MANGOOLA
OPEN CUT
GLENCORE

MANGOOLA COAL CONTINUED OPERATIONS PROJECT

RESPONSE TO IESC ADVICE

FEBRUARY 2020

umwelt
Environmental & Social Consultants

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Response to IESC Advice

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mangoola Coal Operations Pty Ltd

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1.0 Introduction

The Environmental Impact Statement (EIS) for the Mangoola Coal Continued Operations Project (MCCO Project) was placed on public exhibition from 18 July to 28 August 2019. A total of 334 submissions were made in response to the public exhibition of the MCCO Project EIS. This included 13 agency submissions and 321 community and interest group submissions. Of the 321 submissions received from the community and interest groups, 230 submissions were in support of the MCCO Project.

A Response to Submissions (RTS) was prepared by Umwelt (Australia) Pty Ltd (Umwelt) on behalf of Mangoola Coal Operations Pty Ltd (Mangoola) to address the issues raised in the submissions received during the public exhibition period and was submitted to the NSW Department of Planning, Industry and Environment (DPIE) on 18 December 2019.

The majority of agency submissions on the MCCO Project EIS were received following the close of the public exhibition period on 28 August 2019. The submission from the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) was not available at this time due to the timing of the IESC meetings and was provided on 4 October 2019. Due to the date of receipt of this submission, this response to the IESC advice has been provided separately. This response document has been prepared by Umwelt with the assistance of Australasian Groundwater and Environmental Consultants (AGE) on groundwater related responses and Hydro Engineering & Consulting (HEC) on surface water related responses on behalf of Mangoola and seeks to address the issues raised in the IESC advice. The following sections include a brief summary of the MCCO Project and the assessment process to date.

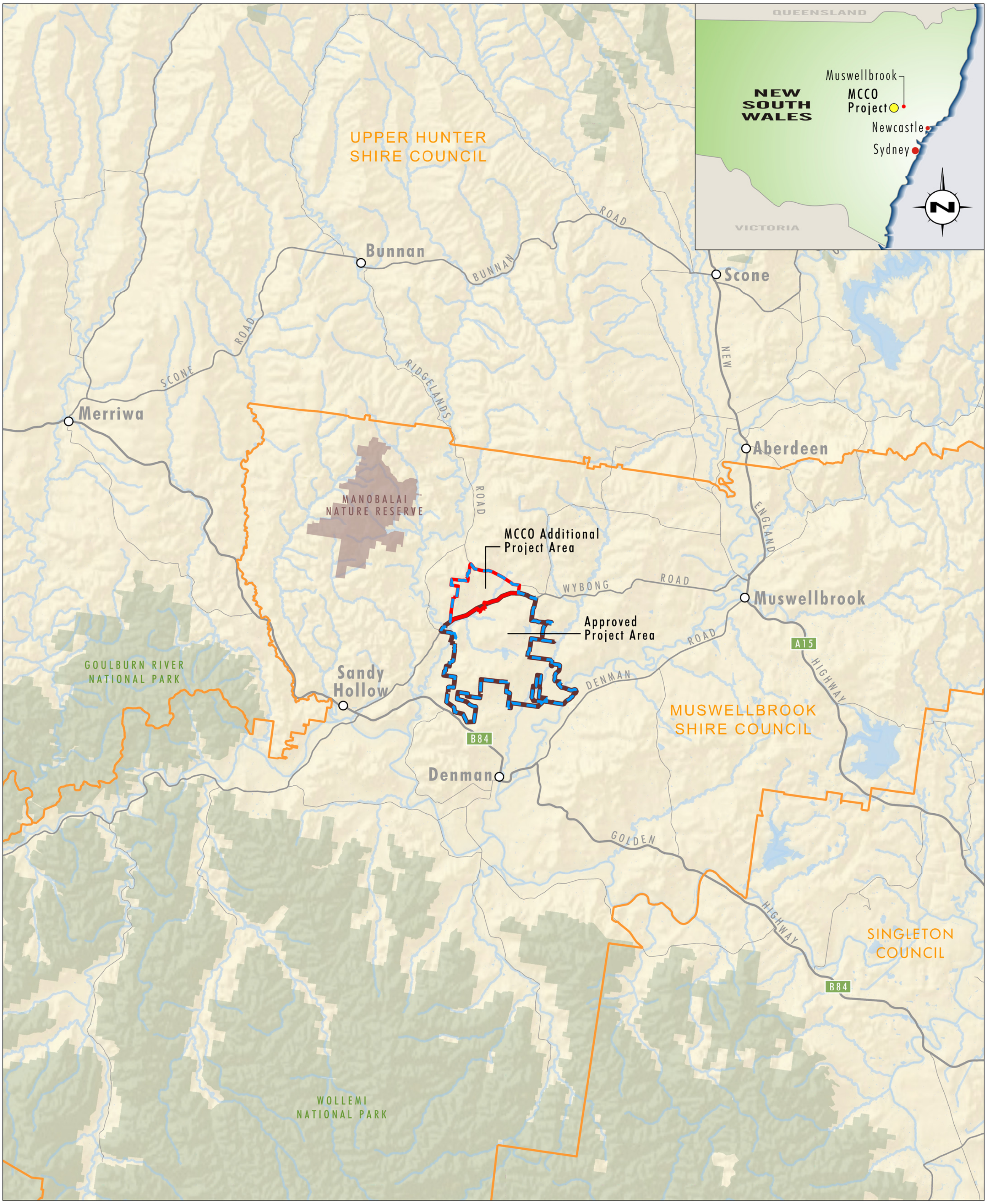
1.1 Project Overview

Mangoola Coal Mine is an existing open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW (**Figure 1.1**). Mangoola has operated the Mangoola Coal Mine in accordance with NSW Project Approval (PA) 06_0014 since mining commenced at the site in September 2010.

Mangoola has identified further coal resources to the north of the existing Mangoola Coal Mine and Wybong Road. Mangoola is seeking approval to extract these further coal resources by continuing the existing mine into this new mining area. The MCCO Project would provide access to approximately 52 Million tonnes (Mt) of additional coal resources which represents approximately eight years of mining in the additional resource. The MCCO Project will require a new development consent under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The MCCO Project Area includes the existing Approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area as shown on **Figure 1.1**. The MCCO Additional Project Area includes the Proposed Additional Mining Area to the north of the existing mine (refer to **Figure 1.2**).It is currently planned that operations in the MCCO Additional Project Area would commence in approximately 2022 (subject to the timing of determination of the required approvals and commencement of the MCCO Project) which would mean that the MCCO Project will require approval to operate until 2030. This represents an extension of one additional year beyond the existing approved life of the mine.

Based on the current progression of mining and future planning of the currently approved operation, whilst approved until 2029, it is expected that mining will be completed in the Approved Project Area by 2025. The MCCO Project will extend the operational life of the Mangoola Coal Mine for approximately five years beyond the currently planned end of coal extraction at the mine and provide for the economic recovery of coal resources using the existing infrastructure, facilities and experienced personnel.



Data Source: Glencore (2019), LPI (2016)

0 5 10 20km

Legend
MCCO Project Area
Approved Project Area
MCCO Additional Project Area
Local Government Area

FIGURE 1.1

Locality Figure

File Name (A4): R25/4004_446.dgn
20191121 14.52

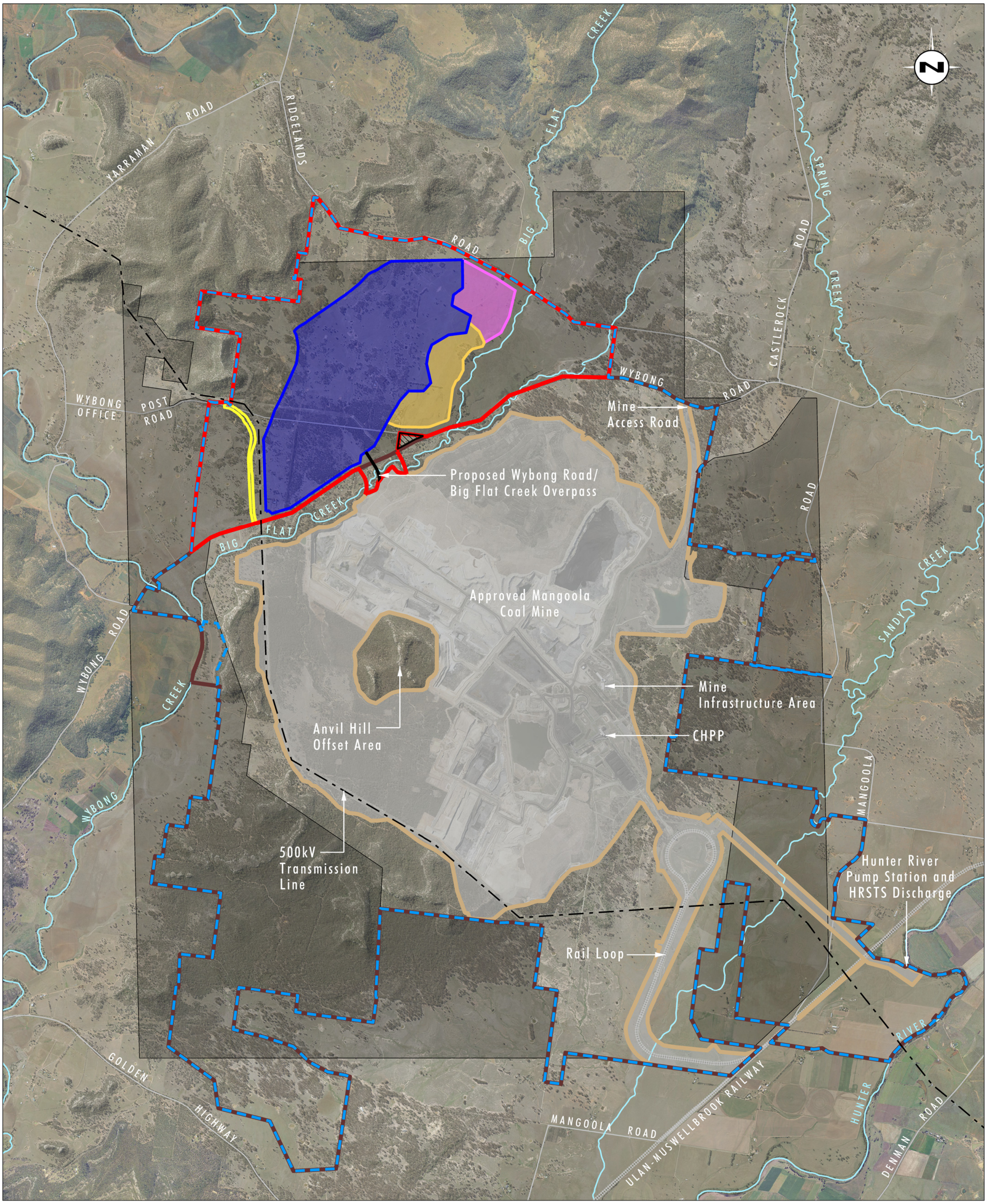


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

Legend

- MCCO Project Area
- Approved Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Proposed Emplacement Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Crown Land (TSR) Excluded from MCCO Project Area
- Assessment Lease 9

FIGURE 1.2

Key Features of the Mangoola Coal Continued Operations Project

File Name (A4): R25/4004_447.dgn
20190319 8.46

1.1.1 Assessment Process to Date

Being development for the purpose of coal mining, the MCCO Project is declared to be State Significant Development (SSD) under the provisions of NSW State Environmental Planning Policy (State and Regional Development) 2011 and will require Development Consent under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act.

The EIS for the MCCO Project was prepared to assess the environmental and social impacts of the Project and accompanied a Development Application under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act. The new development consent being sought is proposed to replace the existing Mangoola Project Approval and the MCCO Project will operate under a new SSD consent which will regulate future mining at the Mangoola Coal Mine including both the existing and proposed mining areas. The EIS for the MCCO Project was prepared in accordance with the requirements of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000*, including the Secretary's Environment Assessment Requirements (SEARs) which were issued by DPIE on 15 February 2019 and identified specific requirements to be addressed by the EIS.

In addition to approval under NSW legislation, the MCCO Project also requires approval under Commonwealth legislation. On 21 January 2019, the MCCO Project was determined to be a Controlled Action (2018/8280) requiring approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) from the Commonwealth Minister for the Environment due to its potential impact on Matters of National Environment Significance (MNES). The MCCO Project was determined to be a Controlled Action for the following MNES:

- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (a Critically Endangered Ecological Community (CEEC) listed under the EPBC Act)
- Prasophyllum sp. Wybong (an orchid listed as Critically Endangered)
- Regent Honeyeater (Anthochaera Phrygia) (a bird listed as Critically Endangered)
- a water resource in relation to a coal mining development.

The assessment path for the MCCO Project was confirmed to be under the bilateral agreement between the Commonwealth and NSW Governments. The then Commonwealth Department of Environment and Energy (now Department of Agriculture, Water and Environment) (DAWE) issued its assessment requirements which were incorporated into the SEARs and addressed in the MCCO Project EIS. The IESC is a statutory committee which independently advises DAWE and DPIE on the potential impacts coal seam gas and large coal mining development may have on Australia's water resources.

Comprehensive assessments of the potential surface water and groundwater impacts of the MCCO Project have been undertaken as part of the MCCO Project EIS. The assessments address the requirements of all relevant NSW and Commonwealth Government legislation and policies and were guided by the requirements of the IESC. This document has been prepared to provide a detailed response to the IESC advice on the MCCO Project.

2.0 IESC Responses

This section has been prepared to provide a detailed response to each of the 52 comments provided in the IESC advice. The responses are presented in the order of the IESC advice and includes each of eight questions that the IESC were asked to provide advice on by DAWE and DPIE.

2.1 General

Question 1 – *"Do the groundwater, surface water assessments within the EIS provide adequate mapping and delineation of surface and groundwater resources?"*

> **Comment 1.** The delineation and mapping of surface water and groundwater resources in the EIS are not uniformly comprehensive. Some investigations and presentation of information are thorough e.g. the assessment of the presence of stygofauna and the identified aquatic ecology in Big Flat Creek and Wybong Creek. For other resources, the investigations or presentation of information needs to be improved e.g. an aquatic ecology assessment of the proposed Hunter River receiving environment and an assessment of impacts to water quality, including from potential discharges.

To assist in identifying the key environment and community issues that required detailed assessment as part of the MCCO Project EIS, a preliminary environmental risk analysis was completed for the MCCO Project. The key risks identified during the preliminary environmental risk analysis were used to guide and scope the relevant technical assessments and the delineation of potential environmental values within and in proximity to the MCCO Additional Project Area.

The MCCO Project does not propose any changes to the disturbance areas, activities or infrastructure currently approved at the existing Mangoola Coal Mine. Therefore, the focus for identifying key environment and community issues that required detailed assessment as part of the MCCO Project EIS was on the proposed new activities, including those in the MCCO Additional Project Area where the additional mining area is proposed.

The ability to discharge from Mangoola Coal Mine to the Hunter River is already part of the existing Project Approval (PA 06_0014), is licensed under Environment Protection Licence (EPL) 12894 and managed in accordance with the Hunter River Salinity Trading Scheme (HRSTS). No changes are proposed to this existing approved discharge facility nor to the existing discharge arrangements. The currently approved facility will be used, if required, as part of the MCCO Project. As the discharge facility is already approved and no changes to this approved facility are proposed, no further assessment of potential discharge impacts on the Hunter River are required for the MCCO Project. No potential impacts, beyond those already approved under the HRSTS, are predicted for the MCCO Project.

