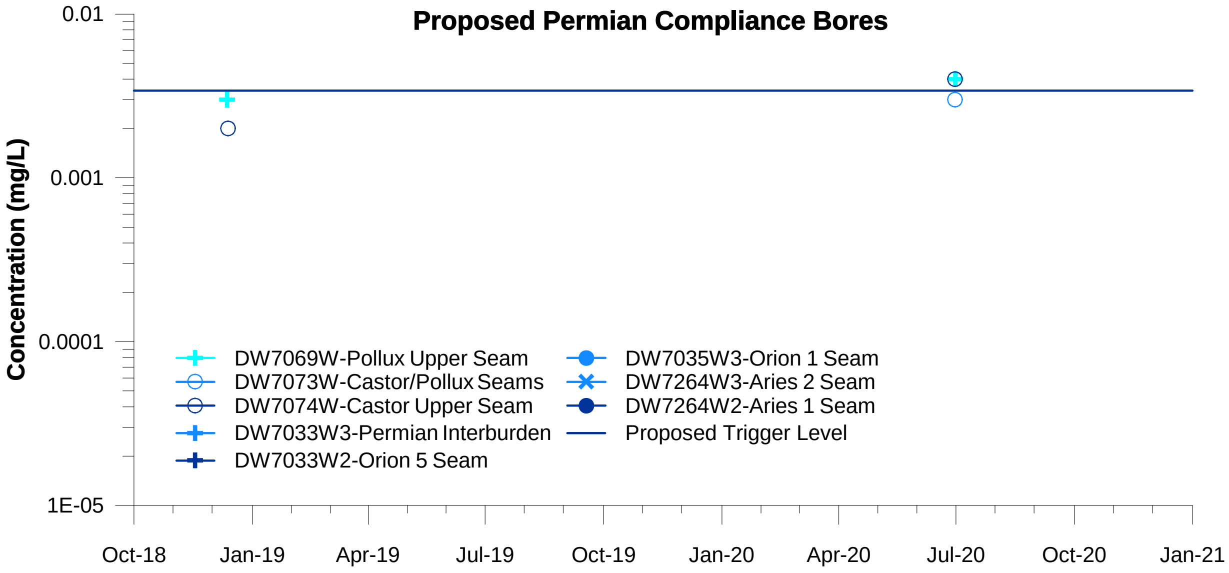
Proposed Permian Compliance Bores

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CLIENT Magnetic South
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Proposed Compliance Bores
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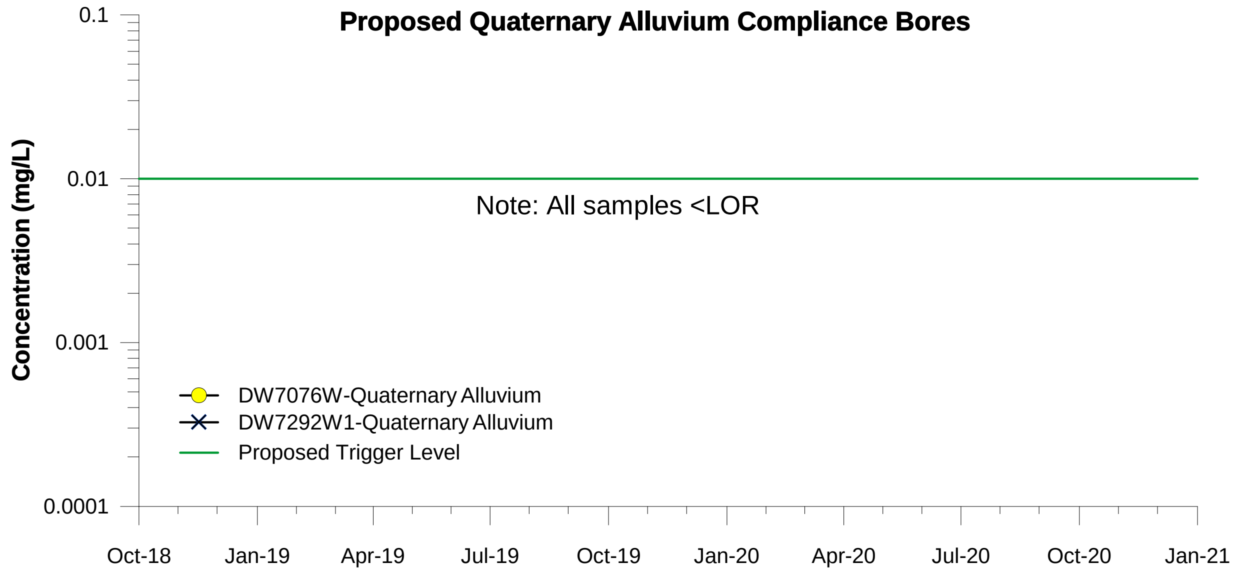
PROJECT No. JBT01-071-005
FIGURE No. **38**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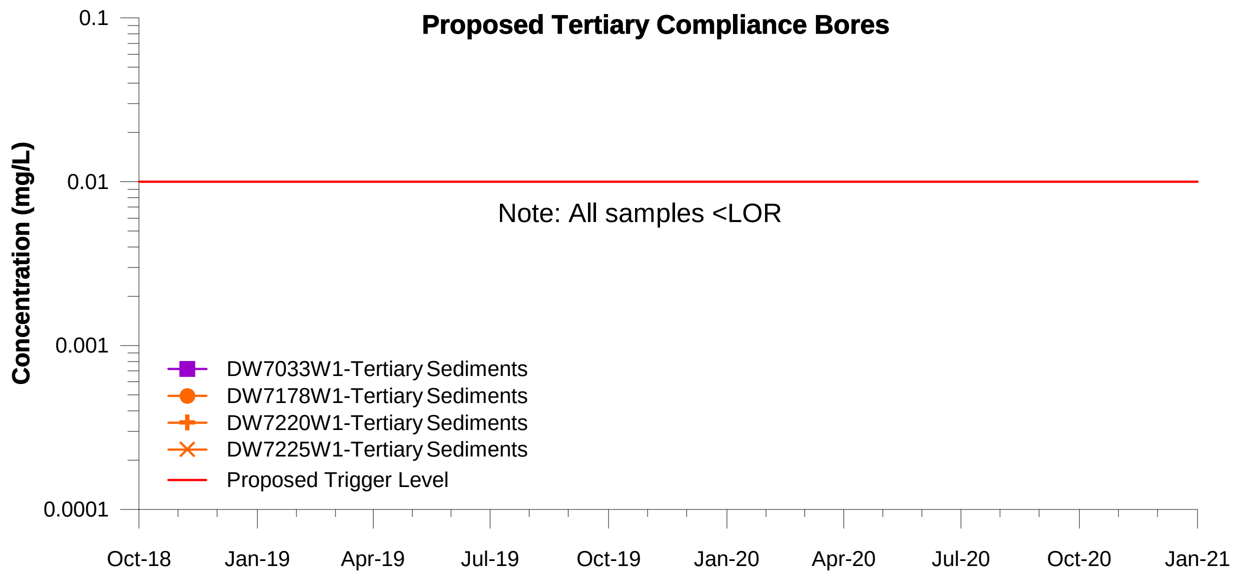
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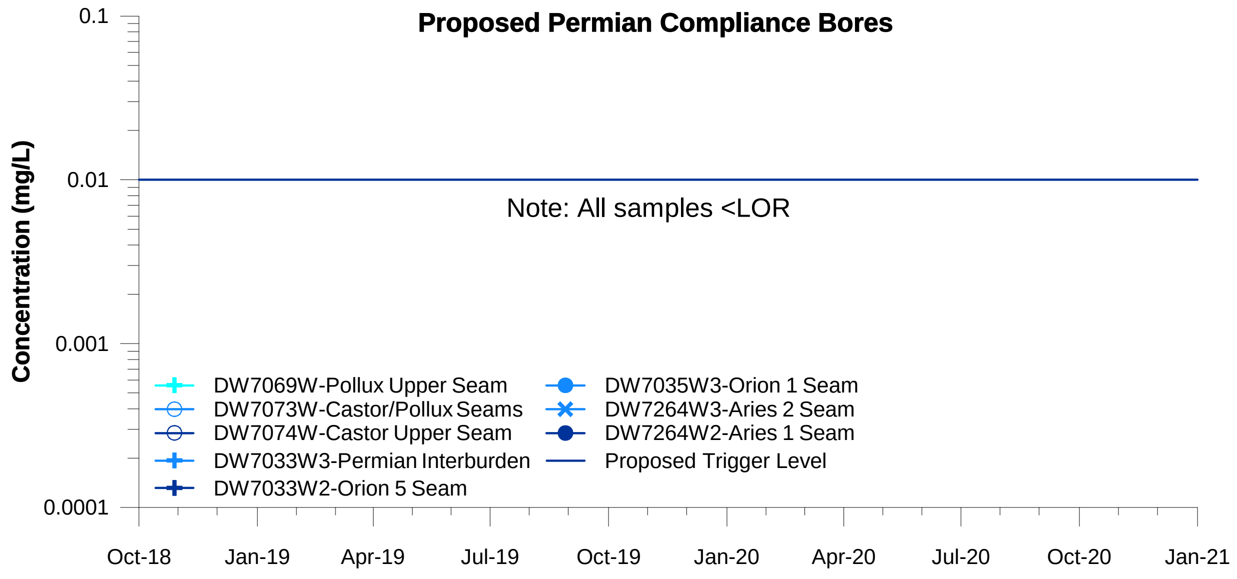
Proposed Permian Compliance Bores

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CLIENT Magnetic South

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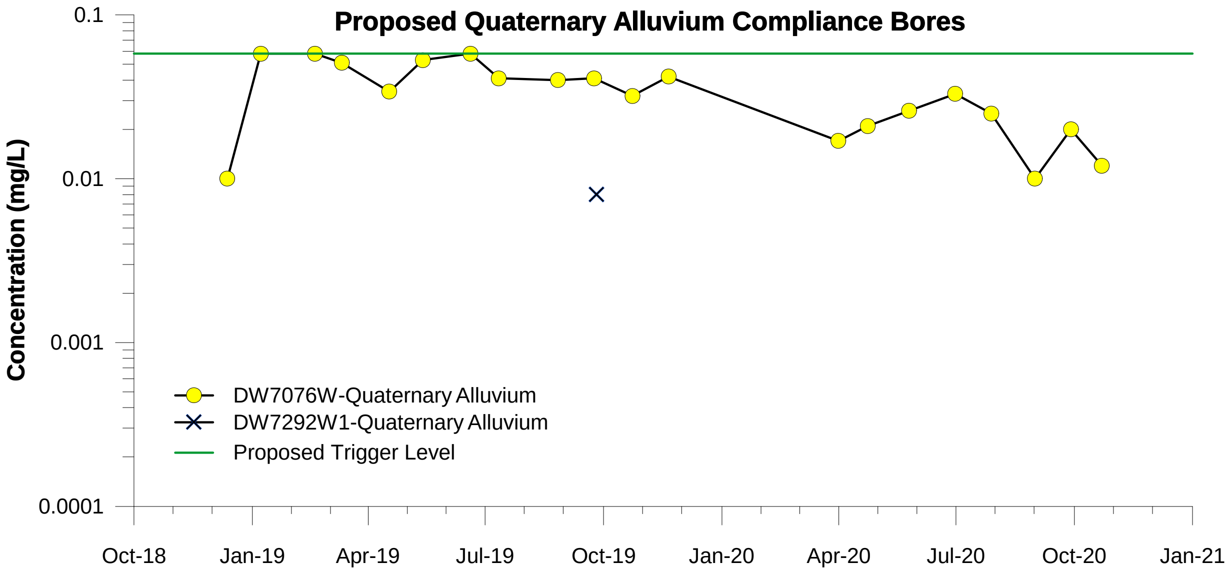
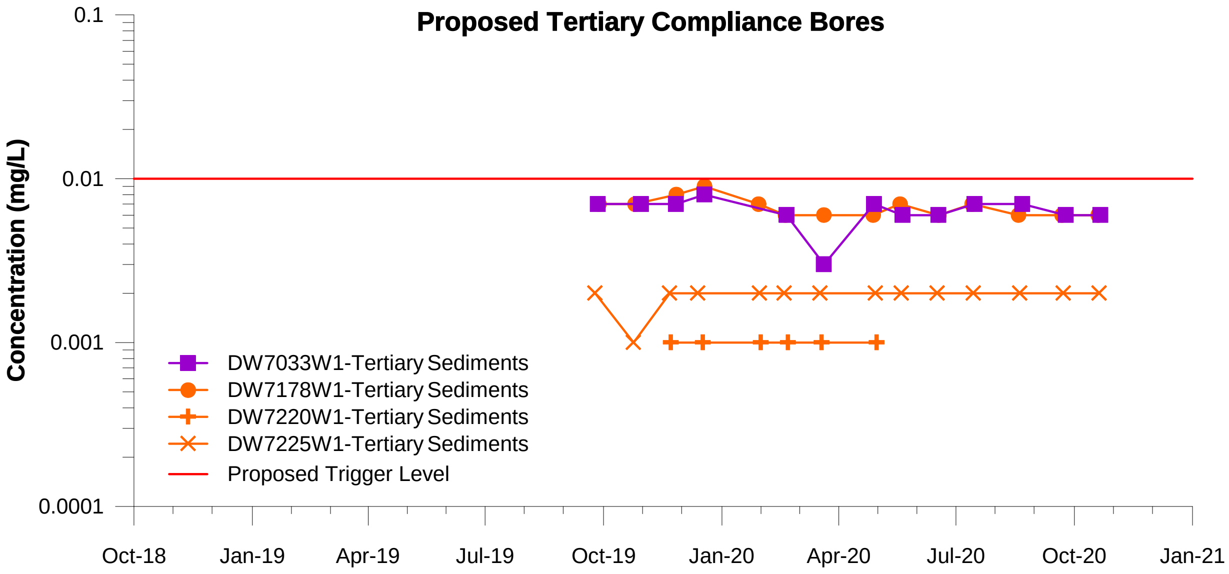
TITLE **Dissolved Selenium (Se) Data**
Proposed Compliance Bores

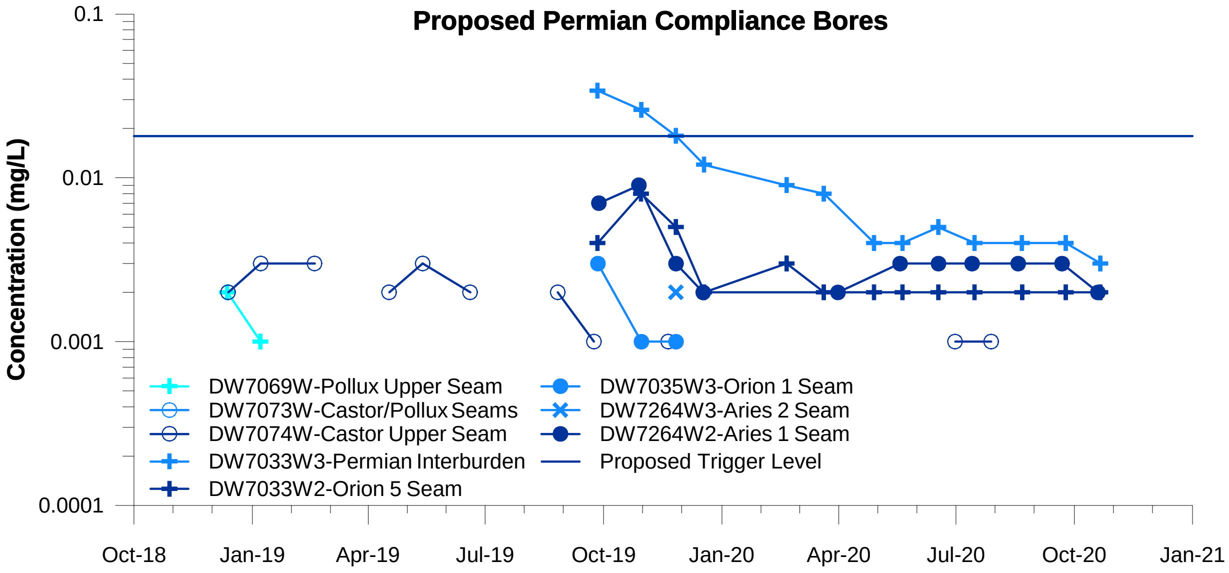
SCALE As Shown **A4**

PROJECT No. JBT01-071-005

FIGURE No. **39**







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CLIENT Magnetic South
PROJECT Gemini Project
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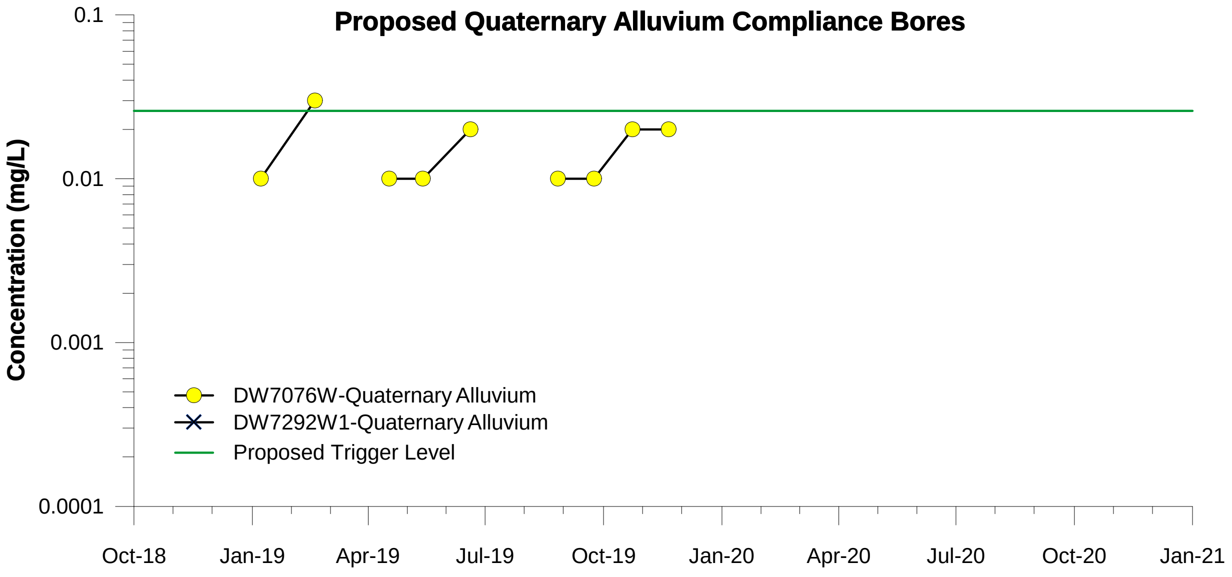
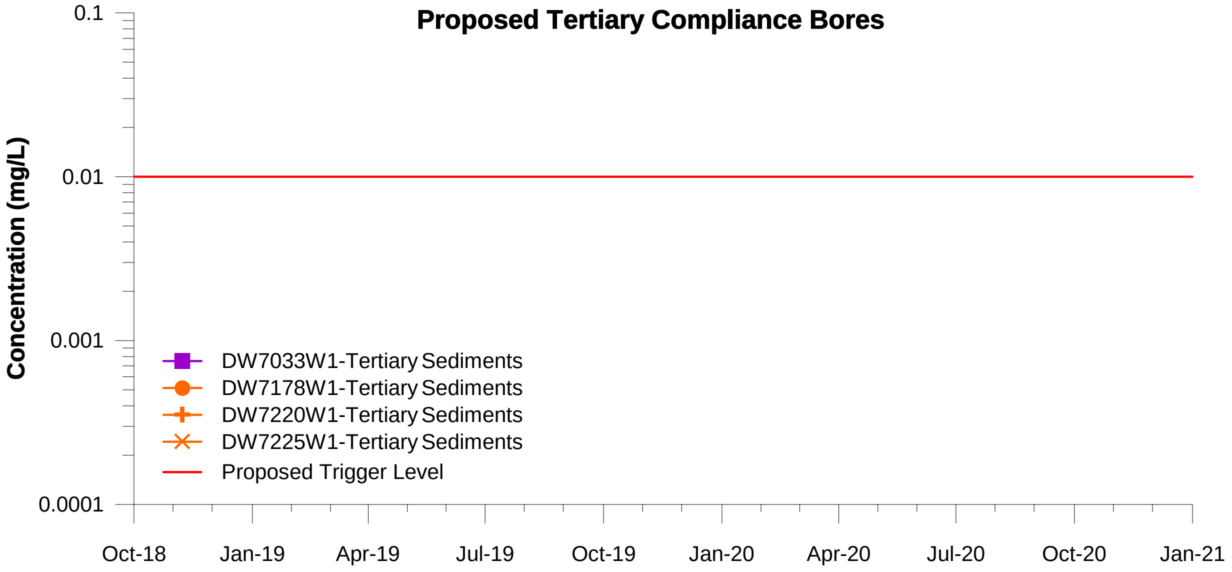
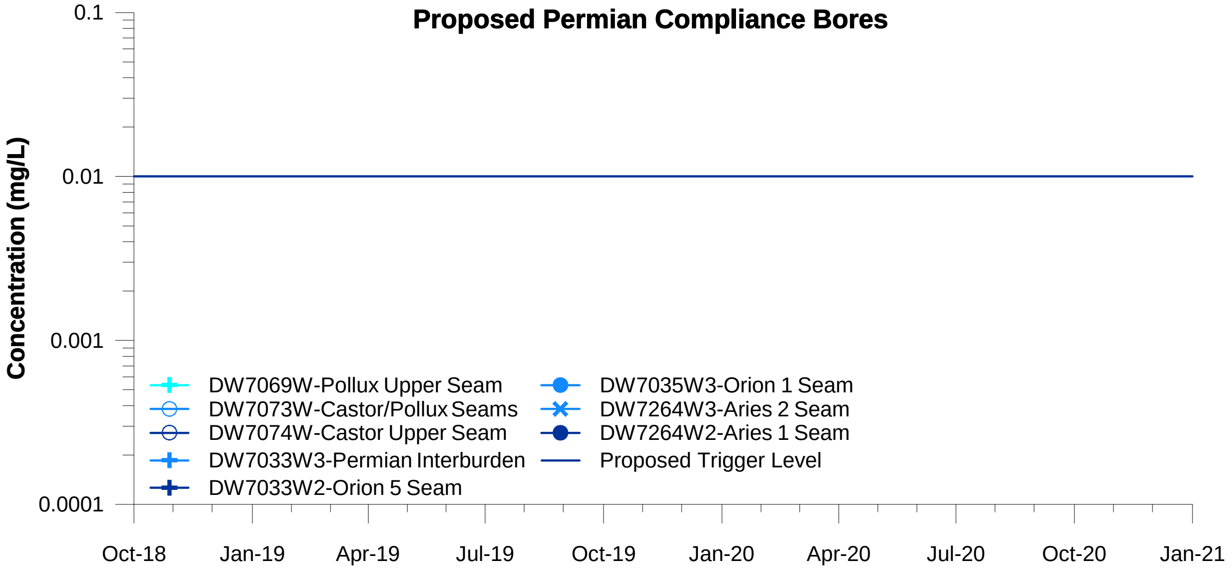
TITLE **Dissolved Uranium (U) Data**
Proposed Compliance Bores
SCALE As Shown **A4**
PROJECT No. JBT01-071-005
FIGURE No. **40**







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CLIENT Magnetic South

PROJECT Gemini Project

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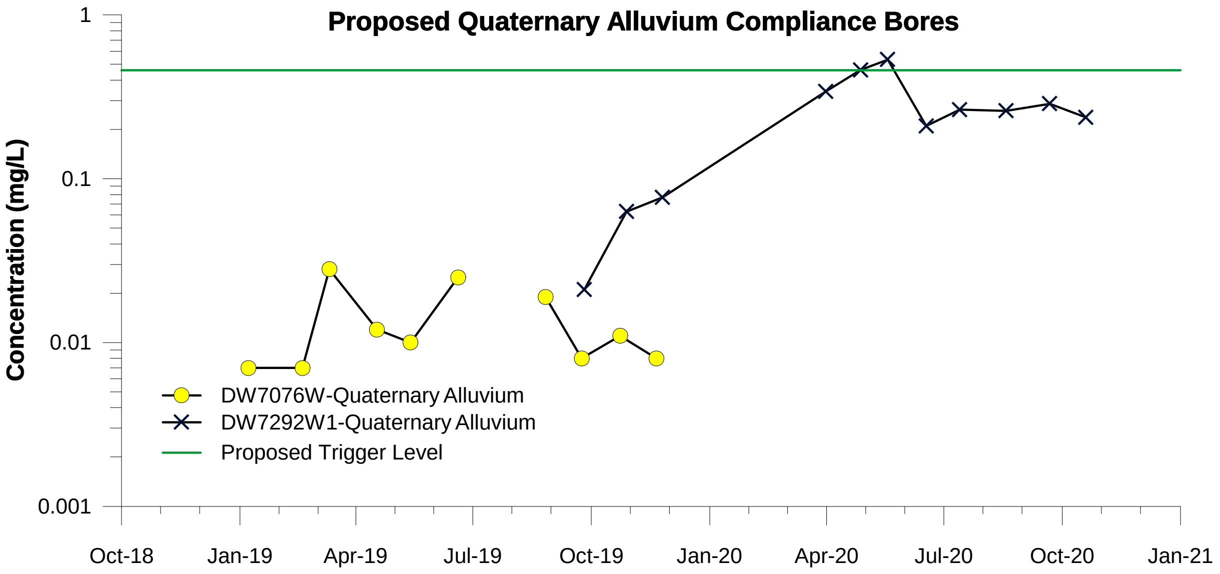
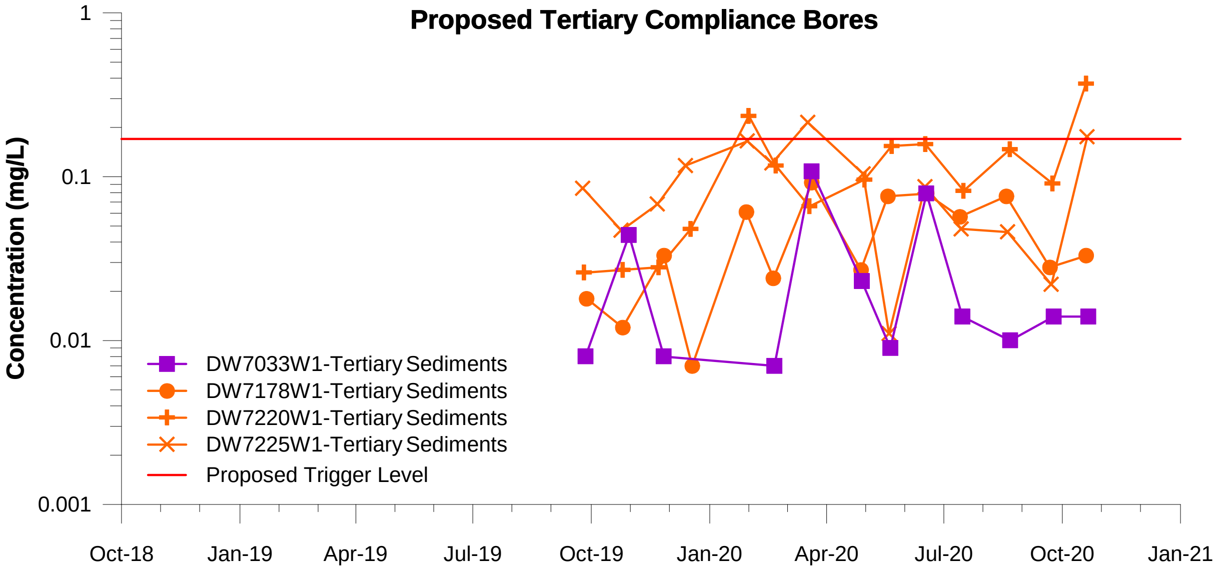
TITLE **Dissolved Vanadium (V) Data**
Proposed Compliance Bores

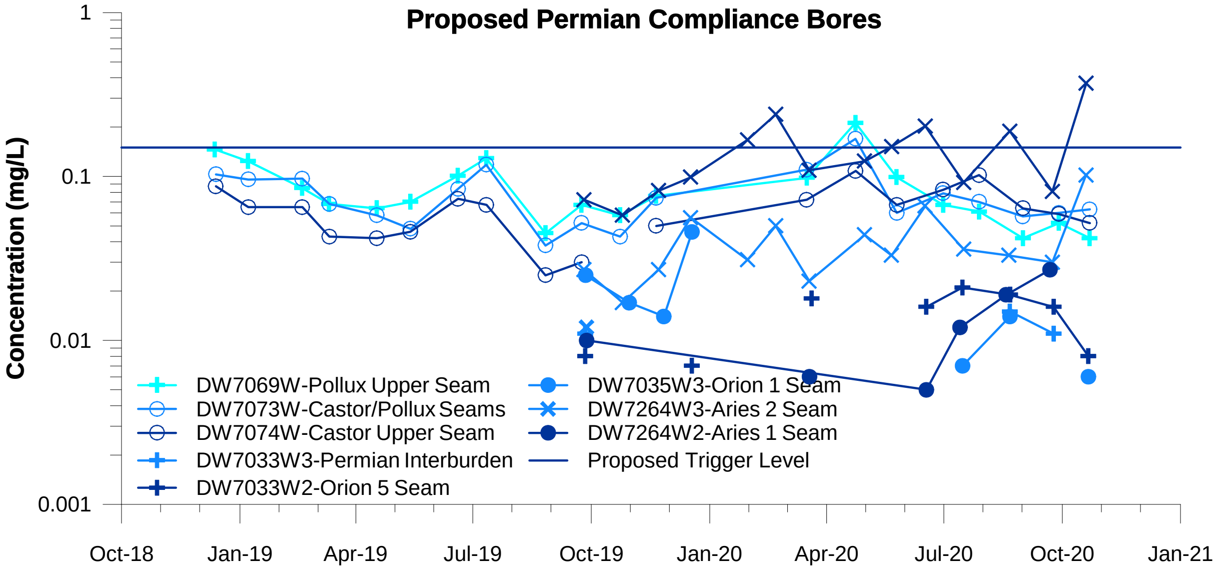
SCALE As Shown **A4**

PROJECT No. JBT01-071-005

FIGURE No. **41**







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CLIENT Magnetic South		PROJECT Gemini Project	
DRAWN JWB	DATE Nov 2020	TITLE **Dissolved Zinc (Zn) Data** **Proposed Compliance Bores**	
CHECKED	DATE		
SCALE As Shown	**A4**	PROJECT No. JBT01-071-005	FIGURE No. **42**

Appendix E Groundwater Monitoring and Management Plan

Report Prepared for Magnetic South Pty Ltd

Gemini Project

UNDERGROUND WATER MONITORING PROGRAM

December 2020

JBT01-071-006

RECORD OF ISSUE

File Name	Description	Issued to:	Date Issued	Method of Delivery
JBT01-071-006	Final	H Carney	14 December 2020	email

JBT Consulting Pty Ltd

John Bradley
PRINCIPAL HYDROGEOLOGIST

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1.0 INTRODUCTION

This Underground Water Monitoring Program (UWMP) for the Gemini Project (the Project) has been prepared by JBT Consulting, on behalf of Magnetic South Pty Ltd (Magnetic South) to satisfy the anticipated conditions of the Project's Environmental Authority (EA) and Associated Water Licence (AWL). The UWMP will be amended as required to reflect the final EA and AWL conditions.

2.0 GEOLOGY AND HYDROGEOLOGY

The Gemini coal deposit is hosted within the Permian Rangal Coal Measures and within the Yarrabee Structural Zone. Seven seams or seam groups have been identified at the Gemini Project site, which belong to either the Rangal Coal Measures or the underlying Burngrove Formation (Boyd 2019). In descending stratigraphic order the seams include the Aries, Castor, Pollux, Orion, Pisces, Virgo and Leo seams. The seams contain a number of individual plies that have identified for mining at site; the main coal seams that are encountered at site and their typical thickness are shown below in Table 3-1.

The surface geology at site is shown in Figure 2-1. It predominantly comprises sediments of the Tertiary Duaringa Formation and Quaternary alluvium associated with ephemeral creeks including Charlevue Creek and Springton Creek. At one location north of Pit C a small area of remnant basalt has been identified from drilling, measuring approximately 600 m long and 200 m wide with a thickness of approximately 20 m (JTB 2019). Groundwater monitoring bore DW7105W1 is located within the basalt and is dry (JBT 2019).

Figure 2-2 shows the project location in relation to the underlying Bowen Basin solid geology (i.e. the surficial unconsolidated Quaternary and Tertiary units have been removed, revealing the relationship between the underlying Triassic and Permian sediments as well as the prevalence of regional-scale faults). The two mining areas (A-B Pit and C Pit) are located in areas where folding has brought the coal seams close to surface at depths that can be economically mined.

Table 2-1: Summary of Regional and Site Stratigraphy

Geological Age	Unit	Coal Seams	Description	Typical Thickness at Site (m)
Quaternary	Alluvium		Unconsolidated soil, silt clay, sand and gravel associated with current surface drainage systems, e.g. Charlevue Creek and Springton Creek	1.5
Tertiary	Duaringa Formation		Mudstone, sandstone, conglomerate, siltstone	15 - 30
	Basalt		Minor basalt at one location north of Pit C.	20
Triassic	Rewan Group		Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate at base	0 - 50
Permian	Rangal Coal Measures	Aries Upper	Feldspathic and lithic sandstone, carbonaceous mudstone, siltstone, tuff and coal seams. Includes the Aries, Castor and Pollux Coal Seam, which are the target coal seam for mining at the Gemini Project	2.1
		Aries Lower		4
		Castor Upper		1.6
		Castor Lower		2
		Pollux Upper		1.9
		Pollux Lower Upper		2.9
		Pollux Lower Lower		3.5
		Orion		6.1
		Pisces Upper		1.7
		Yarrabee Tuff		0.9
		Pisces Lower		0.7
	Burngrove Formation	Virgo	Mudstone, siltstone, sandstone, coal, tuff	2.8
		Leo		4.4
	Gyranda Formation		Siltstone and shale with minor tuff and volcanilithic sandstone and rare coal	0 to 100 m+

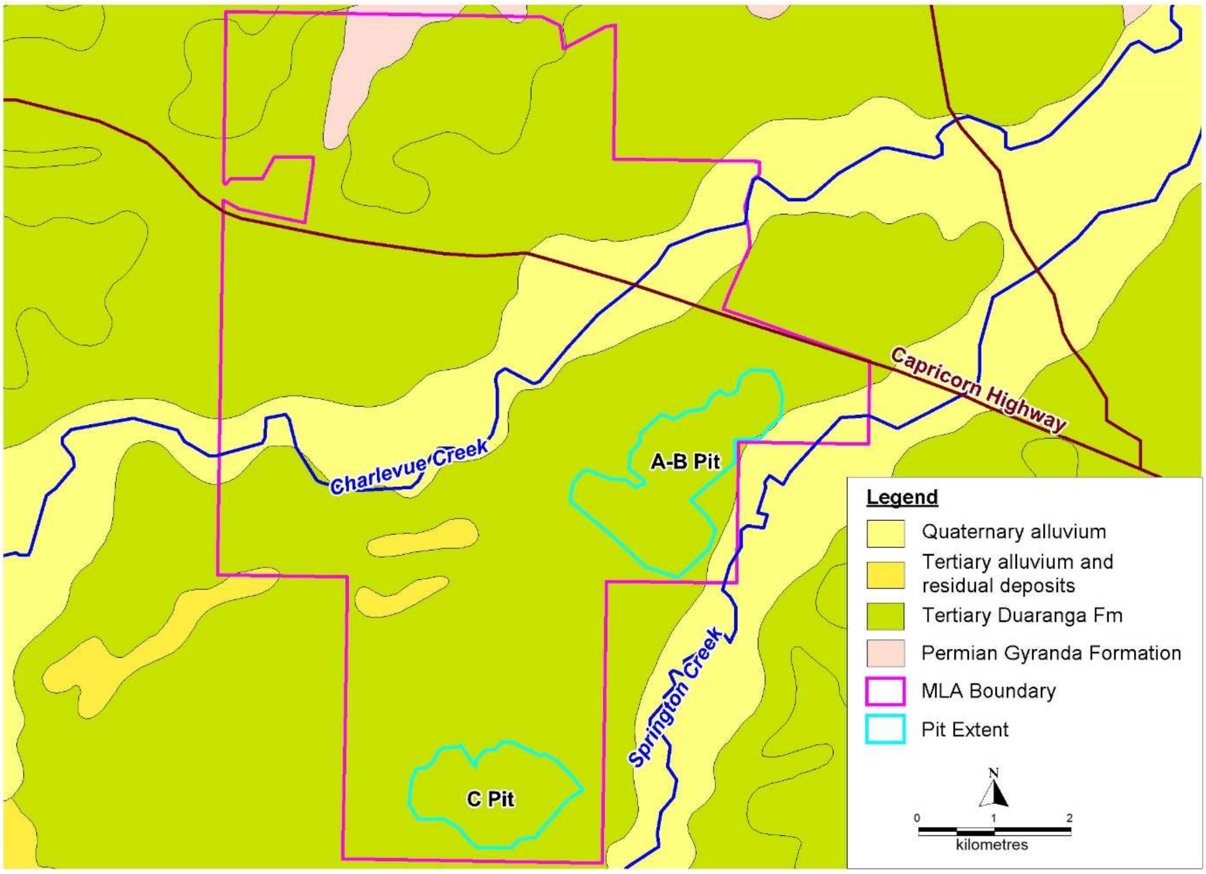


Figure 2-1: 1:100,000 Scale Surface Geology

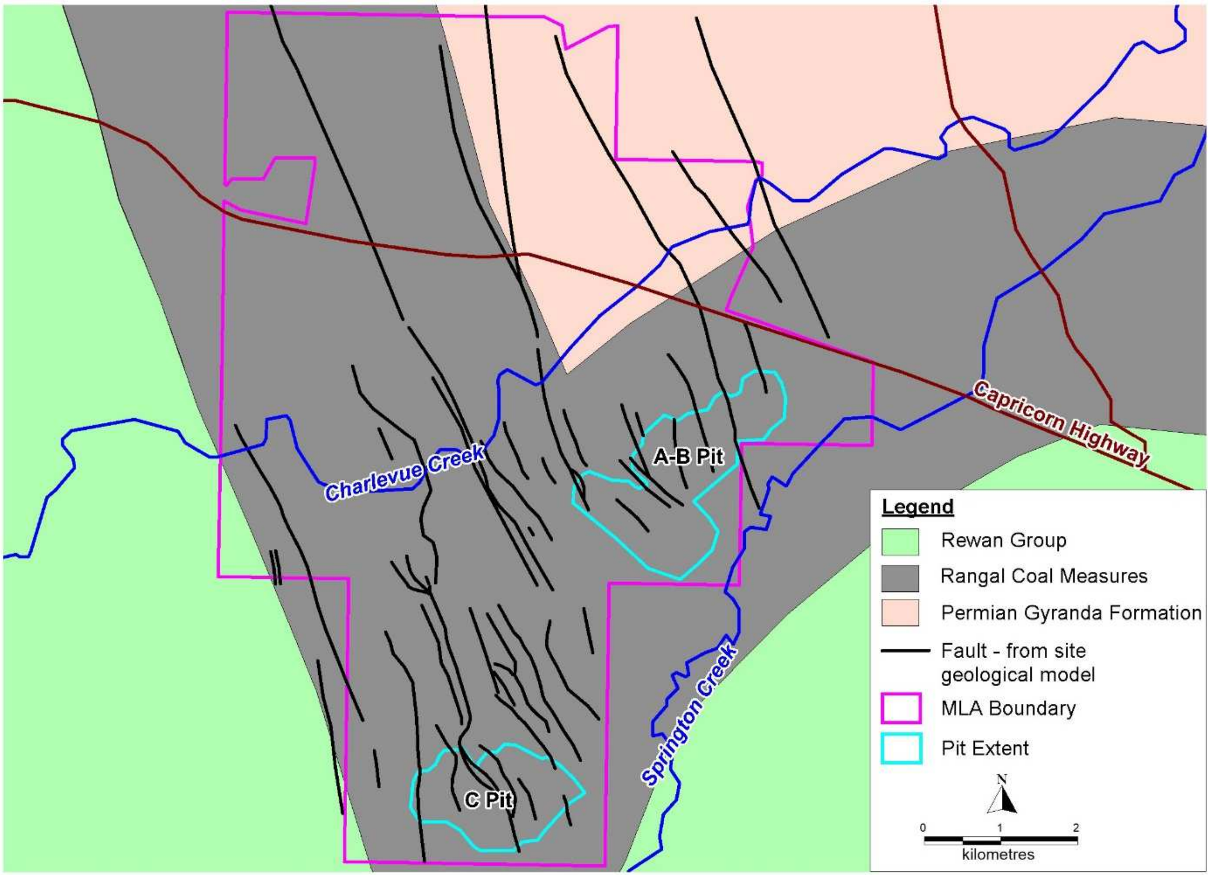


Figure 2-2: Solid Geology

3.0 GROUNDWATER MONITORING BORES

The selection of sampling locations has been determined by assessing the location of existing bores in the Project area, the planned area of mining disturbance, as well as aquifer characteristics. The frequency of monitoring has been determined by considering spatial and temporal factors associated with the aquifer, with the intention to allow any change in groundwater conditions to be determined.

The Gemini Project Monitoring program will include monitoring of 15 Compliance Bores at nine sites and 14 Reference Bores at six sites. Replacement monitoring bores will be constructed (potentially at an alternative location) if any of the bores are decommissioned due to mining. The bores will also be replaced if they become unserviceable for any other reason (e.g. due to bore collapse or failure).

Monitoring sites and monitoring frequency are shown in Table 3-1 and bore locations are presented on Figure 3-1.

Table 3-1: Gemini Project - Groundwater Monitoring Bores

Site	Bore ID	Unit Monitored	Easting (GDA94)	Northing (GDA94)	Collar RL (mAHD)	Monitoring* Frequency
Compliance Bores						
2	DW7068W	Tertiary	730785	7382391	134	2-Monthly
3	DW7069W	Permian	730397	7382699	132.57	2-Monthly
	DW7071W	Permian	730394	7382703	132.4	2-Monthly
4	DW7073W	Permian	729926	7382666	122.09	2-Monthly
	DW7074W	Permian	729922	7382666	122.04	2-Monthly
	DW7075W	Tertiary	729918	7382666	121.83	2-Monthly
5	DW7076W	Quaternary Alluvium	729750	7382723	119.81	2-Monthly
6	DW7033W1	Tertiary	731543	7383768	124.4	2-Monthly
	DW7033W2	Permian	731546	7383773	124.45	2-Monthly
	DW7033W3	Permian	731548	7383777	124.43	2-Monthly
7	DW7035W3	Permian	730957	7384050	116.67	2-Monthly
11	DW7178W1	Tertiary	732174	7383260	128.65	2-Monthly
15	DW7264W2	Permian	733391	7382921	112.24	2-Monthly
	DW7264W3	Permian	733391	7382925	112.24	2-Monthly
17	DW7292W1	Quaternary Alluvium	732905	7381108	113.58	2-Monthly
Reference Bores						
8	DW7082W1	Permian	728989	7378746	135.26	2-Monthly
	DW7082W2	Permian	728986	7378742	135.33	2-Monthly
9	DW7093W1	Permian	730096	7378974	139	2-Monthly
	DW7093W2	Permian	730092	7378973	139.05	2-Monthly
	DW7093W3	Permian	730088	7378974	139.12	2-Monthly
10	DW7105W2	Permian	730193	7380729	128.7	2-Monthly
12	DW7220W1	Tertiary	729775	7379648	128.68	2-Monthly
	DW7220W2	Permian	729775	7379651	128.64	2-Monthly
	DW7220W3	Permian	729774	7379655	128.68	2-Monthly
13	DW7221W1	Permian	729846	7379745	129.32	2-Monthly
	DW7221W2	Permian	729845	7379742	129.25	2-Monthly
14	DW7225W1	Tertiary	730467	7378359	140.64	2-Monthly
	DW7225W2	Aries 3 Seam	730466	7378355	140.69	2-Monthly
	DW7225W3	Castor Seam	730465	7378351	140.7	2-Monthly

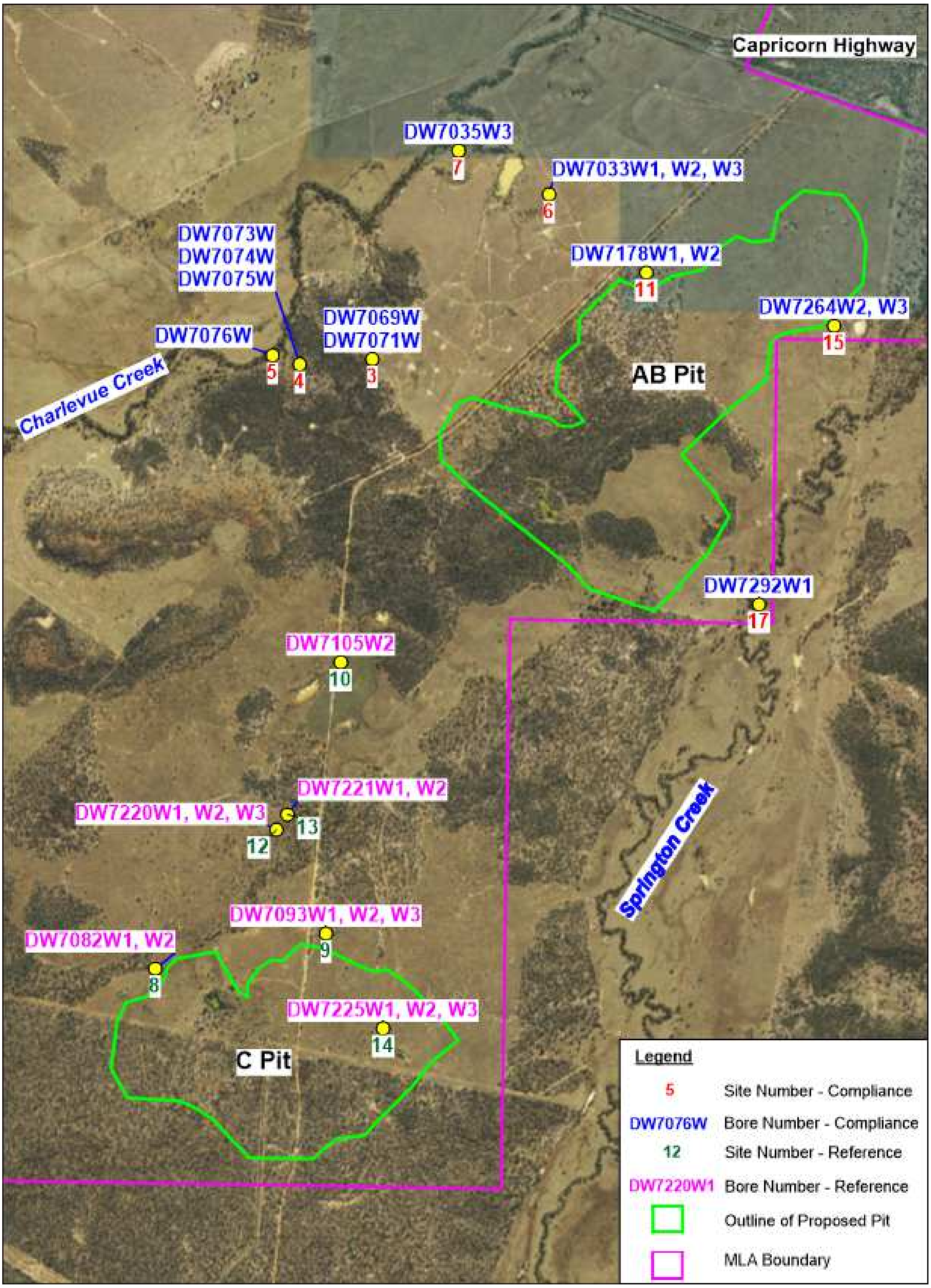


Figure 3-1: Groundwater Monitoring Bore Locations

4.0 GROUNDWATER MONITORING

4.1 Water Level Monitoring

Water level monitoring will be undertaken at all sites on a 3-monthly basis, with data loggers fitted to groundwater monitoring bores that the monitor the Quaternary alluvium. The alluvial bores that are to be fitted with data loggers are located adjacent to Charlevue Creek (DW7076W) and Springton Creek (DW7292W1). The logger data from these will be analysed to establish seasonal variations in water levels, including response to rainfall recharge and response to flow events. The monitoring frequency will be 6-hourly initially, with the long-term monitoring interval to be determined by a suitably qualified person following review of initial data.

4.2 Water Quality Monitoring

A water quality monitoring program will be undertaken for the parameters shown in Table, at the monitoring frequency and for the parameters shown below in Table 4-1. Groundwater quality parameters to be analysed have been determined based on likely and potential contaminants identified in the baseline assessment, which may be elevated as a result of mining operations, or may be of significance for protection of environmental values. The water quality data in compliance monitoring bores (Table 3-1) will be assessed against the trigger values shown in Table 4-1.

Table 4-1: Groundwater Quality Monitoring Parameters and Limits

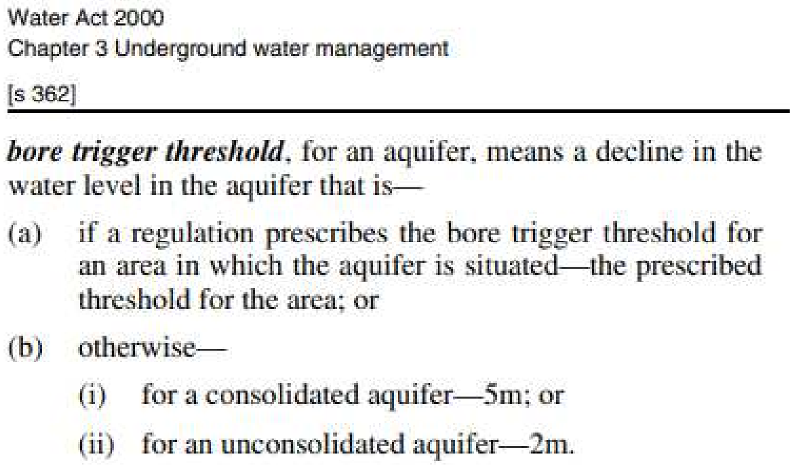
Parameter	Groundwater Unit and Trigger Values		
	Quaternary Alluvium	**Tertiary**	**Permian**
pH (pH units)	5.5 – 8.5	5.5 – 8.5	5.5 – 8.5
Electrical conductivity (µS/cm)	16209	22362	28692
Metals/metalloids (dissolved – mg/L) (1)			
Aluminium	0.09	0.13	0.13
Arsenic	0.013	0.013	0.019
Boron	4.66	1.46	1.42
Cadmium	0.0002	0.0002	0.0002
Cobalt	0.004	0.004	0.019
Chromium	0.001	0.001	0.001
Copper	0.069	0.065	0.083
Mercury	0.0001	0.0001	0.0001
Manganese	1.9	1.9	1.9
Molybdenum	0.034	0.034	0.034
Nickel	0.056	0.02	0.02
Lead	0.034	0.034	0.034
Selenium	0.01	0.01	0.01
Uranium	0.058	0.01	0.018
Vanadium	0.026	0.01	0.01
Zinc	0.46	0.17	0.15
Major Ions (mg/L)			
Sulphate	226	346	766
Calcium, chloride, potassium, magnesium, sodium, alkalinity	For interpretation purposes only		

(1) All metals and metalloids to be measured as total (unfiltered) and dissolved (filtered).

4.3 Assessment of Groundwater Monitoring Data Against Trigger Values

4.3.1 Water Level Data

Proposed groundwater level triggers are based on the bore trigger thresholds in the *Water Act 2000* as shown in the excerpt below:



Water Act 2000
Chapter 3 Underground water management

[s 362]

bore trigger threshold, for an aquifer, means a decline in the water level in the aquifer that is—

(a) if a regulation prescribes the bore trigger threshold for an area in which the aquifer is situated—the prescribed threshold for the area; or

(b) otherwise—

  (i) for a consolidated aquifer—5m; or

  (ii) for an unconsolidated aquifer—2m.

Proposed water level triggers are therefore:

- Consolidated aquifers (Permian Sediments/ Rewan Group) – 5 m/year
- Unconsolidated aquifers (Quaternary Alluvium, Tertiary sediments) – 2 m/year

4.3.2 Water Quality Data

The assessment of water quality data will be undertaken as follows:

- Two consecutive exceedances of a trigger value as defined in Table 4-1 will constitute a trigger level exceedance
- Four consecutive exceedances of a trigger value as defined in Table 4-1 will constitute a limit exceedance.

The response to a trigger level exceedance will be in accordance with the requirements of the EA.

5.0 MONITORING AND SAMPLE ANALYSIS METHODS

Sampling of groundwater will be conducted in accordance with the procedures and practices outlined in the Queensland Monitoring and Sampling Manual, i.e.:

> DES (2018) *Monitoring and Sampling Manual: Environmental Protection (Water) Policy.* Department of Environment and Science.

The method of sample collection will be selected to ensure that water samples are collected that are representative of the water chemistry of the formation in which the bore is screened. Sampling may be undertaken using pumps or bailers (where appropriate), with the sampling methodology for each monitoring bore to be determined by a suitably qualified person.

Prior to any water quality sampling, water level measurements will be taken and reported to an accuracy of 0.01 m.

A calibrated field water quality meter will be used for assessment of field parameters (EC, pH) and to allow determination of the stabilisation of parameters (e.g. EC, pH, temperature, dissolved oxygen, redox) during well purging and prior to collection of samples.

Duplicate samples will be collected at the approximate number of one duplicate sample for every ten samples.

Once collected, bottled and labelled, samples will be appropriately chilled and stored and sent to a NATA accredited laboratory, accompanied by chain of custody documentation.

6.0 STORAGE AND PUBLISHING OF MONITORING DATA

All monitoring results will be compiled and kept for a minimum of at least five years.

Monitoring data required to be collected under the UWMP will be published within the following timeframes:

(a) For water level data, within 10 business days from measurement; and,

(b) For water quality data, within 40 business days from measurement.

7.0 REPORTING

An Annual Monitoring Report will be prepared by an appropriately qualified person and will include, as a minimum:

(a) the underground water levels in the monitoring bores of the approved Underground Water Monitoring Program;

(b) any changes in water quality in the monitoring bores;

(c) maps showing the actual water level drawdown contours caused by the take of associated water for each aquifer;

(d) details of any review undertaken of the numerical underground water model since the previous Annual Monitoring Report;

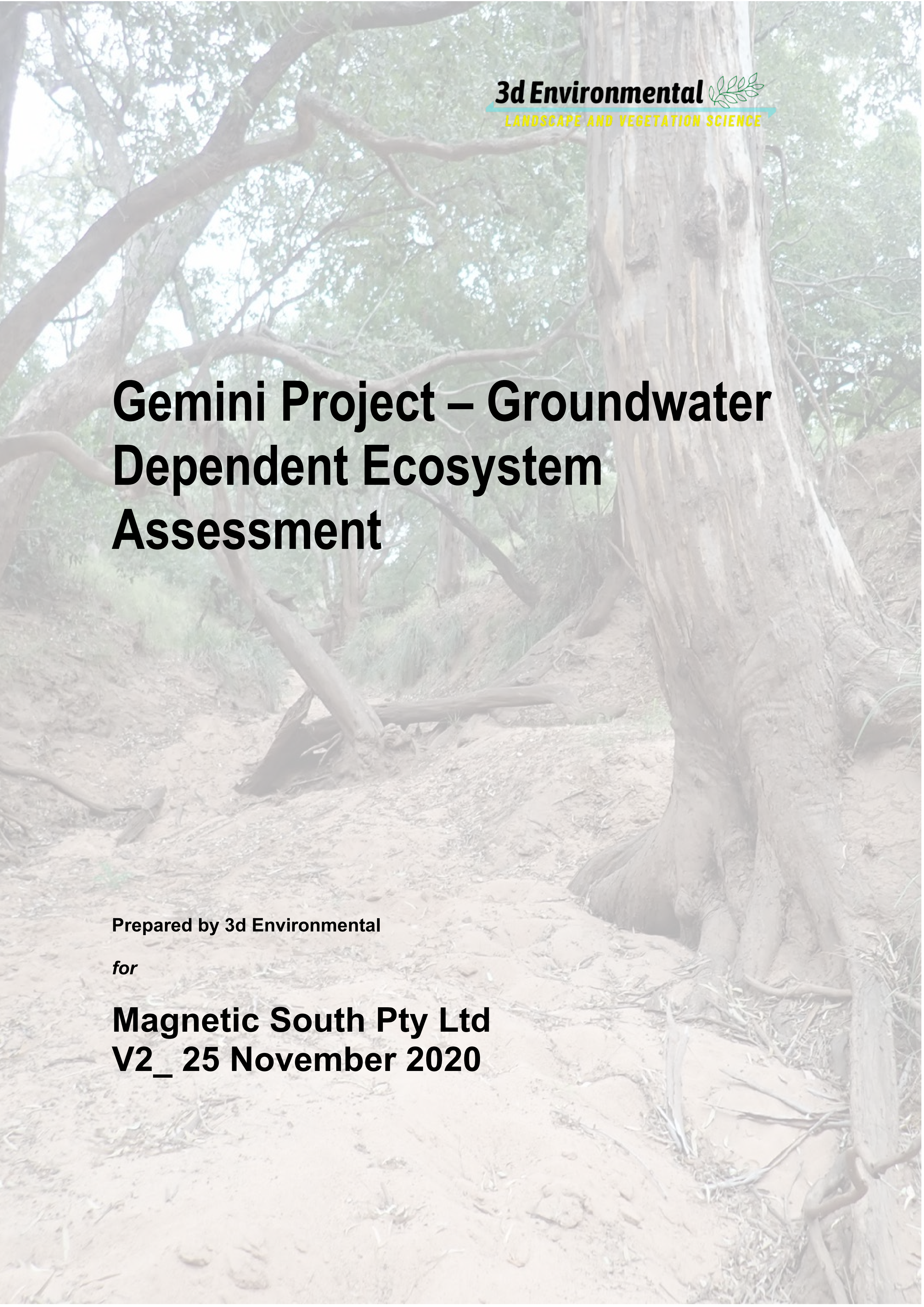
(e) an assessment of any differences between the actual water level impact and the impact predicted for the same period in the most current numerical underground water model;

(f) details of any bores which are predicted by the most current numerical underground water model to be located in the affected area; and

(g) raw data provided in a format as requested by the chief executive.

The Annual Monitoring Report will be provided to the Department of Resources (DOR) within three months after the end of the relevant water year (i.e. by end of September each year)

Appendix F Groundwater Dependent Ecosystem Assessment



3d Environmental
LANDSCAPE AND VEGETATION SCIENCE

Gemini Project – Groundwater Dependent Ecosystem Assessment

Prepared by 3d Environmental

for

Magnetic South Pty Ltd
V2_ 25 November 2020

Project No. 2020_253
Project Manager: David Stanton
Client: Magnetic South Pty Ltd
Purpose: Groundwater dependent ecosystem assessment for the Gemini Project, Magnetic South Pty Ltd.

Draft	**Date Issued**	**Issued By.**	**Purpose**
Revision 1	13 November 2020	David Stanton	First Draft GDE Assessment Report
Revision 2	25 November 2020	David Stanton	Second Draft following comments by G Brampston / Heath Carney.

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Executive Summary

Magnetic South Pty Ltd (the ‘Proponent’) proposes to develop the Gemini Project, 110 km east of Emerald and 125 km west of Rockhampton, within the Bowen Basin, Central Queensland. The project centres on Mining Lease application 700056 and will mine metallurgical coal using open cut mining methods, with the operational footprint including both mining pits and associated infrastructure. An assessment of the presence of GDEs within the Project area is presented in this document as a component of the approval process.

To complete the GDE assessment, multiple lines of evidence including measurement of leaf water potential, soil moisture potential and analysis of stable isotopes from various sources were applied to assesses the dependence of vegetation in the Gemini Project area on groundwater. Based on a targeted survey effort, two areas of likely groundwater dependence, and hence GDEs, were recognised in the Project area being:

1. Charlevue Creek Area 1, being an area identified as a terrestrial GDE on Charlevue Creek, to the west and upstream of the mine infrastructure area.
2. Springton Tributary Area 1, being a terrestrial GDE associated with an ephemeral drainage system, currently located within the footprint of the mine infrastructure area.

The study confirmed that the Charlevue Creek GDE area is hosted in an area of recent river alluvium which forms a flood terrace that is dissected by the channel of Charlevue Creek and traversed by a series of flood overflow channels. The GDE area is supported by an unconfined, fresh and seasonal alluvial aquifer that is perched above the regional groundwater table associated with Tertiary, Permian and older alluvial sediments. The supporting perched aquifer is conceptualised to be seasonally recharged during surface flows including flood events and associated rainfall. Based on salinity data and stable isotope comparisons between twig xylem and groundwater samples, it is inferred that the perched aquifer is hydraulically disconnected from the regional Tertiary and alluvial aquifers which hold groundwater with salinity values that range from mildly to highly toxic to trees. Based on stable isotope data, there is no indication that trees at this site, nor any tree sampled during the GDE assessment is utilising groundwater associated with the regional Tertiary, alluvial or Permian coal seam aquifers to any significant degree.

The Springton Tributary Area 1 GDE system is supported by a seasonally variable perched aquifer system that is hosted in a thick, coarse sand horizon developed below the flood plain of the minor tributary. The strong iron staining associated with the sandy aquifer material provides evidence for considerable seasonal fluctuation in groundwater levels, which are inferred to recharge and drain rapidly in response to rainfall and surface flows. Similar to the Charlevue Creek GDE system, the Springton Tributary system is perched above the regional Tertiary groundwater table and trees at the site, based on evidence from stable isotope analysis, show no evidence for utilisation of the deeper groundwater system.

The Springton Tributary GDE system covers an area of 5.54 hectares and is located entirely within the mine infrastructure area, which necessities clearing and unavoidable direct impact. The environmental values and impacts associated with direct clearing of vegetation on are discussed in the Terrestrial Flora and Fauna Report (AARC 2019).

The Charlevue Creek GDE system is supported by an alluvial aquifer that is conceptualised to be perched above, and hydraulically disconnected from the deeper regional aquifers associated with the Tertiary sediments, older alluvial systems, and the Permian coal seams. Groundwater drawdown associated with mining void development is modelled to impact the regional groundwater table below the Charlevue Creek GDE system. Due to limited connectivity between the perched alluvium and deeper groundwater systems, it is anticipated that these impacts will not be propagated into the perched aquifer system. Furthermore, the perched aquifer that supports the Charlevue Creek GDE system is recharged by surface water flows, flooding and seasonal rainfall events which will not be altered by mining development.

Mitigations to prevent impact to the Charlevue Creek system include general operational measures associated with project approval conditions which include development of the Mine WMS and ESCP. With these routine mitigations, in conjunction with ongoing groundwater sampling of the existing groundwater monitoring network to be completed as part of the ongoing groundwater monitoring program, it is considered that the risk to the Charlevue Creek GDE system posed by mine development is negligible.

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Glossary

Alluvial aquifer	An aquifer comprising unconsolidated sediments deposited by flowing water usually occurring beneath or adjacent to the channel of a river.
Aquifer	A geological formation or structure that stores or transmits water to wells or springs. Aquifers typically supply economic volumes of groundwater
Aquatic GDE	Vegetation supported by surface expression of groundwater (e.g. spring fed watercourses and associated fringing vegetation).
Base flow	Streamflow derived from groundwater seepage into a stream.
Capillary fringe	The unsaturated zone above the water table containing water in direct contact with the water table though at pressures that are less than atmospheric. Water is usually held by soil pores against gravity by capillary tension.
Confined aquifer	A layer of soil or rock below the land surface that is saturated with water with impermeable material above and below providing confining layers with the water in the aquifer under pressure.
Perched groundwater system	A groundwater system or aquifer that sit above the regional aquifer due to a capture of infiltrating moisture on a discontinuous aquitard.
Phreatic zone	The zone of sub-surface saturation separated from the unsaturated zone in unconfined aquifers by the water table.
Phreatophyte	Plants whose roots extend downward to the water table to obtain groundwater or water within the capillary fringe
Obligate phreatophyte	A plant that is completed dependent on access to groundwater for survival
Edaphic	Relating to properties of soil or substrate including its physical and chemical properties and controls those factors impose on living organisms.
Evapotranspiration	The movement of water from the landscape to the atmosphere including the sum of evaporation from the lands surface and transpiration from vegetation through stomata
Facultative phreatophyte	A plant that occasionally or seasonally utilises groundwater to maintain high transpiration rates, usually when other water sources aren't available.
Fractured rock aquifer	An aquifer in which water flows through and is stored in fractures in the rock caused by folding and faulting.
Fluvial	Relating to processes produced by or found in rivers
Groundwater	Those areas in the sub-surface where all soil or rock interstitial porosity is saturated with water. Includes the saturated zone and the capillary fringe.
Water table	The upper surface of the saturated zone in the ground, where all the pore space is filled with water.
Groundwater dependent ecosystems (GDE)	Natural ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (Richardson et al. 2011)

Infiltration	Passage of water into the soil by forces of gravity and capillarity, dependent on the properties of the soil and moisture content.
Leaf water potential (LWP)	The total potential for water in a leaf, consisting of the balance between osmotic potential (exerted from solutes), turgor pressure (hydrostatic pressure) and matric potential (the pressure exerted by the walls of capillaries and colloids in the cell wall).
Leaf area index (LAI)	The ratio of total one-sided area of leaves on a plant divided by the area of the canopy when projected vertically on to the ground.
Local Meteoric Water Line (LMWL)	Describes the relationship between hydrogen and oxygen isotope (Oxygen-18 and Deuterium) ratios in local natural meteoric waters. LMWL is usually developed from precipitation data collected from either a single location or a set of locations within a “localised” area of interest (USGS, 2018).
Percolation	The downward movement of water through the soil due to gravity and hydraulic forces.
Permeability	A materials ability to allow a substance to pass through it, such as the ability of soil or rocks to conduct water under the influence of gravity and hydraulic forces.
Permanent wilting point	The water content of the soil at which a plant can no longer extract water and leaves will wilt and die. Usually -1.5 Mpa (-217 psi). Generally applied to crops although Australian flora typically have much larger stress thresholds.
Piston flow	The movement of a water front through the soil uniformly downwards to the aquifer, with the same velocity, negligible dispersion, pushing older water deeper into the soil profile.
Preferential flow	Movement of surface water rapidly from surface to aquifer along preferential flow paths, bypassing older moisture in the upper soil profile.
Unconfined aquifer	An aquifer whose upper surface is at atmospheric pressure, producing a water table, which can rise and fall in response to recharge by rainfall
Soil water potential	A measure of the difference between the free energy state of soil water and that of pure water. Essentially a measure of the energy required to extract moisture from soil.
Stable isotope	An isotope that does not undergo radioactive decay.
Standard Wilting Point	The minimum LWP or corresponding soil moisture potential that can be tolerated before a plant wilts in response to negative water supply. This is accepted at -15 bars or -1.5 MPa (or -217.55 PSI)
Specific Yield	The ratio of the volume of water that a saturated rock or soil will yield by gravity to the total volume of the rock or soil.
Surface water	Movement of water above the earths’ surface as runoff or in streams
Transpiration	The process of water loss from leaves, through stomata, to the atmosphere.
Terrestrial GDE	Terrestrial vegetation supported by sub-surface expression of groundwater (i.e. tree has roots in the capillary fringe of groundwater table).
Vadose zone	The unsaturated zone, above the water table in unconfined aquifers

Water Potential	The free energy potential of water as applied to soils, leaves plants and the atmosphere.
Wetting front	The boundary of soil wet by water from rainfall and dry soil as the water moves downward in the unsaturated zone.

1.0 Introduction

Magnetic South Pty Ltd (Magnetic South) (the 'Proponent') proposes to develop the Gemini Project located approximately 110 km east of Emerald and 125 km west of Rockhampton, within the Bowen Basin, Central Queensland, herein referred to as 'the Project' (**Figure 1**). The project centres on Mining Lease Application (MLA 7000556) and will mine metallurgical coal using open cut mining methods, with the operational footprint including both mining pits and associated infrastructure.

Coal mining developments have potential to alter natural groundwater regimes or groundwater quality and may therefore impact on ecosystems that are reliant on a groundwater resource. These ecosystems are captured under the general term of groundwater dependent ecosystems (GDEs). This report provides an assessment of the presence of GDEs within the Project area and includes an assessment of potential project related impacts to GDEs.

1.1 Project Background

The main activities associated with the Project include:

- Exploration activities continuing to support mine planning.
- Development of a Mine Infrastructure Area (MIA) including mine offices, bathhouse, crib rooms, warehouse/stores, workshop, fuel storage, refuelling facilities, explosives magazine and sewage, effluent and liquid waste storage.
- Construction and operation of a facilities specific to coal handling including Run-of-Mine (ROM) coal, product stockpiles and rejects bin/overflow.
- Construction and operation of a surface conveyor including rail loading facilities connecting to coal terminals at Gladstone for export.
- Construction of access roads from the Capricorn Highway to the MIA. Development of internal roads and mine haul roads will be ongoing including a causeway over Charlevue Creek.
- Installation of a raw water supply pipelines, 66 kV transmission line and substation.
- Development of mine areas (open cut pits) and out-of-pit waste rock emplacements as well as drilling and blasting of competent waste material.
- Mine operations using conventional surface mining equipment (excavators, front end loaders, rear dump trucks, dozers) and progressive placement of waste rock in emplacements adjacent to and near the open cut voids.
- Progressive establishment of soil stockpiles, laydown area and borrow pits (for road base and civil works) with material sourced from quarries where required.
- Development of water storage dams and sediment dams, and the installation of pumps, pipelines, and other water management equipment and structures including temporary levees, diversions, and drains.

Mining will extract up to 1.9 Million tonnes per annum (Mtpa) ROM Coal, with an average 1.8 Mtpa for a construction/production period of approximately 20 years. The project footprint is shown in **Figure 1**.

1.2 Project Objectives

Objectives of GDE assessment are to:

- Identify if vegetation within and surrounding the Project area accesses and utilises groundwater for transpiration, either permanently or intermittently, consistent with classification of a GDE.
- Determine the source and nature of aquifers utilised by GDEs, if any.
- Identify the degree of dependence of vegetation communities on groundwater for survival and sustenance through periods of drought.
- Provide an assessment of potential mining impacts on identified GDEs extending throughout the life of the mine.