The delineation and detailed mapping of water resources undertaken for and presented in the MCCO Project EIS includes:

- hydrologic modelling of the existing Big Flat Creek and the fully developed MCCO Project
- assessment of upslope runoff diversions and the management of water within disturbed portions of the MCCO Additional Project Area
- water quality and salt balance modelling in order to forecast water supply and discharge requirements of the MCCO Project during operations and post-closure

- a field program to ground-truth the permeability of key stratigraphic horizons to confirm hydraulic properties and the permeability of geological units within the MCCO Additional Project Area

- a 3D numerical groundwater flow model of the MCCO Project to identify potential groundwater impacts from the MCCO Project and the existing Mangoola Coal Mine operations

- mapping of potential groundwater-dependent ecosystems (GDEs) within and in proximity of the MCCO Project and assessment of the extent to which these GDEs are likely to be reliant on groundwater (refer to **Section 2.4**)

- stygofauna sampling of existing groundwater bores to assess the potential presence of stygofauna within the groundwater regime

- aquatic habitat assessment and qualitative sampling along Big Flat Creek and Wybong Creek.

These assessments were undertaken in accordance with the SEARs issued for the MCCO Project which incorporated DAWE's assessment requirements. The assessments address the requirements of all relevant NSW and Commonwealth Government legislation and policies and were guided by the requirements of the IESC.

The delineation and mapping of water resources provided in the MCCO Project EIS is considered to address all potential environmental risks that have been identified for the MCCO Project.

Comment 2. The provision of an ecohydrological conceptual framework (Umwelt 2019e, pp. 52–67) within the EIS provides a clear framework for identifying the risks of most importance. However:

a) a comprehensive risk assessment for the project that included details of surface water and groundwater-related risks may have helped to ensure that all issues were appropriately addressed. A risk assessment is provided for the project (Umwelt 2019b) but this provides very limited detail of water-related risks; and

b) the ecohydrological model needs to be more comprehensive as, at present, while two GDEs are assessed to be potentially impacted, no attempt has been made to quantify the impacts of the predicted drawdowns on other groundwater-dependent ecosystems (GDEs). This limits the application of the model in identifying causal pathways and the likely severity of potential impacts of altered hydrology on water-dependent ecological assets. These causal pathways can then be used to guide appropriate monitoring and mitigation strategies.

Response to 2a)

A preliminary environmental risk analysis was completed for the MCCO Project prior to the preparation of the MCCO Project EIS. This preliminary environmental risk analysis covered the entire MCCO Project Area was undertaken to identify the key environmental and community issues that required detailed assessment as part of the preparation of the MCCO Project EIS. The preliminary environmental risk analysis (dated July 2017) was included in the Preliminary Environmental Assessment (PEA) (Umwelt 2017) provided to DPIE. The preliminary environmental risk analysis was subsequently revised following completion of the relevant technical assessments for the MCCO Project EIS as these assessments provide updated information on the level of risk associated with each aspect, including consideration of the appropriate controls or mitigation. The preliminary risk assessment considered potential impacts on water resources including surface water and groundwater. The key risks identified in the preliminary risk assessment for water resources include:

- changes to downstream flow regimes, flood extents and flood behaviour

- impacts on downstream water quality from disturbed areas

- impacts on Big Flat Creek, Wybong Creek and the Hunter River

- area of influence of dewatering and level of groundwater drawdown
- impacts on Wybong Creek alluvial aquifer and surface water drainages
- interactions and potential impacts on groundwater regime including GDEs, stygofauna habitats, local groundwater users and surface water baseflows.

The preliminary environmental risk analysis undertaken for the MCCO Project is considered fit for purpose for the stage of the MCCO Project at which it was undertaken (i.e. to inform the scope of the EIS). It identified all key water-related risk and guided detailed technical assessments and the delineation of water resources within and in proximity to the MCCO Project. The scopes for the water assessments were then further defined by the SEARs (provided after the risk assessment was completed), including the specific requirements of DAWE. Whilst it is noted that as suggested by the IESC, a more detailed water specific risk assessment could have been undertaken early in the project assessment process, it is considered that the scope of the water assessments undertaken are comprehensive, follow relevant guidelines and address all government agency assessment requirements. It is therefore considered that they have appropriately assessed and addressed the water related risks of the MCCO Project.

Response to 2b)

The MCCO Project EIS includes detailed assessments of impacts on biodiversity and water resources and considers the interactions between water impacts and potential consequential impacts on biodiversity for water-dependent ecological assets. This includes:

- Biodiversity Assessment Report (BAR) – prepared in accordance with the NSW Framework for Biodiversity Assessment (FBA) which considers both direct and indirect impacts on biodiversity due to impacts on water and riparian vegetation
- Aquatic Ecology Assessment – which considers impacts on aquatic ecology due to the MCCO Project and is included as an appendix to the BAR
- Groundwater Dependent Ecosystem Assessment (Section 6.10 of the EIS main text) – which identifies potential GDEs and assesses the impact of the MCCO Project on these potential GDEs
- Stygofauna Assessment – which included survey of and assessment of impacts on Stygofauna
- Groundwater Impact Assessment (GIA) – which assessed the impacts of the MCCO Project on groundwater resources and consequential impacts on biodiversity such as impacts on GDEs
- Surface Water Assessment (SWA) – which assessed the impacts of the MCCO Project on surface water
- Assessment on Commonwealth Matters – which addressed the DAWE specific assessment requirements in the SEARs with a particular focus on ecohydrological impacts on listed threatened flora species and communities under the EPBC Act.

The GDE assessment provided in Section 6.10 of the EIS, which incorporated the findings from supporting detailed technical studies provided for scoping of any potential ecohydrological impacts on GDEs. As a result, the following potential direct and indirect impacts on GDEs were considered and assessed within the MCCO Project EIS:

- clearing of native vegetation within the MCCO Additional Disturbance Area including some woodland/forest vegetation that has access to shallow groundwater and was therefore identified as a potential GDE

- drawdown of groundwater within the vicinity of the MCCO Project, including the potential for any drawdown in areas occupied by GDEs. With regard to GDEs in the vicinity of the MCCO Project, the predicted drawdowns of relevance are those in layer 1 of the groundwater model which relates to drawdown in alluvium, colluvium and regolith layers

- potential groundwater quality changes and interactions during active mining operations and post mining operations

- reduced long-term surface water catchment yield in Big Flat Creek and Wybong Creek which may result in a small reduction in surface flow and baseflow during operations of the MCCO Project

- potential surface water quality impacts to Wybong Creek and Big Flat Creek from the MCCO Project

- post mining changes in alluvial and surface water fluxes due to residual drawdown created by flow of groundwater to the final voids.

The GDE assessment covered a broad area surrounding the MCCO Project Area with all GDEs and potential GDEs in this broad assessment area identified and considered in the assessment. Further details regarding the GDE assessment area and the GDEs and potential GDEs considered in the assessment are provided below in response to Comment 7.

The GDE assessment considered all of the above potential impacts on water resources in regard to all of the GDEs within the broad assessment area. The assessment found that the vast majority of these GDEs and potential GDEs were not predicted to be impacted by the MCCO Project. It is correct as noted in the IESC comment that two GDEs were identified as impacted by drawdown, however, the assessment did not exclude or not consider the other GDEs. It found that the other GDEs in the assessment area were not predicted to be impacted.

In regard to impacted GDEs, the assessment identified that areas of terrestrial vegetation with a low to moderate potential to be dependent on shallow groundwater resources as being impacted by the MCCO Project. This included direct removal within the MCCO Additional Disturbance Area and drawdown impacts on some areas of terrestrial vegetation outside the MCCO Additional Disturbance Area.

The potential ecohydrological impacts on GDEs that were scoped and assessed within the MCCO Project EIS are considered adequate and suitably scaled to the predicted level of impact on GDEs. Additionally, the impact assessment undertaken as part of the MCCO Project EIS was used to guide suitable ongoing monitoring and mitigation measures for GDEs.

Further details of the approach taken for the GDE assessment and the GDE assessment findings are outlined in the response to Comment 7 below and in **Section 2.4**.

Comment 3. The delineation of physical groundwater resources is generally appropriate. The proponent has characterised the local groundwater system based on an existing monitoring network, knowledge from the nearby existing Mangoola mine, and targeted investigations.

Noted.

Comment 4. The proponent should provide further evidence of their description of the units described as colluvium in Big Flat Creek, as the IESC considers it more likely that this unit is alluvium, deposited under a different depositional system to the alluvium along Wybong Creek. The proponent should clarify the implications of this classification for the groundwater conceptualisation and parameterisation.

The description of the near surface sediments along Big Flat Creek has evolved over time as information has become available through comprehensive investigations. Prior to geological data being available for the Big Flat Creek area the sole source of information was the NSW government geological mapping sheet for the area. The map for the area did not show any alluvium or colluvium at the surface, with bedrock outcropping along the alignment of Big Flat Creek. Quaternary alluvium was only mapped in the lower part of Big Flat Creek close to the junction with Wybong Creek. This is logical as Wybong Creek is a more significant creek with a larger catchment that produces floods that accumulate sediments forming alluvial plains.

More detail on the geology along Big Flat Creek became available during preparation of the original EIS for the Mangoola Coal Mine (previously referred to as the Anvil Hill Project) which was prepared by Mackie Environmental Research (MER) (2006). The original EIS and subsequent updates to the numerical model (MER 2013) concluded that a layer of Quaternary alluvium existed along Big Flat Creek due to the presence of sands, clays and rounded pebbles encountered during exploration.

MER (2015) reviewed the interpretation of the geology along Big Flat Creek as the approved operations progressed closer to the creek and the material underlying the creek was able to be directly observed in the pit wall. Additional drilling data also became available and MER concluded the shallow material along Big Flat Creek consisted of a thin layer of 'colluvial' material overlying highly weathered conglomerate. MER defined the colluvial material as 'a mixed assemblage of unconsolidated materials that have been transported relatively short distances'. MER acknowledged that the material along Big Flat Creek could be a mixture of colluvium and alluvium, however differentiating between the two types of deposits was highly uncertain given the source bed rock was conglomerate containing rounded sands and gravels. Whilst it was acknowledged the materials would be a mixture of alluvium and colluvium, the term 'colluvium' was adopted to differentiate the thinner deposits along Big Flat Creek, from the thicker and more transmissive alluvial sediments deposited along Wybong Creek. MER recommended additional investigation to verify the basal transition from colluvium to underlying weathered bedrock along Big Flat Creek.

In response, during October 2017, Mangoola commissioned the drilling of twenty shallow bores in transects perpendicular to Big Flat Creek to further investigate the underlying geology. The results of this work are described in the Groundwater Impact Assessment for the MCCO Project EIS by AGE (2019) as part of the MCCO Project groundwater investigations. The majority of boreholes commissioned in 2017, were drilled through the colluvium and extremely weathered shallow bedrock until a more competent, less weathered, bedrock was reached. A clear contact between the base of the colluvial materials was commonly not visible as the colluvial materials were derived from the underlying weathered conglomerate bedrock that was very similar visually. Whilst the contact between the layers was difficult to identify, the previous conclusions and classification of the colluvium by MER as comprising a mixed assemblage of unconsolidated materials that have been transported relatively short distances was considered to remain appropriate.

The classification of the shallow material along Big Flat Creek has evolved over time as new information from drilling has become available and the material has been exposed and observed in the pit walls. The fact the material has been observed directly where it has been intersected by mining has provided strong evidence and certainty that the classification as colluvium is appropriate.

Whilst the classification of the material has evolved in response to new information it is not considered to have any influence on the nature of impacts predicted for the MCCO Project. This is because the hydrogeological properties for the conceptual and numerical models have been based on the materials encountered rather than generic alluvial or colluvial values. AGE (2019) describes the field testing campaigns to measure hydraulic conductivity of the material underlying Big Flat Creek. The numerical model developed for the MCCO Project included separate zones separating the Big Flat Creek colluvium from the Wybong Creek alluvium, allowing hydraulic properties in these areas to differ based on history matching water levels during the calibration process.

In conclusion, utilising the term colluvium to classify the mixed assemblage of unconsolidated materials that have been transported relatively short distances along Big Flat Creek is considered appropriate based on the setting and information collected from the area over time. Regardless of the terminology adopted, the classification of the sediments is not considered to have had any impact on the nature and scale of groundwater impacts predicted for the MCCO Project.

Comment 5. The assessment of the presence of stygofauna is sufficiently comprehensive (see discussion in response to question 7).

Noted.

Comment 6. Investigation of local groundwater use is appropriate, though incomplete at the time the EIS was prepared as bore registration details for three bores were outstanding (AGE Consultants, p. 90). While the proponent has provided estimates of impacts to these bores, these estimates should be refined as soon as construction information is available.

Further field investigations of the three landholder bores identified in the MCCO Project EIS was undertaken by AGE during the response to submissions phase. The AGE report for field assessment of private groundwater bores is provided as Appendix 12 of the MCCO Project Response to Submissions dated December 2019 and is also reproduced in **Appendix 1** of this response to assist the IESC by providing consolidated information.

The scope of work included:

1. Inspecting each private bore to confirm the exact location, depth and usage.
2. Collecting water samples from each private bore for laboratory analysis of water quality.
3. Using the MCCO Project numerical groundwater model to estimate drawdown at each private groundwater bore.

Property owners were contacted prior to fieldwork and inspection of the groundwater bores to ensure that appropriate land access arrangements were in place. Fieldwork was undertaken by an AGE hydrogeologist on 23 October 2019. Three properties were visited and the landowners provided information on their water bores. They are referenced in this document as follows:

- Residence 261 - Bore 1
- Residence 157 - Bore 2
- Residence 130 - Bore 3.

Each bore was inspected to gather information on its exact location and usage. Where possible a water sample was collected from the bore for laboratory analysis of water quality. The location of each bore, and the location used in the MCCO Project EIS numerical groundwater model are shown on Figure 3.1 of **Appendix 1**. Information provided by each landholder on their bores is summarised in **Table 2.1**.

Table 2.1 Private landholder bore information

Bore Information	Residence 261 Bore	Residence 157 Bore	Residence 130 Bore
Easting[#]	0280609	0280751	0277511
Northing[#]	6432443	6430608	6427358
Drill Date	2018	2011	Unknown*
Purpose	Stock and domestic	Stock and domestic	Stock and domestic
Total Depth (m)	94	85	30
Pump Depth	84	80	25
Water Level (mbgl)	Unable to measure**	Unable to measure**	14.58
Yield during development (L/s)	1.4	6-7	Unknown^^
Yield (currently)(L/s)	2^	1.5	Unknown^^
Pump	Electric submersible	Electric submersible	Windmill
Sampled for laboratory analysis	Yes	Yes	Grab only[+]
Electrical conductivity (µS/cm)	12,720	4,112	3,753
pH	6.86	7.27	7.15
Temperature (Celsius)	20.6	21.1	21.9

GDA94, MGA Zone 56
* Present on property at time of acquisition (1999)
** Unable to measure due to sealed headworks
^ Pumps bore dry (requiring 30 minute recovery – landholder information)
^^ Not enough wind to pump and estimate
+ No purging undertaken, a singular sample taken of the bore at a specific depth and time

Water samples were pumped from Bores 1 and 2 and stored in laboratory supplied sample bottles for transport to the analytical laboratory. A sample could not be pumped from Bore 3 as there was no wind to operate the windmill pump at the time of the inspection. The results of water quality analyses for Bores 1 and 2 are provided in **Appendix 1**. The laboratory analyses indicate the groundwater from both bores tested is not suitable for human consumption based on salinity. The salinity of the water sample from Bore 1 indicates if this water is used for beef cattle there is potential for loss of production and decline in condition and health. Bore 2 is suitable for a wide range of stock watering.

Figure 3.1 in **Appendix 1** shows the location of each bore measured with a handheld GPS and the location previously assessed (based on available data at that time) during the MCCO Project EIS. The figure shows the actual locations are slightly different to those represented in the MCCO Project EIS numerical model. The updated bore locations were used to recalculate the drawdown at each revised location using the MCCO Project numerical model. The predicted maximum drawdown at each bore is provided in **Table 2.2**. The table shows that for the updated bore locations and depths there are no bores were drawdown is predicted to exceed the 2 m threshold specified in the Aquifer Interference Policy (AIP) for 'make good' measures.