1.3 Relevant Legislation

Environmental Protection Act 1994: Under regulatory provisions of the Environmental Protection Act 1994 (EP Act), a site-specific Environmental Authority (EA) is required under Section 125 of the EP Act. A component of the EA will be requirement is to address impacts to GDEs, and this report has been prepared in response to an information request requiring further assessment of the potential for impact to GDEs.

1.4 GDE Definition Used for Assessment

The definition of a GDE applied to this assessment is consistent with the definition provided in the guidance document *Modelling water-related ecological responses to coal seam gas extraction and coal mining* prepared by Commonwealth of Australia (2015) on the advice from the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) and IESC 2018a. This definition is described below:

> *Groundwater dependent ecosystems (GDEs): Natural ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (Richardson et al. 2011). The broad types of GDE are (*from *Eamus et al. 2006a and 2006b):*
>
> - Ecosystems dependent on surface expression of groundwater (springs).
> - Ecosystems dependent on subsurface presence of groundwater (terrestrial GDEs).
> - Subterranean ecosystems (caves).

Ecosystems dependent on surface expression of groundwater are extended to spring fed streams and rivers, otherwise defined as aquatic GDE's.

1.5 Groundwater Definition Used in this Assessment

Eamus (2006a) defines groundwater (when related to GDEs) as;

> *'all water in the saturated sub-surface; water that flows or seeps downwards and saturates soil or rock, supplying springs and wells, water stored underground in rock crevices and in the pores of material'.*

For this assessment of GDEs, the term groundwater refers to those areas in the sub-surface where all soil or rock interstitial porosity is saturated with water including the associated capillary fringe. It is assumed that in the overlying unsaturated zone, water may be present in varying amounts over time although saturation is rarely reached during infiltration or percolation of rainfall, stream water or other surface sources of groundwater recharge moving under gravity. The definition of groundwater excludes wetting fronts, being the transitional zone between wet and dry soil that surrounds a water body; and ephemeral zones of saturation that result from rapid infiltration pf surface water, whereby the down-gradient migration of infiltrating water is merely slowed rather than halted.

1.6 Climatic Considerations

The annual rainfall at Duaringa Post Office (25km to the east) for January 2019 to June 2020, being the nearest reliable recording station to the Project, is presented in **Figure 2**. The data indicates below average rainfall for nearly all months through 2019 with a total rainfall of 321.3mm for the year, being half the long-term annual average of 704.3mm (BOM 2020a). February 2020, four months preceding the survey, was extremely wet with 346.7mm falling for the month compared to the long-term monthly average of 115.3mm. Following this intense period of precipitation, rainfall for the four months preceding the survey (March to June 2020) was dry with below average rainfall recorded across all months. There was no rainfall recorded at Duaringa for two weeks preceding the survey which was completed across 6 days from 27th June 2020 to 2nd July 2020.

Plant growth in the region is strongly limited by moisture rather than temperature (Hutchinson et al. 1992) which is reflected in the evapotranspiration rates at the Duaringa Post Office for the 2019 – 2020 period, with data for all months indicating evapotranspiration as being considerably higher than rainfall except in February 2020. Annual evapotranspiration rates tend to peak in January and are typically at their lowest in June / July (**Figure 3**) (BOM 2020a).

The region has experienced several significant drought events, many of which have resulted in tree dieback. The early to mid-1990's drought, the worst on record for central and north Queensland, and the millennium drought from 2000 through to 2007 both resulted in substantial dieback of native woodland habitats, typically affecting ironbark woodlands and most severely on basaltic substrates (Fensham and Holman 1999; Fensham et al 2009). **Figure 4** demonstrates the major climatic cycles in terms of Cumulative Rainfall Departure (CRD) (Weber and Stewart 2004), representing a cumulative departure of monthly rainfall from the long-term mean monthly rainfall (1990 to 2020) from point data at Dingo (SILO 2020). Strongly decreasing rainfall trends between 1990 to 1996; and 2000 to 2007 representing major drought periods are strongly evident. Following a period of relatively stable / average rainfall conditions occurring between 2013 to 2017, the current trend is for decreasing rainfall with below average conditions experienced post 2017 indicating a longer-term regime of ecological water deficit preceded the assessment. The analysis of cumulative rainfall departure is relevant to this assessment as shallow water tables generally follow similar trends, with rising water tables during upward precipitation trends.

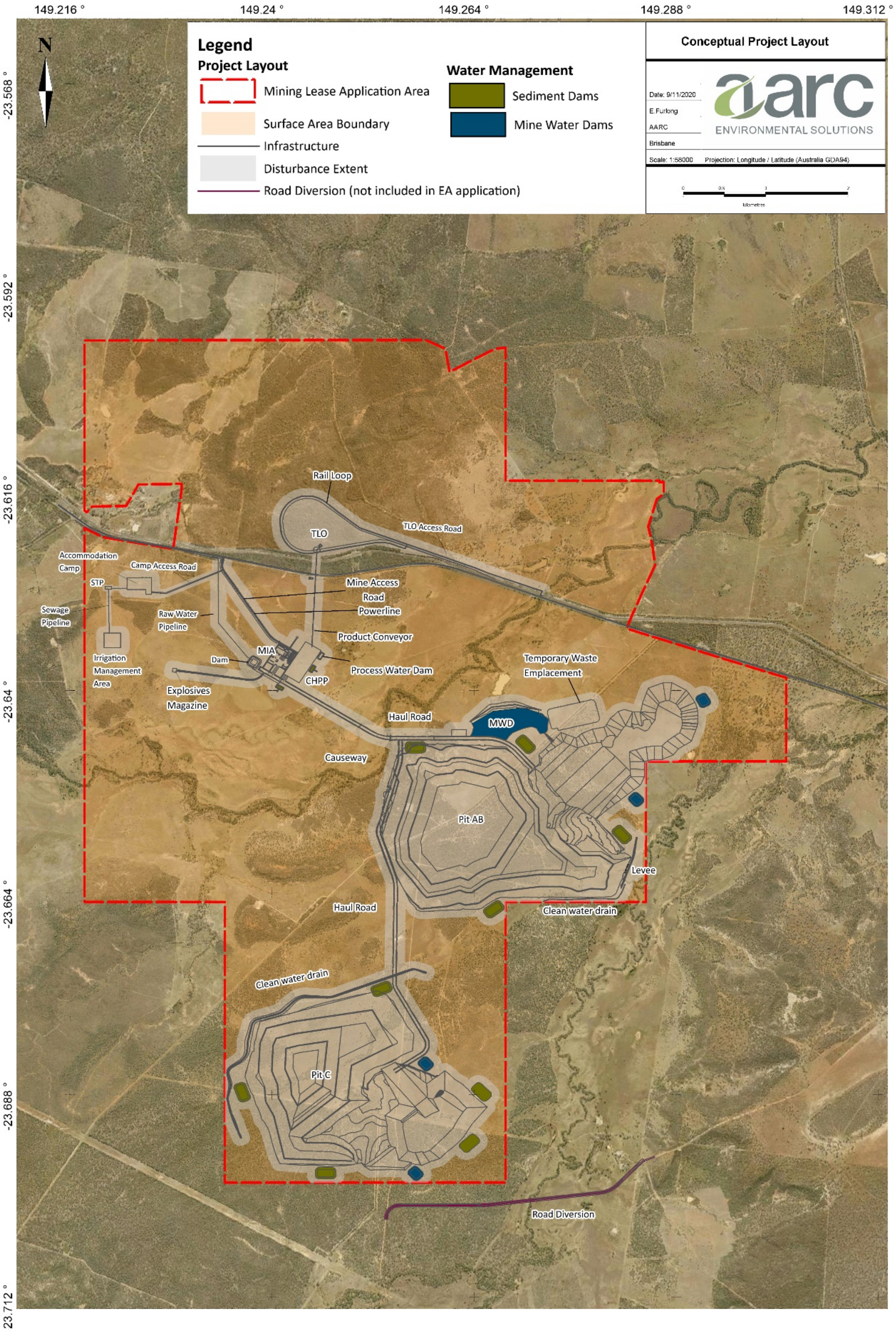


Figure 1. Project location and facilities.

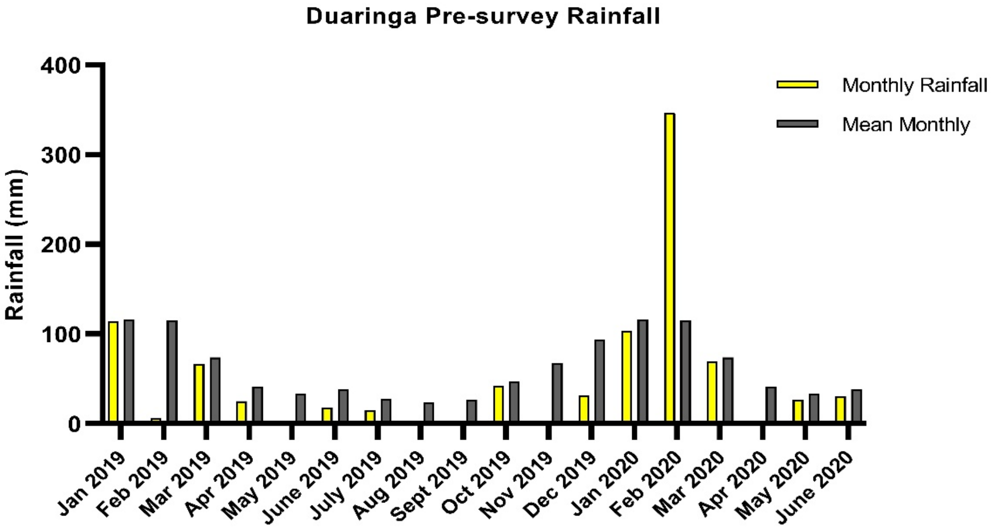


Figure 2. Rainfall for the period from January 2019 to June 2020 from the Duaringa Post Office recording station.

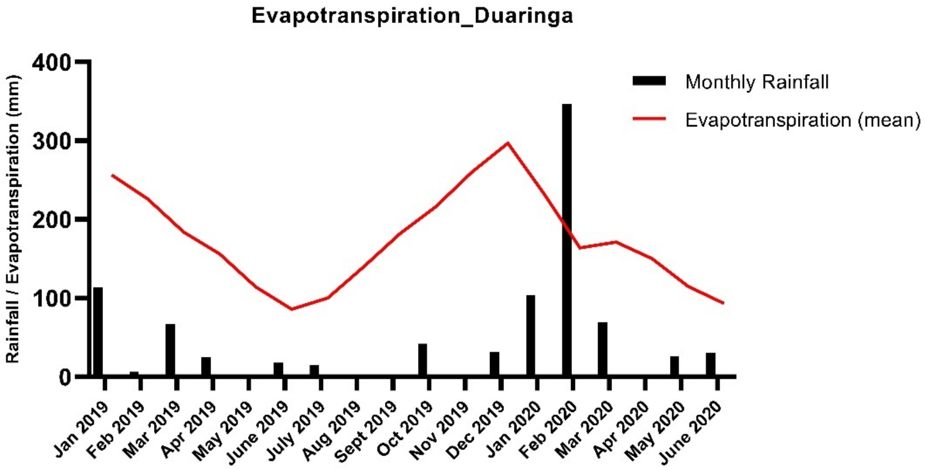


Figure 3. Evapotranspiration compared to rainfall for January 2019 to March 2020 from the Moranbah Airport.

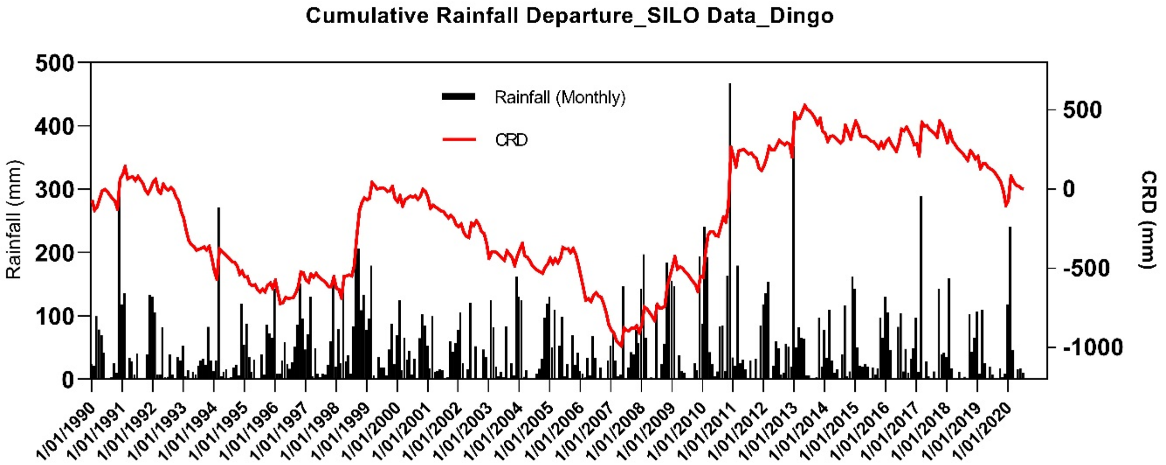


Figure 4. Cumulative Rainfall Departure calculated for Dingo from SILO (2020) indicating a drying climatic cycle leading up to the survey in June 2020.

2.0 Ecohydrological Setting

As GDEs define a continuum between groundwater, soils and surface ecology, this section provides a description of both biotic factors and abiotic controls, enabling linkages to be drawn between groundwater and terrestrial ecology within impact assessment sections.

2.1 Ecological Characteristics of GDE Species and Communities

2.1.1 Regional Ecosystems

Regional ecosystem (RE) mapping completed by AARC (2019), provided in **Figure 5**, for the Project defines broad number of regional ecosystems, typically dominated by eucalypt woodland and open forest habitats. This includes:

- RE 11.3.25, dominated by forest red gum (*Eucalyptus tereticornis)* and river red gum (*Eucalyptus camaldulensis)* with scattered Moreton Bay ash (*Corymbia tessellaris*), Clarkson's bloodwood (*Corymbia clarksoniana*) and river oak (*Casuarina cunninghamia*) is the dominant regional ecosystem associated with major watercourses and drainage lines in the Project area.
- RE 11.3.2, dominated by poplar box (*Eucalyptus populnea*) associated with loamy flood plain areas on older, higher alluvial terraces. RE11.3.2 is typically mapped as a terrestrial GDE in BOM GDE mapping databases (BOM 2020b).
- RE11.5.2, typically dominated by narrow leaf ironbark (*Eucalyptus crebra*) with scattered poplar box occurring on older residual sands and gravels above flood level.
- 11.7.2 dominated by lancewood (*Acacia shirleyi)* on residual jump ups.

The dominant species within these regional ecosystems and their potential capacity to utilise groundwater are discussed in **Section 2.1.3**.

2.1.2 Mapped Groundwater Dependent Ecosystems

The mapping of GDEs has been completed at a national level by the Bureau of Meteorology which has produced the GDE Atlas (BOM 2020b) which identifies the following GDEs types, consistent with the definition of a GDE applied in this assessment.

- **Aquatic** ecosystems that rely on the surface expression of groundwater–this includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands, and springs. Marine and estuarine ecosystems can also be groundwater dependent, but these are not mapped in the Atlas.
- **Terrestrial** ecosystems that rely on the subsurface presence of groundwater–this includes all vegetation ecosystems.
- **Subterranean** ecosystems–this includes cave and aquifer ecosystems.

The BOM GDE layer has been compiled with national scale datasets and rules to describe the potential for groundwater interaction, and within the assessment area corresponds directly with GDE and potential aquifer mapping produced by DES (2018). Due to the limited ground verification, the dataset is considered unsuitable for site specific GDE assessment. The mapping of GDEs over the Project Area and surrounds, as produced by BOM (2020b) is provided in **Figure 6**. In general, this assessment shows ‘Low Potential’ for ‘Terrestrial’ GDEs associated with riparian vegetation and watercourses. It is noted that an area mapped as a ‘High Ecological Significance’ wetland is also indicated on **Figure 6**, which in prior versions of the GDE Atlas was mapped as a ‘Low Potential Aquatic GDE’ (refer to Terrestrial Ecology Assessment prepared by AARC 2019). Updates to the GDE Atlas incorporated in August 2020 no longer consider this wetland area to represent a GDE, either terrestrial or aquatic.

2.1.3 Groundwater Dependent Species

Eucalypts: The GDE investigation area and surrounds are characterised by the presence of both river red gum (*Eucalyptus camaldulensis)* and forest red gum *(Eucalyptus tereticornis*) which typically form the upper canopy of the riparian ecosystem RE11.3.25. Moreton Bay ash *(Corymbia tessellaris)* and minor Clarkson’s bloodwood (*Corymbia clarksoniana)* are found in some localities, more typically in elevated positions on the riverbank. Poplar box *(Eucalyptus populnea)* is more typically found on elevated upper terraces at greatest distance and elevation from the stream channel.

River red gum is a well-studied species known to have deep sinker roots, hypothesised to grow down towards zones of higher water supply (Bren et al., 1986) and the species mixes with forest red gum along the river frontage. For this assessment, the physiological attributes of river red gum and forest red gum are assumed to be similar as the species can inhabit and mix within a similar ecological niche. Forest red gum is however a more adaptable species, occupying dry hill slopes in some localities and it would be expected to be more tolerant of changes to hydrological regime than *Eucalyptus camaldulensis* which is a riparian specialist. Malik and Sharma (2004) found that *Eucalyptus tereticornis* also has a strong capacity to extract moisture from the shallow soil profile (0 – 150cm). Therefore, attributing forest red gum with the ecological characteristics of the more specialised river red gum is prudent from a risk management perspective, because it adopts the attributes of the species with the highest sensitivity.

River red gum is adapted to arid and semi-arid environments and will go through alternate phases of shedding and regaining its crown, depending on the availability of water and it is adapted to do so and over time and across the flood frequency classes, having capacity to self-regulate and adjust their transpiration rates to match the average flood return interval (Collof 2014) while the species maintain a strong capacity for genetic selection to increase capacity for the species to survive drought stress. Trees less able to survive drought tend to die off, hence the genes that are associated with drought tolerance traits become more common in the remaining population.

The species is considered opportunistic in its water use, sourcing water according to osmotic and matric water potential and source reliability (Thorburn et al., 1993; Mensforth et al., 1994; Holland et al., 2006; Doody et al., 2009) with the water requirements obtained from three main sources being groundwater, rainfall, and river flooding. Flooding enables the species to survive in semi-arid areas (ANBG 2004) where stands are intimately associated with the surface-flooding regime of watercourses and related groundwater flow. River red gum are considered a facultative phreatophyte, shifting between a combination of surface soil moisture and groundwater during periods of high rainfall, then shifting to exclusive use of groundwater during drier periods. They are likely to achieve this shift through inactivation of surface roots during drier periods with increased reliance on deeper tap roots when surface water is unavailable. River red gum will often use saline groundwater in preference to fresh surface water, probably because it represents a more reliable supply (Colloff 2014). Doody et al. (2015) demonstrated that soil moisture alone can sustain the health of *Eucalyptus camaldulensis* through periods of drought up to six years before significant decline in tree health is noted.

The maximum potential rooting depth of river red gum is subject to considerable conjecture in current literature, although it is widely accepted that the species has capacity to access deep groundwater sources (Eamus et al 2006a). Horner et al. (2009) found rooting depths at 12–15 mbgl based on observed mortality in plantation river red gum forests on the Murray River Floodplain. From excavations in 20 year-old plantation forests of *Eucalytpus tereticornis,* Kallarackal and Somen (1998) found that roots were traceable to depths of 9.3 mbgl and Jones et al (2020) found maximum rooting depths of 8.1 mbgl in river red gum in a broad study area in the Great Artesian Basin. In conclusion, maximum rooting depth of red gum is likely to be variable, dependent on-site geology and depth to saturation with the capillary fringe being the general depth at which root penetration will be arrested (Eamus et al 2006b).

All eucalyptus species are potential users of groundwater (Cook et al 2007) although few studies demonstrating this dependence exist. Fensham and Fairfax (2007) consider both poplar box and narrow-leaved ironbark to possess a shallow rooting system with limited investment in deep root architecture, rendering them susceptible to droughting. Poplar box is more typically associated with upper terraces that are elevated above the river channel requiring a deeper rooting system to access groundwater. Narrow leaf ironbark generally occupies more elevated portions of the landscape, away from drainage lines where depth to groundwater would be greatest. For the remaining species, O'Grady et al (2006b) concluded the following when studying groundwater usage of trees on a tropical floodplain savannah:

1. Clarkson's bloodwood utilised groundwater when the water table was at 10 mbgl indicating the potential for the species to develop a deep sinker root. Clarkson's bloodwood should be considered a facultative phreatophyte. It is likely that Clarkson's bloodwood occurring on the banks of ephemeral watercourses will utilise groundwater if it is within reach of rooting depth and not saline.
2. Moreton Bay ash demonstrated groundwater usage when the water table was at 4 mbgl, although it is not known whether the species has capacity to utilise deeper groundwater sources. Moreton Bay ash should be considered a facultative phreatophyte.

Both Moreton Bay ash and Clarkson's bloodwood are scattered throughout the frontages of Springton and Charlevue Creek's within RE11.3.25, generally occupying lower terraces where depth to groundwater decreases.

River oak: The water use strategy of river oak (*Casuarina cunninghamiana)* appears dependent on its position relative to a watercourse. O'Grady et al (2006b) determined river oak mainly utilised river water when adjacent to a stream channel, which is its most common topographic position. There has been no demonstration that river oak has capacity to utilise deeper groundwater sources. River Oak is not considered to be groundwater dependent in the Project area.

Lancewood: The acacia's, in particular lancewood, are considered shallow rooted species and based on their ecological preference for elevated portions of the landscape, are considered unlikely to utilise groundwater to any degree.

2.2 Hydrogeological Setting

The project mining area is in the north-west extent of the Bowen Basin, a broad sedimentary basin formed in the Permian / Triassic period with a variable cover of Tertiary period sediment and basic volcanic rocks (basalts). The surface geology is summarised from DNRM (2018) as below:

- Quaternary age alluvial deposits are associated with the major drainage features of Charlevue and Springton Creek's which occur to the west and east of the proposed mining area respectively.
- The Tertiary age Duaringa Formation dominates the surface geology providing exposures of weathered mudstone, sandstone, siltstone and conglomerate.
- Residual ferricrete occurs as scattered surficial deposits throughout the landscape.
- Permian period sedimentary rocks of the Rangal Coal Measures (Rr) which includes the economic seams to be mined, though are not exposed at the surface within the area of development (see **Figure 7**).

JBT Consulting (2020) describes the hydrogeological regimes associated with the various lithologies in the assessment area. Information from this assessment, coupled with more recent ground water quality data, is summarised below:

- Recharge of the alluvium is via direct rainfall with the water level ranging from 8.77 m to 11.19 mbgl for bores adjacent to the creek channels. The EC at bore DW7076W (Charlevue Creek alluvium) ranges from 14,439 µS/cm to 17,106 µS/cm. Field value from bore DW7292W1 (Springton Creek alluvium) range from 1669 - 5948 µS/cm. Hydraulic conductivity (K value) measured in the alluvium from a single monitoring bore is 0.097 m/day, with rates calculated by chloride mass balance to range from 0.4 to 0.8 mm/year indicative of extremely low rates of infiltration.
- The Tertiary sediments of the Duaringa formation are variably saturated with the elevation of the base of Tertiary being a control on the occurrence of water within the sediments. The water level with the Tertiary sediments ranges from dry (5 bores, ranging in depth from 14 to 23 m) to 15.38-44.74 mbgl (where water is present). Recharge of the Tertiary sediments is via direct rainfall calculated by chloride mass balance to range from 0.4 to 0.8 mm/year. The salinity of groundwater in the Tertiary sediments ranges from 1, 439 (DW7220W1) to 26, 831 µS/cm (DW7282W1) indicative of a low rate of recharge as well as a long residence time for groundwater.
- Groundwater in the Permian sediments occurs preferentially in the coal seams due to the open nature of the cleats, providing a conduit for infiltrating rainfall. Standing water level (SWL) in the coal seam ranges from 16.91 to 46.62 mbgl. Interburden is hydraulically tight with (K = 0.001 to 0.002 m/day) compared to the coal seams where hydraulic conductivity is typically much higher, ranging from 0.002 to 5.387 m/day. Salinity of groundwater in coal seams ranges from 984 µS/cm (DW7105W2 in the Pollux lower to upper seam) to 33,343 µS/cm.

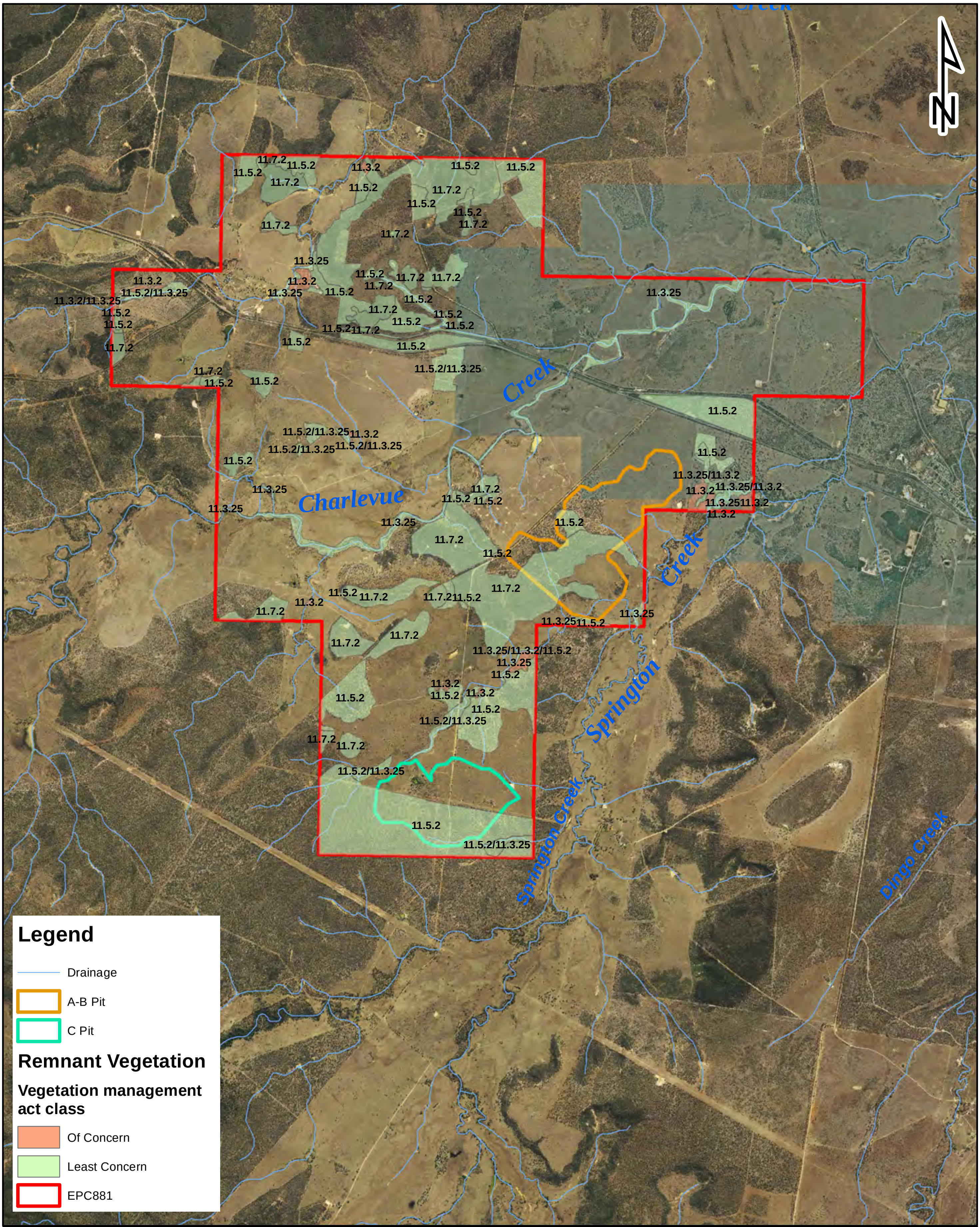
While direct infiltration of rainfall will be the predominant source of groundwater recharge over much of the Project area, surface flows and seasonal flooding on drainage lines will provide a significant localised source of recharge for alluvial sediments, particularly along the major watercourses of Charlevue and Springton Creeks .

A summary of groundwater monitoring bores used to inform the assessment of GDEs, including target unit, standing water level (SWL), salinity (EC) is provided in **Table 1** summarised from the hydrogeology report produced by JBT (2020) and groundwater monitoring data collected in May to September 2020. The location of groundwater monitoring bores is shown in **Figure 8**.

Table 1. Details of groundwater monitoring bores used to inform assessment.

Hole	**Groundwater Unit**	**SWL (mbgl)***	**Field Salinity Range (µS/cm)****
DW7076W	Alluvium	8.77	14439 – 17106
DW7292W1	Alluvium	11.19	1669 - 5948
DW7220W1	Tertiary	15.38	1439 - 1757
DW7225W1	Tertiary	32.37	9425 – 10348
DW7282W1	Tertiary	26.25	22483 - 26831
DW7033W1	Tertiary	29.94	7001 - 7748
DW7220W2	Permian Coal (Castor)	19.25	1594 - 1799
DW7082W1	Permian Coal (Castor Lower)	17.99	11115 - 12779
DW7035W3	Permian Coal (Orion 1)	21.75	13516- 14400
DW7221W1	Permian Coal (AR3)	20.50	3325 - 3977
DW7178W2	Permian Coal (PLU2)	38.45	24933 - 26921
DW7082W2	Permian Coal (Pollux Upper)	17.04	13317 - 14100
DW7105W2	Permian Coal (PLU1)	31.18	984 - 1326
DW7221W2	Permian Coal (Castor)	20.50	7851 - 14661
DW7033W2	Permian Coal (Orion 5)	29.01	14393 - 15733
DW7220W3	Permian Coal (PLU1)	19.04	17398 - 20041
DW7225W2	Permian Coal (AR3)	32.10	14691 - 15585
DW7093W1	Permian Coal (Pollux 2)	28.44	13310 - 15868
DW7282W2	Permian Coal (AR3)	32.10	30478 - 33343
DW7264W2	Permian Coal (AR1)	21.59	20756 - 23690
DW7225W3	Permian Coal (Castor)	31.60	15202 - 16333
DW7093W3	Permian Coal (PLL2)	28.46	17043 - 18467
DW7264W3	Permian Coal (AR3)	21.58	17757 - 19307
DW7033W3	Permian Interburden	28.93	12973 - 15280
DW7093W2	Permian Interburden	28.45	13699 - 16117

*Date of measurement between 19 May 2020 and 25 September 2020; **Date of measurement range from 25 Sept 2019 to 17 July 2020; **Bold** = specimen submitted for stable isotope sampling.



Source: AARC (2019)

Figure 5. Field verified regional ecosystem mapping.

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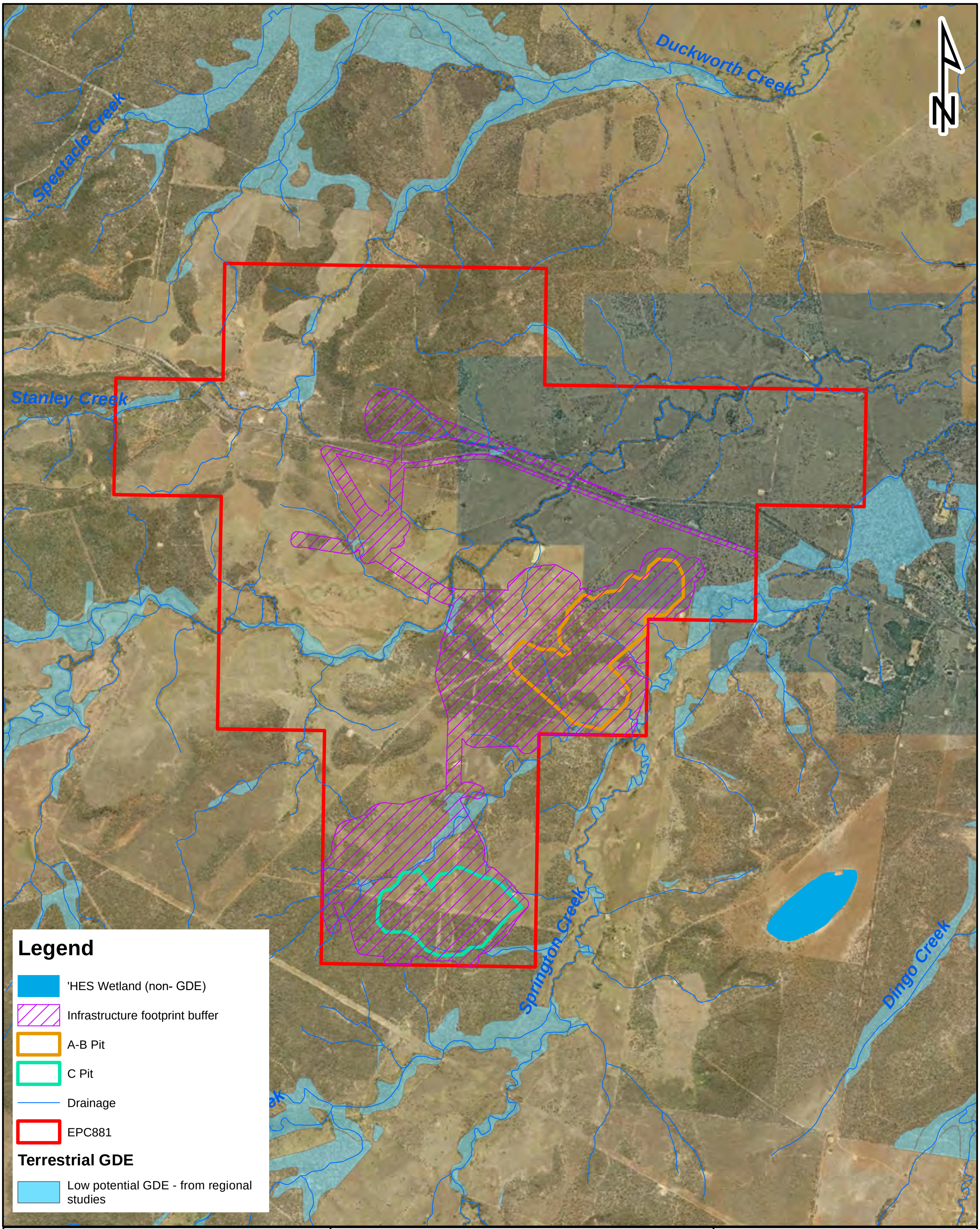

Source: BOM GDE Atlas (2020).

Figure 6. Groundwater Dependent Ecosystems in the assessment area

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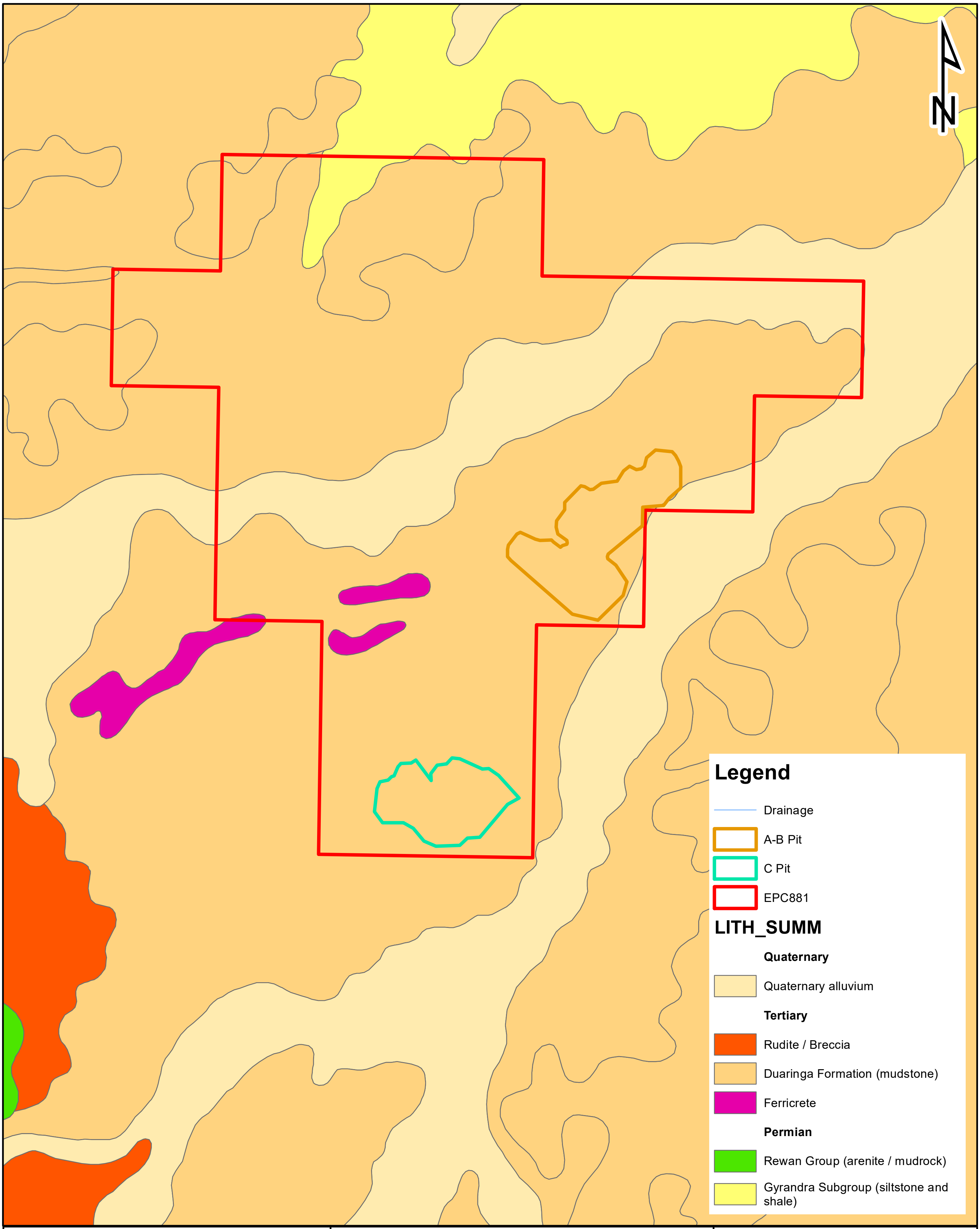

Source: Detailed Surface Geology Queensland (DNRM 2018)

Figure 7. Surface geology in the Project area

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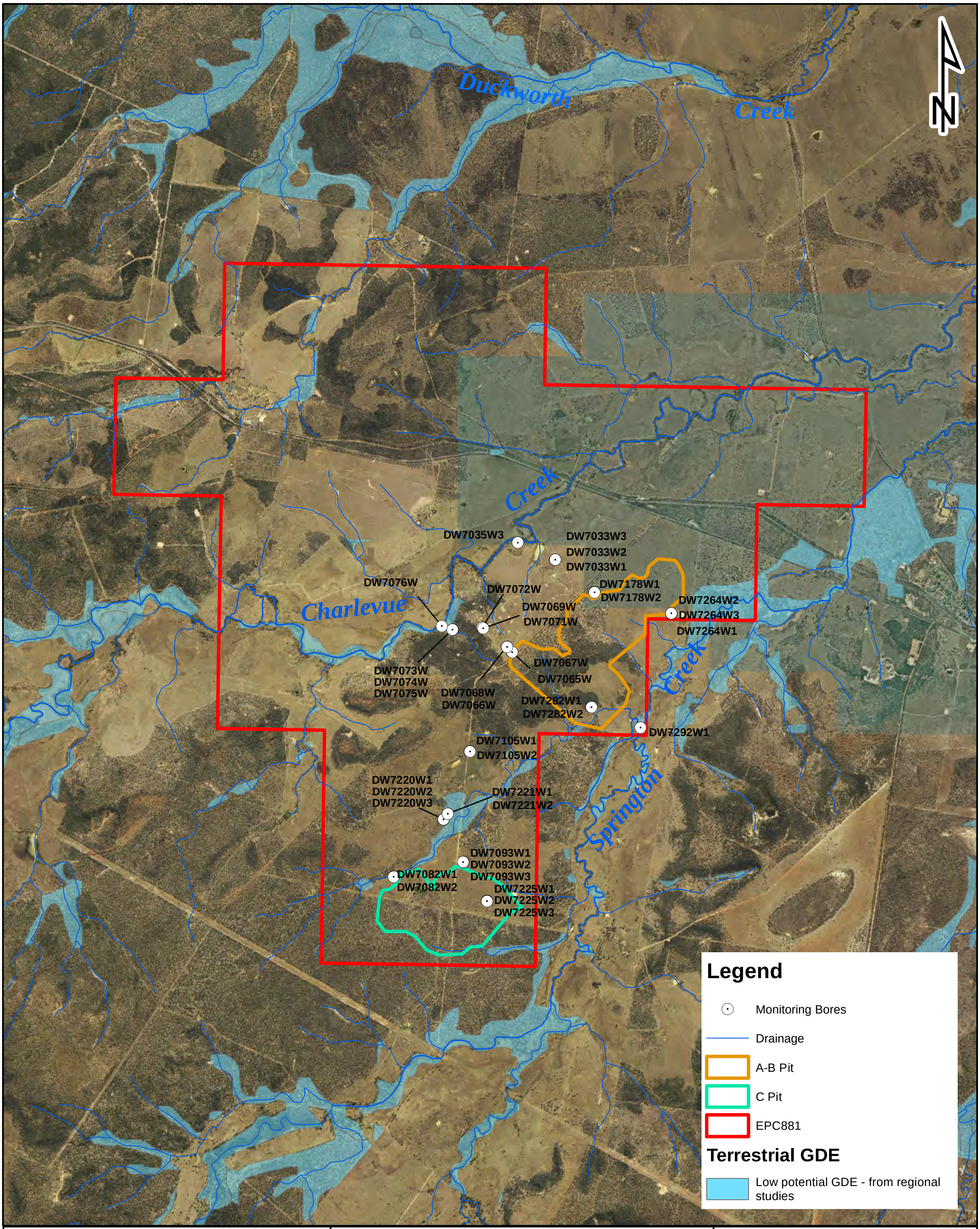

Source: BOM GDE Atlas (2020).

Figure 8. Groundwater monitoring bores in the Project area against mapped GDEs.

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3.0 Methods

The following section provides an overview of methods used to assess groundwater dependence of vegetation within the Project Area and surrounds. It describes site selection, use of shallow hand auger holes, assessment of leaf water potential (LWP), soil moisture potential (SMP) and analysis of stable isotope composition in a manner that is consistent with Jones et al (2020) and supplemented with methodology from Richardson et al (2011), IESC (2018b) and Eamus (2009).

Field assessment was completed over a six-day period from the 27th June 2020 to 2nd July 2020. In prior reference to **Figure 3**, Weather conditions during the survey were mild to warm, with an estimated maximum daily temperature from 26°C to 30°C.

3.1 Site Selection

The survey focused on areas mapped as potential GDEs in BOM (2020b) with additional sites identified where vegetation characteristics were otherwise indicative of potential groundwater dependence. Assessment sites were generally confined to drainage lines including the larger systems of Springton and Charlevue Creek. In total, four broad areas were targeted for assessment (as per **Figure 9**) being:

1. Charlevue Creek Area1 providing representation of a reach of Charlevue Creek where riparian vegetation is well developed and preserved within a broad alluvial flood plain. Vegetation in this area is mapped as RE11.3.25 in AARC (2019) and the area is considered representative of the best developed and preserved riparian vegetation within the Project area. This area was targeted in Sites M7, M8 and M9. Charlevue Creek in this area is incised into a broad alluvial flood plain to a depth of approximately 6m with a sandy channel floor (see **Figure 9**).
2. Charlevue Creek Area 2 provides representation of a more disturbed reach of Charlevue Creek where riparian vegetation has been reduced to a thin strip within the confines of the river channel and immediate stream banks. This area is similar to Charlevue Creek Area 1 though vegetation is not as well preserved, and the area is not recognised as a potential GDE in the GDE Atlas (BOM 2020b). Charlevue Creek Area 2 was sampled in Sites M10 and M12.
3. Springton Creek Area 1 provides a representation of the riparian vegetation fringing Springton Creek which is in closest proximity to the proposed AB Pit. Vegetation on this reach is mapped as RE11.3.25 in AARC (2019) with flood plain vegetation, represented by RE11.3.2, extending for several hundred metres on either side of the flood channel in some localities. All fringing vegetation is mapped as a 'low potential' terrestrial GDE in the GDE Atlas (BOM 2020b). Springton Creek Area 1 was sampled at Sites M5, M6 and M14. Site M14 was specifically targeted within the road reserve as a representation of RE11.3.2 (*Eucalyptus populnea* dominant woodland), an ecosystem which could not be sampled elsewhere within the EPC Area due to land access restrictions.
4. Springton Creek Tributary Area 1, provided representation of a larger ephemeral tributary of Springton Creek which is closest to C Pit. Vegetation is mapped as a 'low potential' terrestrial GDE in the GDE Atlas (BOM 2020b). The area was assessed with Site M1 and M4.

Other more discrete targets were chosen to test for groundwater dependence in other areas including:

1. Site M2, targeting an area mapped as a 'low potential' GDE that was mapped as RE11.5.2 in vegetation mapping completed by AARC (2019).
2. Site M3, targeting a mapped 'low potential' GDE within a minor depression that drains into Springton Creek.
3. Site M11, targeting another area mapped as a 'low potential' GDE within a minor depression that drains into Charlevue Creek. Vegetation is mapped as RE11.5.2 in the terrestrial ecology report prepared by AARC (2019).
4. Site M13, targeting the riparian fringe of Charlevue Creek in an off-tenure location, within an area not recognised as a potential GDE (BOM 2020b).

The HES Wetland mapped to the east of the assessment area (see **Figure 6**) was also observed from the road edge during field inspection, though could not be accessed on foot due to entrance restriction imposed by the landowner. The location of all GDE assessment localities is shown in **Figure 10**.

Figure 9. Sandy channel bed of Charlevue Creek at Site M7.

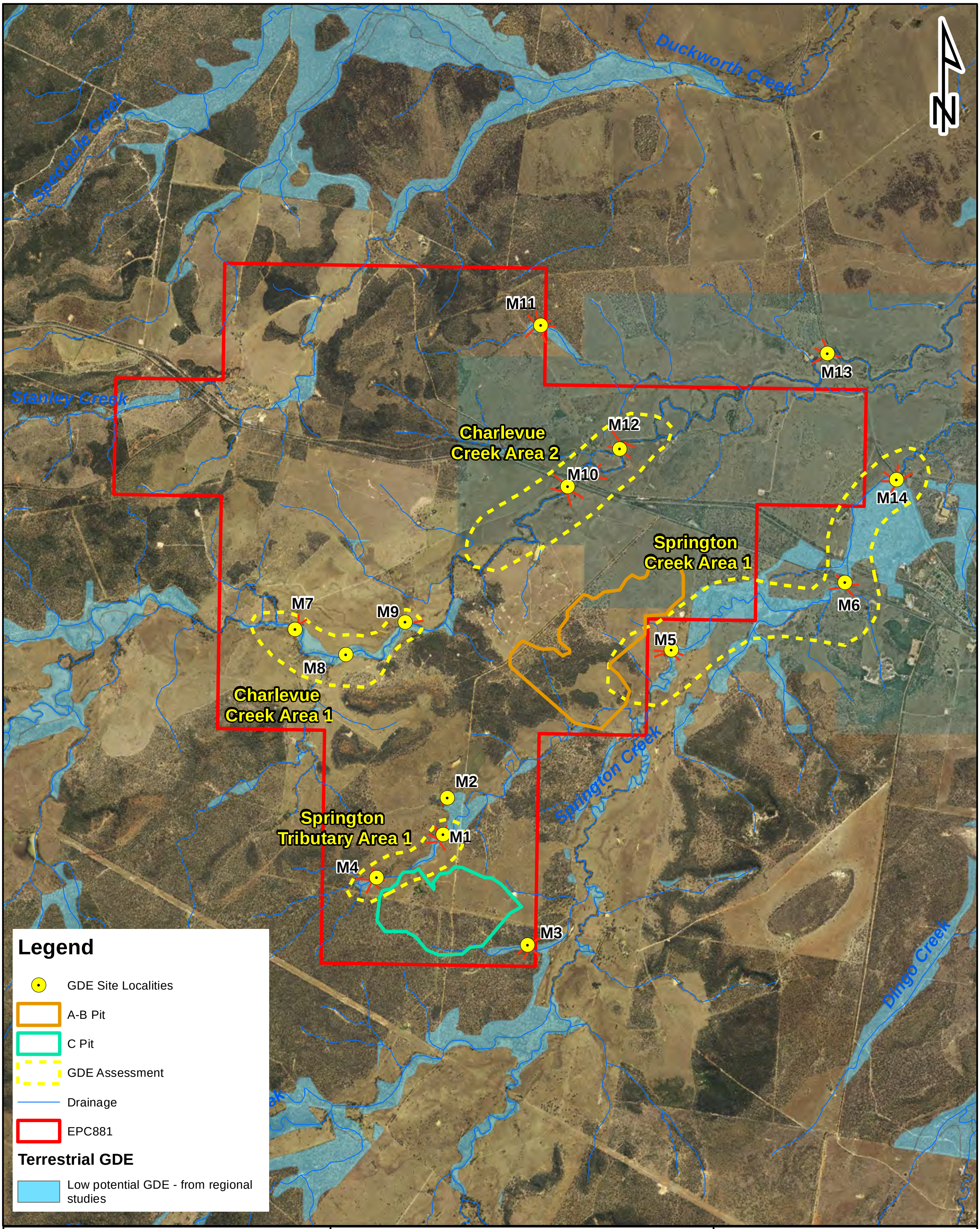

Figure 10. The location of GDE assessment sites and areas.

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3.2 Hand Auger Sampling

Where practical, a hand auger placed to a maximum depth of 2.35m was utilised to sample shallow soil and sub-soil and collect samples at varying depths in the soil profile. Hand auger placement was limited by substrate and the auger could not penetrate deeply in some localities due to hard substrates, or refusal occurred at relatively shallow depths in the soil profile due to the presence root material. In total, 19 auger holes were placed across the 14 GDE assessment sites. Within each auger hole, the following observations were made at regular depth intervals:

1. Soil structure, colour, and texture.
2. Presence of root matter.
3. Soil moisture / water and depth to saturation.

Soil sampling was undertaken at regular intervals (generally 0.2m with following samples taken every 0.5m) down the soil profile for analysis of stable isotopes of oxygen (δ18O) and deuterium (δ2H). Duplicate samples were retained for analysis of soil moisture potential (SMP). The location of hand auger samples is shown in figures relevant to each GDE assessment site (see **Section 4.0**).

3.3 Leaf Water Potential

Leaf Water Potential (LWP) is defined as the amount of work that must be done per unit quantity of water to transport that water from the moisture held in soil to leaf stomata. LWP consists of the balance between osmotic potential, turgor pressure and matric potential. It is defined as the amount of work that must be done per unit quantity of water to transport that water from the moisture held in soil to leaf stomata. It is a function of soil water availability, evaporative demand, and soil conductivity.

LWP was measured pre-dawn (prior to sunrise) as per standard protocol. Due to a lack of transpiration, LWP will equilibrate with the wettest portion of the soil that contains a significant amount of root material. Pre-dawn LWP will shift to a lower status as soil dries out on a seasonal basis (Eamus 2006a). Measurement pre-dawn LWP thus gives an indication of the water availability to trees at each assessment site and provides an indication as to whether trees are tapping saturated zones of the soil profile where water is freely accessible, or utilising moisture that is more tightly bound to soil particles.

Survey localities were visited pre-dawn (first light to pre-sunrise) and leaves were collected from the canopy with the aid of a 7.5m extension pole fitted with a lopping head. Leaves were collected from three to six mature canopy trees at each site with 66 trees sampled in total across all assessment areas. Collected samples were double bagged in black plastic to avoid moisture loss and sun exposure and LWP was measured on-site within half an hour of harvest. Suitable leaf material was trimmed with a fine blade and inserted into an appropriate grommet for sealing within a Model 3115 Plant Water Status Console (Soil Moisture Equipment Corp, 2007). The chamber was sealed and gradually pressurised with nitrogen until the first drop of leaf water emerged from the petiole. Two reading readings were taken at each GDE site to calculate an average with a third taken where significant differences between reading was noted. Readings were taken in pounds per square inch (PSI) which is converted to a negative value in millipascals (MPa) for direct comparison to SMP measurements. The location of trees sampled for LWP relative to GDE assessment areas is shown in provided in **Section 4.0.**

3.4 Soil Moisture Potential

Duplicate samples collected during soil augering were subject to analysis of SMP (SMP) at regular intervals with an aim to collect samples at 0.2 mbgl, 0.5 mbgl and at 0.5 to 1.0m intervals to the end of hole. As samples were collected, they were immediately sealed in airtight plastic vials and placed on ice. For each interval sampled, one sample was dispatched to the Australian National University (ANU) Stable Isotope Laboratory (Farquhar Laboratory) for the analysis of the naturally occurring stable isotopes of hydrogen and oxygen within soil moisture (see **Section 3.6.1**). The second sample was retained for the measurement of laboratory tested SMP.

SMP, which includes the matric (dryness) and osmotic (saltiness) potential, is a measure of the energy required to extract moisture from soil. Water only has capacity to move down a hydraulic gradient from soil to root (Gardner 1960) and only areas in the soil profile that have a SMP that is less negative than measured pre-dawn LWP will be accessible as a source of moisture. It is widely agreed in ecohydrology and plant physiology fields, that large, mature trees are unable to extract moisture from regions in the soil profile where the total SMP is significantly below LWP measured in pre-dawn leaf material (Feikema et al. 2010, Lamontagne et al. 2005, Thorburn et al. 1994, Mensforth et al. 1994, Holland et al 2009 and Doody et al. 2015).

For crops, the maximum suction roots can apply to a soil/rock before a plant wilts due to negative water supply is approximately -15 bars or -1.5 MPa (or -217.55 psi). This wilting point is considered relatively consistent between all plant species (Mackenzie et al, 2004), although many Australian plants have adapted to conditions of low water availability and can persist strongly in soil conditions where soils moisture potential is below standard wilting point (Eamus 2006a). As a general measure however, where measured LWP is below standard wilting point, it indicates plant water deficit, and the tree is unlikely to be supported by a saturated water source unless highly saline.

The measurement of SMP was completed in the laboratory by a portable Dew Point Potentiometer (WP4C) (Meter Group Inc, 2017). The WP4C meter uses the chilled mirror dew point technique with the sample equilibrated within the headspace of a sealed chamber that contains a mirror and a means of detecting condensation on the mirror. Soil moisture potential samples were measured in megapascal pressure units (MPa). A single 7 ml soil sample was inserted into the WP4C meter using a plastic measuring tray with a stainless-steel base.

3.5 Stable Isotope Sampling and Analyses

Trees may utilise water from a range of sources including the phreatic zone (saturated zone), the vadose zone (unsaturated zone) and surface water. The stable isotopes of water, oxygen 18 (18O) and deuterium (2H) are useful tools to help define the predominant source of water used by terrestrial vegetation. The method relies on a comparison between the stable isotope ratios of water contained in plant xylem (from a twig or xylem core) with stable isotope ratios found in the various sources of water including a shallow groundwater table, potential sub-artesian aquifer water sources or shallow soil moisture. Methods used to assess stable isotopes are detailed below.

3.5.1 Soil moisture isotopes

Sampling was undertaken at regular intervals in auger holes to capture isotopic signatures from a range of potential plant moisture sources from the upper soil surface to the top of the phreatic zone in shallow water tables. The sampling intervals for soil moisture isotope analyses was dependent on auger yield and soil variation although in general, the initial soil sample taken within the top 20cm of the soil profile and subsequent samples taken at 0.5m intervals down the soil profile to the end of hole. Approximately 200mg of soil was collected for isotope analysis, sealed in airtight plastic sampling containers, double sleaved in click-seal plastic bags and placed on ice for storage prior to dispatch to ANU Stable Isotope Laboratory for analysis where they were snap frozen until analysis was complete.

3.5.2 Xylem water isotopes

Twigs were collected from the outer canopy branches of target trees used to sample LWP. The following sampling procedure was applied:

1. Outer branches of trees of the GDE target tree were harvested for twig material. Two duplicate samples were prepared from each branch for analysis.
2. The position of trees subject to assessment were marked with a GPS and structural measurements were recorded including height and diameter at breast height (dbh).
3. Outer branches from each tree were harvested with an extendable aluminium pole.
4. Stem material equivalent approximately 5cm in length was sourced using clean stainless-steel secateurs.
5. Bark was immediately removed, and stems were sealed in wide mouth sample containers with leakproof polypropylene closure (approx. 125ml volume) and immediately labelled with the tree number and placed in an iced storage vessel prior to dispatch to the ANU Stable Isotope Laboratory.
6. Upon receipt of samples at the ANU Stable Isotope Laboratory, samples were snap frozen (-18°C) until analysis.
7. For all twigs, samples were taken from xylem as close to the centre of twig as possible. For both xylem and soil samples, extracted water was analysed using a Picarro L2140i cavity ring-down spectrometer.

For xylem water analysis, multiple samples were taken from a single branch sample at all sampling localities. From each branch sampled, the twig samples retuning the lowest degree of isotopic enrichment was used as the reference. This is because there may be considerable partitioning of isotope ratios across a twig cross-section (moving from the xylem to phloem) and it is not always possible to sample the same region of a twig consistently when multiple samples are submitted for analysis. There is also potential for fractionation of stable isotope values, particularly 2H, during movement of water through the xylem from roots to leaves (Evaristo et al 2017, Petit and Froend 2018). As fractionation will likely result in isotopic enrichment rather than depletion, the least enriched sample from each tree is considered most likely to be representative of the soil moisture or groundwater source.

3.5.3 Groundwater monitoring bore sampling

To compare the isotopic signature of groundwater to that of vegetation, groundwater samples from developed monitoring wells were collected which were despatched to Australian National University (ANU) for analysis of stable isotopes of oxygen and deuterium. Monitoring wells where groundwater was sampled for stable isotope analysis have been indicated in **Table 1** (**Section 2.2**).

3.5.4 Data reconciliation and interpretation

Data interpretation followed a structured approach in which multiple lines of evidence were filtered to provide an assessment of groundwater dependence. The biophysical measurement of LWP formed the primary assessment, followed by the adjunct comparison with SMP, with stable isotope data used to provide supplementary evidence where ambiguity remained. Further context to the approach is provided below.

Step 1. LWP: An initial comparison was undertaken to identify individual trees with LWP measurements within the expected range for known terrestrial GDEs subject to various salinity regimes. This data is drawn from a range of published sources including Jones et al (2020), Holland et al (2006) and Mensforth et al (1994) and values are conservatively applied against laboratory calculated values for water at various salinity levels (Meter Group Inc, 2017):

- Expected LWP for trees in equilibrium with a fresh to brackish saturated source of moisture (EC<1500 µS/cm) = >-0.2MPa.
- Expected LWP for trees in equilibrium with a moderately saline soil moisture source (EC>1500 to 10 000 µS /cm) =<-0.2MPa to >-0.55MPa.
- Expected LWP for trees in equilibrium with a saline soil moisture source (EC>10 000 to 17 000 µS /cm) = <-0.55MPa to >-0.9MPa.

Trees that demonstrate LWP values that are more negative than expected ranges for the local groundwater salinity regime are assessed to not be groundwater dependent and not subject to additional scrutiny, other than for comparative purposes. A value of 17 000 µS /cm was chosen as a reference as this represents the upper levels of salinity measured in the alluvium at Springton monitoring bore DW7076W (**see Table 1**).

Step 2. SMP: For trees where LWP was within the expected range of values for GDE’s under specific local salinity regimes, an assessment of SMP from the auger profile was undertaken to identify the likelihood that moisture for transpiration was being supplied from the upper soil profile, or whether deeper sources of moisture must be inferred. As described in **Section 3.4**, water only has capacity to move down a hydraulic gradient from soil to root meaning that only those portions of the soil profile that have a SMP that is less negative than measured pre-dawn LWP will be accessible as a source of moisture (Gardner 1960). This does not provide an absolute assessment of groundwater dependence though identifies potential sources of moisture to provide context to assessment of stable isotopes (Step 3).

Step 3. Stable Isotope Signatures: For trees that demonstrate potential groundwater dependence from LWP measurements, stable isotope signatures from the xylem samples were compared to signatures from the upper 2m of the soil profile, groundwater, and surface water from pools in creek lines to provide a fingerprint for the source of moisture being utilised.

Where three lines of evidence indicated utilisation of a groundwater source, the tree was generally accepted as being groundwater dependent. Where ambiguity remained in the assessment, additional features were considered including site specific geology, geomorphology, soil physical properties and depth to water table at the location were utilised to inform the final assessment of groundwater dependence for any tree or site.

3.6 Limitations and Other Information Relevant to the Assessment

This assessment provides a snapshot of eco-hydrological process at each of the four GDE assessment localities identified during pre-survey desktop assessment and field reconnaissance. Specific limitations include:

1. Climatic conditions preceding the assessment were dry, although preceding wet season rainfall events (in February 2020) would have saturated shallow portions of the soil profile with residual wetness being present in some soil horizons. Where ambiguity in biophysical measurements were apparent, stable isotope signatures were relied upon to differentiate groundwater from other soil moisture sources.
2. Access was limited in some localities due to landowner / site access restrictions. Sampling localities were modified prior to the assessment to allow sampling to be completed within the constraints of pre-dawn survey requirements. It is not anticipated that changes to original survey plans has negatively influenced or compromised the outcomes of the assessment.
3. Due to the intensive nature of the data collection, representative areas were chosen for GDE sampling which were used as a basis for extrapolation over broader areas considered to present similar ecohydrological function. The data collection process aimed to inform conceptualisation of the types of GDEs present on the site and their general distribution, so an informed risk assessment could be completed.
4. The ecological processes and hydrogeological conditions encountered within the Project area are complex and transient. Interpretations and conceptualisations presented here are based upon multiple lines of evidence and represent what the author considers is the most appropriate interpretation of the data. However continued refinement of the presented conceptual models may result from further data collection.

4.0 Results

Survey results are divided into individual sections which apply to the each of the assessment methods employed including, LWP, SMP and assessment of stable isotopes. For data interpretation and discussion, presented in **Section 5.0**, these data form multiple lines of evidence which are the basis for identification and characterisation of GDEs throughout the Project area.

4.1 Leaf Water Potential Measurements

A summary of LWP sampling results for all trees, including locations of sampled trees relative to the watercourse is provided in **Appendix A.** Representation of average LWP results within the four broad assessment areas, including the 14 assessment sites is provided in **Figure 11** with spatial representation of average water availability per site provided in **Figure 12**. The results indicate:

1. The following sites demonstrate average LWP that is consistent with utilisation of a saturated low salinity (<1500 µS/cm) source of moisture, possibly groundwater, or near saturated portions of the soil profile:
    a. Charlevue Creek Area 1 (Sites M7, M8[1] and M9) and Site M10 at Charlevue Creek Area 2.
    b. Site M1 in Springton Tributary Area 1.
2. The following sites demonstrate average LWP values that suggest utilisation of a non-saturated source of readily available soil moisture in the vadose zone, or utilisation of a saline groundwater source with a salinity not greater than 10 000 µS/cm.
    a. Site M4 in Springton Tributary Area 1
    b. Site M12 in Charlevue Creek Area 2.
    c. Site M11 and Site M13.
3. The following sites demonstrate average LWP results indicative of moisture utilisation from a dry portion of the soil profile in the vadose zone.
    a. All sites associated with Springton Creek Assessment Area 1 (Site M5, Site M6 and Site M14).
    b. Site M2 and Site M3.

For point 3, the results of LWP analysis are more negative than would be imparted by use of saline groundwater in the alluvium, attributed with a maximum salinity of 17 000 µS/cm (based on monitoring bore DW7076W on Springton Creek). Based on these results, all sites associated with Springton Creek Assessment Area 1, Site M2 and Site M3 are unlikely to represent terrestrial GDEs with trees sourcing moisture from dry portions of the soil profile / vadose zone. Further analysis of assessment sites listed against Point 1 and Point 2 are provided in the following sections for SMP and stable isotopes. A more comprehensive analysis of LWP data for individual trees is provided in **Figure 13,** which indicates levels of water availability for different species sampled across all sites.

---

[1] Note average LWP results are inflated through inclusion of Tree 5, which is a Eucalyptus populnea on the margins of the flood plain.

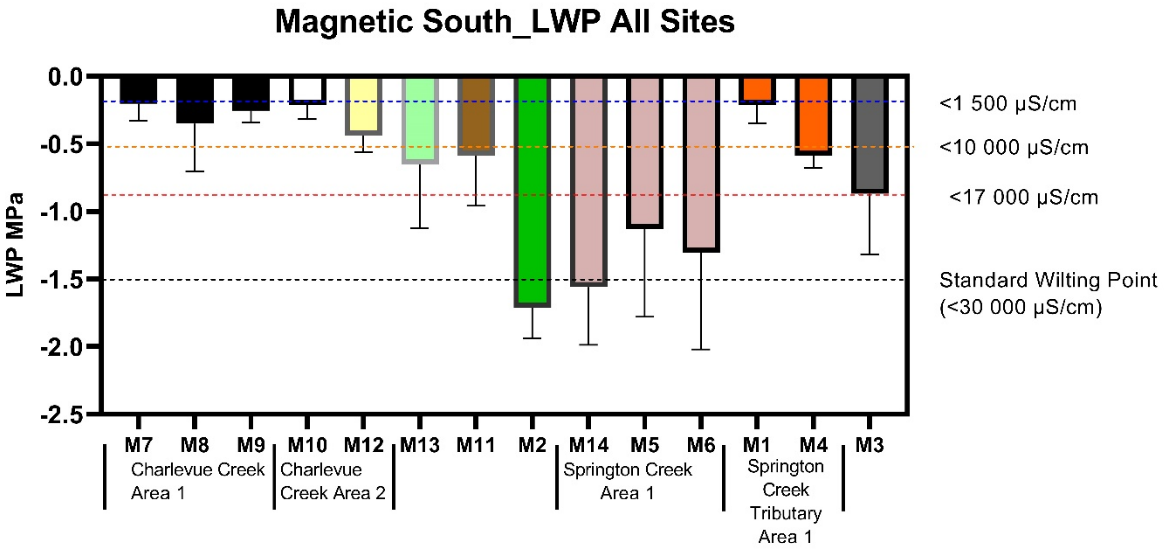
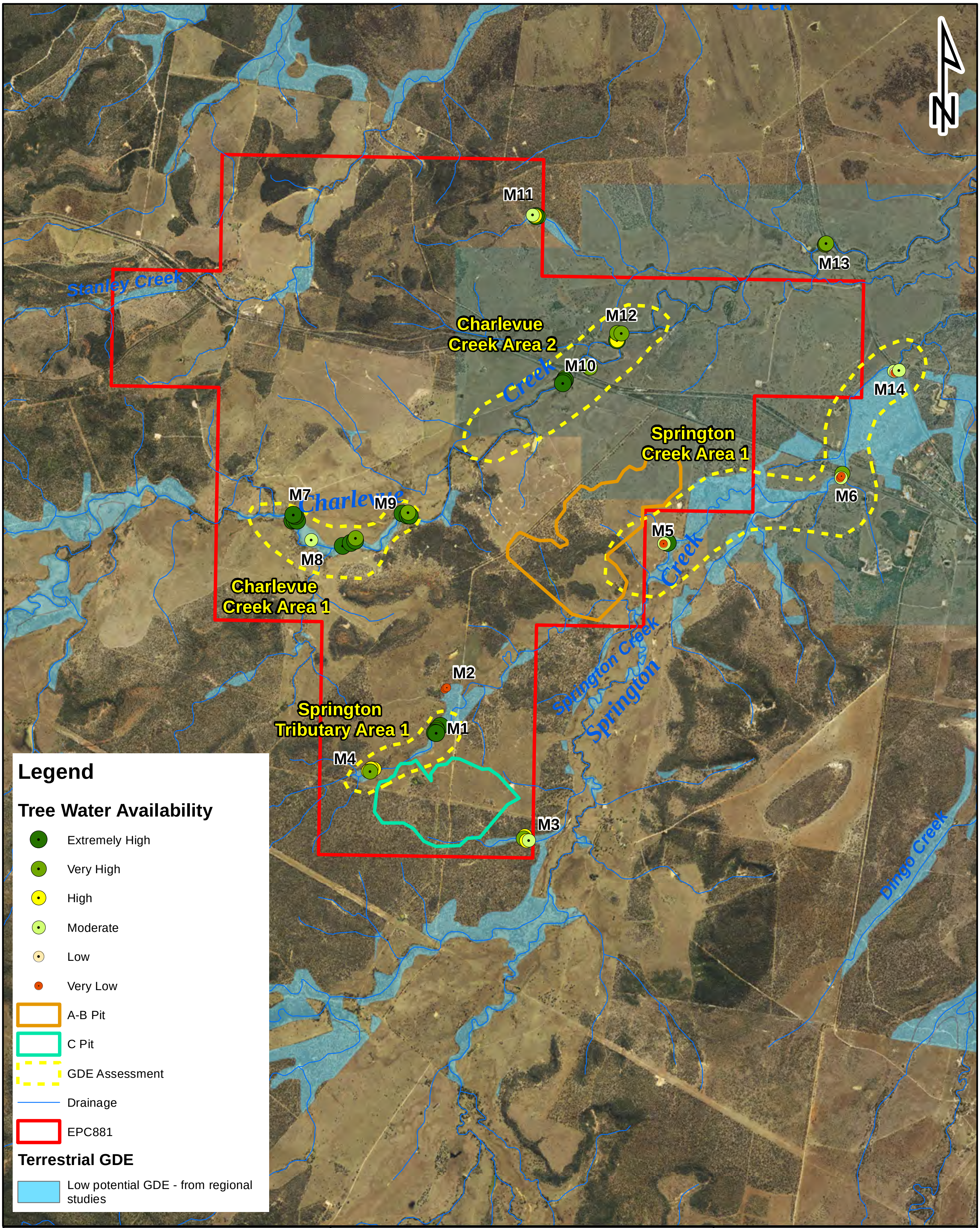


Figure 11. Average LWP readings for all GDE Assessment Areas. The blue line (>-0.2MPa) indicates typical LWPs for trees in equilibrium with a non-saline saturated source of soil moisture; the orange line (>-0.55MPa) indicating typical values for trees in equilibrium with a moderately saline soil moisture source (EC 10 000 µS/cm) and the red line indicative of trees in equilibrium with saline source of moisture at 17000 µS/cm. Standard Wilting Point (<-1.5MPa) is also indicated.