Table 2.2 Private bore predicted cumulative drawdown

Bore ID	Total depth (m)	Pump depth (m)	Standing water level (mbgl)	Model layer at pump depth	Predicted maximum drawdown (m)	
					MCCO Project EIS	Updated Assessment
Bore 1	94	84	N/A (Sealed headworks)	4	-	0.182
Bore 2	85	80	N/A (Sealed headworks)	4	3.1	1.296
Bore 3	30	25	14.58	4	-	0.008

Whilst the numerical modelling indicates the drawdown at the private bores will not exceed the AIP trigger, there is some unavoidable uncertainty in the groundwater modelling predictions. To account for this, Mangoola will seek to monitor water levels at the three private bores (subject to landholders granting permission and ability to install monitoring equipment). The monitoring program for each of the private bores will be documented in the Water Management Plan and include a Trigger Action Response Plan (TARP) that initiates investigation should there be indications of drawdown that could be related to mining. If investigations indicate the potential to exceed the drawdown threshold in the AIP then Mangoola will initiate make good measures.

Comment 7. GDEs are a matter of national environmental significance under the Commonwealth 'water trigger'. The proponent adopts a more restricted interpretation, in which it is only GDEs that host listed threatened species or are threatened ecological communities that they consider to be matters of national environmental significance (Umwelt 2019d p. 54). The only justification given for the classification of groundwater-dependence of vegetation types is their 'location… in the landscape and their floristics' (Umwelt 2019c, Appendix F, p. 34). Consequently, the proponent should provide a more detailed assessment of the local occurrence of GDEs. Their assessment is limited to areas in which groundwater was <10 m from the surface prior to groundwater drawdown from the existing mine. The proponent's justification for this is that the IESC's Explanatory Note on assessing GDEs states that vegetation in areas with groundwater <10 m from the surface are likely to be groundwater dependent (Doody, Hancock and Pritchard 2019, p. 22). The proponent has not explained why they have not assessed GDEs against the other criteria and principles described in the Explanatory Note as being indicative of groundwater-dependence, such as vegetation communities occurring adjacent to persistent water. The proponent only considers a few of the vegetation types that occur within this area to be dependent on groundwater. It is unclear on what basis other vegetation types have been classified as having low dependence on groundwater, even where they occur in areas with a shallow water table. See further discussion at paragraph 37.

Regarding the IESC's comments that the "*proponent adopts a more restricted interpretation*" of GDEs, we note the source of this view expressed by the IESC, however, confirm that this was not the case. We acknowledge that the specific wording used in that section of the assessment could have been more clearly worded. The report in question was seeking to state that none of the terrestrial vegetation identified as a potential GDE (and therefore being a MNES) was also listed as a threatened ecological community under the EPBC Act. It was not meant to infer that only vegetation that was a listed community was considered in the GDE assessment and indeed this was not the case. The GDE assessment considered all potentially occurring GDEs.

<u>GDE Assessment Area</u>

The potential impacts from the MCCO Project on GDEs are associated with the proposed additional mining activities within the MCCO Additional Project Area and the consequential impacts on groundwater and surface water. In this regard, the assessment area for all potentially occurring GDEs within or in proximity to the MCCO Project was taken as the conservative extent of the conceptual groundwater model as shown on **Figure 2.1**. An assessment of impacts was undertaken for all of the GDEs within the assessment area to determine if any had the potential to be impacted by the MCCO Project. The conservative maximum extent of potential groundwater drawdown due to the MCCO Project was the key parameter used for boundary definition for the assessment of impacts on GDEs. The GDE assessment area adopts the concept of going beyond the maximum extent of groundwater drawdown, as indicated by the extent of the area included in the groundwater model for the MCCO Project.

Identification of GDEs

As per Section 2.1 of the IESC's *Information Guidelines Explanatory Note Assessing groundwater-dependent ecosystems* (Explanatory Note) (IESC 2019), three types of potential GDE were considered in the assessment:

- Subterranean – aquifer and cave systems
- Aquatic
  - River base flow systems: aquatic and riparian systems that exist in or adjacent to streams fed by groundwater
  - Wetlands: aquatic communities and fringing vegetation dependent on groundwater fed lakes and wetlands
- Terrestrial – ecosystems dependent on subsurface expression of groundwater.

An initial desktop review of known GDE information including regional GDE mapping and vegetation mapping was used to identify the locations of potential GDEs within the GDE assessment area. Areas of potential GDEs were further refined following the completion of field surveys (including flora, fauna and stygofauna surveys) and site inspections (e.g. inspection of Big Flat Creek and the MCCO Additional Project Area).

The initial desktop review considered available GDE mapping at a national, regional and local scale and included:

- National Atlas of Groundwater Dependent Ecosystems (GDE Atlas) (Doody et al 2017)
- Australian Government Bioregional Assessment Program for the Hunter subregion
- regional mapping prepared by NSW Department of Industry – Water
- previous local project-based vegetation mapping in the locality.

Doody *et al* (2017) provide a detailed explanation of the methods used to identify GDEs in the GDE Atlas, including establishing conceptual linkages between groundwater and various ecosystems, and a set of rules for groundwater dependency. The GDE Atlas also applied remote sensing data (feature layers) for groundwater inflow dependent ecosystems to classify the potential presence of GDEs.

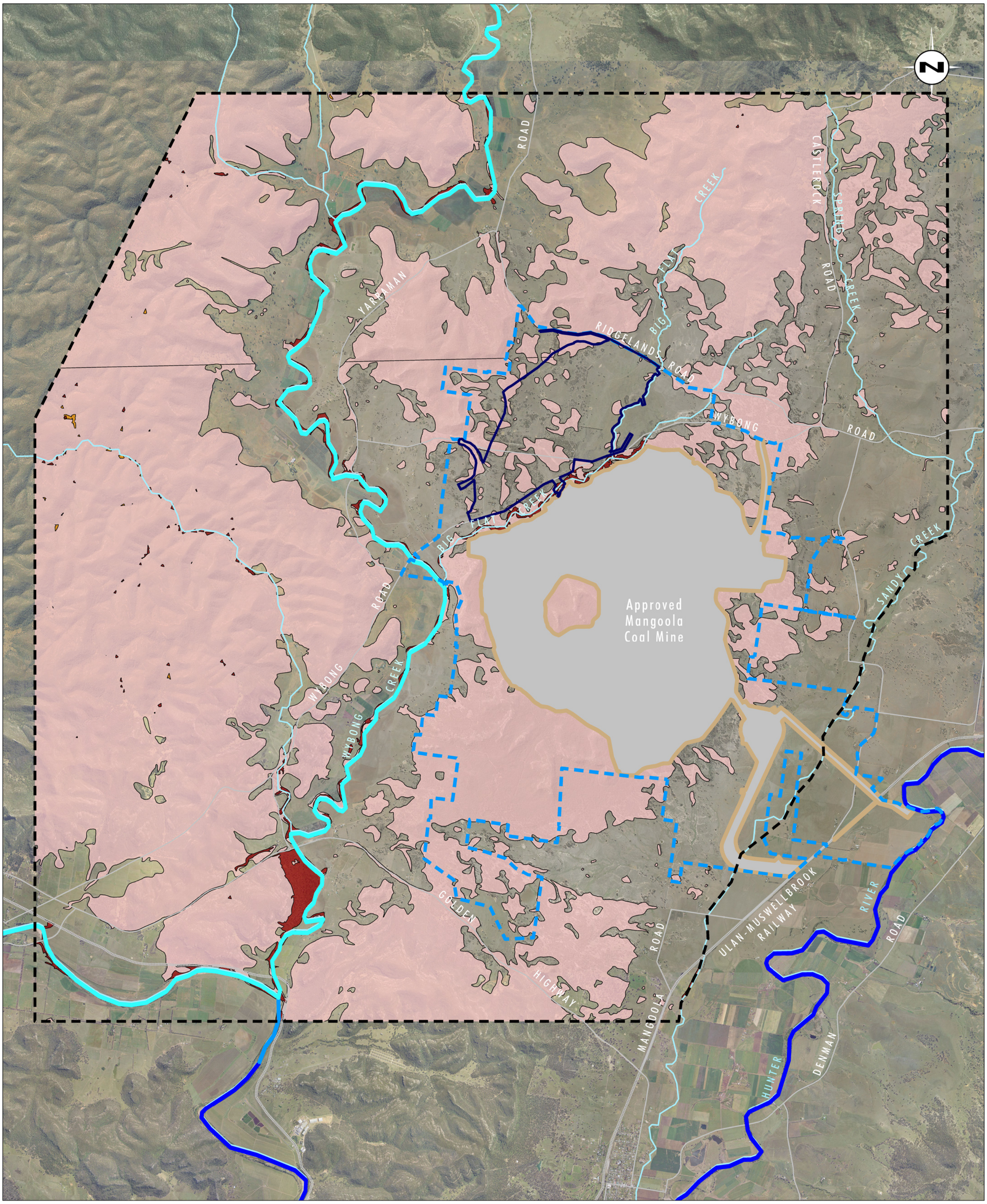


Image Source: Glencore (April 2018), Google Earth (2018)
Data Source: Glencore (2019), BOM (Jan 2018)

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Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Disturbance Area
- Groundwater Model Extent (GDE Study Area)

GDE Atlas

Terrestrial Groundwater Dependant Ecosystems:

- High Potential GDE
- Moderate Potential GDE
- Low Potential GDE

Aquatic Groundwater Dependant Ecosystems:

- High Potential GDE
- Moderate Potential GDE
- Low Potential GDE

FIGURE 2.1

GDE Assessment Area and Potential GDEs from Regional Mapping

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Identification of Aquatic, Terrestrial and Subterranean GDEs

Figure 6.24 of the MCCO Project EIS (reproduced in this report as **Figure 2.1**) shows mapping of potential terrestrial and aquatic GDEs from the GDE Atlas. Note that the GDE Atlas mapping incorporates regional GDE mapping data for the area of interest developed by the NSW Department of Industry - Water.

The figure shows, for the full extent of the GDE assessment area the:

- high, moderate and low potential terrestrial GDEs
- high, moderate and low potential aquatic GDEs.

These classifications of potential are based on the GDE Atlas.

Aquatic GDEs

Big Flat Creek, which is ephemeral, is not identified in this national scale mapping as being associated with any aquatic GDEs. The GDE Atlas identified Wybong Creek as having a moderate potential for being an aquatic GDE. A small section of the Goulburn River, south of the confluence with Wybong Creek is identified as having a low potential for being a river GDE. Aquatic (riverine) GDEs include riparian communities that utilise baseflow from groundwater as an important contributor to their ecological processes.

Terrestrial GDEs

The GDE Atlas identifies a range of terrestrial woodland and forest communities with potential to be GDEs. These are mapped in the vicinity of Wybong Creek, Big Flat Creek and the Goulburn River. Discontinuous alluvium areas along the lower 1km of Big Flat Creek (outside the MCCO Additional Project Area), which are considered to be part of the Wybong Creek alluvium; small patches of alluvium along other tributaries of Wybong Creek; and the Goulburn River floodplain are mapped as high potential terrestrial GDEs. This is consistent with the information provided in the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009*.

The communities mapped as high potential terrestrial GDEs include:

- River red gum/river oak grassy riparian woodland of the Hunter Valley (Wybong Creek, Goulburn River and Hunter River)
- Swamp Oak/Weeping grass grassy riparian forest of the Hunter Valley (Big Flat Creek).

A further nine terrestrial woodland/forest communities are mapped in the GDE Atlas as low potential GDEs within the GDE assessment area (refer **Figure 2.1**).

Subterranean GDEs

The GDE Atlas does not identify any subterranean GDEs in the vicinity of the MCCO Project and none had been identified in other regional scale mapping.

Local/project specific mapping of potential GDEs

Following the review of regional mapping, local data was used to further identify any potentially occurring GDEs in the GDE assessment area.

Data considered in this step include:

- aerial photography and topographic LIDAR data of the MCCO Project Area
- geology, geomorphology and soil mapping at the local scale (from Soil Assessment and GIA, Appendices 19 and 12, respectively of the MCCO Project EIS)
- hydrological data for the streams (Big Flat Creek, Wybong Creek) (from the SWA, Appendix 11 of the MCCO Project EIS)
- vegetation mapping (from the BAR, Appendix 13 of the MCCO Project EIS)
- definition of aquifers, depths and connectivity (from the GIA (Appendix 12 of the MCCO Project EIS) refer to Sections 4.2 and 4.3)
- mapping of locations where groundwater depth is less than 10 m (in relation to potential terrestrial GDEs only). The Explanatory Note (IESC 2019) states that terrestrial vegetation located in areas with shallow groundwater (less than 10 metres below the surface) are likely to be GDEs, as the plants can easily reach and extract groundwater
- field assessments of ecological communities
- stygofauna assessment (Section 6.10.2.3 of the MCCO Project EIS and Appendix 14 of the MCCO Project EIS). Shallow alluvial aquifers inherently have a high likelihood of being GDEs and require sampling for stygofauna (Explanatory Note (IESC 2019)).

Terrestrial vegetation mapping and modelled shallow groundwater

Section 6.10.2 of the MCCO Project EIS integrates information about groundwater depth and terrestrial vegetation community mapping. Figure 6.25 of the MCCO Project EIS (reproduced in this report as **Figure 2.2**) shows native woodland/forest communities in the Upper Hunter region which are distributed where the pre mining groundwater is modelled and/or measured as being within 10m of the surface. This area where the pre-mining groundwater level is within 10m of the surface is only one of the aspects used to assess the potential presence of GDEs and has only been considered in regard to terrestrial GDEs, along with other lines of evidence.

In the area of interest, groundwater is assessed as being at less than 10m below the surface along creek valley and lower valley side slopes. No shallow groundwater is mapped in the steep sandstone terrain, other than along the valley floors.