Figure 13 shows that LWPs for both *Eucalyptus tereticornis* and *Eucalyptus camaldulensis* vary considerably across the survey area with trees at Site M1, M7, M8 and M9 demonstrate extremely high water availability (>-0.2Mpa). In comparison, *Eucalyptus camaldulensis* at Site M5 and M6 (Springton Creek) demonstrate LWP indicative of extreme moisture deficit (<-2.0 MPa in some cases). This highlights the ability of both species to adapt to extremely dry conditions.

Both *Eucalytpus populnea* (Site M8, M2 and M14) and *Eucalyptus crebra* (Site M2) demonstrate high levels of water deficit at all sites (LWP values from -0.9MPa to -2.0MPa) consistent with the findings of Fensham and Fairfax (2007) that these species have limited investment in deep root architecture and are not adept at utilising deeper sources of soil moisture or groundwater. Similarly, the single coolabah (*Eucalyptus coolabah)* measured at Site M13 is suffering considerable water deficit, which would be expected considering the propensity of the species to occupy heavy clay soils which hold on to water very tightly when dry, and also provide an impediment to deeper root penetration. A spatial representation of water availability for individual trees measured at each assessment site is provided in **Figure 14** to **Figure 18**.



Source: BOM GDE Atlas (2020).

Figure 12. Average tree water availability per assessment site.

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0 1.25 2.5 3.75 5

Kilometers

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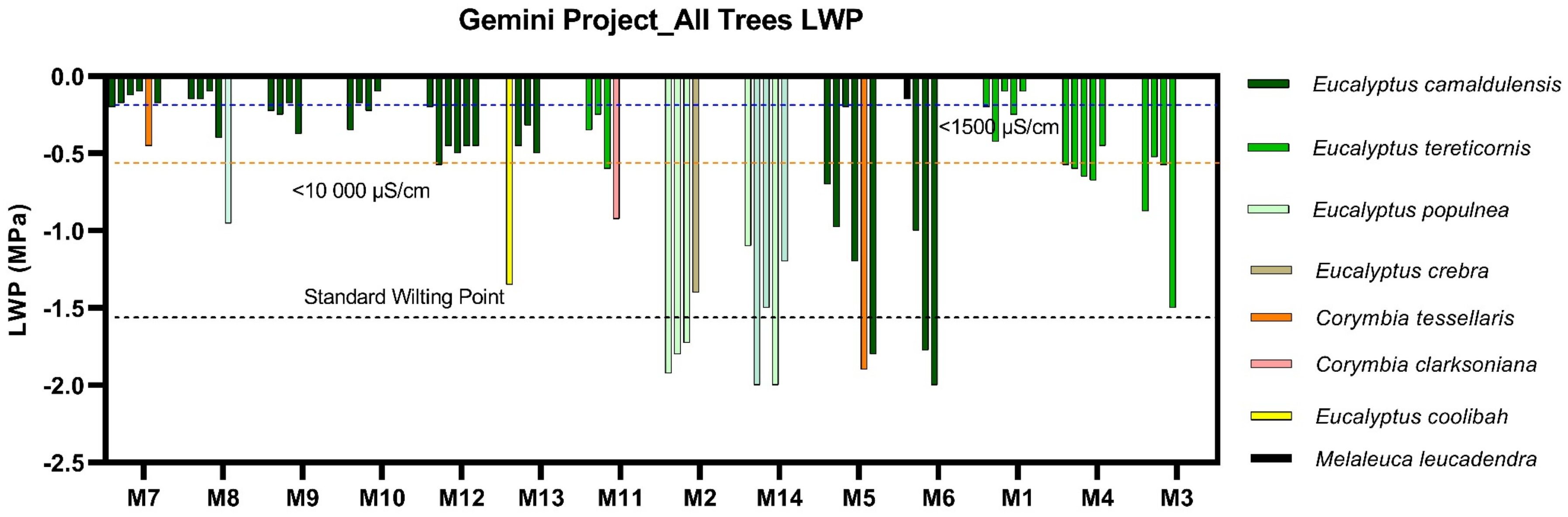
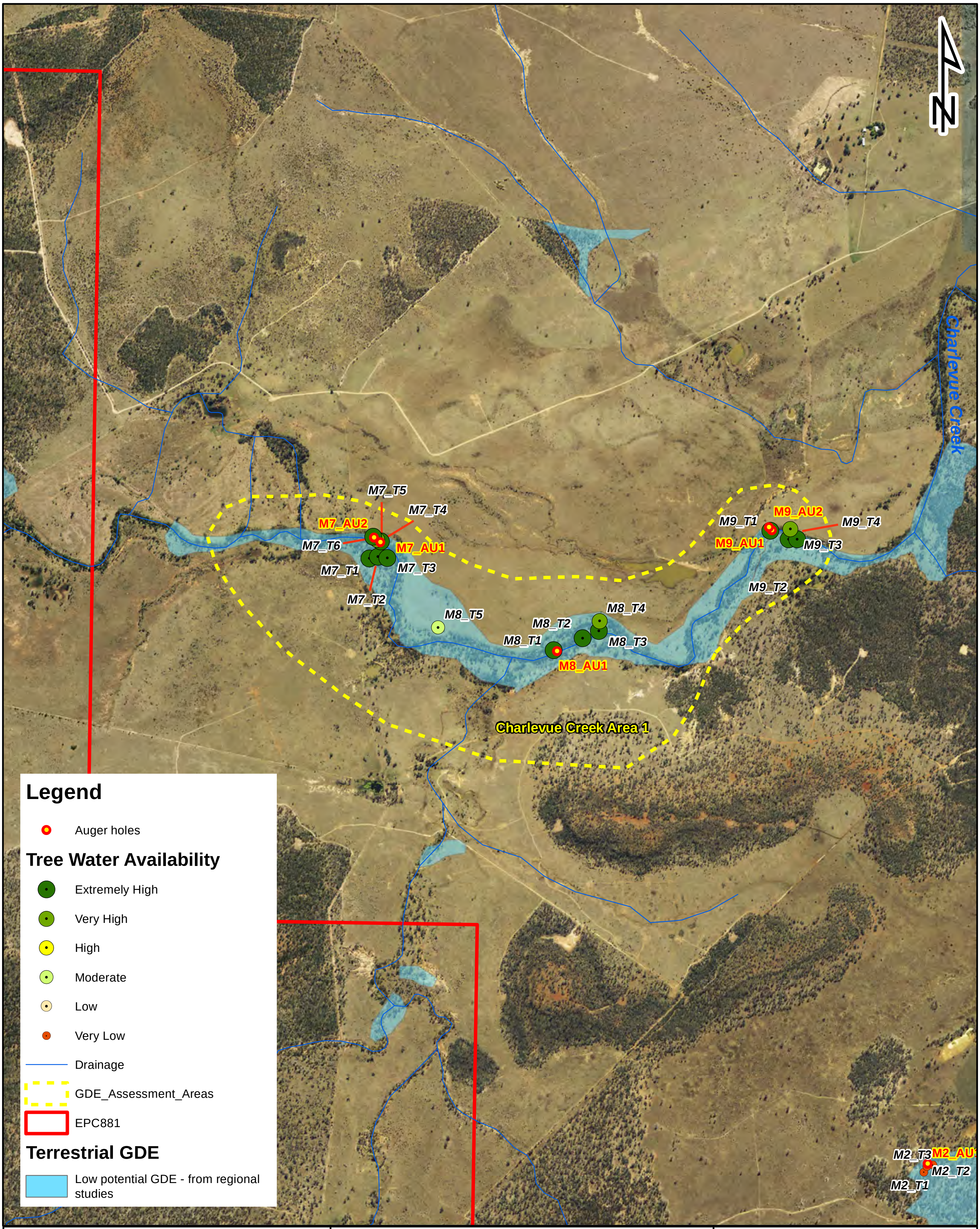


Figure 13. LWP measurement for all trees and species at all sites assessed during the GDE survey.



Source: BOM GDE Atlas (2020).

Figure 14. Tree Water Availability in Charlevue Creek Area 1

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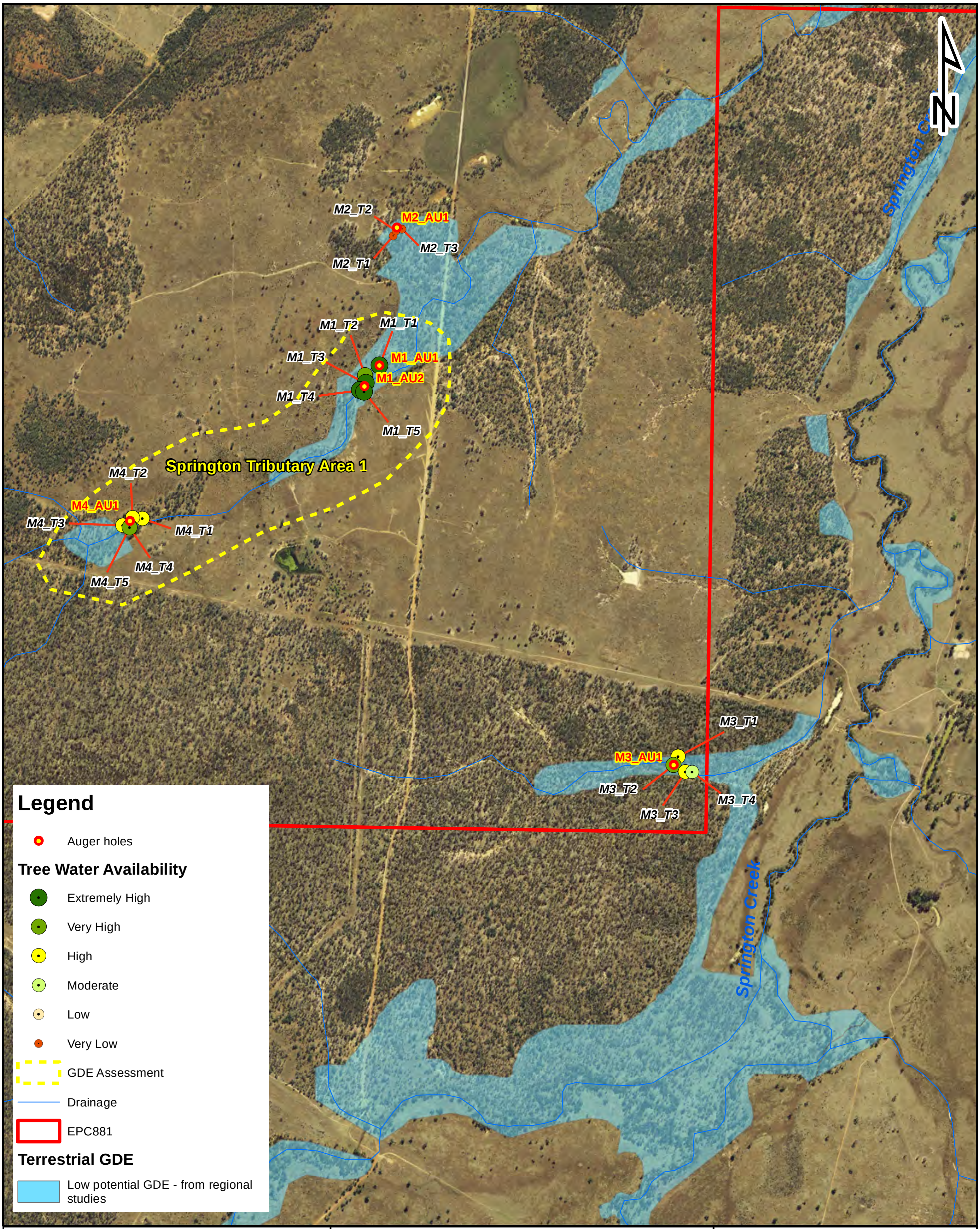

Source: BOM GDE Atlas (2020).

Figure 15. Tree Water Availability in Springton Tributary Area 1 and Site M3

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0 0.4 0.8 1.2 1.6

Kilometers

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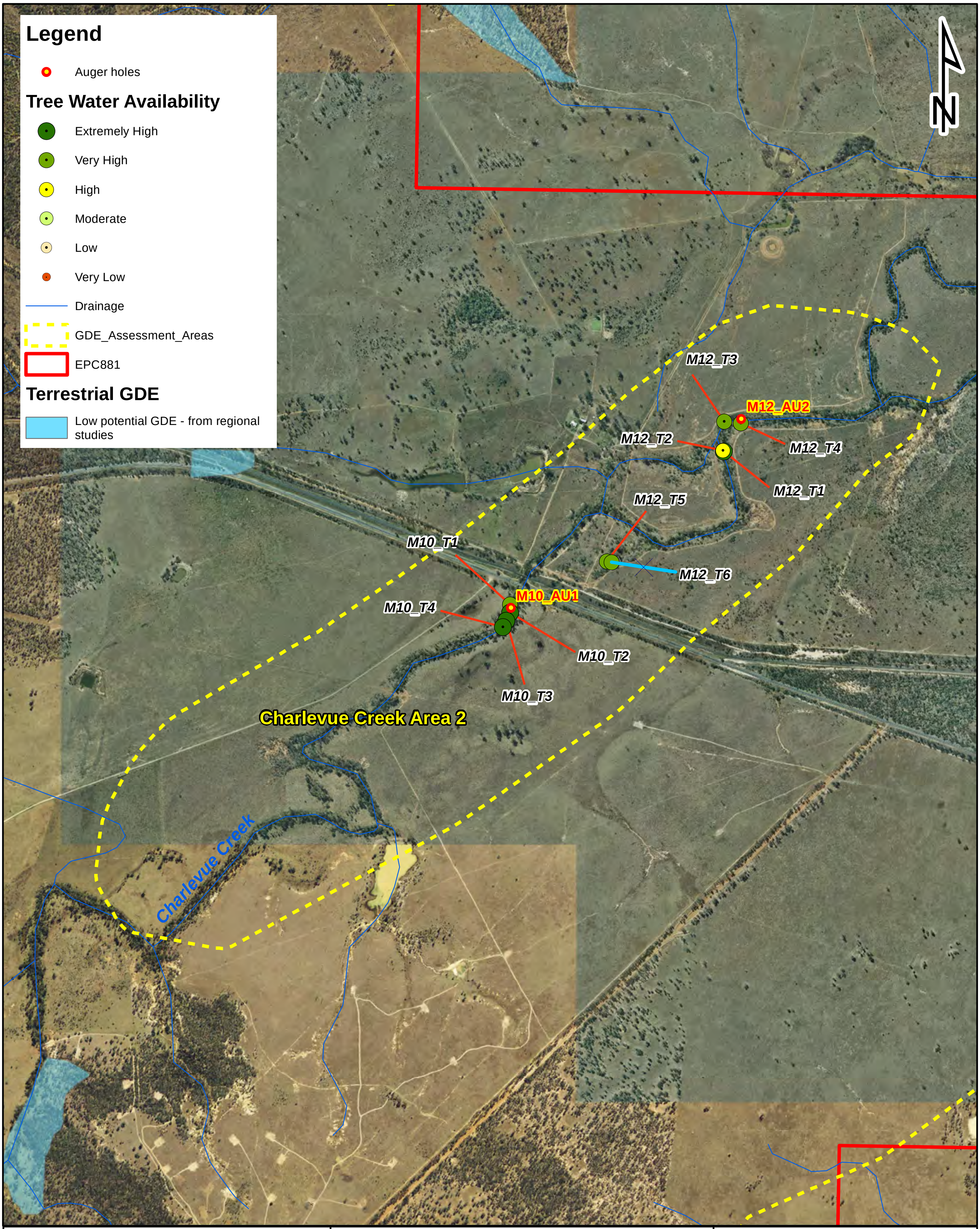

Source: BOM GDE Atlas (2020).

Figure 16. Tree Water Availability in Charlevue Creek Area 2

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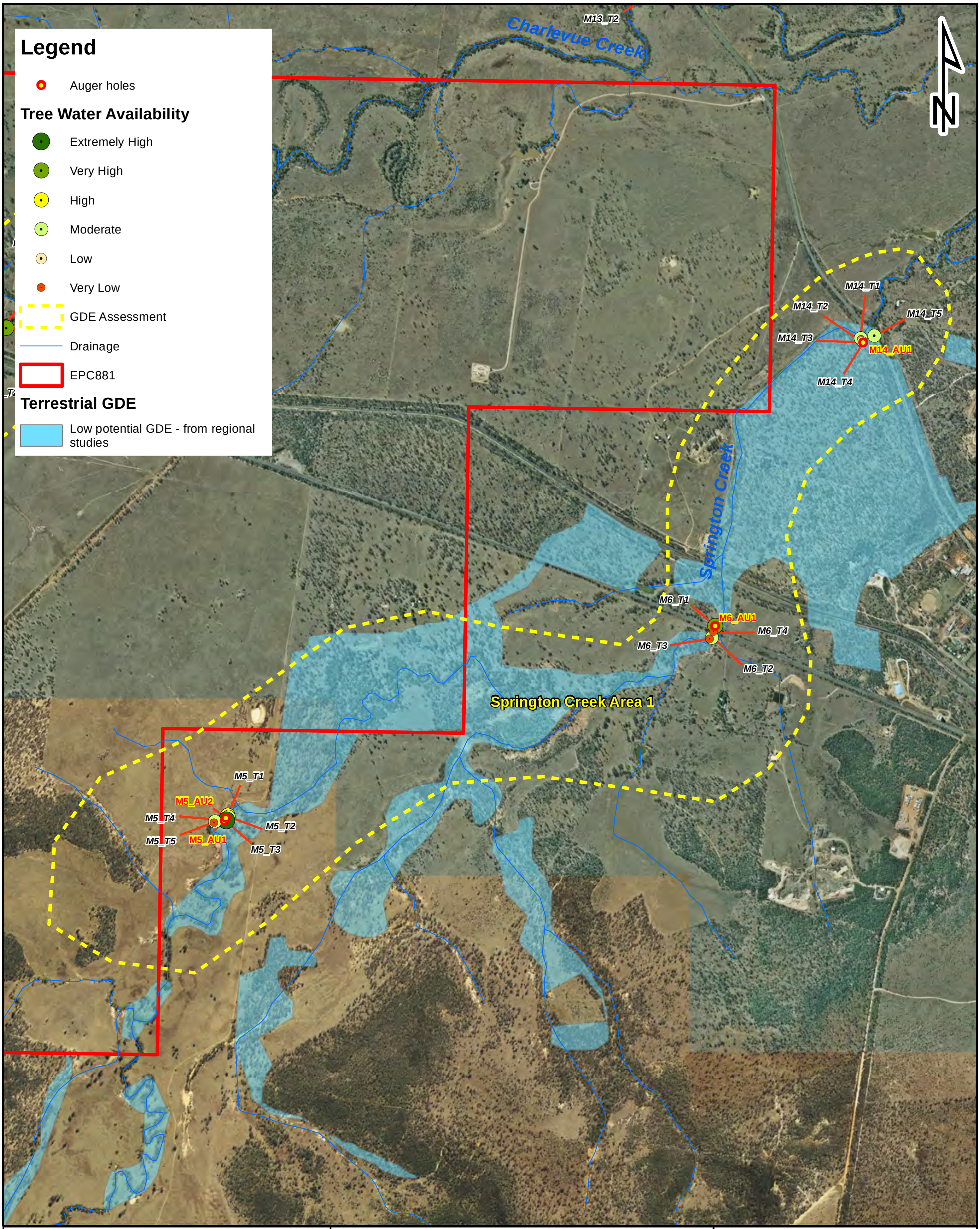

Source: BOM GDE Atlas (2020).

Figure 17. Tree Water Availability in Springton Creek Area 1

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0 0.4 0.8 1.2 1.6

Kilometers

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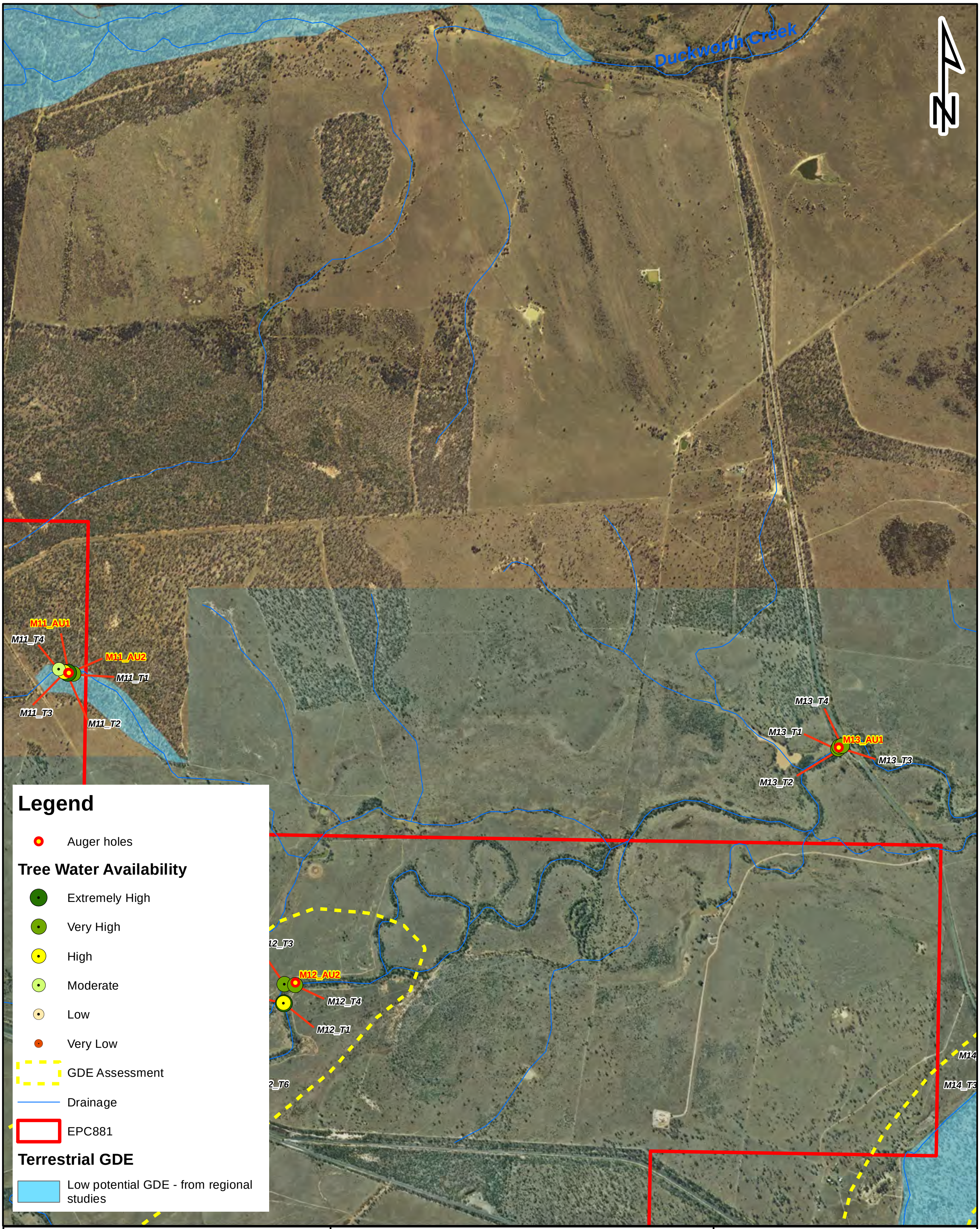

Figure 18. Tree water availability at Site M11 and M13 on Charlevue Creek and minor tributary

Client

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0 0.5 1 1.5 2

Kilometers

Scale 1:30,000

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4.2 Hand Auger Profiling and Soil Moisture Potential

Summary profiles from hand auger holes for site where an auger was completed are provided in **Appendix B** which provide an indication of soil structure, texture and moisture content. As per **Section 3.5.4**, the purpose of the SMP testing is to identify, for those trees where LWP measurement indicate potential groundwater dependence, whether sufficient moisture is available in the upper unsaturated portion of the soil profile (i.e vadose zone) to explain LWP measurements that may be indicative of groundwater usage, either saline or otherwise. From **Section 4.1**, this includes the following:

1. All trees in Charlevue Creek Area 1 (except for Tree 5 at Site M8 being *Eucalyptus populnea)*.
2. Trees in Charlevue Creek Area 2 (including Site M10 and M12)
3. All trees in Springton Creek Tributary Area 1 (Site M1 and M4).
4. Tree 2, Tree 3 and Tree 4 at Charlevue Creek Site M13.
5. Tree 1, Tree 2 and Tree 3 at Site M11.

Where collected, data from other sites including Springton Creek Area 1, are also presented for comparative purposes. Penetration of the auger at Site M11 was arrested at a shallow depth (0.35 mbgl) due to intersection of basement rock, and at Site M6 where the alluvial soil profile was cemented. Auger profiles are not provided for these sites although soil samples were extracted from the stream bank for analysis of SMP and stable isotopes.

Charlevue Creek Area 1: Two auger holes were placed at both Site M7 and Site M9 to depths of 2.2mbgl with one auger hole placed on the terrace, and a second auger hole placed in the floor of the sandy creek channel. Details of auger holes (M7_AU1, M7_AU2 and M9_AU1 and M9_AU2) are provided in **Appendix B**. Additional auger holes were placed at Site M8 for the purpose of collecting samples for stable isotope analysis. Downhole SMP profiles for Site M7 and M9 are presented in **Figure 19a** and **Figure 19b** demonstrating that moisture availability generally increases with depth down the auger hole. For auger holes placed in the stream channel (M7_AU2 and M9_AU3), SMP was > -0.02MPa down most of the profile, corresponding with the LWP for most trees. This suggests that free water is available for tree uptake throughout most of the sandy soil profile. For augers placed on higher alluvial terraces, SMP increased significantly at depths below 1.5mgbl, and generally matched measured LWPs at depths of 2.2mbgl. This indicates moisture at, or deeper than this depth, is available for moisture uptake by trees.

Charlevue Creek Area 2: Single auger holes were placed at both Site M10 and Site M12 with M10_AU1 placed on the upper terrace (5m from top of bank) while M12_AU1 was placed in the channel floor, 5m below the terrace. For M10_AU1, SMP to depths of 2.2 mbgl was significantly more negative than LWP of trees sampled at the site (**Figure 20a**), indicating trees are sourcing moisture from regions of the soil profile that are deeper than 2 mbgl. For M12_AU1 (Site M12) SMP at depths below 1 mbgl matched measured LWP for trees at the site indicating that soil moisture within the profile below these depths is available for uptake by trees (**Figure 20b**). Auger M12_AU1 was completed at 1.2 mbgl due to a high density of tree root material which arrested deeper penetration of the auger.

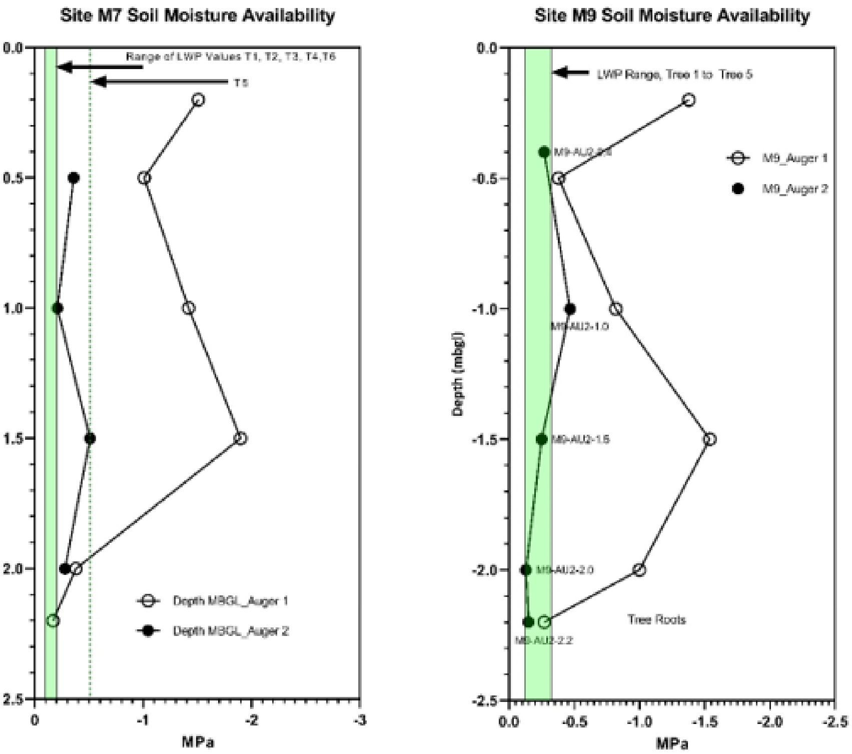

Figure 19. Downhole SMP for auger holes placed at Site M7 (19a) and Site M9 (19b on left) indicating increasing water availability at depths >2mbgl. The green shading indicates the range of LWPs measured in trees at these sites.

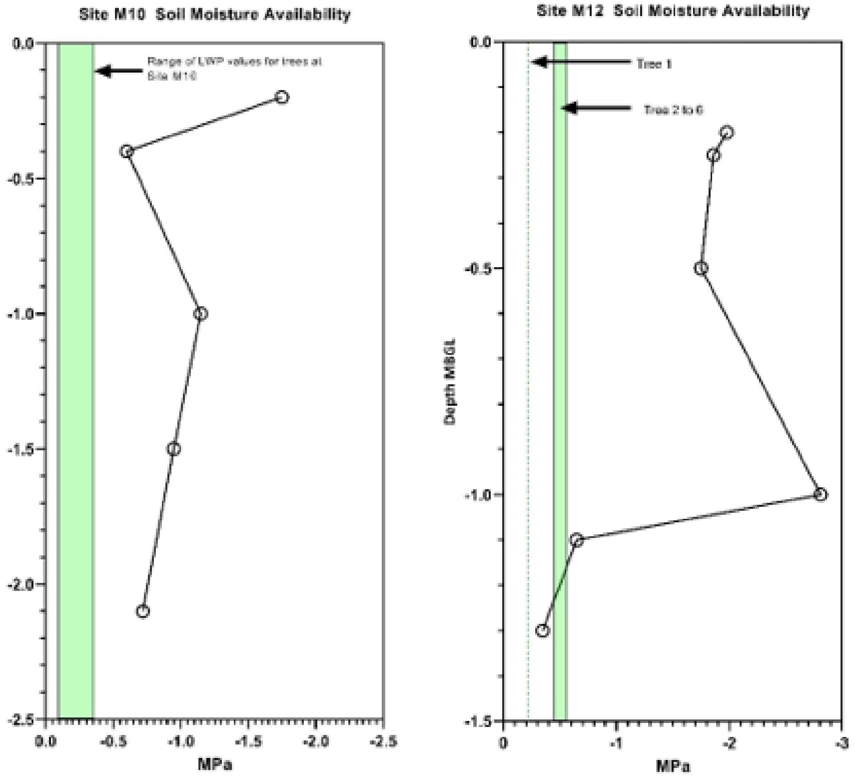

Figure 20. Downhole SMP for auger holes placed at Site M10 (20a) and Site M12 (20b on right) indicating increasing water availability at depths >2mbgl. The green shading indicates the range of LWPs measured in trees at these sites.

Springton Tributary Area 1: Single auger holes were placed at Site M1 and Site M4 at Springton Tributary Area 1. Site M1 was installed to a depth of 2.2m, with a coarse sand layer intersected between 1.5m and the end of hole (**Figure 21a**). The sand was strongly mottled with iron staining suggesting the sand formed a seasonal aquifer with strongly fluctuating water levels. While no free water was intersected in the auger, it is expected that saturation would occur rapidly after rainfall, and that free water may have been available deeper in the sandy profile. At 2.2 mbgl, a coarse gravel band was intersected which arrested deeper auger penetration and it is possible that free water may have been present at deeper levels in the soil profile. Downhole SMP does indicate high levels of moisture availability in the sand, matching LWP for trees measured at the site, and moisture would be available for uptake between 1.7 and 2.0 mbgl. For Site M4 (see **Figure 21b**), a fine silty sand was intersected between 1.0 and 1.3 mbgl with a hardpan at the base which arrested deeper auger penetration. The entire hole was dry with SMP that was considerably lower than LWP for trees recorded at the site, indicating that trees are most likely accessing soil moisture from deeper regions of the soil profile.

Springton Creek Area 1: There were severe difficulties installing auger holes into any of the three Springton Creek sites (M5, M6 and M14) due to the compacted nature of the soils, and basement rock outcrop in some localities. Auger penetration was arrested at Site M6 at 0.35 mbgl due to a cemented soil horizon and at M14, penetration was arrested at 1.2mbgl due to compacted soils. SMP measurements for Auger M14_AU1 ranged from -1.1 to -3.5 MPa, which corresponded to the low LWP measurements recorded in poplar box at the site (-1.1 to -2.0 MPa) suggesting that trees may be extracting moisture from the shallow soil profile in this locality.

A single auger hole was installed into the channel of Springton Creek at Site M5, to a depth of 1.9 mbgl. The hole was placed below Tree 3, which was the only tree at the site to demonstrate a high LWP (>-0.2 MPa) indicative of high moisture availability in the soil profile (see **Figure 13**). The results indicate SMP in the soil profile below the channel sufficiently explains the high LWP recorded in Tree 3, with moisture between 0.75 and 1.9 mbgl available for tree uptake (see **Figure 22**). Other trees (Tree 1, Tree 2, Tree 4, Tree 5 and Tree 6) all demonstrate significant water deficit indicating trees are accessing moisture from a much drier soil profile in those locations.

Site M13 (Charlevue Creek): Auger M13_AU1 was installed in the road reserve within the creek channel, encountering 2m of moist heavy clay. **Figure 23** demonstrates Tree 1 (*Eucalyptus coolabah),* which was located on the upper terrace 10 from the top of bank, was sourcing moisture from an extremely dry portion of the soil profile, and moist soil conditions were largely restricted to the channel where other trees were sampled. SMP in auger M13_AU1 is extremely high from surface down to 2.0 mbgl, accounting for the high LWP recorded in Tree 2 to Tree 4. The moist conditions recorded in the auger hole are likely to represent a wetting front below the stream channel, although no free water was intersected.

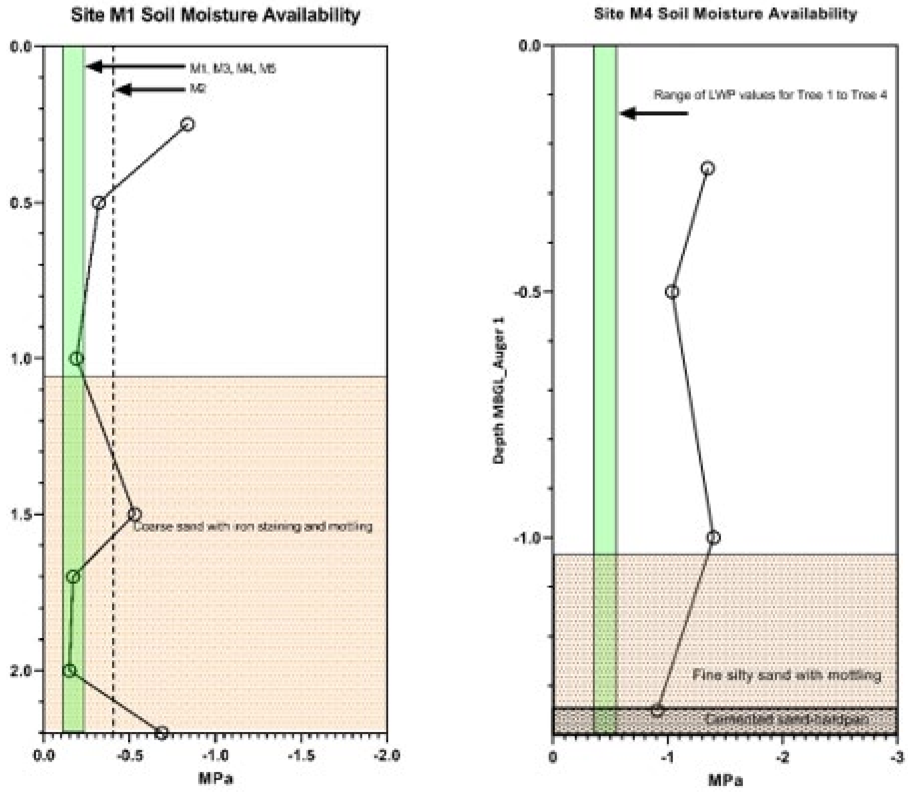

Figure 21. Downhole SMP for Site M1 (Figure 21a) and Site M4 (Figure 21b right) at the Springton Creek Tributary Area 1.