The Australian Government Bioregional Assessment Program for the Hunter Subregion includes mapping of water-dependent assets. These include surface water features (wetlands, swamps and floodplains), aquifers and alluvial strata, vegetation classes that are considered to be groundwater dependent, and a range of habitat corridors. At the regional scale, this mapping shows limited water dependent assets mapped in the vicinity of the MCCO Project Area. No water dependent assets are mapped within the Project Area. Riverine forest is mapped in the vicinity of Wybong Creek and the Goulburn River. A small section identified in the regional mapping as rainforest is also mapped to the north of (and outside of) the MCCO Additional Project Area.

umwelt

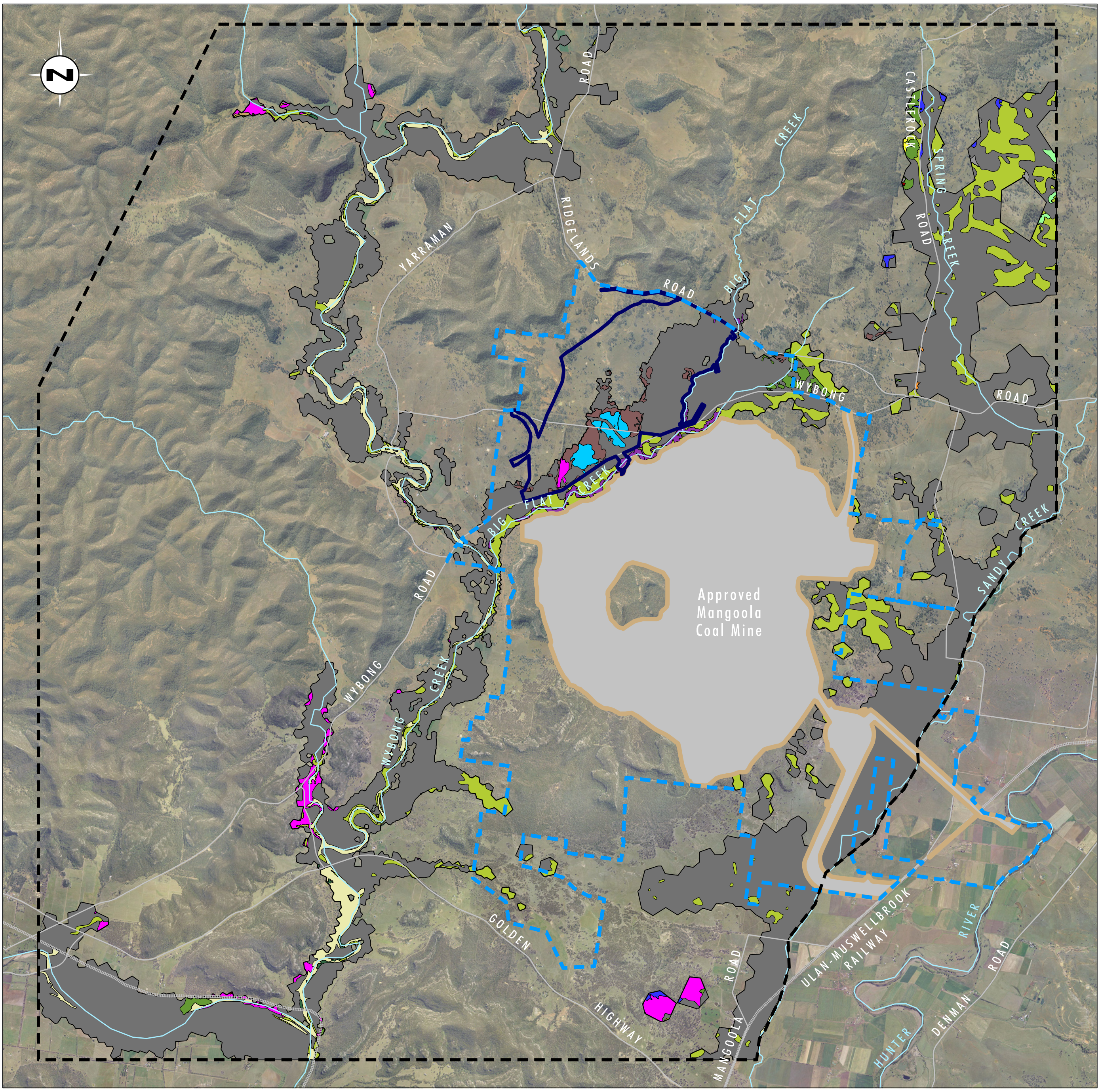

Image Source: Glencore (2018), Google Earth (2018)
Data Source: Glencore (2019), AGE (2019)

0 1.0 2.5 5.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Disturbance Area
- Groundwater Model Extent (GDE Study Area)
- Groundwater Within 10m of Surface
- HU654/PCT1310 - White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley
- HU757/PCT1543 - Ficus rubiginosa/ Alectryon subcinereus/ Notelaea microcarpa/ dry rainforest of the Central Hunter Valley
- HU812/PCT1598 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
- HU817/PCT1603 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- HU818/PCT1604 - Eucalyptus crebra/ Eucalyptus moluccana/ Corymbia maculata shrub/ grass open forest of the central and lower Hunter
- HU819/PCT1605 - Eucalyptus crebra/ Notelaea microcarpa shrubby open forest of the central and upper Hunter
- HU821/PCT1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter
- HU825/PCT1611 - Eucalyptus crebra/ Callitris endlicheri shrub/grass woodland upper Hunter and northern Wollemi
- HU826/PCT1612 - Eucalyptus crebra/ Eucalyptus punctata/ Notelaea microcarpa woodland of Central Hunter
- HU869/PCT1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin
- HU883/PCT1669 - Eucalyptus fibrosa/ Eucalyptus punctata/ Eucalyptus sparsifolia/ Corymbia trachyphloia shrubby open forest on sandstone ranges of the Sydney Basin
- HU884/PCT1670 - Eucalyptus sparsifolia/ Eucalyptus punctata shrubby open forest on sandstone ranges of the Sydney Basin
- HU905/PCT1691 - Eucalyptus crebra/ Eucalyptus moluccana grassy woodland of the central and upper Hunter
- HU906/PCT1692 - Bull Oak Grassy Woodland of the Central Hunter Valley
- HU928/PCT1714 - Eucalyptus camaldulensis/ Casuarina cunninghamiana grassy riparian woodland of the Hunter Valley
- HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley

FIGURE 2.2

Native Woodland / Forest Vegetation Communities where Pre-mining Groundwater is within 10m of Surface

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The regional scale GDE mapping was supplemented by ground-truthed vegetation mapping of the MCCO Project Area, conducted as part of the overall BAR for the MCCO Project.

Detailed floristic and vegetation mapping surveys were undertaken for the MCCO Project building on previous work undertaken over many years within the MCCO Project Area. Vegetation communities were delineated during surveys via identification of repeating patterns of plant species assemblages in each of the identified strata. The vegetation communities identified during surveys were assigned to plant community types (PCTs) and categorised into vegetation zones.

As shown on **Figure 2.2**, 16 PCTs have been mapped in locations where groundwater may occur within 10m of the surface.

Stygofauna assessment

Section 6.10.2.3 of the MCCO Project EIS and Appendix 14 assess the potential presence of stygofauna in groundwater within and surrounding the MCCO Additional Project Area and the potential impact of the MCCO Project on any stygofauna that may be present. No stygofauna were identified in the stygofauna survey area.

As outlined in the assessment, although no stygofauna were collected from the Wybong alluvium, it is potentially suitable habitat because of its hydrological connection to the Goulburn River, adequate porosity, and acceptable water quality.

Summary of potential GDEs

As an outcome of the process described above to identify potential GDEs that required consideration in the GDE assessment, a number of GDEs and potential GDEs were identified. The term potential GDEs is used as some of the terrestrial vegetation may or not be a GDE but they were included in the assessment on a precautionary basis so that the full extent of potential impacts could be assessed.

A summary of GDEs and potential GDEs that were identified and considered in the GDE assessment is provided in **Table 2.3**. As discussed above, the GDE assessment identified that the only GDEs predicted to the impacted by the MCCO Project are some of the terrestrial GDEs with low to moderate groundwater dependence in areas within the direct impact area (i.e. the area to be mined) and the groundwater drawdown area in close proximity the MCCO Proposed Additional Mining Area. The vast majority of the GDEs identified in the table below are therefore not predicted to be impacted by the MCCO Project but are included here from completeness to show what was considered in the assessment process.

Table 2.3 Potential GDEs within and in proximity to the MCCO Project

GDE
Aquatic/riverine
Wybong Creek - River GDE All instream and riparian communities, including: • Native woodland/forest vegetation in areas of alluvium in the riparian zone (along Wybong Creek and the Goulburn River) and in areas with shallow groundwater (<10 m) which is likely to feed river base flow, being: HU928/PCT1714 - *Eucalyptus camaldulensis*/*Casuarina cunninghamiana* grassy riparian woodland of the Hunter Valley. This community does not occur within the MCCO Project Area.

GDE
Goulburn River - River GDE All instream and riparian communities, including: • Native woodland/forest vegetation in areas of alluvium in the riparian zone (along Wybong Creek and the Goulburn River) and in areas with shallow groundwater (<10 m) which is likely to feed river base flow, being: HU928/PCT1714 - *Eucalyptus camaldulensis*/*Casuarina cunninghamiana* grassy riparian woodland of the Hunter Valley. This community does not occur within the MCCO Project Area.
Subterranean
Wybong Creek and Goulburn River stygofauna
Terrestrial
Native woodland/forest vegetation in areas with shallow groundwater (<10 m from surface) on flats (generally colluvial) and lower slopes. This includes the following PCTs: • PCT1310 - White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South Bioregion • PCT1543 - *Ficus rubiginosa*/*Alectryon subcinereus*/*Notelaea microcarpa*/dry rainforest of the Central Hunter Valley • PCT1603 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter • PCT1604 - *Eucalyptus crebra*/*Eucalyptus moluccana*/*Corymbia maculate* shrub/grass open forest of the central and lower Hunter • PCT1605 - *Eucalyptus crebra*/*Notelaea microcarpa* shrubby open forest of the central and upper Hunter • PCT1611 - *Eucalyptus crebra*/*Callitris endlicheri* shrub/grass woodland upper Hunter and northern Wollemi • PCT1612 - *Eucalyptus crebra*/*Eucalyptus punctata*/*Notelaea macrocarpa* woodland of Central Hunter • PCT1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin • PCT1669 - *Eucalyptus fibrosa*/*Eucalyptus punctata*/*Eucalyptus sparsifolia*/*Corymbia trachyphloia* shrubby open forest on sandstone ranges of the Sydney Basin • PCT1670 - *Eucalyptus sparsifolia*/*Eucalyptus punctata* shrubby open forest on sandstone ranges of the Sydney Basin • PCT1691 - *Eucalyptus crebra*/*Eucalyptus moluccana* grassy woodland of the central and upper Hunter • PCT1692 - Bull Oak Grassy Woodland of the Central Hunter Valley
Native woodland/forest vegetation communities in areas with shallow groundwater (<10 m from surface) in riparian and floodplain locations, but likely depending on groundwater under the floodplain, rather than base flows where groundwater intersects creek beds, including: • HU812/PCT1598 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter • HU821/PCT1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter • HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley. • HU928/PCT1714 - *Eucalyptus camaldulensis*/*Casuarina cunninghamiana* grassy riparian woodland of the Hunter Valley (note when on the river bank and potentially accessing baseflow, this would be considered to be a riverine GDE, so is also included in that part of the table).

Assessment of Groundwater Dependence

The 16 PCTs identified as potential terrestrial GDEs were further assessed to determine the likely level of groundwater dependence of this terrestrial vegetation. Local terrain, soil characteristics, proximity to a watercourse, the floristics of the community and presence of species that are known to be dependent on groundwater (such as *Eucalyptus camaldulensis*) were considered. **Table 2.4** lists the 16 PCTs that are associated with areas where pre mining groundwater is at less than 10 m depth and that were identified as potential terrestrial GDEs. In this table, a range of criteria that are indicative of high groundwater dependence are shown and each PCT which comprises a potential terrestrial GDE is reviewed against each of the criteria. The criteria includes consideration of the nature of the groundwater sources and the ecological characteristics of each PCT, taking into consideration their typical position in the landscape (e.g. floodplain or riparian) and floristics (e.g. presence of species with known groundwater dependence) and the dominant canopy species in the community.

Table 2.4 Assessment of terrestrial GDE groundwater dependence within the GDE assessment area

Plant Community Type	Known GDE/Floodplain tree species	Known Riparian tree species	Distance to creek bank	Water table intersects creek bed	Likely Level of Groundwater Dependence
HU654/PCT1310 - White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South Bioregion	No	No	Not associated with creek bank	Unlikely	Low
HU757/PCT1543 - *Ficus rubiginosa/Alectryon subcinereus/Notelaea microcarpa*/dry rainforest of the Central Hunter Valley	No	No	Unlikely to be associated with creek bank	Unlikely	Low
HU812/PCT1598 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	No	Yes	Likely to be associated with Wybong creek bank, not BFC	Unlikely BFC Likely in Wybong Ck	Moderate
HU817/PCT1603 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	No	No	Unlikely to be associated with creek bank	BFC No	Low
HU818/PCT1604 - *Eucalyptus crebra/Eucalyptus moluccana/Corymbia maculate* shrub/grass open forest of the central and lower Hunter	No	No	Unlikely to be associated with creek bank	Unlikely	Low
HU819/PCT1605 - *Eucalyptus crebra/Notelaea microcarpa* shrubby open forest of the central and upper Hunter	No	No	Unlikely to be associated with creek bank	Unlikely	Low
HU821/PCT1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	No	Yes	Possibly on bank for Wybong Ck tributaries, not BFC	BFC No Wybong Ck possible	Moderate
HU825/PCT1611 - *Eucalyptus crebra/Callitris endlicheri* shrub/grass woodland upper Hunter and northern Wollemi	No	No	Unlikely to be associated with creek bank	Unlikely in BFC	Low

Plant Community Type	Known GDE/Floodplain tree species	Known Riparian tree species	Distance to creek bank	Water table intersects creek bed	Likely Level of Groundwater Dependence
HU826/PCT1612 - Eucalyptus crebra/Eucalyptus punctata/Notelaea microcarpa woodland of Central Hunter	No	No	Unlikely to be associated with creek bank	Does not occur in BFC or Wybong Ck	Low
HU869/PCT1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	No	No	Unlikely to be associated with creek bank	Unlikely in BFC	Low
HU883/PCT1669 - *Eucalyptus fibrosa/Eucalyptus punctata/Eucalyptus sparsifolia/Corymbia trachyphloia* shrubby open forest on sandstone ranges of the Sydney Basin	No	No	Unlikely to be associated with creek bank	Unlikely in BFC	Low
HU884/PCT1670 - *Eucalyptus sparsifolia/Eucalyptus punctata* shrubby open forest on sandstone ranges of the Sydney Basin	No	No	Unlikely to be associated with creek bank	Unlikely in BFC	Low
HU905/PCT1691 - *Eucalyptus crebra/Eucalyptus moluccana* grassy woodland of the central and upper Hunter	No	No	Possibly on creek bank in BFC and Wybong Ck	BFC Possible Wybong Ck Possible	Low
HU906/PCT1692 - Bull Oak Grassy Woodland of the Central Hunter Valley	No	No	Unlikely to be on Creek bank	BFC Unlikely	Low
HU928/PCT1714 - *Eucalyptus camaldulensis/Casuarina cunninghamiana* grassy riparian woodland of the Hunter Valley	Yes	Yes	On creek bank and floodplain, Wybong Ck	BFC No Wybong Ck possible	High
HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley	No	Yes	Likely on creek bank Wybong Ck	BFC Unlikely	Moderate

Categories were used to differentiate the likely level of groundwater dependence and were assigned to each PCT as shown in **Table 2.4**. An example of each category is provided below:

- Low – PCT typically occurs on slopes, ridges or outcrops – away from permanent or ephemeral watercourses. Canopy species dominated by dry forest eucalypt species including *Eucalyptus crebra*, *Eucalyptus moluccana* or *Corymbia maculata.*

- Moderate – PCT typically occurs on the lower slopes or flats (underlain by colluvial and/or alluvial materials), generally in proximity of a drainage line or depression, but not restricted to the riparian zone. Canopy species include more floodplain related Eucalypt species including *Eucalyptus tereticornis* or *Eucalyptus blakelyi* and non-eucalypt species including *Casuarina glauca.*

- High – PCT occurs exclusively on floodplains or along a permanent watercourse in the riparian zone. Canopy species contain species either known to be or highly likely to be dependent on groundwater, including *Eucalyptus camaldulensis*. As noted above, all woodland/forest vegetation on alluvial zones has been identified as a likely high dependent GDE.

The GDE assessment undertaken for the MCCO Project EIS provided in Section 6.10 and associated detailed technical assessments is considered appropriate and conservative in its scoping of all potential GDEs within or in proximity to the MCCO Project. Furthermore, the identification of terrestrial GDEs and the assessment of likely dependence on groundwater is considered to be appropriate, considering a wide range of factors such as position in the landscape and floristic species of the PCT.

Comment 8. The assessment of surface water resources is generally appropriate. It is notable that the proponent has established two streamflow gauging sites in addition to the one operated by the New South Wales Department of Industry, though it would be useful if the additional data required to develop robust rating curves for all sites were collected. Local climate data is being collected in addition to the available regional climate data sets, and streamflow quality is monitored at a further twenty sites. Various hydrologic and hydraulic modelling procedures have been used to supplement the available gauging information to provide information on flow regime, water management, and flood risks.

Noted.

Comment 9. Water quality monitoring is currently undertaken as part of the existing coal mine's operation in accordance with the Mangoola Coal Surface Water Monitoring Plan (not provided). The surface water assessment (Appendix 11) for the proposed mine extension includes a summary of water quality data in the Wybong Creek and Big Flat Creek catchments, including physico-chemical parameters and total metals. However, no data is provided for currently monitored sites in the Hunter River e.g. SW14 (downstream of the HRSTS discharge location) or SW15 (downstream of the Sandy Creek/Hunter River confluence). This water quality data is required as controlled release from the Pit Water Dam is allowed, though has not been required to date. The IESC notes it was not clearly stated by the proponent if there had been any or no discharges into the Hunter River at the Hunter River Salinity Trading Scheme (HRSTS) discharge location or if the discharge facility has been constructed. This information is required.

The Mangoola Coal Mine Surface Water Monitoring Plan has been developed and implemented as required by the existing project approval (PA 06_0014) and is available online at:

https://www.mangoolamine.com.au/en/publications/Pages/management-plans.aspx

As required by Condition 30 of PA 06_0014, this plan was developed in consultation with the NSW Environment Protection Authority (EPA) and the NSW Department of Primary Industries (DPI) Water and approved by DPIE.

The results of water quality monitoring for all existing monitoring sites (including those on the Hunter River) are included in the Mangoola Coal Mine Annual Reviews, available online at:

https://www.mangoolamine.com.au/en/publications/Pages/annual-reviews.aspx#gl-1.

A water quality summary of data from sites SW14 and SW15, as requested by the IESC, is given as **Appendix 2**.

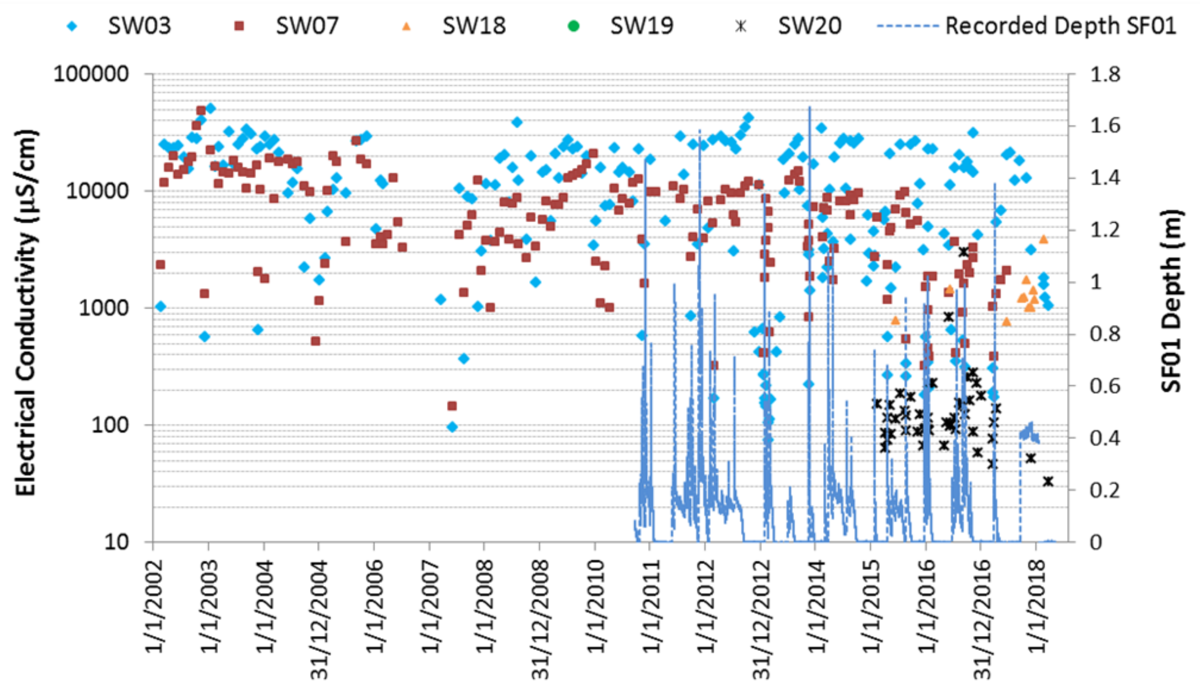
The water quality data presented in the SWA for the MCCO Project EIS (HEC [2019]) relates to the MCCO Project and the assessment of potential impacts associated with the MCCO Project. As discussed above, the ability to discharge from the Pit Water Dam (PWD) to the Hunter River is already approved and no changes to the approved facility are proposed and it was for this reason that the assessment did not include data from SW14 and SW15.

Presently, the approved infrastructure for controlled discharge from the PWD to the Hunter River via the HRSTS has not been constructed. However, Mangoola has a trigger action response plan (TARP) in place that will initiate construction of the discharge system from the PWD to the Hunter River if the total site water inventory exceeds 2,250 ML (equal to 55% of the capacity of the PWD and Raw Water Dam combined). The Mangoola operational water management system also contains a TARP that governs when water should be discharged from the PWD to the Hunter River in accordance with the HRSTS once the release infrastructure is in place. The trigger for initiating discharge is based on the stored water volume in the PWD and these triggers are not planned to change as part of the MCCO Project.

Comment 10. The summary of physico-chemical water quality parameters for Wybong Creek and Big Flat Creek that is presented show that water quality is highly variable, with many exceedances of ANZECC/ARMCANZ (2000) (now ANZG, 2018) guidelines for pH, EC, turbidity and TSS. Electrical conductivity in Big Flat Creek is high, with average conductivity of 13 000 µS/cm. The proponent considers the high salinity to be naturally occurring, although they provide little justification for this. Site-specific guidelines are also presented in Table 8 (Appendix 11), however, it is not clear if these were derived only from reference sites, as downstream sites have much higher trigger values than upstream sites. This should be clarified as it is not appropriate to derive site-specific trigger values from impacted sites (see Explanatory Note on Deriving site-specific guideline values for physico-chemical parameters and toxicants (Huynh T and Hobbs D, 2019)).The proponent also records exceedances of default guideline values for aquatic ecosystem protection for aluminium, chromium, copper, lead and zinc in Big Flat Creek, both upstream and downstream. The proponent considers that the exceedances are therefore indicative of background conditions, since exceedances also occur upstream of mining. A discussion of the likely source geology of these metals and consideration of potential for anthropogenic influence would add confidence to this conclusion.

Recorded water quality data for Big Flat Creek is available from 2002, prior to the commencement of the Mangoola Coal Mine (mining operations commenced in September 2010). Recorded electrical conductivity data is plotted in **Graph 2.1** (expanded from Figure 8 in HEC [2019] to present further data). The location of monitoring sites is shown on **Figure 2.3**. Analysis of this data demonstrates the prevalence of recorded high salinity in Big Flat Creek at locations both upstream and downstream of the existing operation, both before and after the commencement of current operations, for the full period of available data. In addition, Mangoola does not discharge mine water to Big Flat Creek and there are no records of overflows from the Northern Out Of Pit Sediment Dam (NOOP1) into Big Flat Creek (refer Figure 14 in HEC [2019]). Therefore, the mining operations are not the cause of the elevated salinity and other parameters.

As stated in Section 2.6.2.1 of HEC (2019), the highest recorded salinity in Big Flat Creek is at a location upstream of mining operations (SW03). It is therefore clear that the high salinity in Big Flat Creek is unrelated to mining activity. The land use of the catchment of Big Flat Creek upstream of the Mangoola owned land is low intensity agriculture and therefore no site specific land use based sources have been identified in the catchment that would cause the elevated results. The concentration of solutes occurring in groundwater and surface waters within undisturbed catchments is influenced by evaporative concentration of rainfall and dissolution of minerals from the rocks that interact with the waters. The GIA for the MCCO Project EIS determined that salts in rainfall are concentrated in the soil profile and then transported via overland flow to waterways or leached into the water table when significant rainfall events occur. This is a natural process that has been observed to create brackish and saline streams and groundwater systems in many parts of the Australian continent.



Graph 2.1 Recorded Electrical Conductivity and Flow Depth for Big Flat Creek and Tributaries

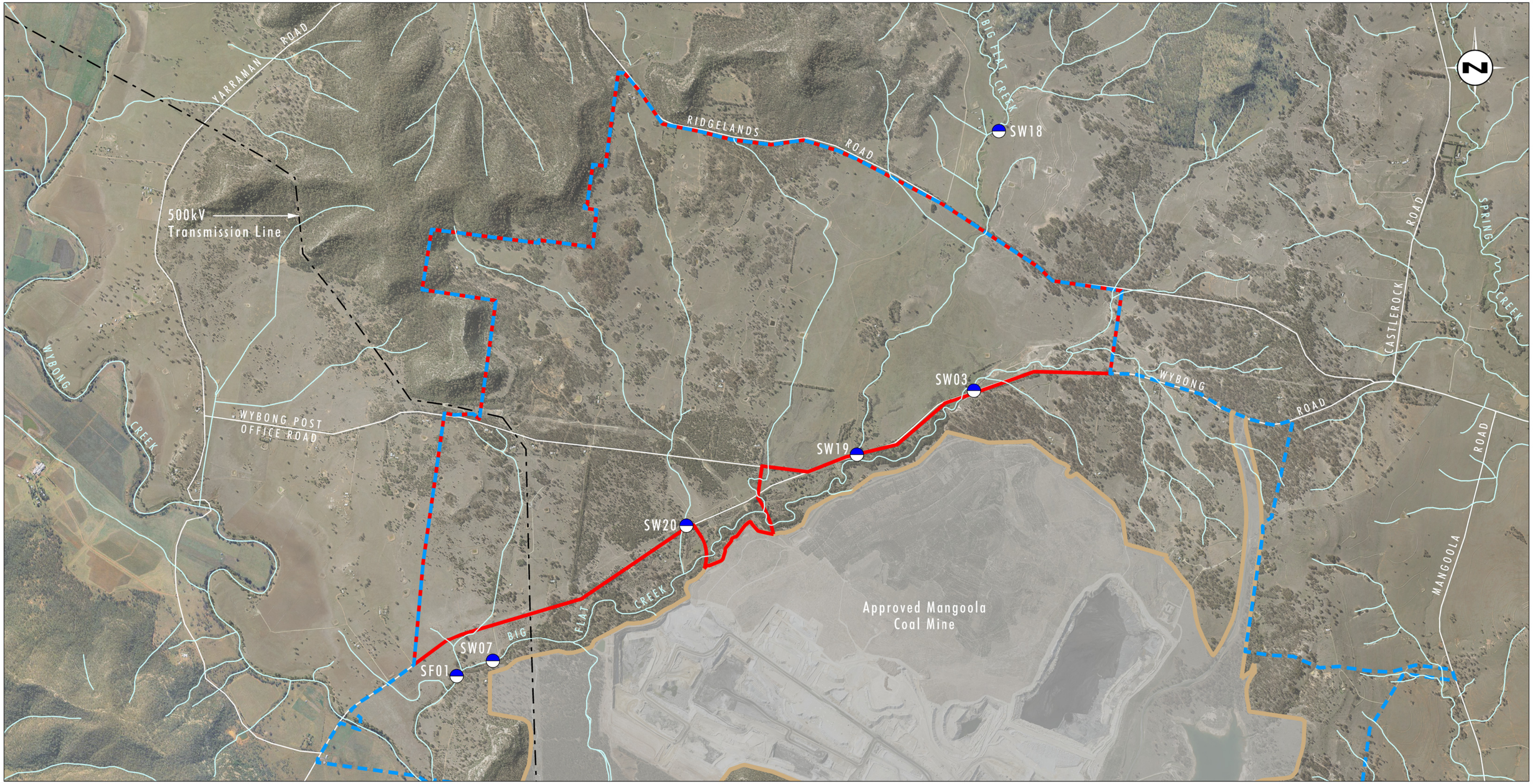


Image Source: Glencore (April 2018)
Data Source: Glencore (2018)

0 0.5 1.0 2.0km
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Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Surface Water Monitoring Location (Existing)

FIGURE 2.3

Existing Surface Water Monitoring Sites for Big Flat Creek

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Site specific trigger values (SSTVs) have been derived from the monitored data for each monitoring site as the 80th percentile of monitored values where sufficient monitored data are available to derive this statistic (a minimum of ten records). The aim of the SSTVs is to provide a baseline against which to compare future monitored water quality in order to assess if an impact attributable to mining or associated operations may be occurring. This approach has been approved as part of existing water management plans for many coal mining operations in the Hunter Valley and elsewhere in NSW (triggers are also known as impact assessment criteria). If SSTVs are exceeded, these lead to the gathering of additional information or further investigation to determine whether an impact has occurred and if there is a risk to the environment. It is also noted that water quality baseline data from monitoring locations which are not impacted by existing mining activity in many cases already exceed the ANZECC (2000) default guideline trigger values.

ANZECC (2000), Volume 1, Section 3.1.1.2, Step 3 states:

"*Determine appropriate guideline trigger values. Determine guideline trigger values for all indicators, taking into account level of protection. For physical and chemical stressors and toxicants in water and sediment, the preferred approach to deriving trigger values follows the order: use of biological effects data, then local reference data (mainly physical and chemical stressors), and finally (least preferred) the tables of default values provided in the Guidelines (see figure 3.1.2).*"

It is the second approach that has been adopted here (local reference data).

ANZECC (2000), Volume 1, Section 3.1.4.1 states:

"*…the best reference conditions are set by locally appropriate data. If the disturbance to be assessed has not yet occurred, then pre-disturbance data provide a valuable basis from which to define the reference condition.*"

"*In summary, the reference condition must be chosen using information about the physical and biological characteristics of both catchment and aquatic environment to ensure the sites are relevant and represent suitable target conditions. Some of the important factors that should be considered are these:*

…

- *the definition of a reference condition must be consistent with the level of protection proposed for the ecosystem in question - unimpacted, or slightly modified or relatively degraded…*"

This is also in accordance with the revised Water Quality Guidelines (ANZG, 2018) which are progressively superseding the ANZECC (2000) Guidelines. ANZG (2018) states:

"*For modified ecosystems, 'best available' reference sites may provide the only choice for the reference condition. If the test or assessment site departs in a meaningful way from the condition of the reference site or designated reference condition, then that site is assessed to be affected in some way.*"

It is clear from the above therefore, that a reference site need not be (as recommended by Huynh and Hobbs [2019]) in an "unimpacted or minimally impacted condition" with "minimal disturbance to local and upstream environments". This is particularly so in most Hunter Valley catchments (such as Big Flat Creek) where previous and on-going anthropogenic activity (e.g. agricultural land uses) has had an impact and, in the specific case of Big Flat Creek, water quality is naturally poor (refer Section 2 above and Section 2.6.2.1 in HEC [2019]). There has been no recorded discharge by Mangoola to Big Flat Creek and therefore, to paraphrase ANZECC (2000), the disturbance being assessed (the MCCO Project) has not yet occurred and therefore pre-disturbance data provide a valuable basis from which to define the reference condition.

Given the monitored substantial change in baseline water quality along the length of Big Flat Creek (refer Section 2.6.2.1 in HEC [2019]), the use of water quality data from an upstream site such as SW18 (refer Figure 3 in HEC [2019]) is not appropriate in defining the reference condition. Apart from the fact that water quality at SW18 is also affected by upstream grazing activity and historical land uses, if the SSTV for SW18 for EC (1,208 µS/cm) was adopted for Big Flat Creek downstream of the MCCO Project, this would be exceeded much of the time for existing conditions (this value is exceeded in approximately 86% of records for SW07). Similarly, it is not appropriate to use the adjacent Wybong Creek monitoring sites to define the reference condition because the prevailing water quality in Wybong Creek is significantly different to Big Flat Creek (refer Figure 9 in HEC [2019]). It is therefore considered appropriate to adopt specific trigger values for specific locations on the two creeks.

The ANZG (2018) also states:

"When using guideline values derived using reference-site data, comparison of the annual median of measured test site data is made with the guideline value."

"As a default, our recommended approach for deriving guideline values in this way is to calculate an appropriate percentile of reference-site data. Typically, the 80th percentile."

In addition to comparison of the annual median of measured data with the SSTVs, Mangoola proposes to compare the measured data with the SSTVs (80th percentile of monitored values) following each round of monitoring (i.e. monthly, flow permitting). Should an exceedance be identified, this will lead to the gathering of additional information or further investigation to determine whether an impact has occurred and if so, if it is due to the mine. Where any impact associated with the mine has been identified, the investigation will assess if there is a risk to the environment. This will allow for any potential 'spikes' or short-term water quality impacts to be identified and investigated, in addition to assessing gradual trends/changes in water quality of the surrounding surface water systems.