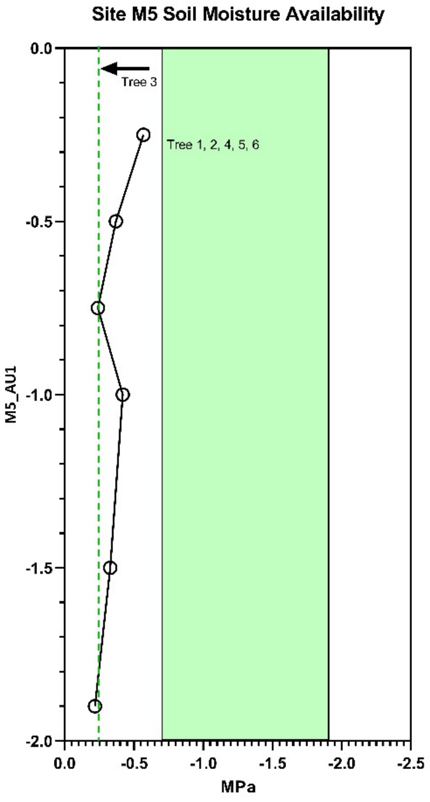

Figure 22. Soil moisture availability at site M5, Springton Creek Area 1.

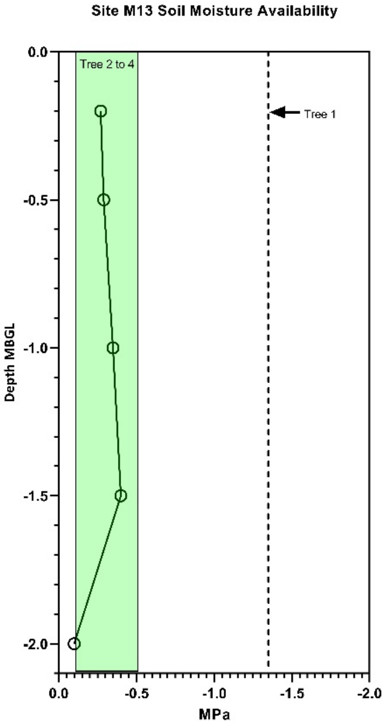

Figure 23. Soil moisture availability at Site M13, Charlevue Creek.

4.3 Stable Isotope Sampling and Analyses

Figure 24 shows stable isotope values (δ18O and δ2H) for all values including soil, surface water (from stream pools), groundwater and twig xylem water analysed during the assessment. The main groupings have been circled to better indicate the inter-relationship between the groups and highlight areas of dataset overlap. The scatter shows:

1. Broad isotopic overlap between soil and all other sample types, with soil presenting the greatest spread of isotopic values. Twig xylems samples were generally enriched above the soil and groundwater with some overlap between soil and groundwater.
2. Twig (xylem) samples and groundwater samples do not demonstrate any overlap with groundwater demonstrating much more depleted isotopic values, although twig samples overlap with isotopic values of surface waters.
3. There is no overlap between surface water samples and groundwater, the latter being subject to significant evaporative enrichment.

The broad scatter of isotopic values in the soil samples is expected, as this would be imparted by infiltration of surface water with varying degrees of isotopic enrichment including direct infiltration of unfractionated rainfall or infiltration of evaporatively enriched surface waters. The most significant feature is however the complete lack of overlap between twig samples (which are relatively isotopically enriched) and groundwater samples (isotopically depleted) indicating trees are not utilising groundwater in the regional Tertiary or alluvial aquifers to any degree, even when groundwater would be within reach of maximum rooting depth (e.g. SWL at 8.7 mbgl in alluvium at DW7076W and 11.19 mbgl at DW7292W1). This is not unexpected due to the salinity of groundwater that is typical of the regional aquifer systems. The results imply that any groundwater usage by trees on the Project site is from fresh perched aquifers that are recharged through infiltration of evaporatively enriched surface water and are disconnected from the regional aquifer. Note all stable isotope biplots include the Local Meteoric Water Line (LMWL) for Rockhampton from Crosbie et al (2012) which provides a reference to identify evaporative trends. Raw data for all isotopic samples is provided in **Appendix D**. Stable isotope results for individual sites are briefly discussed below:

Charlevue Creek Area 1 and Charlevue Creek Area 2: Biplots showing the isotopic composition of soils, twigs, groundwater, and surface water from Charlevue Creek Area 1 is shown in **Figure 25** and Charlevue Creek Area 2 in **Figure 26**. For both areas, the results highlight the strong differentiation between isotopic composition of twig samples and groundwater, indicating the regional groundwater table is not being utilised by trees to any degree. There is also no consistent pattern in the soil samples with isotopic enrichment being evident at various depths, where they match the isotopic compositions of twig samples (e.g. M7 Au1_2.0m; M7 AU1_1.15m at Charlevue Creek Area 1) indicating possible utilisation of moisture from those depths in the soil profile. Surface water samples were collected from an overflow channel at Site M8 for Area 1 and from a residual pool at M10 for Area 2, and both are isotopically enriched above all other samples, indicative of exposure to evaporative processes.

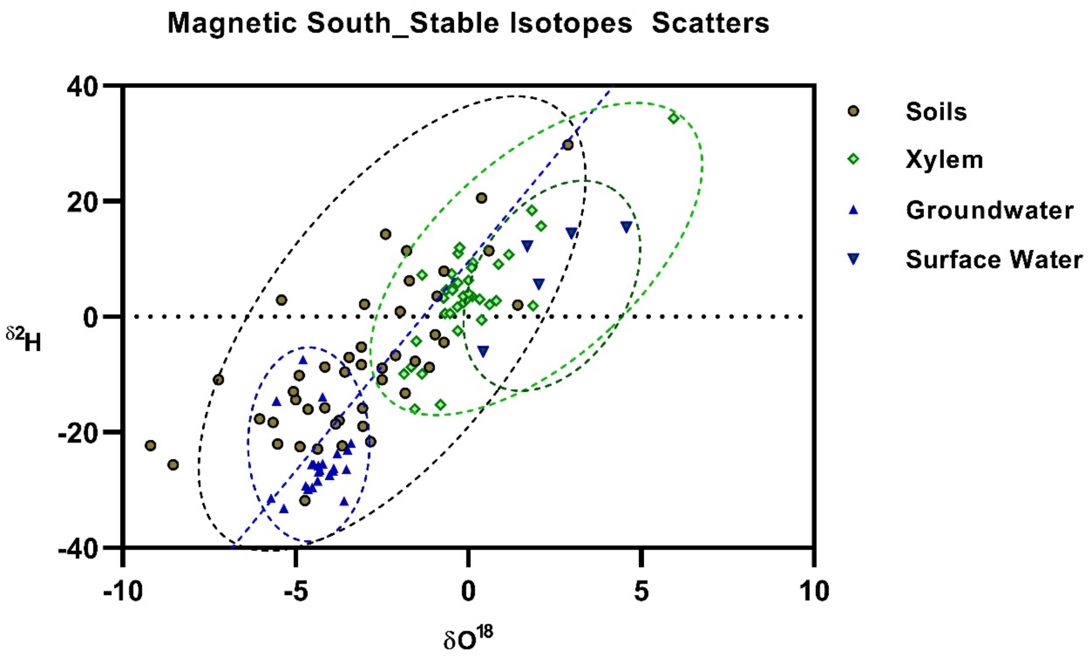

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Figure 24. Stable isotope scatters for all data with LMWL for Rockhampton indicated in by the blue line after Crosbie et al (2012) shown as reference. The circles delineate the sample groupings of soils, xylem, groundwater and surface water.

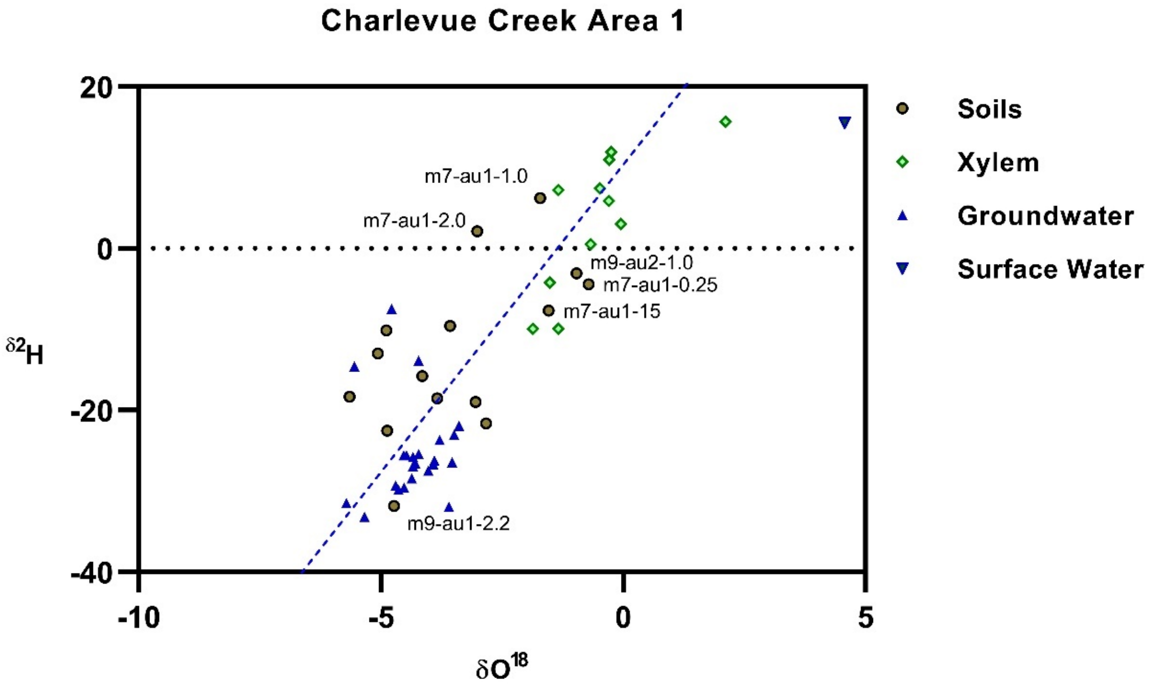

Figure 25. Stable isotope biplot for Charlevue Creek Area 1 with the LMWL shown in blue dashed line.

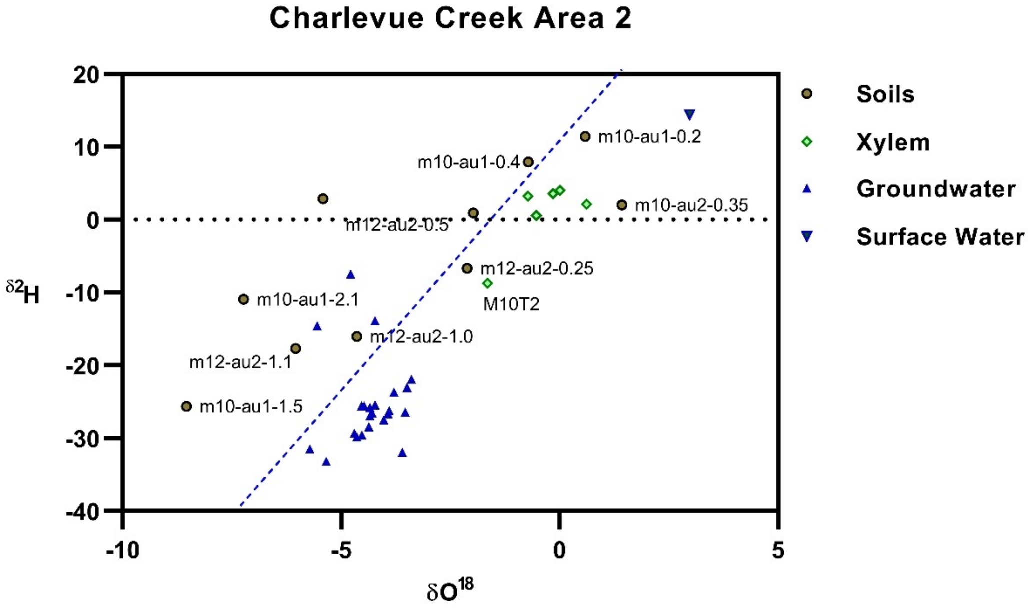

Figure 26. Stable isotope biplot for Charlevue Creek Area 2 with the LMWL shown in blue dashed line.

<u>Springton Tributary Area 1:</u> Biplots showing the isotopic composition of soils, twigs, and groundwater from Springton Tributary Area 1 (Site M1 and M4) is shown in **Figure 27.** Like Charlevue Creek Area 1 and Area 2, the results highlight the strong differentiation between isotopic composition of twig samples and groundwater, indicating the regional groundwater table is not being utilised by trees to any significant degree. There is overlap between twig samples and SMP from some soil samples (particularly M1_AU1_1.5) indicating moisture is being source from these regions by some trees. The enrichment of stable isotope values from twig samples indicates trees are utilising an evaporatively enriched source of moisture, most likely from zones that are deeper in the soil profile, where infiltrated surface water has been able to penetrate.

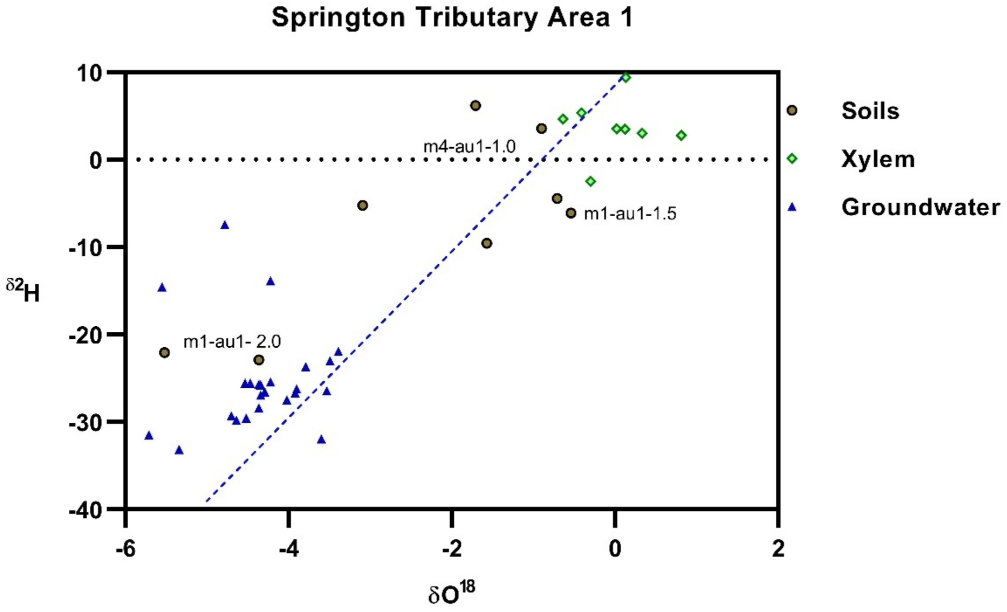

Figure 27. Stable isotope biplot for Springton Tributary Area 1 with the LMWL shown in blue dashed line.

Springton Creek Area 1: Biplots showing the isotopic composition of soils, twigs, groundwater and surface water from Springton Creek Area 1 (Site M5, M6 and M14) are shown in **Figure 28.** As per previous assessment areas, there is a strong differentiation between isotopic composition of twig samples and groundwater, indicating the regional groundwater table is not being utilised by trees to any degree. Soil samples are generally isotopically enriched over twig samples however, in auger sample M5_AU1, isotopic enrichment increases with depth in the soil profile (see **Figure 29**). This effect strongly suggests that Tree 3 at M5 (being the only tree with high LWP from Site M5) is utilising moisture at depth underneath the stream channel, where it is sourcing infiltrated surface flows that have been subject to evaporative enrichment.

Tree 1 at Site M6, a *Melaleuca leucadendra* on the margins of a semi-permanent waterhole, similarly demonstrates high LWP (see **Figure 13**). Isotopic analysis indicates this tree is utilising moisture directly from the surface water body as indicated by isotopic overlap with the surface water sample from this site (M6SW1 compared to M6_T1). The isotopic values of other trees generally overlap with the isotopic composition of soil moisture from deeper portions of the soil profile. From **Section 4.2 (Figure 22)**, this moisture is from a dry portion of the soil profile which is likely to be below the total depth of the auger profile at M5_AU1.

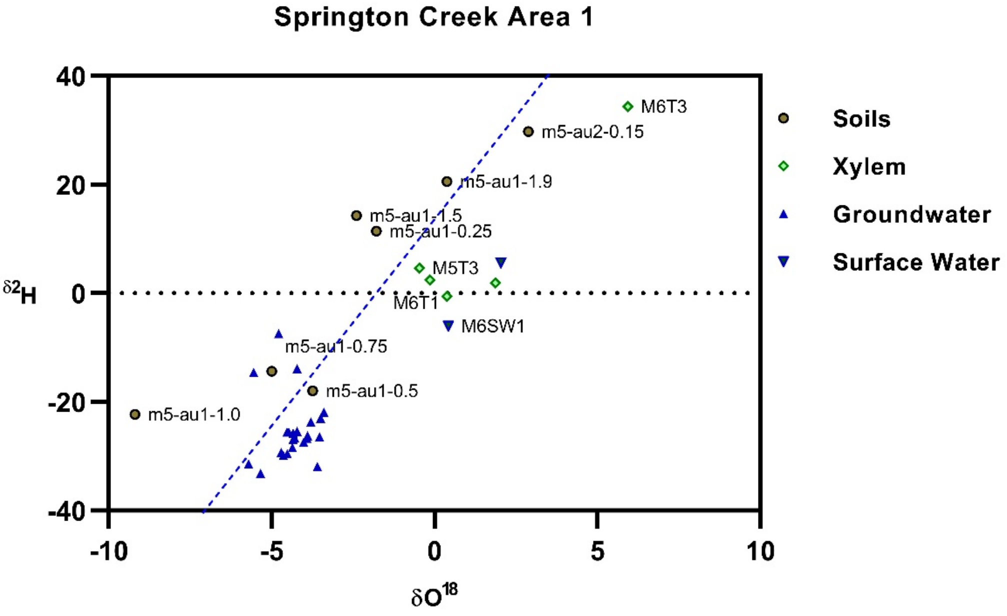

Figure 28. Stable isotope biplot for Springton Creek Area 1 with the LMWL shown in blue dashed line.

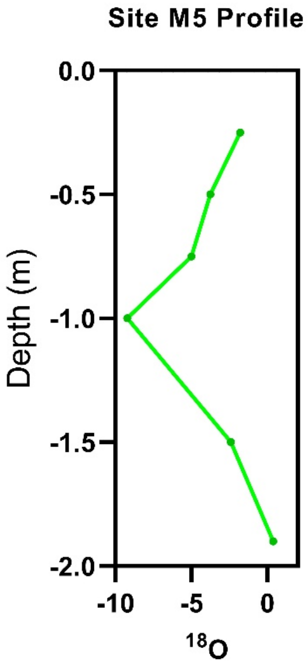

Figure 29. Isotopic profile downhole in Site M5 (M5_AU1) indicating increasing isotopic enrichment below 1 mbgl.

Site M13 (Charlevue Creek): A biplot showing the isotopic composition of soils, twigs, surface water and groundwater from Site M13 at Charlevue Creek is shown in **Figure 30.** The differentiation between isotopic composition of groundwater and twig samples is highly apparent. Twig samples overlap with the isotopic composition of the surface water sample collected at the site (M13SW1). This strongly suggests that trees at Site M13 are utilising water from the wetting front below the creek channel, in moist clays, which is consistent with the high LWP recorded from most trees at the locality (see Figure 13).

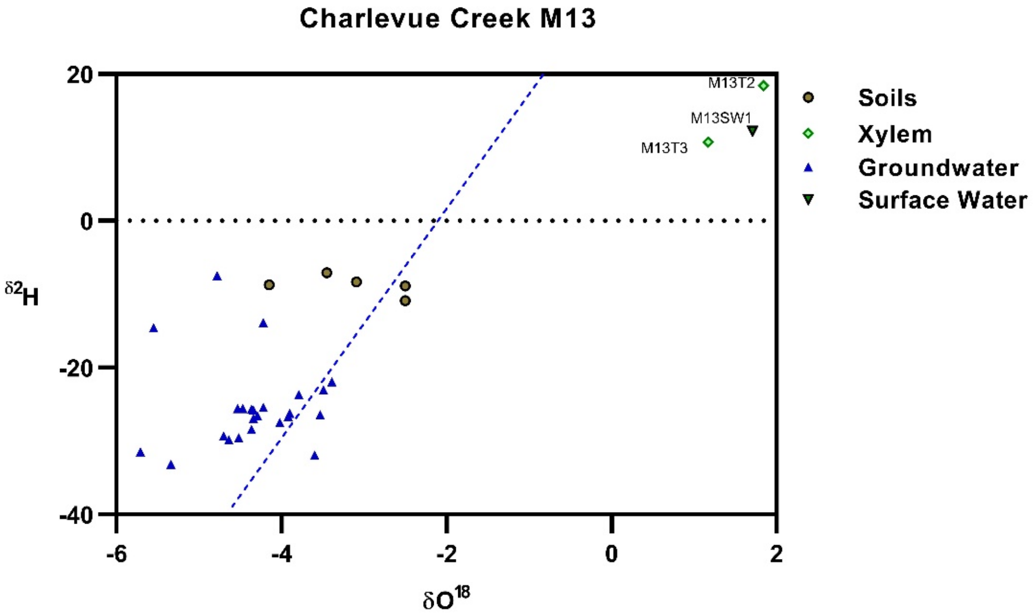

Figure 30. Stable isotope biplot for Charlevue Creek Site M13, demonstrating strong differentiation between groundwater and twig xylem.

Other Sites (M2, M3, M11): The remaining sites all demonstrate strong differentiation between groundwater samples and twig xylem, indicating that groundwater is not being utilised by trees at these localities to any significant degree (see **Figure 31**).

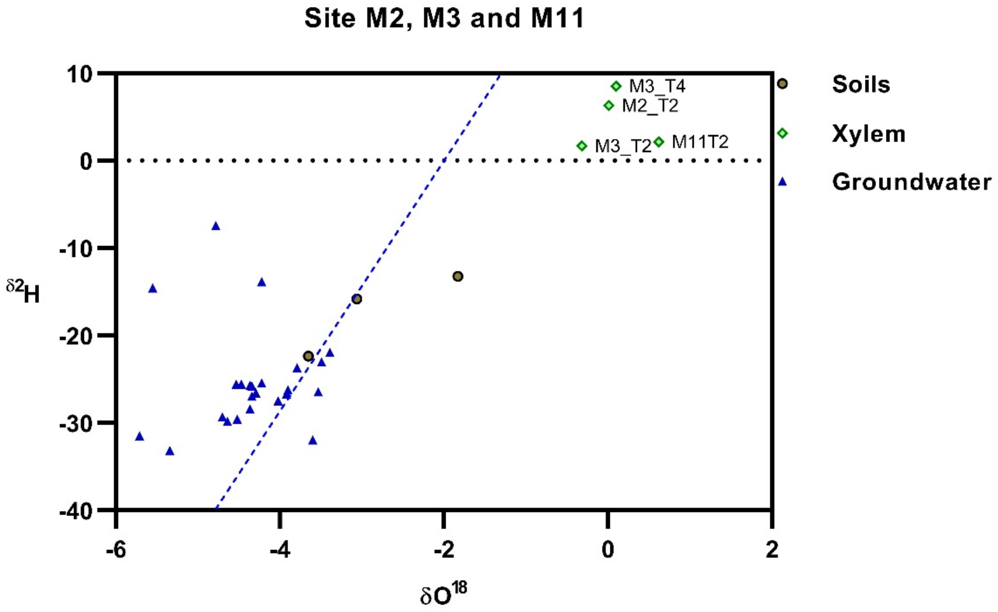

Figure 31. Stable isotope biplot for Charlevue Creek Site M2, Site M3 and Site M13, demonstrating strong differentiation between groundwater and twig xylem.

5.0 Discussion and Conceptual Site Models (CSMs)

5.1 Suitability of Groundwater Resources to Support GDEs

Groundwater may be hosted in nearly all geologies in some form and an assessment of its utility to support GDEs is required. The Permian Sediments (Rewan Group and Rangal Coal Measures) are low permeability units that are generally considered aquitards. Groundwater occurs in fracture zones and the degree of permeability is constrained by the degree of fracturing and the low primary porosity of the sediments. Coal seams are the primary aquifers in the Permian sediments and the upper units subcrop into the Tertiary sediments where there may be some leakage and exchange of groundwater between the two geological units. The shallowest recorded groundwater levels in the coal seams are from Pollox Upper Seam (17.04 mbgl) which is close to the inferred threshold depth beyond which tree roots / groundwater interaction is unlikely to occur (DNRM 2013). Similarly, the shallowest groundwater in the Tertiary sediments was recorded in DW7220W1 at 15.35 mbgl which is also at the inferred threshold for tree root penetration, while the groundwater in the alluvium may be considerably shallower (8.77 mbgl in DW7076) suggesting that it may be physically accessible to tree roots.

While physical accessibility provides one controlling factor, salinity also plays a significant role in determining the suitability of groundwater to support ecological processes, including its capacity to support terrestrial GDEs. A lower osmotic potential will be associated / measurable in the leaves of trees exposed to saline soils or groundwater, which will be reflected in a lower total LWP. Eamus et al (2006b) identifies river red gum as being a relatively salt-tolerant species, growing well in groundwater salinities of almost 1,500 µS/cm. In addition, Mensforth et al. (1994) identified that river red gum will continue to utilise groundwater with salinity as high as 40,000 µS/cm in the absence of a fresh source of soil moisture, although higher levels of tree stress will be apparent. Measured groundwater salinity in the alluvial and Tertiary sediments ranges from 1 439 µS/cm to 26 831 µS/cm, which would be in the mildly to highly toxic range for river red gum. Trees may prefer not to utilise brackish to saline groundwater if more suitable fresh water sources, including infiltrating rainfall and surface water, are available. Based on relatively unambiguous data from comparison of stable isotope signatures between twigs and groundwater, there is no indication that groundwater in even the shallowest regional aquifers within the physical reach of tree roots is being utilised by trees to any significant degree. Where LWP measurements indicate the likelihood that trees are utilising a saturated groundwater source, the stable isotope signatures from twigs indicate this groundwater must be from a perched source of fresh water that is disconnected from the regional groundwater table. Two areas where utilisation of a source of perched groundwater is indicated are identified on Charlevue Creek (particularly Charlevue Creek Area 1) and Springton Tributary Area 1, which are discussed in the following sections, with the location of these areas, relative to infrastructure areas shown in **Figure 32**. There is no evidence for trees associated with the main channel of Springton Creek, including the floodplain areas occupied by RE11.3.2 (*Eucalyptus populnea* dominant) are utilising groundwater from the regional alluvial or Tertiary aquifers.

5.2 Ecohydrological Function of the HES Wetland

The HES wetland feature is an internally drained clay pan with no external connections to watercourses or other wetland areas. Despite an extremely wet February four months prior to the field inspection, there was no indication of any surface water associated with this feature. This suggests that there is no baseflow into the system, which would be expected if the wetland was linked to a semi-confined aquifer that is recharged directly by rainfall. Ponded surface water in the system clearly evaporates quickly, in conjunction with associated infiltration into the clay subsoil.

The HES wetland was observed from the roadside to comprise a low woodland with a predominant canopy of *Melaleuca nervosa* and emergent forest red gum (*Eucalyptus tereticornis).* Neither of these species are obligate phreatophytes, having capacity to survive in situations where considerable water deficit may occur, such a clay pans and dry hillslopes. While there is a possibility that the HES wetland is supported by a shallow fresh perched water table that is recharged directly by rainfall, there is no suggestion that the feature is supported by a deeper confined aquifer system that is linked to the coal seams proposed for mining. The feature is therefore not considered a concern for this assessment because:

1. The wetland is nourished by surface water flows from within its own internal catchment which does not form part of the mining footprint.
2. There is no indication of baseflow into the system, or inputs from groundwater linked to aquifers in the coals seams.

This is supported by information contained in both national (BOM 2020) and state (DES 2018) GDE mapping databases which do not support this feature as being a GDE.

5.3 Conceptual Site Models / Cross Sections.

Conceptual Site Models (CSMs) illustrating the conceptualised interaction between groundwater and terrestrial ecology have been developed for two likely GDEs in this section. The location of these cross sections is shown on **Figure 32,** being a north south block section through Charlevue Creek Area 1, and an east west cross section through Springton Creek Area 1. The purpose of the CSMs is to illustrate the interaction between terrestrial vegetation and sources of soil moisture for transpiration as they interact and vary on a seasonal basis. CSMs presented in this section are not drawn to scale and are intended to represent soil / moisture and tree relations diagrammatically. It is also noted that these areas provide the most extensive interpreted GDE areas within the Project site and provide a firm basis for conceptualisation of impacts. It is not possible however to exclude other areas where there may be minor or highly seasonal groundwater usage that is similar to what is conceptualised in the models, most likely on Charlevue Creek.

5.3.1 Charlevue Creek Area 1.

Figure 33 defines a N/S section through Charlevue Creek at the approximate location of **Cross Section A**, extending for approximately 500m to the south of the channel and 100m to the north. **Figure 33a** illustrates a dry season scenario where a shallow fresh water aquifer occurs at the base of recent flood plain sediments. The flood plain defines a broad ‘flood terrace’ that is confined between gentle Tertiary rises and is inferred to be a more recent alluvial feature than areas associated with Charlevue Creek that are otherwise mapped as alluvium. The flood terrace is strongly incised by the main channel of Charlevue Creek to depths of up to six metres and traversed by shallow overflow channels which are activated during periods of overbank flow. Water is held at depth in the dry sandy creek bed, where residual, isotopically enriched surface water from prior flows remains hydraulically connected to alluvial aquifer. This connection may be broken during extended drought periods with evapotranspiration depleting the alluvial aquifer and, in this sense,, the alluvial aquifer is considered a seasonal feature. The shallow alluvial aquifer is also disconnected from the deeper, brackish to saline Tertiary aquifer that lies at the interface between Tertiary and weathered Permian sediments. While there is some diffuse leakage indicated from the perched into the Tertiary aquifer, this leakage is relatively minor, evidenced from the generally high and temporally consistent salinity of the Tertiary aquifer.

In **Figure 33b**, a flood scenario is indicated where overbank flow activates overflow channels, greatly enhancing recharge of the perched aquifer. The alluvial water table bulges due to bank recharge adjacent to the stream channel, and the watercourse loses surface flow into the alluvial sediments in a typical 'losing stream' scenario. Lateral infiltration of surface flows into the stream channel continues until the level of the surface water drops below the level of the recharged alluvial water table, as shown in the post flooding scenario (**Figure 33c**). In the post flooding scenario, baseflow from the alluvial water table back into the stream channel may occur, acting to sustain surface flows for a short period following flooding.It is noted that during flooding, the perched alluvial aquifer remains hydraulically disconnected from the Tertiary aquifer with only minor leakage through the Tertiary sediments. The salinity of the Tertiary system suggests that recharge through the Tertiary sediments occurs via diffuse 'piston flow' where the movement of a water front occurs through the soil uniformly downwards to the aquifer, pushing older water deeper into the soil profile. Preferential flow, where water migrates through the substrate rapidly via preferential flow paths is not anticipated as this would rapidly and permanently dilute the salinity of the Tertiary aquifer. Preferential flow would also create pathways for tree root penetration into the Tertiary groundwater system, for which there is no evidence.