In conclusion, the SSTVs have been derived as the 80th percentile of monitored values, in accordance with ANZECC (2000) and supported by ANZG (2018). These will be used as a baseline against which to compare future monitored water quality.

The concentration of major ions and trace metals occurring in groundwater and surface waters within undisturbed catchments is influenced by two main processes being:

1. evaporative concentration of rainfall

2. dissolution of minerals from the rocks that interact with the waters.

The influence of each process depends on a range of factors including soils, climate, vegetation, and geology. The groundwater assessment for the MCCO Project determined, using a range of methods, that the recharge rates to the Triassic/Permian geological units are low. Under these circumstances, most rainfall moves as overland flow which is evaporated or transpired by vegetation. The latter two processes result in salts in rainfall being concentrated in the soil profile and then transported via overland flow to waterways or leached into the water table when significant rainfall events occur. As discussed above, this is a natural process observed across Australia that creates brackish and saline streams and groundwater systems.

The evaporative concentration of salts and subsequent transport to waterways from overland flow can also result in increased concentrations of trace metals in waterways. This process has led to the detection of aluminium, chromium, copper, lead and zinc at concentrations at Big Flat Creek which exceed threshold guidelines for aquatic ecosystems. The detection of trace metals in Big Flat Creek beyond threshold guidelines for aquatic ecosystems does not indicate anthropogenic contamination but rather a naturally occurring process common in groundwater settings where evaporation is high and recharge rates are low.

Applying guidelines for fresh water aquatic ecosystems under these circumstances is not considered appropriate given natural occurrence of salinity within the surface and groundwater systems. The interaction of incident rainfall with weathered rocks is also expected to release some major ions and trace metals. The Triassic and Permian bedrock is not noted for its ability to naturally store and release high concentrations of trace metals, compared to other geological environments. This combined with the generally pH neutral water quality means the geology of the MCCO Project Area is not predicted to promote the dissolution and release of high concentrations of trace metals, and therefore evaporative concentration is expected to be a significant mechanism for the occurrence of trace metals in the Big Flat Creek catchment. A geochemical assessment was done as part of the EIS and its findings concluded with the above analysis, identifying that runoff and seepage from overburden is not expected to be acidic and is not expected to contain significant metals concentrations.

Comment 11. The proponent has appropriately assessed aquatic biota in Big Flat Creek and Wybong Creek through a program of field surveys (Umwelt 2019c, Appendix F). However, no aquatic ecology assessment of the proposed Hunter River receiving environment has been undertaken.

As discussed in further detail above, the proposed development does not result in any changes to the existing approved mine water discharge facility to the Hunter River and there are no impacts resulting from the MCCO Project on the Hunter River which required assessment. It was for this reason that the aquatic ecology assessment did not include the Hunter River.

2.2 Surface Water

Question 2 – *"To what extent can decision makers have confidence in the predictions of potential impacts on surface water resources provided in the EIS, including in regard to potential steam flow losses, water quality, discharges and flooding?"*

Question 3 – *"Are the assumptions used in the modelling reasonable and is there sufficient data within the model to provide meaningful predictions, including worst-case impacts on surface water resources?"*

Comment 12. The assessment of impacts to the volume of water flow due to groundwater drawdown and reduction in catchment area is generally considered appropriate. The assessment of impacts to water quality, including from potential discharges, is incomplete. The flood modelling is considered broadly appropriate, with some outstanding issues. These themes are discussed below.

Noted.

Comment 13. The proponent provides appropriate estimates of impacts from the project on streamflow in the short and long-term. The estimates take account of impacts of reduction in catchment area arising from mine works and the reduced baseflow derived from groundwater modelling. Estimates that include cumulative impacts from the existing project are provided (HEC 2019, pp 76–78). Large cumulative reductions in flow to Big Flat Creek are expected, due to the 53% reduction in the catchment area; following rehabilitation, this catchment reduction will be 14%. The proportional reductions to the downstream Wybong Creek are smaller, due to the larger catchment size. The assessment of impacts on catchment yields for Big Flat Creek are heavy reliant on streamflow gauging recorded at GS 210088 (Dart Brook), a catchment which is more than an order of magnitude larger than the relevant reach of Big Flat Creek. It would appear that streamflows have been transposed by catchment area without regard to the non-linearities involved, and thus the IESC agrees that inferences regarding baseflow conditions in Big Flat Creek are conservatively high. This approach would be expected to over-estimate the impacts in volumetric terms, but accordingly it would be expected that the impacts of reductions in baseflow are under-estimated in terms of the proportion of time that zero flows will occur. Overall, it is considered that only a low level of confidence can be given to the estimates of impacts on local surface water yields, though the assessment of a modest reduction in streamflows in Wybong Creek appears justified.

With regard to the IESC comment relating to non-linearities in streamflow transposition between catchments, it is inferred that this refers to the difference between the differing catchment areas of Big Flat Creek and Dart Brook at GS 210088, the latter which has a catchment area of 799 km^2 compared to Big Flat Creek's catchment area of 37 km^2 (as of 2017). Transposition of AWBM parameter values (without any parameter adjustment) between catchments of significantly varying area has been shown by Boughton (2006) to reproduce streamflow yields with a high degree of reliability without non-linearity. In this case, due to the absence of reliable stream flow data for Big Flat Creek, the use of the data from Dart Brook was identified as the next best available option. It is noted that estimating stream flow for ephemeral creeks is a common requirement in a surface water assessment as most minor creeks are not often subject to flow monitoring and or may present challenges due to extended periods of no flow.

As stated in Section 2.6.1.2 of HEC (2019), there is unlikely to be any significant baseflow in Big Flat Creek and therefore the MCCO Project is not predicted to significantly impact on baseflow (refer also note on Figure 28 of HEC [2019]). The calibrated AWBM of Dart Brook at GS 210088 has only been used to assess the potential impacts of catchment area reduction on Big Flat Creek, not baseflow.

Comment 14. Discharge locations, volumes and qualities are not clearly presented in the EIS. The proponent states that they may discharge water from the Pit Water Dam into the Hunter River, in accordance with their existing licence. Licensed discharges will occur under the provisions of the HRSTS, which will manage salinity impacts. Other than HRSTS-controlled release, the proponent has predicted discharges from sediment dams, which are intended to spill periodically during rainfall events that exceed sediment dam design capacity, in accordance with 'Blue Book' (Landcom 2004) requirements for sediment dams. No spills are predicted from any other dams. The two dams, MNSD3 and MSSD3 which are the closest to the confluence of Big Flat Creek and Wybong Creek have been simulated to have a spill volume, under the predicted 95th percentile, of over 300 ML (HEC 2019, p. 100).

As discussed in **Section 2.1**, discharge from the PWD to the Hunter River under the provisions of the HRSTS is already permitted as part of the existing approved operations and EPL 12894 and no changes to this approved discharge facility are proposed as part of the MCCO Project and therefore no assessment of this facility was required as part of the EIS.

The approved infrastructure for controlled discharge to the Hunter River via the HRSTS has not been constructed. However, Mangoola has a TARP in place that will initiate construction of the discharge system from the PWD to the Hunter River if the total site water inventory exceeds a trigger value. A Mangoola operational water management system TARP governs when water should be discharged from the PWD to the Hunter River in accordance with the HRSTS once the release infrastructure is in place. Depending on climatic conditions, the need for this facility may be triggered at any time and it may be constructed and used regardless of whether or not the MCCO Project proceeds.

As noted in the IESC comment, the only other discharge locations associated with the MCCO Project are periodic overflows (spillway flows) from sediment dams. Sediment dams receive runoff from overburden emplacements (active and undergoing rehabilitation) and pre-strip areas rather than active mine areas. Six additional sediment dams (additional to those that are part of the approved mine) are proposed: three in the MCCO Additional Project Area being MNSD1, MNSD2 and MNSD3; and three in the existing Approved Project Area being, MSSD1, MSSD2 and MSSD3 (shown on Figure 16 in HEC 2019).

These sediment dams are designed to have periodic overflows and have been sized to capture runoff from a 95th percentile, 5-day rainfall event in accordance with the 'Blue Book'. The design minimum capacities of these dams are given in Table 14 of HEC (2019) and vary from 24.8 ML to 240.9 ML. These dams would be similar to existing sediment dams which are part of the existing approved Mangoola Coal Mine. These sediment dams would be integrated into the mine water management system, with pumped transfer of any accumulated water to the existing PWD in order to reinstate sediment dam storage capacity within 5 days of a rainfall event during their operational lifetime. Once rehabilitation is successfully established on mine landforms and the sediment dam catchment areas have stabilised, sediment controls would no longer be necessary and the rehabilitated area runoff can be returned to the existing catchment. This typically occurs when vegetation ground coverage exceeds 70% of the surface area and water quality monitoring shows a similar runoff quality to that of the natural catchment.

A 'buffer' volume of 569 ML would be maintained in the PWD (between 'normal' operating volume and 'high' operating volume) to store water during and following rainfall periods (refer Table 23 in HEC [2019]). Consequently, the risk of overflows that occur when the design capacity of the sediment dams is exceeded is low as indicated by modelling of the MCCO Project water management system. Model simulated overflow from the sediment dams is summarised in **Table 2.5** (note that MSSD2 is not included because overflow occurs to MSSD3). Simulation of daily flow in Big Flat Creek was undertaken using the AWBM with model parameters from calibration against flow in a nearby stream – Dart Brook – as outlined in Section 3.2.4.1 of HEC (2019). The model simulates 121 "realisations" derived using historical daily climatic data from 1892 to 2012 as outlined in Section 3.3.2 of HEC (2019).

Table 2.5 Simulated Project Sediment Dam Overflow

Storage	Percentage of Model Realizations in Which Overflow Occurs	Number of Overflow Events in Those Realizations in Which Overflow Occurs	Average Overflow Volume (ML)	Average Big Flat Creek Flow During Overflow Period (ML)
MNSD1	6%	1	37.5	747
MNSD2	<1%	1	280	1,611
MNSD3	9%	1	38.6	801
MSSD1	21%	1 – 2	30.7	456
MSSD3	21%	1 – 2	162	936

The modelled data summarised in **Table 2.5** indicates that overflow from the sediment dams should occur infrequently if at all. Modelling also indicates that the volume of overflow, should it occur, would be small in comparison to the overall flow in Big Flat Creek with considerable dilution occurring as a result.

The low risk of sediment dam overflow is reinforced by the fact that in nine years of operation there has been no overflow from the existing NOOP1 sediment dam at the Mangoola Coal Mine. The existing Southern Out Of Pit (SOOP) south and SOOP north sediment dams are known to have exceeded their design sizing criteria with overflow (via spillway flow) to an unnamed tributary of Sandy Creek on only one occasion following a rainfall event on 30 March 2019. Rainfall of 88 mm was recorded in a 24 hour period leading up to this event, which exceeded the sediment dam design capacity of a 5 day 95th percentile event (64.7 mm). Recorded rainfall intensity for durations between 3.5 hours and 8 hours exceeded a 2% annual exceedance probability. This event was reported to the NSW EPA, with no monitored deterioration in water quality from upstream to downstream in the receiving creek. Recorded sediment dam pH during the overflow event was near neutral, while recorded electrical conductivity and total dissolved solids values were near to or below the minimum values recorded in routine water quality sampling for the period of available data for these two sediment dams (refer Table 10 in HEC [2019]).

During any unlikely overflow events, the concentration of environmentally significant constituents in the sediment dams is likely to be low because, during such events, inflow from catchment surface runoff will predominate over baseflow (seepage). Surface runoff from overburden and rehabilitated catchment areas would be less likely to contain elevated concentrations of environmentally significant constituents than seepage which has the potential to leach such constituents from the overburden. An increased rate of seepage could be expected following such an event however this would be managed by pumping to the PWD.

Therefore, the likelihood of any impact of sediment dam discharge on downstream water quality is considered low.

No spills from any other (non sediment dam) storages are forecast and there are no spills forecast from dams containing mine water.

Comment 15. Impacts from controlled and uncontrolled discharges are not discussed in the EIS. Any impacts from discharge into the Hunter River will be cumulative with existing impacts from agriculture and mining and these potential impacts should be discussed in the context of current and future monitoring. The IESC notes that while the HRSTS effectively manages impacts from salinity, it is not intended to manage other contaminants. The proponent should provide an assessment of all potential impacts from discharges, including from metal contaminants and cumulative impacts.

As discussed in response to Comment 1, discharge from the PWD to the Hunter River under the provisions of the HRSTS is already permitted as part of the existing approved operations and EPL 12894 and no changes to this approved discharge facility are proposed as part of the MCCO Project. The currently approved facility will be used, if required, as part of the MCCO Project.

Whilst no changes to the approved discharge facility are proposed as part of the MCCO Project, further discussion of possible discharge requirements are provided below.

Controlled discharge from the PWD via the HRSTS will comprise a very small component of the flow in the Hunter River (as governed by the discharge rules of the HRSTS) and dilution will be substantial. Water balance model results (HEC, 2019) provide forecast annual release volumes. With reference to Figure 42 in HEC (2019) the forecast median annual controlled discharge volume varies from zero to 120 ML. This compares with a median annual flow recorded in the Hunter River at Denman of approximately 181,000 ML, meaning the forecast maximum median discharge represents 0.07% of the recorded median annual river flow. Similarly Figure 42 in HEC (2019) indicates a 95^{th} percentile annual controlled discharge volume of between 558 ML and 1,469 ML. This compares with a 95^{th} percentile annual flow recorded in the Hunter River at Denman of approximately 660,000 ML, meaning the forecast 95^{th} percentile discharge represents between 0.08% and 0.22% of the recorded 95th percentile annual river flow.

It is recognised that the above analysis does not allow for the fact that controlled discharge does not occur on each day and that there are substantial periods of river flow when controlled discharge does not occur. Therefore simulated controlled daily discharge volumes were sourced from the MCCO Project water balance model (refer HEC [2019]) in order to calculate the percentage of flow in the Hunter River at Denman that these forecast discharges would represent for each discharge day – i.e. the forecast discharge dilution.

A modelled mine life realisation corresponding to the median overall total controlled discharge volume was selected for illustrative purposes. For each simulated day, the controlled discharge volume was compared with the flow rate for the Hunter River at Denman. Discharge was found to occur only on 1.6% of days on average. For the 12¼ year simulation period, on average the controlled discharge volumes equated to 3.9% of river flow on those (rare) discharge days. On a single day selected from the model output with a ‘typical’ (median) discharge volume, the discharge equated to less than 0.1% of river flow.

The above illustrates that any contaminants present in the PWD at the time of controlled discharge would therefore be highly diluted by flow in the Hunter River. Further, it is noted that any discharges would occur within the rules of the HRSTS and in compliance with an EPL issued by the NSW EPA which collectively ensure that strict controls are in place for any discharges to minimise the potential for impacts.

Comment 16. The northern upslope diversion on the proposed project will discharge directly into Big Flat Creek (HEC 2019, Figure 15, p. 57). The south-western diversion would include a culvert crossing under the realigned Wybong Post Office Road and a silting basin further to the south-west, with a discharge to an existing natural drainage (HEC 2019, p. 66). The northern upslope diversion discharges upstream of the project area into Big Flat Creek, which could improve the water quality, as the monitoring data has highlighted high electrical conductivity (EC) values in Big Flat Creek upstream of the project area.

Noted.

Comment 17. It is not clear if the proponent has constructed the approved discharge facility under the EPL 12894 (HEC 2019, p. 88).

As discussed in response to Comment 9, the discharge facility approved as part of PA 06_0014 (as modified) and licensed under EPL 12894 has not yet been constructed. As described in the sections above, Mangoola has a TARP in place that will initiate construction of the discharge system from the PWD to the Hunter River if the total site water inventory exceeds 2,250 ML.