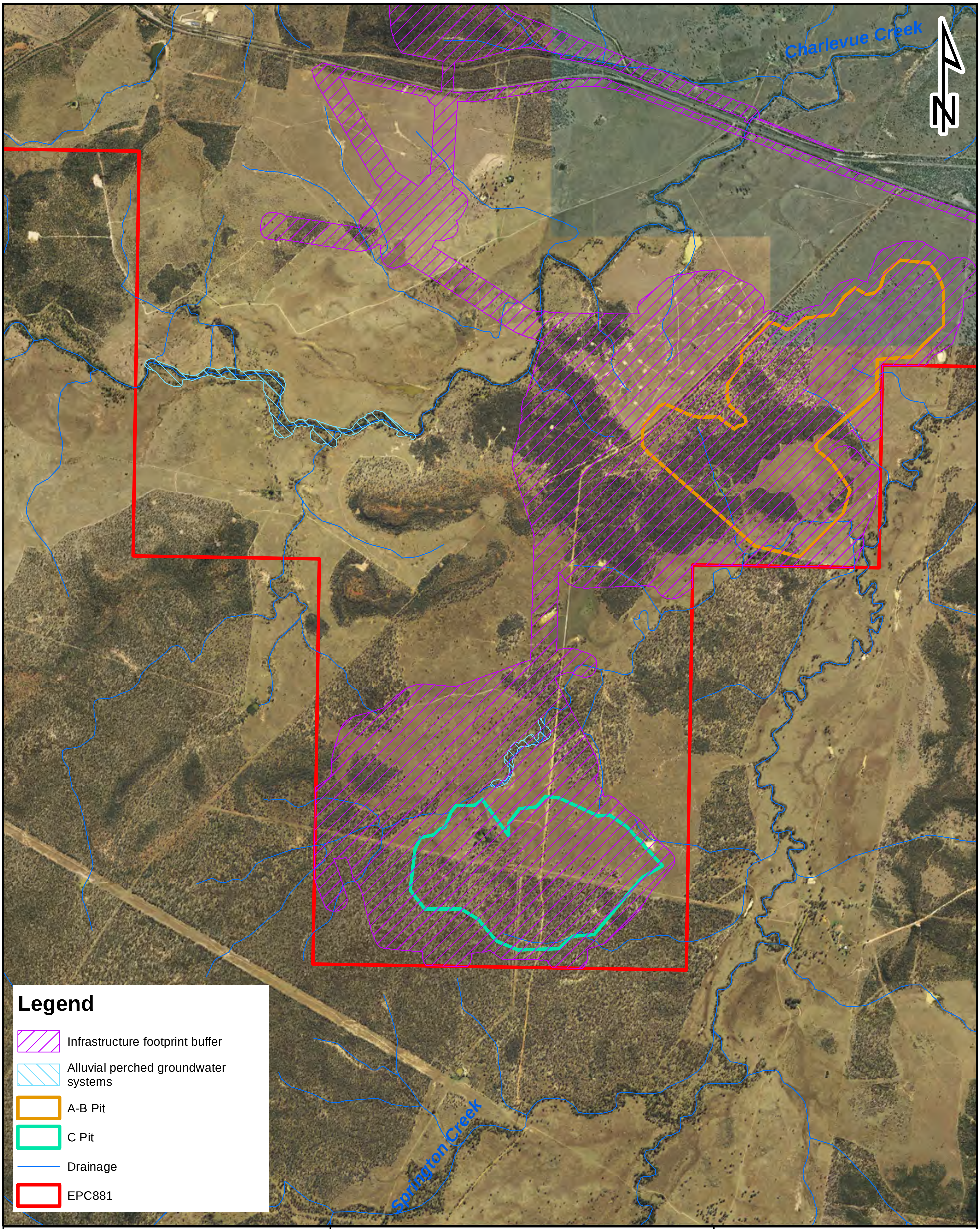

Figure 32. Location of confirmed terrestrial GDE areas

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Figure 33a. Charlevue Creek Area 1- Dry Season Regime

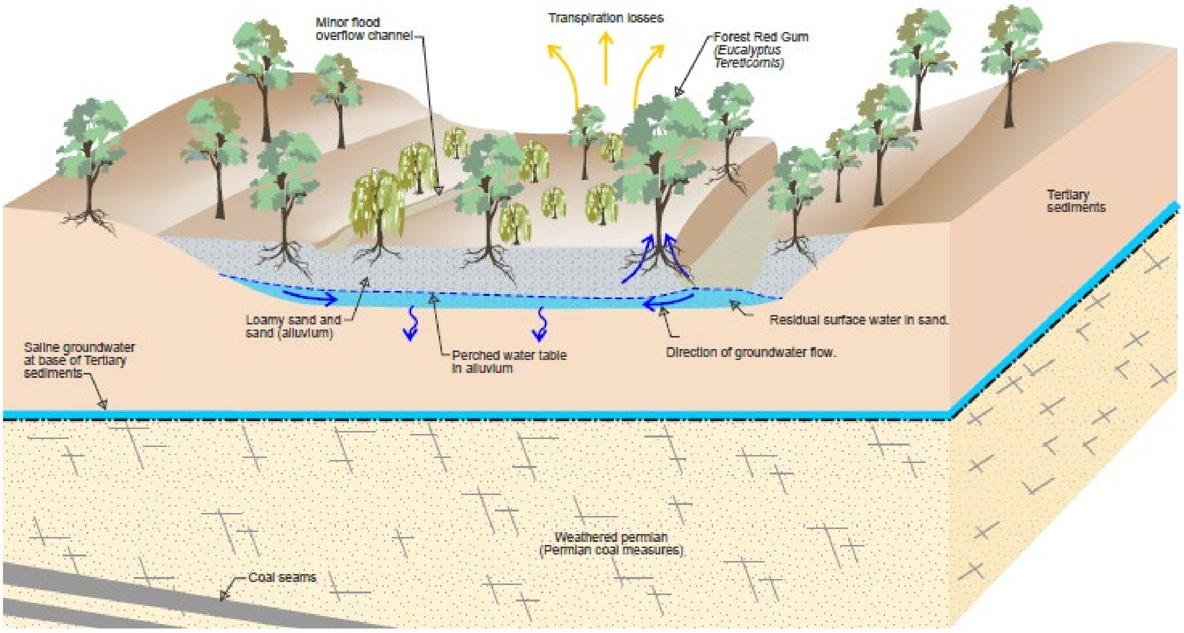


Figure 33b. Charlevue Creek Area 1- Flood Regime

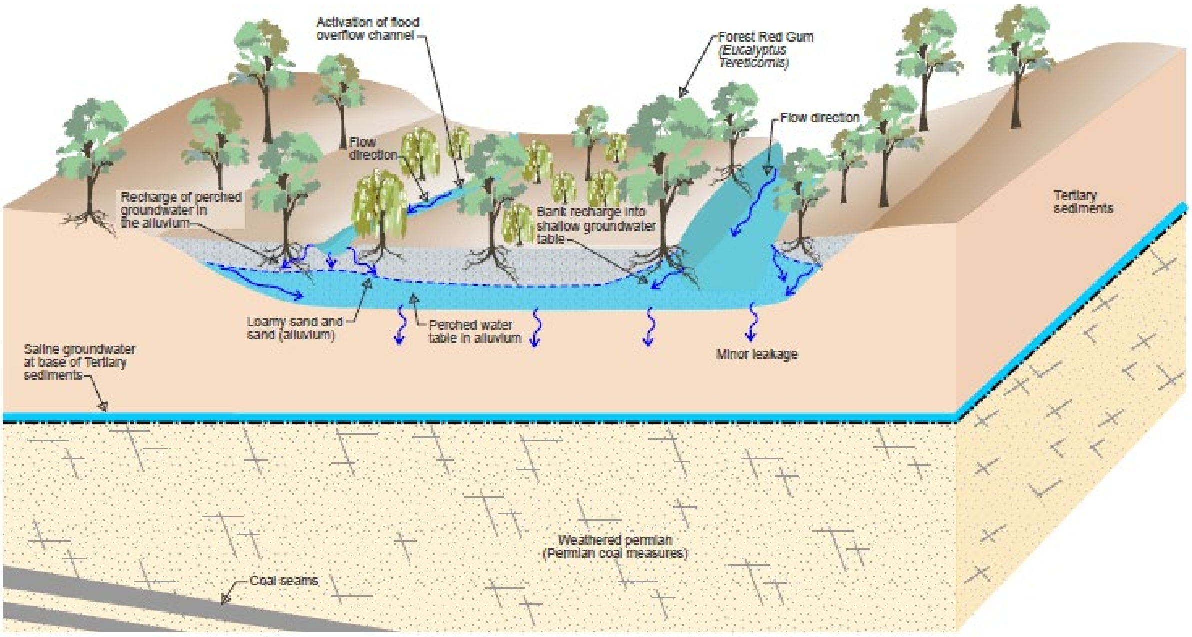


Figure 33c. Charlevue Creek Area 1- Post Flooding (Baseflow)

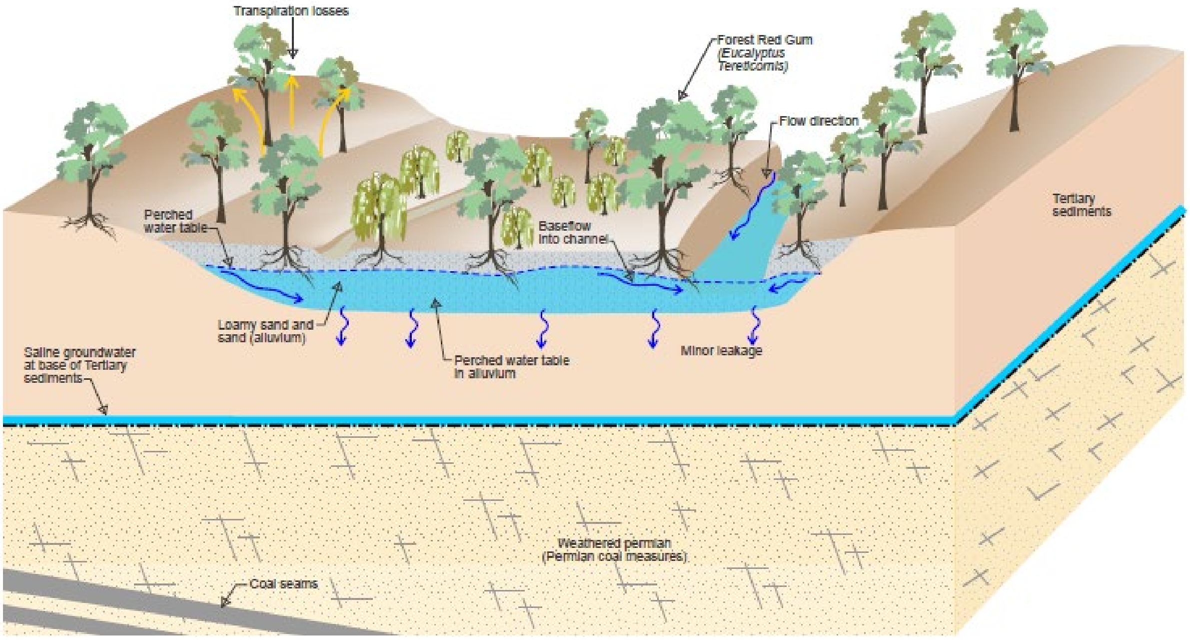


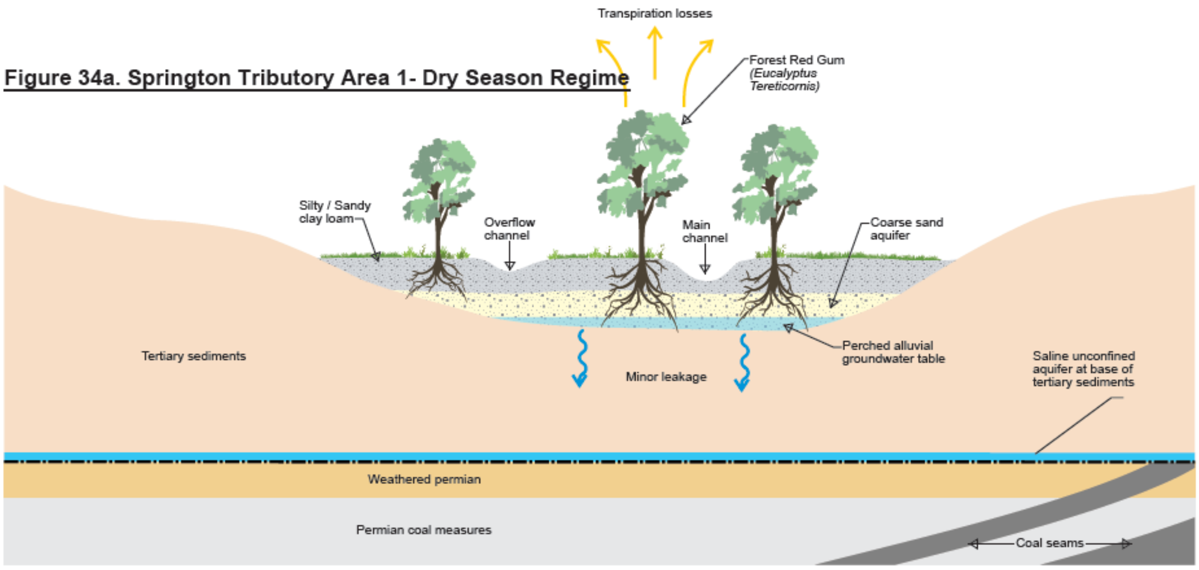
Figure 33. Conceptual model of the Charlevue Creek GDE system showing dry season scenario (33a), flooding scenario (losing system) (33b) and post flooding / baseflow scenario (33c).

5.3.2 Springton Tributary Area 1

The thick interval of coarse sand intersected in Auger holes (see profile for M1_AU1 in **Appendix B**) in this locality provides excellent aquifer material, and the presence of strong iron staining and mottling indicates that the sandy interval hosts a fluctuating perched seasonal aquifer that fills and drains rapidly in response to surface flows and seasonal rainfall. During the dry season, the perched aquifer is depleted rapidly through transpiration, with only minor leakage inferred into the underlying Tertiary sediments and groundwater table as shown in **Figure 34a.** Tree roots from the dominant red gum are inferred from stable isotope analysis to be utilising isotopically enriched moisture from the saturated portion of the sandy soil profile, with some shallow anchorage in the Tertiary sediments expected.

In the wet season (**Figure 34b**), the aquifer recharges rapidly through infiltration of surface water, which is enhanced by activation of numerous overflow channels, and drainage flows from the surface of the Tertiary system. The period that the aquifer material remains saturated will depend on follow up recharge and climatic factors, with greatest depletion occurring during periods of high evapotranspiration. Similar to the Charlevue Creek CSM, the salinity of the Tertiary system suggests that recharge through the Tertiary sediments occurs via diffuse 'piston flow' where the movement of a water front through the soil uniformly downwards to the aquifer occurs. While some leakage from the perched into the deeper Permian / Tertiary aquifer is expected, it is not considered to be a significant input into the deeper aquifer systems, as evidenced by their high, and relatively stable levels of groundwater salinity. Due to the low hydraulic conductivity of the Tertiary sediments, there is no capacity to sustain baseflow back into the drainage feature. Based on field evidence, the GDE system relies on its own local catchment and surface flows to replenish the perched groundwater system.

Figure 34a. Springton Tributary Area 1- Dry Season Regime



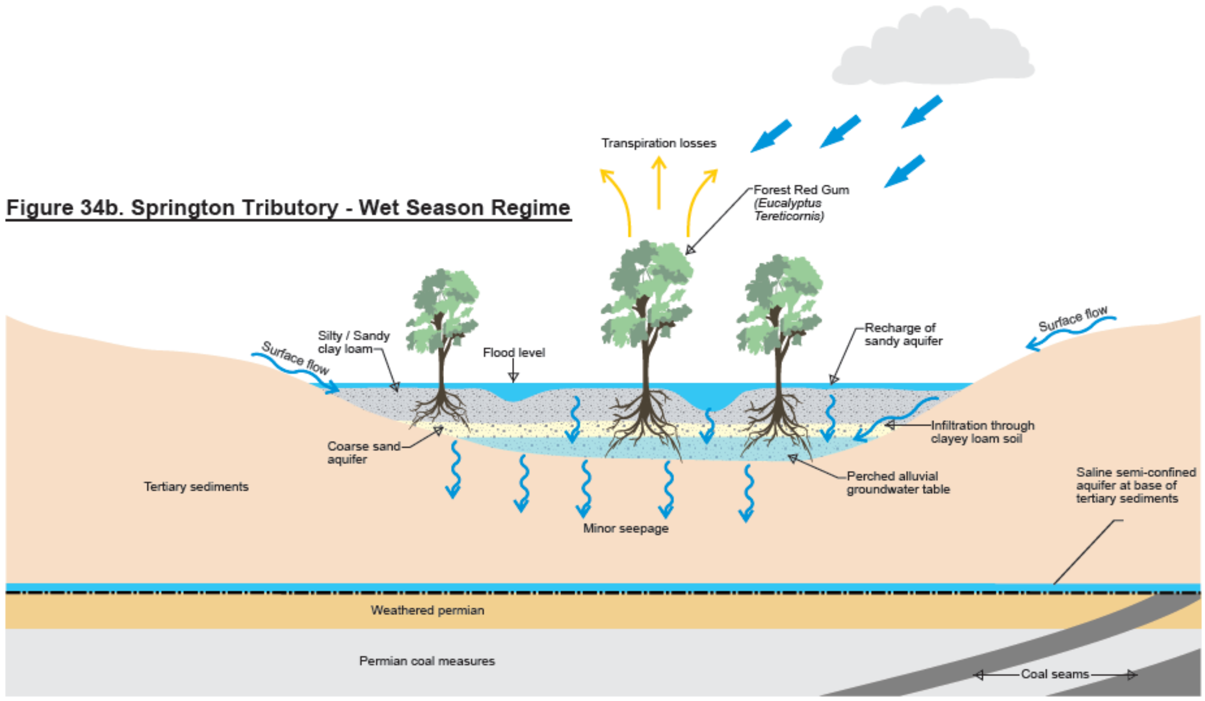


Figure 34. Cross section model of the Springton Tributary Area 1 perched aquifer system in the dry season (**Figure 34a**) and wet season (**Figure 34b**).

6.0 Assessment of Impacts to GDEs

Section 6.1 provides a summary of findings for the Charlevue Creek Area 1 and Springton Tributary Area 1 GDE areas, with potential impact mechanisms and their relevance to GDEs within the Gemini project area, discussed in **Section 6.4**. Potential measures for impact mitigation are provided in **Section 6.3** and a risk assessment has been undertaken in **Section 6.5** consistent with the approach identified in the IESC summary guide – assessing groundwater dependent ecosystems (IESC 2018c).

6.1 Summary of Findings Relevant to Impact Assessment

The assessment of impacts to GDEs is based on the findings of the extent and distribution of GDEs identified in this report, and the groundwater impact assessment report (JBT 2020). In summary:

Charlevue Creek Area 1 GDE System:

1. Charlevue Creek is an ephemeral watercourse system defined by an incised channel, up to six metres deep and up to 15 m wide. In this locality, the flood plain widens to form a broad flood terrace that is up to 200m wide, formed from well drained recent alluvial silts and sands.
2. The stream channel has a sandy floor that holds residual water from surface flows for an extended period into the dry season. Water held in the channel sands is conceptualised to have hydraulic linkage with a localised perched groundwater system, which becomes gradually depleted through transpiration into the dry season.
3. The depth of the perched aquifer would fluctuate seasonally with the likelihood that brief periods of baseflow are associated with retreating channel flows. For most of an annual seasonal cycle, the creek channel would be losing water into the alluvial sediments and perched groundwater table.
4. The hydraulic connectivity between the perched groundwater system and the deeper groundwater in the Tertiary sediments is insignificant although there may be minor leakage of groundwater from the perched groundwater system into the Tertiary sediments.
5. The observed good health of mature forest red gum in the Charlevue Creek system, coupled with the extremely high LWP measured during field assessment suggests that trees are not utilising saline groundwater from the Tertiary sediments to any degree, a statement which is strongly supported by analysis of stable isotope compositions from twigs and groundwater.

Springton Gully Area 1 GDE System

1. The Springton Tributary system is an ephemeral watercourse defined by a flat, weakly incised flood plain that has numerous overflow channels that are activated during flooding.
2. A seasonal aquifer is associated with a coarse sand interval intersected below the flood plain and main creek channel. The aquifer is conceptualised as being perched above the regional Tertiary aquifer and fluctuates seasonally dependant of surface flow inputs, with complete saturation potentially occurring during sustained flood events.
3. The hydraulic connectivity between the perched groundwater system and the deeper groundwater in the Tertiary sediments is predicted to be insignificant although there may be

minor leakage of water from the perched system into the Tertiary sediments. This is supported by the high, and relatively stable salinity levels reported from groundwater associated with the Tertiary system.

4. Red gum at this locality are conceptualised to be utilising the perched groundwater system to sustain transpiration into the dry season, though the perched aquifer will likely become depleted during extended periods without recharge.

6.2 Potential Impacts to GDEs

The GDE Toolbox (Richardson et al 2011), provides a starting point for investigating potential impacts on GDEs exposed to threat through the following impact mechanisms:

1. A total or partial loss or reduction in the volume or pressure of the aquifer being utilised by GDEs.
2. A change in the magnitude and timing of volume fluctuations in the aquifer being utilised by GDEs.
3. Changes to the interaction between surface flows and aquifers being utilised by a GDE.
4. Change in chemical composition of an aquifer detrimentally impacting the health of a GDE.

These potential changes can result in:

1. Loss of canopy vigour leading to senescence of groundwater dependent vegetation.
2. Changes to sub-canopy and groundcover because of increased light penetration through the canopy of senescing vegetation
3. Change in species composition with replacement of species not adapted to changing ecological parameters with species that have greater capacity to absorb change.

Direct clearing of a GDE system is also an additional impact which needs to be considered in the context of the Project.

6.2.1 Direct clearing

Vegetation clearing will result in direct impact to 5.54 ha of riparian vegetation (RE11.3.25) which is recognised as a GDE in the Springton Tributary Area 1 GDE system. This clearing action will result in direct removal of the area mapped as Springton Tributary Area 1 GDE system. The extent of clearing has been shown in **Figure 32** with further information on direct impacts is provided in the Terrestrial Ecology Assessment Report (AARC 2019). As this GDE system has been identified to be cleared, it is not considered further in the risk assessment which focuses on the GDEs associated with Charlevue Creek.

6.2.2 Partial or total loss or reduction in pressure of the aquifer being utilised by GDEs.

Charlevue Creek Area 1: The predicted water table drawdown (from JBT 2020) associated with development of mining voids is shown in **Figure 35.** Excluding the GDE area proposed for clearing, Charlevue Creek Area 1 is intersected by both the 2m and 5m drawdown contours which reflects drawdown in the water table associated with mining, affecting groundwater in the Tertiary and alluvial sediments. The alluvial landform associated with the Charlevue Creek GDE system supports a seasonal perched Aquifer. Based on salinity and stable isotope data collected from groundwater and twigs, the perched aquifer is not considered to be hydraulically connected to the regional groundwater system associated within the Tertiary and older alluvial sediments. Furthermore, considering the perched groundwater system is not in hydraulic connection with regional groundwater table, this unit is not predicted to be subject to drawdown and no impact to groundwater dependent vegetation associated with Charlevue Creek will be incurred.

6.2.3 Change in the magnitude and timing of volume fluctuations in the aquifer being utilised by GDEs.

Volume fluctuations in the perched groundwater system associated with Charlevue Creek are regulated by surface flows rather than upward propagation of deeper regional groundwater tables. The interaction between surface flows and the perched groundwater system is elaborated further in **Section 6.2.4**.

6.2.4 Changes to the interaction between surface flows and aquifers being utilised by a GDE.

Streams in the Project area are ephemeral and based on the observed behaviour of other streams in the region, streamflow mostly occurs shortly after rainfall between September and April. The proposed mine operations and associated infrastructure footprint (MIA) are largely located outside of the Charlevue Creek and Springton Creek flood inundation areas (WRM 2019). The Charlevue Creek GDE system is located upstream from the proposed mining voids and there will be no loss of catchment area due to mining development that could potentially reduce upstream surface flows. Therefore, surface flow behaviour in the area upstream from the GDE area will be unaffected and similarly, there should be no change to either flood frequency, duration, or intensity that might impact recharge of the perched aquifer.

WRM (2019) report minor increases in flood level immediately upstream from the proposed haul road crossing with increases of 0.01 to 0.05m propagating upstream into the Charlevue GDE Area. These changes to flood intensity are considered insignificant in terms of recharge to the perched alluvial groundwater system.

The assessment of changes in flows, and changes in flood levels and velocities (WRM, 2019) demonstrates that the development of the mining operation will not result in a significant impact on the hydrology of Charlevue Creek to a degree that it would affect the recharge of the perched alluvial groundwater system that supports the GDE.

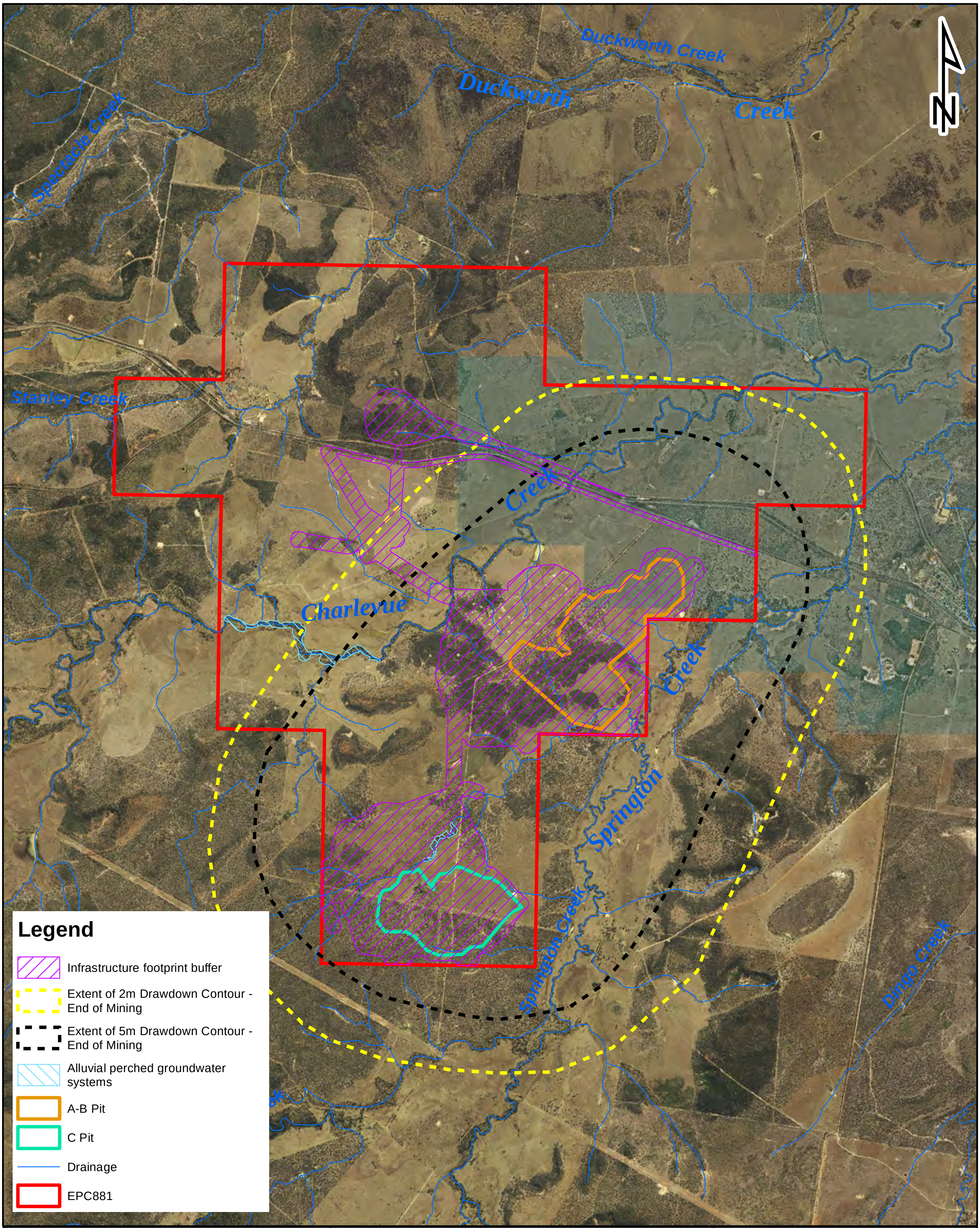


Figure 35. Identified GDE systems in relation to MIA and modelled groundwater drawdown.

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6.2.5 Change in chemical composition of an aquifer detrimentally impacting the health of a GDE

The perched groundwater system supporting GDEs on Charlevue Creek is underlain by an unconfined brackish to saline groundwater system in the Tertiary sediments and Permian coal seams. The potential for saline water from these groundwater units to contaminate the fresh perched groundwater system is negligible as upward propagation of saline water under hydrostatic pressure will not occur.

Other potential sources of water quality contamination would be from:

1. discharge of saline mine affected water, or saline leachate into the environs of Charlevue Creek, upstream from or potentially into the Charlevue GDE system. This could potentially increase the salinity of the perched groundwater system and impact GDE health.

2. Discharge of saline water from sediment dams upstream from, or into the Charlevue GDE system, potentially increasing the salinity of the perched groundwater system and impacting GDE health.

Water captured in sediment dams is expected to have low salinity and coarse sediments will settle out, such that any impacts to downstream water quality associated with discharge are expected to be minor (WRM 2019). The management of mine affected water is dealt with in **Section 6.4.1**, although WRM (2019) concludes that any unplanned overflows from the Mine Water Dam, would overflow to the mine pit with the only potential mine water release points being the Mining Infrastructure Area Dam spillways. These dams will be operated in such a way that the risk of release is small.

The groundwater impact assessment (JBT 2020) also concluded that there is no potential pathway for mine pit water from either the AB Pit, or the C Pit, via the base of the Tertiary sediments to migrate into sensitive ecological receptors and there is low risk that water from the mining void will contaminate surrounding groundwater systems.

6.3 Cumulative Impacts

JBT (2020) concluded that there are no existing mining operations within the zone of predicted groundwater drawdown from mining at the Project site, and therefore there are no cumulative impacts to assess.

6.4 Mitigation and Management Measures

It should be noted that the GDE assessment identified a GDE system that is subject to clearing impacts, which will need to be considered in the overall ecological offsets package. Apart from direct clearing impacts, **Section 6.2** identifies that in the absence of mitigation, the risk of impact to GDEs is considered low on account of the hydraulic disconnect between the aquifers supporting GDEs and the regional water table subject to potential impact during mining. While risk assessment is dealt with more comprehensively in **Section 6.5**, general operation measures that will minimise risk of impact to GDEs are provided in **Section 6.4.1.**

6.4.1 General operational measures

Under a project Environmental Authority, a water management system, whose primary objective is to minimise environmental harm, will need to be developed. Any Implemented site Water Management System (WMS) and associated Erosion and Sediment Control Plan (ESCP) will be directly applicable to management of potential impacts to GDEs.

WMS: Specific objectives under a WMS that are relevant to the management of impact to GDEs are:

- Mine affected water:
    - Ensure any controlled releases of mine affected water prevents environmental harm.
    - Minimise uncontrolled discharges in wet periods.
    - Understand, manage, and minimise the potential impact of the water management system on the regional groundwater system.
- Sediment water: Maintain the quality of water discharging from Erosion and Sediment Control (ESC) structures to as close to background levels as reasonably possible.
- Clean water: Separate from the mine affected and sediment water systems as much as practicable and allow it to pass uninterrupted through the catchment.
- Water from the mine Infrastructure area (MIA) (e.g. from fuel storage area): Ensure full separation from other water sources and manage under the specifications of AS1940 - Storage and Handling of Flammable and Combustible Liquids (WRM 2019).

ESCP: Sediment water containment (runoff from spoil and incomplete rehabilitated areas) is managed in accordance with a site ESCP. The ESCP adopts the three cornerstones of erosion and sediment control.

- Drainage control – prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of diverted and surface water through the area of concern.
- Erosion control – prevention or minimisation of soil erosion (from dispersive, non-dispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- Sediment control – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

6.4.2 Groundwater monitoring

A comprehensive groundwater monitoring network will need to be maintained for the duration of the mining venture, extending into post closure periods. The purpose of the groundwater monitoring network will be to:

1. Assess the effects of extraction of authorised groundwater including the monitoring of:
    - impacts on any watercourses dependent on groundwater flow
    - impacts of other groundwater users
    - groundwater level in all identified geological units across and adjacent to mining infrastructure and voids.

  - groundwater inflows and discharges from mine workings

2. To further refine and validate the groundwater flow model used to assess impacts to groundwater; and
3. To consider requirements of any regional groundwater monitoring and assessment program developed to address potential cumulative impacts.

6.5 Risk Assessment

Drawing on information on GDE presence and function from previous sections, a risk assessment has been prepared which presents the likelihood of an impact occurring and the consequence associated with that impact. The significance of the risks is described below:

- ***High significance:*** Complete destruction of a GDE in terms of complete loss of keystone species and conversion to an alternate degraded ecological state. Impacts are irreversible and the only feasible option for mitigation is an environmental offset under relevant environmental policy.
- ***Moderate significance:*** Degradation of a GDE to an extent that 25% or more keystone species are affected by the action. Impacts will be reversible only with mitigation.
- ***Low significance:*** Impacts are short in duration and reversible without mitigation required.
- ***Insignificant:*** Impacts are undetectable when assessed against a relevant ecological baseline.

The ranking applied to the assessment of likelihood including descriptor is provided in **Table 2**, descriptions of magnitude are applied in **Table 3** and the derived risk matrix is provided in **Table 4**. A list of applicable mitigations is provided in **Table 5**. The constructed risk assessment with a residual risk score is provided in **Table 6**.

Table 2. Descriptors and ranking for the likelihood of impact occurring.

Rank	**Likelihood**	**Description**
1	Highly unlikely	There is no precedent for this event in the industry and similar events have not previously occurred.
2	Unlikely	Impacts have been associated with previous industry actions although similar impact pathways are not identified for the Gemini project.
3	Possible	Impact pathways are not clearly understood and impacts have been previously associated with a similar industry action
4	Likely	Impacts have previously been associated with the industry and a clear impact pathway exists.
5	Highly likely	A common event that is consistently associated with a similar industry action/ of an action that is proposed to occur.

Table 3. Descriptors of Impact Magnitude applied in the risk assessment.

Magnitude	**Description**
Negligible	No impact identifiable above baseline ecological conditions
Low	Plant stress linked to mining activity that results in the reduction in volume and duration of groundwater supporting a GDE system that does not result in more than 5% dieback of mature canopy trees (defined as a canopy tree with DBH >60cm). Impact localised and reversible with mitigation.
Moderate	Plant stress linked to mining activity that results in the reduction in volume and duration of groundwater supporting a GDE system that does not result in more than 25% dieback of mature canopy trees (defined as a canopy tree with DBH >60cm). Impact is reversible with mitigation.
High	Significant harm (loss of 25 to 50% of mature canopy trees). Impact is reversible although a significant lag in return to pre-disturbance condition occurs (lag>20yrs). Vegetation is converted from remnant to non-remnant status and significant impacts to habitat for protected fauna species occurs. Biodiversity offsets may be required.
Severe	Irreversible impact to > 50% mature trees that cannot be mitigated. Vegetation is converted from remnant to non-remnant status and significant impacts to habitat for protected fauna species occurs. Biodiversity offsets will be required.

Table 4. Matrix applied in the risk assessment.

		Likelihood				
		Highly Unlikely (1)	**Unlikely (2)**	**Possible (3)**	**Likely (4)**	**Highly Likely (5)**
Consequence	**Severe**	Insignificant	Low	High	High	High
	High	Insignificant	Low	Moderate	High	High
	Moderate	Insignificant	Low	Moderate	Moderate	Moderate
	Low	Insignificant	Low	Low	Low	Low
	Negligible	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

Table 5. List of relevant mitigations

Mitigation No	**Mitigation**
1	GDE Avoidance
2	Water Management System
3	Erosion and Sediment Control Plan
4	Groundwater Monitoring (including construction of additional monitoring bores where applicable).
5	Environmental Offsets

Table 6. Risk assessment for potential impacts.

Impact Pathway	Pre-mitigated Risk			**Comments**	Mitigation Measures	Residual Risk Ranking		
	Likelihood	Consequence	Risk			Likelihood	Consequence	Risk
Springton Tributary Area 1 GDE System								
1. Direct clearing of a GDE system.	5	Severe	High	The GDE is proposed to be cleared. Refer to Terrestrial ecology assessment report (AARC 2019) for clearing impacts.	5	5	Low	Low
2. A total or partial loss or reduction in the volume or pressure of the aquifer being utilised by GDEs.	NA	NA	NA		NA	NA	NA	NA
3. A change in the magnitude and timing of volume fluctuations in the aquifer being utilised by GDEs.	NA	NA	NA		NA	NA	NA	NA
4. Changes to the interaction between surface flows and aquifers being utilised by a GDE.	NA	NA	NA		NA	NA	NA	NA
5. Change in chemical composition of an aquifer detrimentally impacting the health of a GDE[1].	NA	NA	NA		NA	NA	NA	NA
Charlevue Creek GDE System								
1. Direct clearing of a GDE	1	Negligible	Insignificant	Mine and infrastructure footprint is located entirely outside the GDE area.	1	1	Negligible	Insignificant
2. A total or partial loss or reduction in the volume or pressure of the aquifer being utilised by GDEs.	2	Negligible	Insignificant	Perched groundwater system supporting GDE and underlying groundwater system in Tertiary sediments are not considered to have a significant hydraulic linkage.	4	1	Negligible	Insignificant
3. A change in the magnitude and timing of volume fluctuations in the aquifer being utilised by GDEs[1].	2	Negligible	Insignificant	Volume fluctuations in the perched groundwater system are regulated by surface flows, which will have very minor change due to lack of interruption	4	1	Negligible	Insignificant

Impact Pathway	Pre-mitigated Risk			**Comments**	Mitigation Measures	Residual Risk Ranking		
	Likelihood	Consequence	Risk			Likelihood	Consequence	Risk
				to upstream hydrology or catchment excision.				
4. Changes to the interaction between surface flows and aquifers being utilised by a GDE.	2	Low	Low	Flooding volume and frequency will not be significantly impacted by the Gemini development.	2, 3, 4	1	Low	Insignificant
5. Change in chemical composition of an aquifer detrimentally impacting the health of a GDE[1].	2	Low	Low	No controlled releases of mine water planned for either Charlevue Creek or Springton Creek. Uncontrolled releases of mine water are not predicted throughout the life of the mine.	2, 3, 4	1	Low	Insignificant

[1] Assumes freshwater aquifers / groundwater with EC<1500 µS/cm. Withdrawal of saline aquifers / groundwater may have a positive impact on vegetation / habitat condition of a GDE

7.0 Conclusions

Multiple lines of evidence including measurement of LWP, SMP, stable isotopes and physical observation have been applied to assesses the dependence of vegetation in the Gemini Project area on groundwater. Based on the results of a single field survey event, two areas of likely groundwater dependence are recognised being:

1. Charlevue Creek Area 1, being an area identified as a terrestrial GDE on Charlevue Creek, to the west and upstream of the MIA.
2. Springton Tributary Area 1, being a terrestrial GDE associated with an ephemeral drainage system located within the footprint of the MIA.