Comment 18. The proponent has stated that they may use dust suppressants in place of water during dry years (HEC 2019, p. 76). The proponent has not stated what chemicals these agents are, or provided any analysis of the risks to water quality from their use.

As indicated in Section 3.3.5.3 of HEC (2019), dust suppression agents would be used to reduce the demand for haul road dust suppression water rather than "in place of water during dry years" as stated in IESC Comment 18. Dust suppression agents are added in small quantities to water trucks to facilitate their application.

Mangoola currently proposes the continued use of the following two proprietary dust suppression products, supplied to Mangoola by Reynolds Soil Technologies (RST):

- "Kickstart Dynamic": a blend of surfactants used as a surface pre-treatment to increase the efficacy of the subsequently applied product; and
- "RT9 Dynamic": a blend of polymers and surfactants used to improve water penetration, bind fine dust particles and consolidate haul road surfaces.

Safety data sheets provided by the supplier indicate that the two products (in their undiluted forms) are classified as either "non-hazardous" to aquatic ecology or were undetectable in ecotoxicity testing.

Both products have been in use at NSW mines for approximately 15 years and are added at low rates (i.e. highly diluted) to water trucks, with "Kickstart Dynamic" typically experiencing a 1:5,000 dilution while "RT9 Dynamic" is normally diluted at 1:3,000. Typical usage as part of the existing operations by Mangoola averages 7,000 litres per month of "RT9 Dynamic" and 1,000 litres per month of "Kickstart Dynamic". The products are delivered to site in sealed 1,000 litre containers and stored in bunded areas near water truck fill points, with a dosage system implemented to inject the products into the water truck filling system.

These dust suppression agents are typically only used by Mangoola from September through to April, as during winter months and during/following rainfall there is little or no usage requirement. This practise is planned to continue for the MCCO Project.

It should be noted that the dust suppressants would be applied to a very small proportion of the site catchment area, in a highly diluted form for a portion of the year and that runoff from the majority of haul road areas would report to the mine water management system (and not to sediment dams). The risk of any runoff from haul roads which may contain the highly diluted dust suppression agents migrating to nearby creeks is considered low and (given the foregoing) the corresponding risk to creek water quality from the use of such products on haul roads is considered negligible.

Comment 19. The proponent should provide an assessment of the impacts of water discharge that includes: expected quantity, quality and timing of discharges together with assessment of the likely impacts and any proposed mitigation measures (such as water treatment). This may present an ongoing local erosion risk, with implications for downstream water quality (see paragraph 24).

As discussed in response to Comment 1, discharge from the PWD to the Hunter River under the provisions of the HRSTS is already permitted as part of the existing approved operations and no changes to this approved discharge facility are proposed as part of the MCCO Project and therefore no assessment of this facility was required as part of the EIS.

Licensed discharge via the HRSTS from the PWD will be subject to the requirements of the HRSTS and EPL 12894, which include limits on pH and total suspended solids. It is anticipated that EPL 12894 will be varied when the MCCO Project is approved, however, no changes to the current discharge arrangements are proposed. The discharge outlet will be designed with appropriate rockfill, other armouring or appropriate design to control the potential for erosion. If the water quality in the PWD does not meet these criteria, discharge would not occur or the water would be treated prior to discharge in order to meet these criteria.

As discussed above, with regard to overflows from sediment dams, overflow via the spillways of the existing SOOP south and SOOP north sediment dams occurred on one occasion on 30 March 2019, with no monitored deterioration in water quality from upstream to downstream in the receiving creek (Sandy Creek). Spillways for proposed sediment dams for the MCCO Project (i.e. MNSD1, MNSD2, MNSD3, MSSD1, MSSD2 and MSSD3) would be constructed as wide channels complete with rockfill or other suitable armouring and erosion protection to control the potential for erosion associated with spillway flow. As an example, the rockfill armoured spillway of the existing NOOP1 sediment dam is shown in **Plate 1** below.

Plate 2 shows the downstream end of the spillway rockfill armouring which discharges to a level spreader pond, which in turn overflows through an area of logs that afford additional erosion protection. Further protection is provided by hay bale sediment fencing downstream of the logs. Similar protection would be provided for the proposed MCCO Project sediment dams.

Plate 1: NOOP1 Sediment Dam with Rockfill Armoured Spillway

Plate 2: NOOP1 Sediment Dam Spillway Outfall with Level Spreader and Logs

> **Comment 20**. Flood modelling shows areas of high velocity in Big Flat Creek following infrastructure installation. This may present an erosion risk and may adversely impact on the aquatic biota from sediment deposition.

These localised areas would be monitored during the operational life of the MCCO Project in order to assess the need for mitigation measures such as armouring. The combination of appropriate design, armouring if required and monitoring is considered adequate by HEC to mitigate the risk of erosion as a result of the MCCO Project. Further details are given in **Section 2.5** (response to Comment 50).

> **Comment 21**. The project will involve changes to the catchment and building of infrastructure that will alter surface water flow, including during floods. The assessment of impacts on flood regime are made using simulation models of hydrologic and hydraulic behaviour that are widely adopted and well proven, and the adopted approaches to characterise flood risk appear consistent with current guidelines. It is not clear how the parameters of the models have been identified and verified, and thus there is a low level of confidence in the absolute estimates of flood risk. However, given the nature of the adopted approaches, a good level of confidence can be given to estimates of the relative impacts of the proposed mining works on flood risk compared to existing conditions.

Comment noted. Hydrologic model parameters including storm design loss rates and model routing parameters were derived from guidelines in ARR 2016 (refer HEC [2019], Section 2.7.2). As is standard and common practice in flood modelling, hydraulic model roughness parameters were derived from interpretation of aerial and terrestrial photographs and literature guidelines as stated in HEC (2019) Section 2.7.3 – guidelines included Chow (1959). It should be noted that the purpose of the flood modelling was to assess the relative changes that are likely as a result of the MCCO Project rather than detailed infrastructure design.

It is further noted that as part of the response to the submission made on the MCCO Project by the NSW DPIE Biodiversity Conservation Division (BCD), a peer review of the flooding assessment was undertaken and in response to this review and the comments from BCD, the flooding assessment was updated. The updated flooding assessment is provided as part of the RTS report.

> **Comment 22**. The proponent believes that due to the location of the existing Mangoola project site and proposed site, there is little effect on flood levels in Big Flat Creek 1.3 km upstream from the confluence with Wybong Creek. As noted in above, conclusions regarding such relative impacts are considered reasonable.

Noted.

> **Comment 23**. The placement of the flood levee could potentially protect the water storage facilities, (MNSD1 and MNSD2) as part of the proposed project, although this issue is not discussed in the EIS. As elevations of these two water storage sites are not provided, it is difficult to assess the risk of impacts from overflow events.

The exact location and elevation of sediment dams will be determined as part of MCCO Project detailed design. It is intended that the sediment dams be located within the MCCO Additional Project Area such that the proposed flood levee was located between the dams and Big Flat Creek, where the presence of a levee was required to protect against flood inundation. In such an instance overflow from the sediment dams would be managed using controls such as flood gates (subject to the detailed design), which allow flow in a one-way direction only, with appropriate rockfill or similar erosion protection integrated into the design.

Comment 24. Big Flat Creek has highly incised channels downstream from the proposed haul road crossing with high banks in areas ranging from 2.5 to 4 m high (HEC 2019, Attachment A, p. A28-A32). Potential channel stability issues and changes in the velocity in Big Flat Creek have been considered by the proponent, using the 1:20 AEP (greatest peak flow rate) (HEC 2019, p. 67). Results from the TUFLOW modelling predicted that the proposed works would increase flow velocities upstream of the proposed haul crossing. However, the simulated distribution of 1:20 AEP peak flow velocities in Big Flat Creek for a fully developed project shows velocity readings of 3-4 m/s in the areas where there are high banks and highly incised channels downstream of the proposed haul crossing (HEC 2019, Figure 25, p. 72). The higher velocity in this area could also be due to the outlets of the culverts. The proponent should clarify the cause of this area of high velocity and whether any mitigation measures can be provided to avoid erosion impacts.

The areas of predicted 3-4 m/s peak velocity in a 5% AEP occur well downstream (approximately 300 m) of the proposed culverts (refer Figure 25 in HEC [2019]). Further, as indicated in Figure 26 of HEC (2019), no or negligible peak velocity increase is predicted in a 5% AEP in this reach of Big Flat Creek with high bank areas. The high velocity is therefore associated with the existing channel geometry and is not as a result of the MCCO Project. Erosion protection upstream and downstream of the proposed culverts forms part of the proposed design – as described in Section 3.2.2.3 of HEC (2019). Monitoring of the culvert inlet and outlet for erosion would be included in the revised Mangoola Erosion and Sediment Control Plan prepared as part of the implementation of the MCCO Project.

2.3 Groundwater

Question 4 – *"To what extent can decision makers have confidence in the predictions of potential impacts on groundwater resources provided in the EIS, including in regard to groundwater inflows, potential impacts on private bores, change in flux to Wybong Creek Alluvium and salt balance?"*

Question 5 – *"Are the assumptions and the range of scenarios applied in the groundwater modelling reasonable and is there sufficient data within the model to provide meaningful predictions, including worst-case impacts on groundwater resources?"*

Question 6 – "*Does the EIS provide an adequate assessment of cumulative impacts to water resources?"*

Comment 25. The numerical groundwater model makes good use of available data and incorporates thorough (Monte Carlo-based) uncertainty analysis. The results from the uncertainty analysis are presented in a clear format and should be a useful tool for decision-makers. The inclusion of parameter identifiability values goes beyond standard practice and provides useful information on model performance. The features of the groundwater modelling described below help to provide further confidence in model predictions.

Noted.

Comment 26. The model provides a clear indication of cumulative impacts (see further discussion at paragraphs 30–31).

a). The proponent presents good arguments that the Mount Ogilvie Fault is unlikely to have any material effect on model predictions. Little drawdown is predicted to extend as far as this fault. Additionally, the proponent provides additional model scenarios including the fault in the model with two different sets of hydraulic parameters. This showed negligible influence on model predictions.

b). There is a relatively good dataset for calibration of the model for hydraulic conductivity across most of the area of interest; however, the calculated recharge values require further explanation. Groundwater monitoring for the existing mine provides a reasonable spatial coverage except to the northwest of the project. The monitoring of the existing mine's drawdown provides a considered analogue for the response of the groundwater system to the perturbation that will be induced by the project.

c). The model shows reasonable calibration performance. The root mean square error for groundwater heads was 6.06 m, with a scaled root mean square error of 4.9% (AGE Consultants 2019, Appendix A, p. 21). For comparison, the Australian Groundwater Modelling Guidelines, (Barnett et al. 2012), suggest this should be <10%. Additionally, inflows to the existing mine were within 25% of values estimated from sump pumping and a water balance (AGE Consultants 2019, Appendix A, p. 33). Given that there is considerable uncertainty in the groundwater inflow values, the IESC agrees with the proponent's assessment that this represents an acceptable agreement.

d). There is general agreement between calibrated hydraulic conductivity values and those estimated from site investigations (compare AGE Consultants 2019, pp. 71–77 and AGE Consultants 2019, Appendix A, p. 27). The site investigations included several rounds of testing and included slug, packer and core testing.

The sub-points a), c) and d) in comment 26 are noted with a detailed response providing further explanation with regard to the calculation of recharge rates provided below in response to sub-point b).

Recharge was conceptualised as primarily occurring through diffuse infiltration of rainfall through the soil profile. Recharge rates cannot be directly measured and were therefore estimated using a number of different methods as described within appendix A2.4.1 of AGE (2019). The following three methods were used to estimate recharge rates:

- a soil moisture model which utilised daily rainfall and evaporation records to determine the timing of recharge events by correlating periods of excess soil moisture with rising groundwater levels
- a simple Soil & Water Assessment Tool (SWAT) model for the catchment that used soil, land use, topography and local weather data to calculate recharge on a catchment scale
- a chloride mass balance equation for all bores with chloride ion results. The method assumes that the only source of chloride to the system is from evaporated rainfall and dryfall. Therefore, the more concentrated the observed chloride the less recharge has entered the system.

The range of methods provided multiple lines of evidence to guide recharge rates adopted during the numerical modelling process. The numerical model was calibrated by history matching to reproduce the groundwater levels and drawdown observed in the rock mass surrounding the mine. As mentioned in the IESC comments, the hydraulic conductivity dataset is relatively good across much of the area. Given that hydraulic conductivity and recharge rates are interlinked, having good hydraulic conductivity and water level datasets reduces the likelihood that highly inappropriate recharge rates would be adopted during the calibration process. The adopted recharge rates determined during the calibration process were also compared with recharge rates from other models across the Hunter Valley to ensure they were within a plausible range.

Comment 27. Some additional information that could help to further increase confidence in groundwater model predictions is suggested below. These would particularly add confidence that modelling and associated uncertainty analysis captures worst-case scenarios.

a) The proponent maps a number of faults in the project area. These faults are considered in the groundwater assessment as being unlikely to affect groundwater flow, given the small cross-sections of the fault damage zones and potential for fault gouge sediment to seal the faults. No information on fault throw or type is provided. Additional justification should be provided for the assumed behaviour of faults in the project area, particularly Big Flat Creek Fault. Given that Big Flat Creek appears to be partially controlled by this fault, further information of this fault's geological and hydrogeological characteristics is important, particularly in regard to future impacts on baseflow. This discussion should address the potential for the fault to provide a pathway for baseflow in the creek or for leakage to deeper aquifers. Additional groundwater sensitivity scenarios, similar to that conducted for the Mount Ogilvie Fault, may also help to justify the conceptualisation of faults within the project area.

b) The proponent estimated storage parameters (specific yield and specific storage) from Young's Modulus and porosity, rather than from more traditional methods such as pump tests. This approach is a reasonable first approximation if based on several rock core measurements.

i. In situ measurement of storage and geomechanical properties for each hydrostratigraphic unit could be obtained from advanced analysis of high frequency groundwater level data (McMillan et al 2019). This approach could be considered for inclusion in ongoing updates to the model over the life of the mine.

c) Geological cross-sections, that are drawn to scale, should be provided to support the geological conceptualisation. The outline of geology includes two cross-sections that are labelled 'conceptual interpretation – not drawn to scale' (AGE Consultants 2019, pp. 30–31). The IESC does not consider a conceptual cross-section to be a suitable basis for environmental impact assessment.

d) There are only two bores to the northwest of the project area, with one no longer monitored (AGE Consultants, Appendix A, p. 19). This means that confidence in predictions is lower in this area. This shortcoming does not have major consequences for confidence in the model's predictions, as the most likely receptors to be impacted are not in this direction, but rather to the southeast and southwest of the project area.

Response to Comment 27a)

The Big Flat Creek fault was identified in early investigations using ground and aeromagnetic surveys as a normal fault. Displacement was later interpreted from magnetic surveys as approximately 10 m downthrow to the northwest which is not considered significant. The geophysical interpretations have been correlated against widely spaced exploration drilling, however the exact locations and nature of the structures have not been proven as access to the areas around Big Flat Creek is restricted due to the presence of cultural heritage areas and established offset areas associated with the existing operation. It is noted that the proposed additional mining area does not intercept the fault.

The groundwater assessment for the EIS included a number of vertical sections running across Big Flat to illustrate water level trends in the multilevel monitoring bore network (Section 5.2.2.3 figures 5.11 to 5.15 in AGE 2019). These cross sections were updated as part of this response document to illustrate the relationship between Big Flat Creek, measured groundwater levels and the inferred faults adjacent to the MCCO Project Area. The location of the cross sections in relation to the inferred faults and the MCCO Additional Project Area is shown on **Figure 2.4**. The monitored groundwater elevations for each cross-section and the inferred faults are shown in **Graph 2.2** to **Graph 2.5**.