The Charlevue Creek GDE area is hosted in an area of recent river alluvium, forming a flood terrace which is dissected by the channel of Charlevue Creek and traversed by a series of flood overflow channels. The GDE area is supported by an unconfined, fresh alluvial aquifer that is perched above the regional groundwater table associated with Tertiary, Permian and older alluvial sediments, and is seasonally recharged during surface flows including flood events and associated rainfall. Based on salinity data and stable isotope comparisons between twig xylem and groundwater samples, it is inferred that the perched aquifer is hydraulically disconnected from the regional Tertiary and alluvial aquifers which host groundwater with salinity values that range from mildly to highly toxic to trees. Based on stable isotope data, there is no indication that trees at this site, nor any tree sampled during the GDE assessment is using groundwater associated with the regional Tertiary, alluvial or Permian coal seam aquifers to any significant degree.

The Springton Tributary Area 1 GDE system is supported by a seasonally variable perched aquifer system that is hosted in a thick, coarse sand horizon developed below the flood plain of the minor tributary. The strong iron staining associated with the sandy aquifer material provides evidence for considerable seasonal fluctuation in groundwater levels, which are inferred to recharge and drain rapidly in response to rainfall and surface flows. Similar to the Charlevue Creek GDE system, the Springton Tributary system is perched above the regional Tertiary groundwater table and trees at the site, based on evidence from stable isotope analysis, show no evidence for utilisation of the deeper groundwater system.

The Springton Tributary GDE system, covering an area of 5.54 hectares is located within the MIA and is proposed for direct clearing impacts. Environmental offsets will be required as the only viable mitigation and these have been captured within offsets proposed for impacts to other significant terrestrial ecology values (as per AARC 2019).

The Charlevue Creek GDE system is supported by an alluvial aquifer that is perched above, and hydraulically disconnected from the deeper regional aquifers associated with the Tertiary, older alluvium, and Permian coal seams. Groundwater drawdown associated with mining void development is modelled to impact the regional groundwater table below the Charlevue Creek system. However, it is not anticipated that these impacts will not be propagated into the perched aquifer due to limited hydraulic connectivity between the perched and deeper aquifer systems that will be impacted by groundwater drawdown. The Charlevue Creek GDE system is recharged by surface water flows, flooding and seasonal rainfall which will not be altered by mining development.

Mitigations to prevent impact to the Charlevue Creek system include general operational measures associated with project approval conditions which may include development of the Mine WMS and ESCP. Based on these mitigations, it is considered that the risk to the GDE system posed by mine development is negligible.

8.0 References

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Appendices

Appendix A – Tree LWP Measurements and Details

Site No	Tree No	Y	X	Species	DBH cm	Height m	Geomorphic position	LWP1 Mpa	LWP2 Mpa	LWP3 Mpa	Average two lowest	Tree Water availability
M3	T1	-23.69539	149.26649	Eucalyptus tereticornis	46	18	Broad colluvial surface with 0.5m of colluvial sand / silt over sandstone basement. 30m from drainage incision.	-0.9	-0.85	-	0.875	High
M3	T2	-23.69573	149.2663	Eucalyptus tereticornis	47	20	Broad colluvial surface with 1m of colluvial sand / silt over sandstone basement. On broad drainage incision	-0.55	-0.5	-	-0.525	Very High
M3	T3	-23.696	149.26682	Eucalyptus tereticornis	62.5	20	Broad colluvial surface with 1m of colluvial sand / silt over sandstone basement. On broad drainage incision	-0.55	-0.6	-	-0.575	High
M3	T4	-23.69599	149.26712	Eucalyptus tereticornis	60	22	Broad colluvial surface with 1m of colluvial sand / silt over sandstone basement. On broad drainage incision	-1.5	-1.5	-	-1.5	Moderate
M2	T1	-23.67454	149.25365	Eucalyptus populnea	49	22	Residual silty sand. No drainage feature	-1.85	-2	-	-1.925	Very Low
M2	T2	-23.67432	149.25378	Eucalyptus populnea	58	25	Residual silty sand. No drainage feature	-1.7	-1.9	-1.9	-1.8	Very Low
M2	T3	-23.67425	149.25403	Eucalyptus populnea	31	15	Residual silty sand. No drainage feature	-1.65	-1.7		-1.725	Very Low
M2	T4	23.67403	149.25404	Eucalyptus crebra	45	20	Residual silty sand. No drainage feature	-1.4	-1.4		-1.4	Low
M1	T1	-23.67978	149.25313	Eucalyptus tereticornis	67	23	Broad flood plain with anastomosing channel incisions.	-0.2	-0.2		-0.2	Extremely High
M1	T2	-23.68018	149.2525	Eucalyptus tereticornis	32	22.5	Broad flood plain with anastomosing channel incisions. 10m from main drainage channel	-0.4	-0.45		-0.425	Very High
M1	T3	-23.6805	149.25255	Eucalyptus tereticornis	57	22	Directly adjacent to overflow drainage channel. Low rise on broad flood plain	-0.1	-0.1		-0.1	Extremely High
M1	T4	-23.6808	149.25229	Eucalyptus tereticornis	83	20	Broad flood plain. 5m from overflow drainage channel	-0.25	-0.25		-0.25	Extremely High
M1	T5	-23.68085	149.25249	Eucalyptus tereticornis	78	23	Directly adjacent to overflow drainage channel. Broadly incised to depth of 1m.	-0.1	-0.1		-0.1	Extremely High
M4	T1	-23.68612	149.24285	Eucalyptus tereticornis	64	18	Broad flood plain / drainage depression. Tree 25m from weakly incised drainage channel	-0.6	-0.55		-0.575	High
M4	T2	-23.68608	149.24242	Eucalyptus tereticornis	65	20	Broad flood plain / drainage depression. Tree on margins of ephemeral waterhole	-0.6	-0.6		-0.6	High
M4	T3	-23.6864	149.24198	Eucalyptus tereticornis	41	20	Broad flood plain / drainage depression. Tree 25m from weakly incised drainage channel	-0.65	-0.65		-0.65	High
M4	T4	-23.68644	149.24231	Eucalyptus tereticornis	62	20	Broad flood plain / drainage depression. Tree on margins of weekly incised drainage channel	-0.65	-0.7		-0.675	High
M4	T5	-23.68648	149.24229	Eucalyptus tereticornis	60	20	Broad flood plain / drainage depression. Tree on margins of weekly incised drainage channel	-0.45	-0.45		-0.45	Very High
M5	T1	-23.65281	149.28809	Eucalyptus tereticornis	71	26	15m from margins of the flood channel on margins of T1 terrace.	-0.7	-0.7		-0.7	High
M5	T2	-23.65288	149.28814	Eucalyptus tereticornis	100	26	On margins of drainage channel. Located directly on the upper bank	-1	-0.95		-0.976	Moderate

Site No	Tree No	Y	X	Species	DBH cm	Height m	Geomorphic position	LWP1 Mpa	LWP2 Mpa	LWP3 Mpa	Average two lowest	Tree Water availability
M5	T3	-23.65308	149.28803	Eucalyptus tereticornis	100	25	On margins of drainage channel. Located mid-way on the inner bank, 1m above channel floo. Moist clays in channel floor.	-0.2	-0.2		-0.2	Extremely High
M5	T4	-23.65313	149.28740	Eucalyptus tereticornis	100	26	On margins of drainage channel, on loamy soils directly above a weathered sandstone bench.	-1.2	-1.2		-1.2	Moderate
M5	T5	-23.6531	149.28734	Corymbia tessellaris	24	15	5m from margins of drainage channel, growing into fractures in a weathered sandstone bench.	-1.9	-1.9		-1.9	Very Low
M5	T6	23.65337	149.28712	Eucalyptus tereticornis	45	17	Top of cutaway bank, on loamy soils, 6m above channel floor.	-1.8	-1.8		-1.8	Very Low
M6	T1	-23.6427	149.31495	Melaleuca leucadendra	35	18	Directly adjacent to waterhole on lower terrace. At waterline	-0.3	-0.45		-0.45	Very High
M6	T2	-23.64333	149.31476	Eucalyptus tereticornis	48	15	On upper terrace, 15m from drainage channel and 6m above channel floor. Loamy soils, very dry.	-1	-1		-1	Moderate
M6	T3	-23.64340	149.31465	Eucalyptus tereticornis	48	19	On upper terrace, at top of bank directly above drainage channel. 5m above from drainage channel and 6m above channel floor. Loamy soils, very dry.	-1.75	-1.8		-1.775	Very Low
M6	T4	-23.64304	149.31484	Eucalyptus tereticornis	50	22	On upper terrace, 10m from drainage channel and 6m above channel floor. Loamy soils, very dry.	-2	-2		-2	Very Low
M7	T1	-23.6507	149.22957	Eucalyptus tereticornis	110	30	Outer margins of flood plain on shallow overflow. 125m from main drainage channel	-0.2	-0.2		-0.2	Extremely High
M7	T2	-23.65068	149.22994	Eucalyptus tereticornis	50	20	Central portion of flood plain loamy soils. 70m from main drainage channel.	-0.2	-0.15		-0.175	Extremely High
M7	T3	-23.65073	149.23034	Eucalyptus tereticornis	82	28	Central portion of flood plain loamy soils. 25m from main drainage channel and 5m above channel floor.	-0.1	-0.15		-0.125	Extremely High
M7	T4	-23.65008	149.23005	Eucalyptus tereticornis	85	25	Margins of flood channel on upper terrace. Loamy soils 5m above channel floor.	-0.1	-0.1		-0.1	Extremely High
M7	T5	-23.65001	149.22987	Corymbia tessellaris	50	20	Margins of flood channel on upper terrace. Loamy soils 5m above channel floor.	-0.45	-0.45		-0.45	Very High
M7	T6	-23.64989	149.22971	Eucalyptus tereticornis	90	30	4m above drainage channel on inner bench. Loamy soils above sandy channel.	-0.2	-0.15		-0.175	Extremely High
M8	T1	-23.65424	149.23750	Eucalyptus tereticornis	100	26	T1 Terrace 5m from top of bank	-0.35	-0.15	-0.15	-0.15	Extremely High
M8	T2	-23.65375	149.23872	Eucalyptus tereticornis	70	25	Top of T1 terrace 20m from channel	-0.15	-0.15	-	-0.15	Extremely High
M8	T3	-23.65347	149.23941	Eucalyptus tereticornis	100	26	T1 terrace at top of bank	-0.1	-0.1		-0.1	Extremely High
M8	T4	-23.65308	149.23944	Eucalyptus tereticornis	95	25	Inner bench 3m above channel floor	-0.35	-0.45	-0.4	-0.4	Very High
M8	T5	-23.65342	149.23254	Eucalyptus populnea	74.5	28	Upper terrace 100m from stream channel	-0.9	-1.3	-1.05	-0.9525	Moderate
M9	T1	-23.64942	149.24666	Eucalyptus tereticornis	80	25	T1 Terrace 5m from top of bank	-0.2	-0.25		-0.225	Extremely High

Site No	Tree No	Y	X	Species	DBH cm	Height m	Geomorphic position	LWP1 Mpa	LWP2 Mpa	LWP3 Mpa	Average two lowest	Tree Water availability
M9	T2	-23.6497	149.24745	Eucalyptus tereticornis	120	30	T2 terrace 25m from top of ban	-0.25	-0.25		-0.25	Extremely High
M9	T3	-23.64973	149.24781	Eucalyptus tereticornis	120	30	T1 Terrace 5m from top of bank	-0.2	-0.15		-0.175	Extremely High
M9	T4	-23.64933	149.24752	Eucalyptus tereticornis	50	18	Mid bench 2m above channel floor	-0.35	-0.4		-0.375	Very High
M10	T1	-23.62964	149.27157	Eucalyptus tereticornis	129	30	Top of T1 terrace at top of bank	-0.4	-0.3		-0.35	Very High
M10	T2	-23.62993	149.27158	Eucalyptus tereticornis	70	18	Top of T1 terrace at top of bank	-0.15	-0.2		-0.175	Extremely High
M10	T3	-23.63022	149.27144	Eucalyptus tereticornis	35	18	Top of T1 terrace above waterhole	-0.25	-0.2		-0.225	Extremely High
M10	T4	-23.63043	149.27132	Eucalyptus tereticornis	65	23	Top of T1 terrace at top of bank	-0.2	-0.1	-0.1	-0.1	Extremely High
M11	T1	-23.6066	149.26703	Eucalyptus tereticornis	48	20	Margin of shallow drainage channel on sand	-0.4	-0.3		-0.35	Very High
M11	T2	-23.60658	149.26671	Eucalyptus tereticornis	50	20	Margin of shallow drainage channel - 1m above sandy channel	-0.25	-0.25		-0.25	Extremely High
M11	T3	-23.60653	149.26649	Eucalyptus tereticornis	38	21	Margin of shallow drainage channel - 1m above sandy channel	-0.6	-0.6		-0.6	High
M11	T4	-23.60639	149.26616	Corymbia clarksoniana	34	18	5m from margins of drainage channel on sandy loam	-1.1	-0.85		-0.925	Moderate
M12	T1	-23.62416	149.27960	Eucalyptus tereticornis	90	25	In channel	-0.25	-0.2		-0.2	Extremely High
M12	T2	-23.62413	149.27958	Eucalyptus tereticornis	100	25	Within channel banks 2m above channel floor	-0.55	-0.6		-0.575	High
M12	T3	-23.62312	149.27961	Eucalyptus tereticornis	100	24	Mid way up inner bench 4m above channel	-0.45	-0.45		-0.45	Very High
M12	T4	-23.62316	149.28024	Eucalyptus tereticornis	100	22	Top of bank 5m above T1 terrace	-0.5	-0.5		-0.5	Very High
M12	T5	-23.62807	149.27524	Eucalyptus tereticornis	90	29	Overflow drainage depression 200m from flood channel	-0.45	-0.45		-0.45	Very High
M12	T6	-23.62811	149.27540	Eucalyptus tereticornis	100	30	Overflow drainage depression 200m from flood channel	-0.45	-0.45		-0.45	Very High
M13	T1	-23.60996	149.31163	Eucalyptus coolibah	60	20	T2 terrace 15m from top of bank	-1.4	-1.35		-1.35	Low
M13	T2	-23.60999	149.31166	Eucalyptus tereticornis	55	22	Top of bank 6m above channel	-0.5	-0.4		-0.45	Very High
M13	T3	-23.60988	149.31172	Eucalyptus tereticornis	35	16	Top of bank on side channel 3m above channel floor	-0.2	-0.2		-0.32	Very High
M13	T4	-23.60983	149.31187	Eucalyptus tereticornis	50	25	Top of bank 5m above channel floor	-0.5	-0.5		-0.5	Very High

Site No	Tree No	Y	X	Species	DBH cm	Height m	Geomorphic position	LWP1 Mpa	LWP2 Mpa	LWP3 Mpa	Average two lowest	Tree Water availability
M14	T1	-23.62793	149.32273	Eucalyptus populnea	50	17	T2 Terrace away from stream channel	-1.1	-1.1		-1.1	Moderate
M14	T2	-23.62800	149.32277	Eucalyptus populnea	50	16	T2 Terrace away from stream channel	-2	-2		-2	Very Low
M14	T3	-23.62811	149.32284	Eucalyptus populnea	40	15	T2 Terrace away from stream channel	-1.5	-1.5		-1.5	Low
M14	T4	-23.62813	149.32288	Eucalyptus populnea	40	16	T2 Terrace away from stream channel	-2	-2.05		-2	Very Low
M14	T5	-23.62779	149.32351	Eucalyptus populnea	65	15	T2 Terrace away from stream channel	-1.2	-1.2		-1.2	Moderate

Appendix B – Auger Hole Logs

Site No	Auger No	Y	X	Summary	Position	Special features / Tree roots	Depth metres
M3	AU1	-23.69573	149.26631	0-0.25m - fine sand, yellow grey, moist; 0.25 - 0.5m - fine silty sand, moist and yellow with abundant tree roots; 0.5 - 0.75m fine silty sand, moist yellow. EOH at 0.75m on indurated sandstone.	In base of drainage depression	0.5 with abundant fine tree roots	0.75
M2	AU1	-23.67421	149.2538	0-0.75m - dry hard setting silty clay loam, grey brown. EOH @ 0.75m due to density of substrate.	Loamy plain with no distinctive features	0	0.75
M1	AU1	-23.67978	149.25313	0-0.25 - Grey yellow silty loam, dry to moist with tree roots; 0.35m abundant ironstone mottles; 0.25 - 0.5m -Loamy sand, yellow with iron staining and orange / brown mottles; 0.5 - 1.2m - yellow to orange loamy sand becoming coarse loamy sand, moist with strong iron mottling and staining; 1.2 - 1.5m - coarse sand merging on gravel with strong iron mottling, strong yellow to orange iron staining (moist to wet); 1.5 - 1.7 - yellow orange clayey sand with abundant mottling; 1.75- sand with iron cement, strong yellow to orange staining. EOH 1.8m	In base of channel overflow, 2m from base of Tree 3.	Dense tree roots at 0.25m depth	1.8
M1	AU2	-23.68063	149.2525	0-0.5 - Grey yellow silty loam, dry to moist with tree roots; 0.5 - 1m - fine loamy sand with minor clay nodule. Moist, yellow brown; 1 - 1.25m - Fine, moist yellow brown clayey sand with abundant ironstone staining and mottles; 1.25 - 1.5m - ironstained clayey fine sand to medium sand, yellow, moist to very moist; 1.5 - 2.0m - moist orange clayey sand with abundant iron mottling and staining; 2.0 - 2.2m- Moist orange clayey sand with some coarse sand layers, ,minor gravel fragments. EOH 2.2m	In base of channel overflow, 2m from base of Tree 5.	Dense tree roots at 0.25 to 0.5m depth	2.2
M4	AU1	-23.68622	149.2423	0-0.25 - Silty loam, dry, brown-grey with weak iron mottling and nodules; 0.25 - 1m, orange brown silty loam, slightly moist with week iron mottling and staining; 1-1.35m, fine silty sand, grey brown with abundant iron staining and mottling, slightly moist to moist; 1.4m EOH in cemented sand, hardpan layer with ironstone gravel.	Broad poorly defined drainage depression / flood plain, located near weakly incised drainage depression		1.4
M5	AU1	-23.65310404	149.287946	0-0.5m, silty coarse sand and gravel, moist red brown; 0.5m - 0.75m, grey brown fine clayey sand, moist with abundant fibrous tree roots; 0.75m - 1.0m, clayey sand, moist, red brown with ironstone mottling; 1.0 - 1.5m - clayey sand, moist, grey brown with abundand mottling and iron staining; 1.5 - 1.9 - yellow brown silty sand and gravel, moist with cemented hardpan / sandstone at 1.9m EOH.	Placed in stream channel at base of channel floor.	Abundant fibrous tree roots at 0.5m	1.9
M5	AU2	-23.65296	149.28802	Base of channel in grey brown silty / sandy loam. Minor seepage into creek channel	Base of bank adjacent to channel floor.		0.2
M6	AU1	-23.642758	149.314953				0.2
M7	AU1	-23.65010901	149.230038	0-0.35m - fine loamy sand, moist to wet, red brown; 0.35 - 1.0m - fine loamy sand, red brown, moist to wet; 1.0 - 2.2m - uniform moist to wet, red brown sandy loam. Fine tree roots dispersed throughout soil profile.	River flood plain 5m from top of bank.	Dense tree roots at 0.5m; Fine tree root recorded at 1.0 to end of hole dispersed throughout soil profile.	2.2
M7	AU2	-23.649934	149.229753	0 - 0.3, coarse brown sand, dry; 0.3 - 0.5 - moist clayey sand, red brown; 0.5 - 1.0 - Coarse river sand with some clay bands and charcoal, red brown to brown, wet to moist. EOH in wet sand at 2.0m.	Base of sandy channel		2
M8	AU1	-23.65427197	149.237651	0 - 1.0, coarse brown sand, with some clay nodules and charcoal, wet to moist. EOH in wet sand at 2.0m; 1.0 - 1.2m, coarse clayey sand with charcoal, moist to wet. EOH at gravel bed with tree roots immediately above gravel.	Base of sandy channel	1.2m at interface of sand and gravel. Tree roots to 0.25cm, scattered.	1.2

Site No	Auger No	Y	X	Summary	Position	Special features / Tree roots	Depth metres
M9	AU1	-23.64940401	149.246728	0 - 0.25, fine, dry sandy loam, red brown; 0.25 - 0.5m, sandy loam, red brown, abundance of fine tree roots; 0.5 - 1.0m, red brown moist sandy loam, abundant fine tree roots. 1.0 - 1.5m, red brown moist sandy loam, no tree roots; 1.5 - 2.2m, uniform red brown sandy loam, dry with no tree roots.	Top of bank, 4m from edge of channel incision	Fine tree roots to 1.0m.	2.2
M9	AU2	-23.64929304	149.246615	0 - 0.4m, moist, medium to coarse sand, grey brown; 0.4 - 1.0m, medium coarse, grey brown sand to clay sand with charcoal fragments. Moist to wet; 1.0 - 1.5m, medium to coarse fluvial sand, clayey nodules and charcoal, wet to saturated; 1.5 - 2.2, medium to coarse clay sand, clay nodules and charcoal that is wet to very wet. Matted red-gum tree roots at 2.2m at base of sand.	Base of sandy channel	Fine tree roots (red gum) to 25mm recorded at EOH.	2.2
M10	AU1	-23.629771	149.271611	0-0.5m, Red brown silty loam, dry with fine tree roots; 0.5 to 1.5m, red brown silty clay loam, uniform texture becoming moister toward base of hole; 1.5 - 2.1m, friable silty / sandy loam, red brown becoming moist. Abundant tree roots at base of hole.	Upper terrace 5m from top of bank.	Fine tree roots (red gum) to 25mm recorded at EOH.	2.1
M11	AU1	-23.60657701	149.266711	Fine to medim dry sand from surfance to end of hole.	Margins of sandy channel		0.25
M11	AU2	-23.60659302	149.266782	Sand in creek bank, in tree root zone, above base of sandstone basement.	In creek bank		0.5
M12	AU2	-23.62301339	149.280268	0- 0.5, clayey sand, dry, grey brown with abundant fine tree roots; 0.5 - 0.75, clayey sand, grey brown, dry to moist; 0.75 - 1.2, heavy clay, dry, orange brown with charcoal. EOH at 1.2m due to tree roots	Base of incised channel into clay basement	Refusal at end of hole due to dense tree roots.	1.2
M13	AU1	-23.60993698	149.311725	0 - 1.5m, silty clay loam to silty clay, grey brown, with charcoal fragments, moist. Fine tree roots dispersed thoughout clay; 1.5 -2m, loamy clay, grey brown with minor iron mottling, dense and moist. EOH at 2.0m due to extreme clay plasticity.	In stream channel, at base of floor, auger hole penetrated to depths > 1.5m below depth of the surface water.	Dispersed throughout soil profile, to 25mm diameter.	2
M14	AU1	-23.62814499	149.322902	0- 1.2, Silty clay loam, grey brown, dry. Uniform from top of hole to base.	Flood plain surface, 25m from drainage channel.		1.2

Appendix C – Soil Moisture Potential Raw Data

Specimen Number	Type	Date Collected	SMP (Mpa)
M10-AU1-0.2	Soil	2-Jun-20	**-1.75**
M10-AU1-0.4	Soil	2-Jun-20	**-0.6**
M10-AU1-1.0	Soil	2-Jun-20	**-1.15**
M10-AU1-1.5	Soil	2-Jun-20	**-0.95**
M10-AU1-2.1	Soil	2-Jun-20	**-0.72**
M10-AU2-0.35	Soil	2-Jun-20	-0.01
M11_AU2-0.35	Soil	2-Jun-20	-18.55
M11-AU1-0.20	Soil	2-Jun-20	-25.41
M11-CB	Soil	2-Jun-20	-4.4
M12-AU1-0.2	Soil	2-Jun-20	-1.98
M12-AU2-0.25	Soil	2-Jun-20	-1.86
M12-AU2-0.5	Soil	2-Jun-20	-1.75
M12-AU2-1.0	Soil	2-Jun-20	-2.81
M12-AU2-1.1	Soil	2-Jun-20	-0.65
M12-AU2-1.3	Soil	2-Jun-20	-0.35
M13-AU1-0.2	Soil	3-Jun-20	-0.27
M13-AU1-0.5	Soil	3-Jun-20	-0.29
M13-AU1-1.0	Soil	3-Jun-20	-0.35
M13-AU1-1.5	Soil	3-Jun-20	-0.4
M13-AU1-2.0	Soil	3-Jun-20	-0.1
M14-AU1-0.20	Soil	3-Jun-20	-1.11
M14-AU1-0.5	Soil	3-Jun-20	-3.09
M14-AU1-1.0	Soil	3-Jun-20	-1.35
M14AU1-1.2	soil	3-Jun-20	-3.59
M1-AU1-0.2	Soil	30-May-20	-0.7
M1-AU1-1.2	Soil	30-May-20	**-0.14**
M1-AU1-1.5	Soil	30-May-20	**-0.16**
M1-AU2-0.25	Soil	30-May-20	**-0.84**
M1-AU2-0.5	Soil	30-May-20	**-0.32**
M1-AU2-1.0	Soil	30-May-20	**-0.19**
M1-AU2-1.5	Soil	30-May-20	**-0.53**
M1-AU2-1.7	Soil	30-May-20	**-0.17**
M1-AU2-2.0	Soil	30-May-20	-0.15
M1-AU2-2.2	Soil	30-May-20	**-0.69**
M2-AU1-0.25	Soil	30-May-20	-2.9
M2-AU1-0.5	Soil	30-May-20	-12.39
M3-AU1-0.25	Soil	30-May-20	-0.46
M3-AU1-0.5	Soil	30-May-20	**-1.16**
M3-AU1-0.75	Soil	30-May-20	-5.42
M4-AU1-0.25	Soil	30-May-20	**-1.35**
M4-AU1-0.5	Soil	30-May-20	**-1.04**

Specimen Number	Type	Date Collected	SMP (Mpa)
M4-AU1-1.0	Soil	30-May-20	**-1.4**
M4-AU1-1.35	Soil	30-May-20	**-0.91**
M5-AU1-0.25	Soil	31-May-20	-0.57
M5-AU1-0.5	Soil	31-May-20	**-0.37**
M5-AU1-0.75	Soil	31-May-20	-0.28
M5-AU1-1.0	Soil	31-May-20	**-0.42**
M5-AU1-1.5	Soil	31-May-20	**-0.33**
M5-AU1-1.9	Soil	31-May-20	**-0.26**
M5-AU2-0.25	Soil	31-May-20	**-0.15**
M6-AU1-0.1	Soil	1-Jun-20	-0.15
M7-AU1-0.2	Soil	1-Jun-20	-1.51
M7-AU1-0.5	Soil	1-Jun-20	-1.01
M7-AU1-1.0	Soil	1-Jun-20	**-1.42**
M7-AU1-1.5	Soil	1-Jun-20	**-1.9**
M7-AU1-2.0	Soil	1-Jun-20	**-0.38**
M7-AU1-2.2	Soil	1-Jun-20	-0.17
M7-AU2-0.5	Soil	1-Jun-20	**-0.51**
M7-AU2-1.0	Soil	1-Jun-20	-0.36
M7-AU2-1.5	Soil	1-Jun-20	**-0.21**
M7-AU2-2.0	Soil	1-Jun-20	-0.28
M8-AU1-0.5	Soil	1-Jun-20	-2.42
M8-AU1-1.0	Soil	1-Jun-20	-0.66
M8-AU1-1.2	Soil	1-Jun-20	-0.07
M8-AU2-1.0	Soil	1-Jun-20	-1.27
M9-AU1-0.2	Soil	1-Jun-20	**-1.38**
M9-AU1-0.5	Soil	1-Jun-20	-0.38
M9-AU1-1.0	Soil	1-Jun-20	**-0.82**
M9-AU1-1.5	Soil	1-Jun-20	**-1.54**
M9-AU1-2.0	Soil	1-Jun-20	**-1**
M9-AU1-2.2	Soil	1-Jun-20	-0.27
M9-AU2-0.4	Soil	1-Jun-20	**-0.27**
M9-AU2-1.0	Soil	1-Jun-20	**-0.47**
M9-AU2-1.5	Soil	1-Jun-20	-0.25
M9-AU2-2.0	Soil	1-Jun-20	-0.13
M9-AU2-2.2	Soil	1-Jun-20	-0.15

Appendix D – Stable Isotope Analytical Results

Sample	Type	δ^{2}H	δ^{18}O
M13T2	Twig	18.40	1.84
M13T3	Twig	10.74	1.17
M14T1	Twig	-15.25	-0.81
M14T1	Twig	-15.98	-1.55
M14T5	Twig	9.12	0.87
m1t1	Twig	5.34	-0.41
m1t2	Twig	3.00	0.33
m1t3	Twig	4.65	-0.64
m1t4	Twig	9.38	0.13
m1t5	Twig	-2.46	-0.30
m2t2	Twig	6.33	0.01
m3t2	Twig	1.70	-0.32
m3t4	Twig	8.50	0.10
M4T1	Twig	2.76	0.81
M4T4	Twig	3.49	0.12
M4T5	Twig	3.50	0.02
M5T1	Twig	1.92	1.87
M5T2	Twig	2.41	-0.14
M5T3	Twig	4.64	-0.46
M6T1	Twig	-0.56	0.38
M6T3	Twig	34.38	5.94
M7T1	Twig	10.96	-0.29
M7T3	Twig	3.05	-0.05
M7T4	Twig	-4.24	-1.51
M7T6	Twig	7.23	-1.34
M8T1	Twig	11.94	-0.25
M8T2	Twig	5.87	-0.30
M8T3	Twig	15.67	2.11
M8T4	Twig	7.44	-0.48
M9T1	Twig	-9.92	-1.34
M9T2	Twig	-9.92	-1.86
M9T3	Twig	0.54	-0.67
7220W3	Groundwater	-23.70	-3.79
7093W3	Groundwater	-26.21	-3.90
7178W2	Groundwater	-23.02	-3.49
7033W1	Groundwater	-26.45	-3.53
7225W3	Groundwater	-29.81	-4.64
7221W1	Groundwater	-14.58	-5.55
7093W1	Groundwater	-29.56	-4.52
7082W2	Groundwater	-25.79	-4.34

Sample	Type	δ^2H	$\delta^{18}O$
7033W2	Groundwater	-26.57	-4.29
DW7292W1	Groundwater	-14.66	-4.53
7033W3	Groundwater	-28.41	-4.36
7220W1	Groundwater	-33.16	-5.34
7264W2	Groundwater	-27.46	-4.02
7105W2	Groundwater	-26.68	-3.92
7035W3	Groundwater	-26.93	-4.34
7282W2	Groundwater	-13.87	-4.22
7093W2	Groundwater	-7.45	-4.78
7220W1	Groundwater	-31.46	-5.71
7178W1	Groundwater	-21.93	-3.39
7225W2	Groundwater	-25.45	-4.22
7225W1	Groundwater	-29.32	-4.70
7082W1	Groundwater	-25.68	-4.36
7282W1cracked	Groundwater	31.93	-3.60
7264W3	Groundwater	-25.57	-4.47
M5SW1	Surface Water	5.61	2.04
M6SW1	Surface Water	-6.02	0.43
M8SW1	Surface Water	15.52	4.57
M10SW1	Surface Water	14.43	2.98
M13SW1	Surface Water	12.21	1.71
m10-au1-0.2	Soil	11.40	0.59
m10-au1-0.4	Soil	7.92	-0.71
m10-au1-1.0	Soil	2.90	-5.41
m10-au1-1.5	Soil	-25.63	-8.54
m10-au1-2.1	Soil	-10.91	-7.23
m10-au2-0.35	Soil	2.05	1.43
m11-au2-0.35	Soil	-8.80	-1.13
m11-cb	Soil	-22.35	-3.65
m12-au2-0.25	Soil	-6.68	-2.11
m12-au2-0.5	Soil	0.91	-1.97
m12-au2-1.0	Soil	-16.03	-4.64
m12-au2-1.1	Soil	-17.67	-6.04
m13-au1-0.2	Soil	-10.89	-2.50
m13-au1-0.5	Soil	-8.89	-2.50
m13-au1-1.0	Soil	-8.32	-3.09
m13-au1-1.5	Soil	-7.06	-3.45
m13-au1-2.0	Soil	-8.71	-4.15
m1-au2-2.0	Soil	-22.90	-4.36
m3-au1-0.75	Soil	-13.24	-1.83
m3-au2-0.5	Soil	-15.83	-3.06
m4-au1-0.5	Soil	-5.24	-3.09

Sample	Type	δ^2H	δ^{18}O
m4-au1-1.0	Soil	3.58	-0.90
m4-au1-1.35	Soil	-22.06	-5.52
m5-au1-0.25	Soil	11.40	-1.78
m5-au1-0.5	Soil	-18.00	-3.74
m5-au1-0.75	Soil	-14.37	-4.99
m5-au1-1.0	Soil	-22.31	-9.20
m5-au1-1.5	Soil	14.33	-2.39
m5-au1-1.9	Soil	20.54	0.38
m5-au2-0.15	Soil	29.75	2.88
m7-au1-0.25	Soil	-4.43	-0.71
m7-au1-0.5	Soil	-9.58	-3.57
m7-au1-1.0	Soil	6.20	-1.71
m7-au1-15	Soil	-7.69	-1.54
m7-au1-2.0	Soil	2.14	-3.01
m7-au1-2.2	Soil	-10.14	-4.89
m7-au2-0.2	Soil	-21.64	-2.83
m7-au2-2.0	Soil	-18.96	-3.05
m8-au1-0.5	Soil	-15.79	-4.15
m9-au1-2.0	Soil	-18.32	-5.65
m9-au1-2.2	Soil	-31.80	-4.73
m9-au2-0.4	Soil	-12.98	-5.06
m9-au2-1.0	Soil	-3.08	-0.96
m9-au2-1.5	Soil	-22.51	-4.87
m9-au2-2.0	Soil	-18.54	-3.84