The updated graphs show that whilst faults are inferred to be generally aligned along the route of Big Flat Creek, there are no apparent step changes in groundwater levels measured in monitoring bores close to the inferred location of the faults. If the faults were acting as barriers to groundwater flow there would be potential for different groundwater levels to be measured either side of the faults. The water level monitoring generally shows depressurisation from the existing approved operations extends under Big Flat Creek to the north. Some sites show similar depressurisation on the southern and northern sides of Big Flat Creek (refer to **Graph 2.3**) suggesting that structures are not a significant influence on the hydrology of Big Flat Creek.

Section 5.2.2.3 in AGE (2019) also describes how high hydraulic pressures prior to mining occurring below the water table were higher under Big Flat Creek. The higher pressures and upward gradients identified in the deeper monitoring bores under Big Flat Creek would not have expected to have established if a permeable fault was present as it would readily transmit groundwater and resulting in water pressure dissipating through the fault and lowering water levels. There was no continuous baseflow in Big Flat Creek prior to mining below the water table that would also support the potential presence of a transmissive fault. Therefore, the hydrogeological information does not indicate the presence of either a permeable or impermeable fault influencing Big Flat Creek and the underlying groundwater system. It is noted that if the fault was a conduit rather than a barrier then drawdown would likely be less than predicted in the EIS as the fault is not proposed to be intercepted by mining.

Given these lines of evidence the fault does not play a significant role in the groundwater regime and it was not explicitly modelled as a defined hydrogeological unit with higher or lower hydraulic properties in the groundwater model.

The numerical model assumed the main coal seams were continuous across the fault which is a conservative assumption that allowed drawdown impacts from the numerical model to connect between the mining areas and depressurised strata under the creek, as has been observed in the data. Additional groundwater sensitivity scenarios were not completed specifically for the Big Flat Creek fault as the range of appropriate values to use for the fault properties is uncertain and the outputs would be highly speculative. The current model grid and calibrated parameters are capable of reproducing groundwater level trends and drawdown due to mining without directly representing the fault in the model. Therefore, as there is no evidence that the fault plays a significant role in the groundwater regime it did not warrant inclusion in the numerical model. This approach concurred with the conclusions of the peer review conducted by Dr Noel Merrick that supported the approach to modelling the groundwater regime and geological structures. If future monitoring data showed a diversion from the current model predictions then the conceptualisation and modelling would be reviewed and remodelled as required.

Response to Comment 27b)

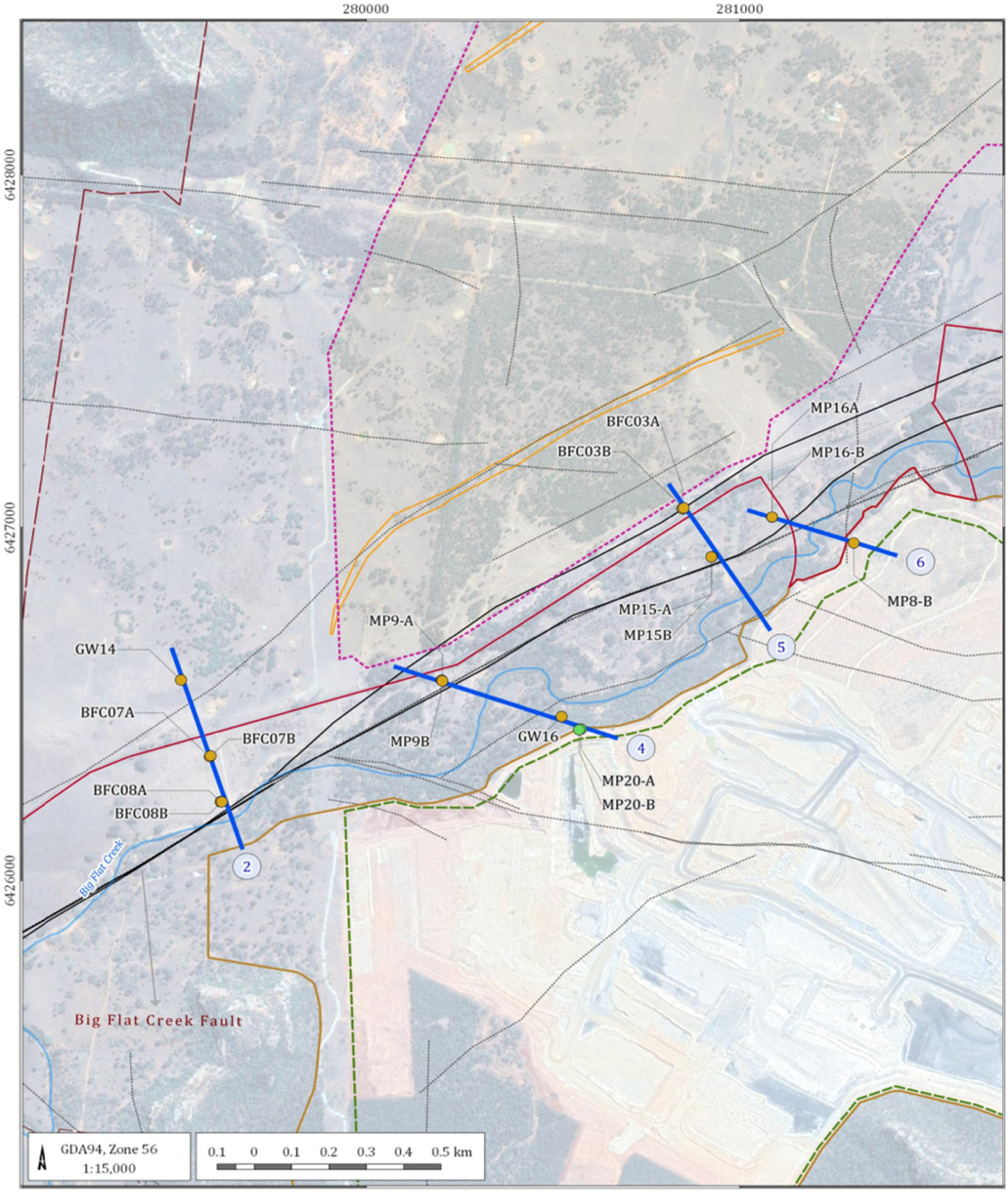
Noted.

Response to Comment 27c)

These sections provided within AGE (2019) were mostly to scale but were labelled 'not drawn to scale' because the thickness of coal seams were adjusted slightly for visual clarity. The locations of the conceptual cross sections for the MCCO Project and its surrounds are shown on **Figure 2.5**. The geological cross sections included within AGE (2019) have now been updated with vertical and horizontal scale bars and are provided in **Figure 2.6** and **Figure 2.7** below. Whilst the coal seams are not exactly to scale in these figures, the scale bar provides an indication of elevation and depth.

Response to Comment 27d)

Noted.



LEGEND

- Cross section lines
- Drainage
- MCCO Project Area
- MCCO Additional Project area
- Proposed Additional Mining Area
- Approved Mangoola Coal Mining Area
- Approved Mangoola Coal Mine Disturbance Area

Proposed GWMP network

- 2014 GWMP - still active
- 2019 GWMP - still active

Surface geology

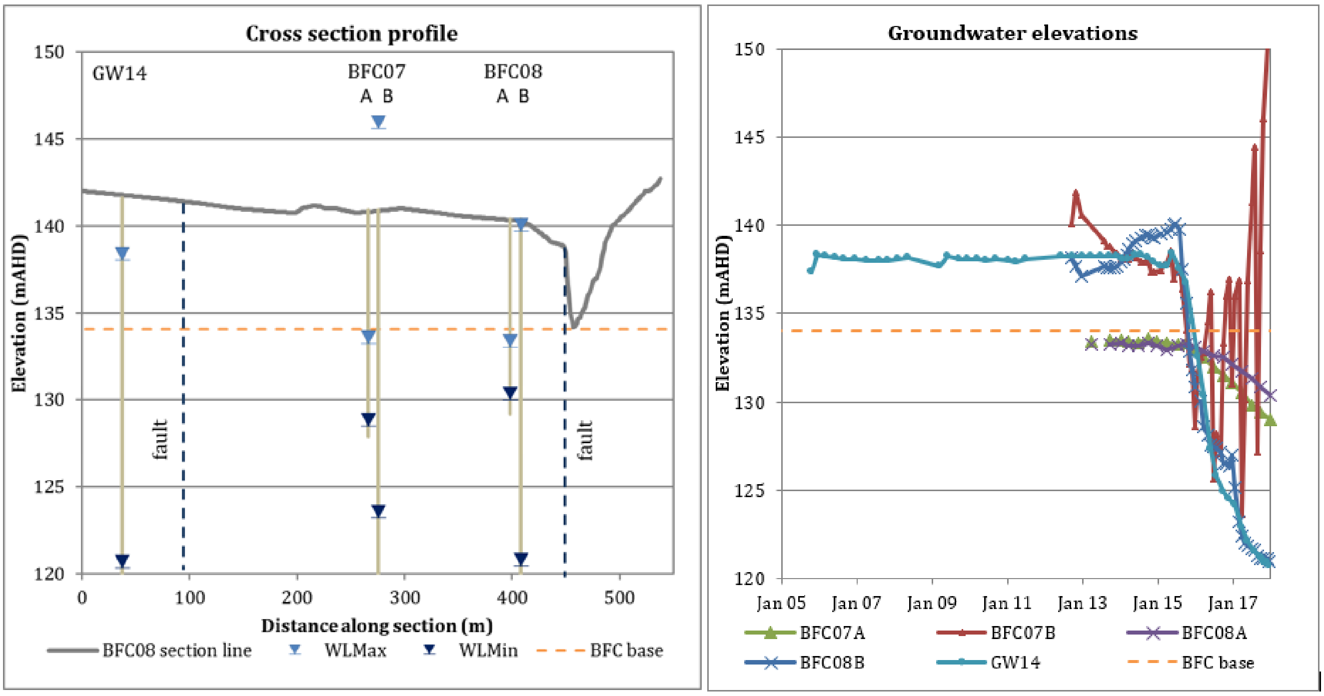
- Fault
- Dyke

(6) Section #

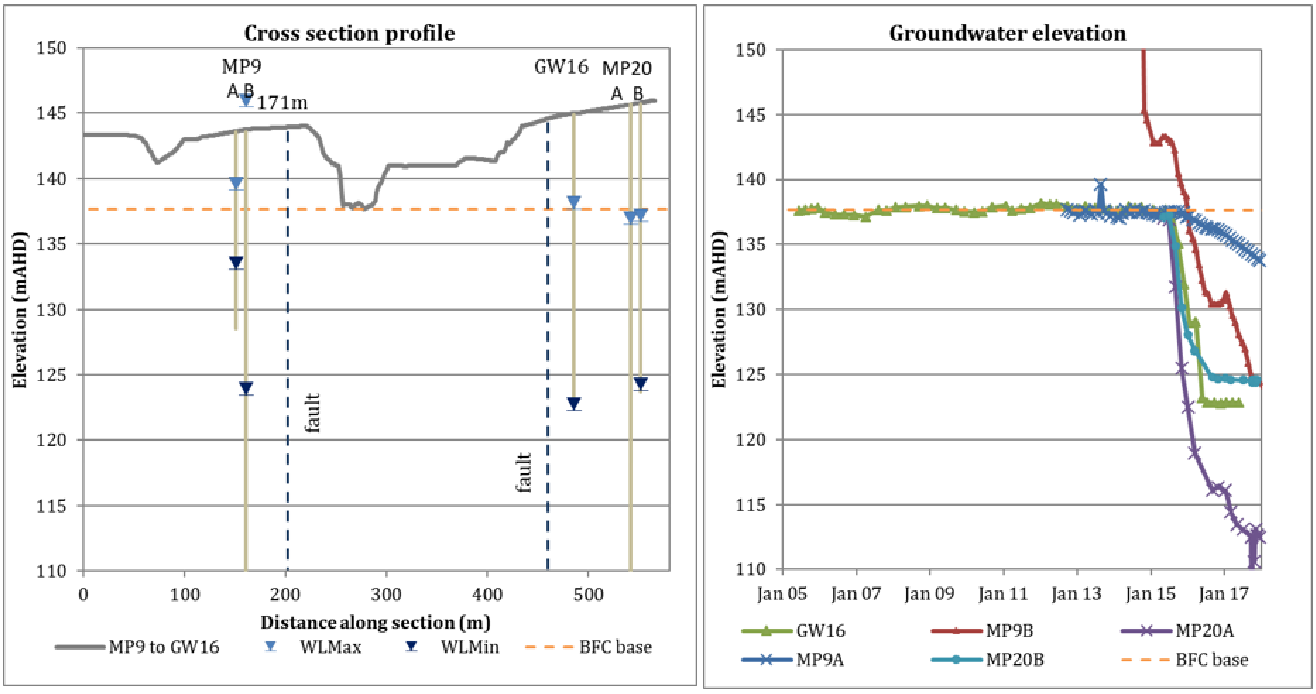
Image Source: AGE (2019)

FIGURE 2.4

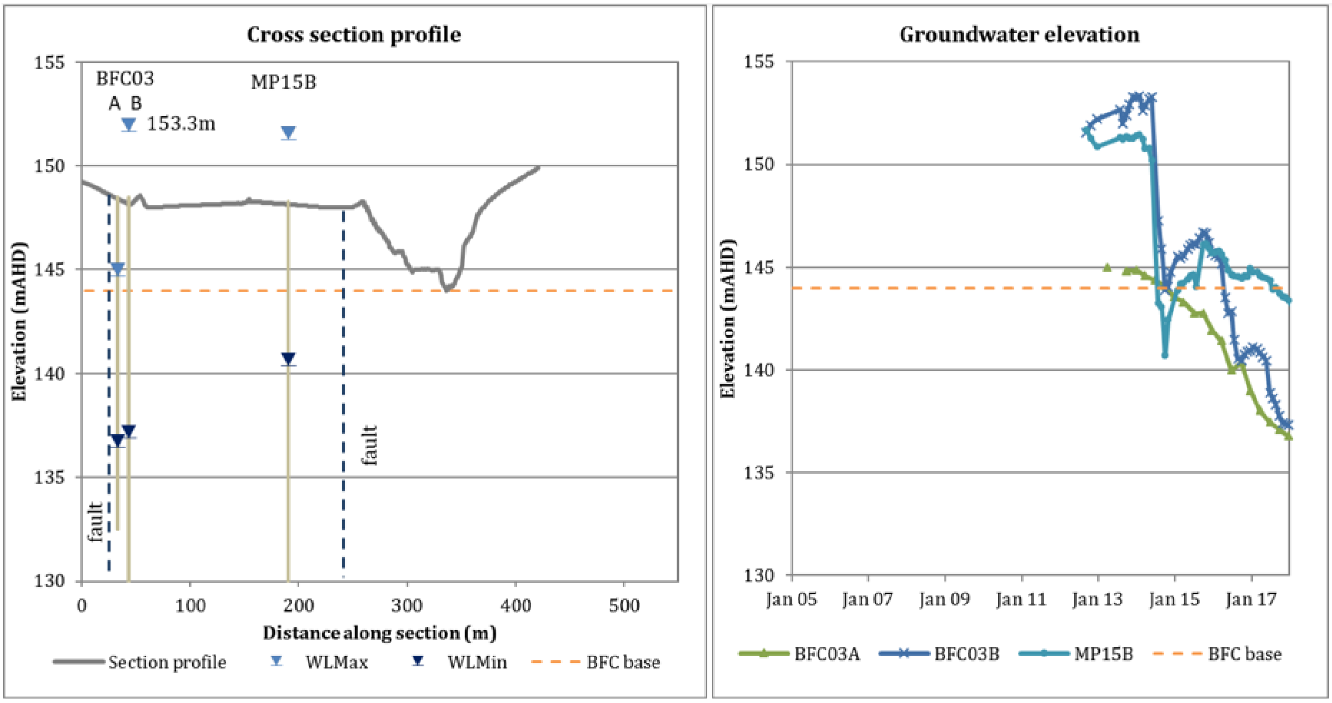
Conceptual Overview of Big Flat Creek Fault Cross Sections



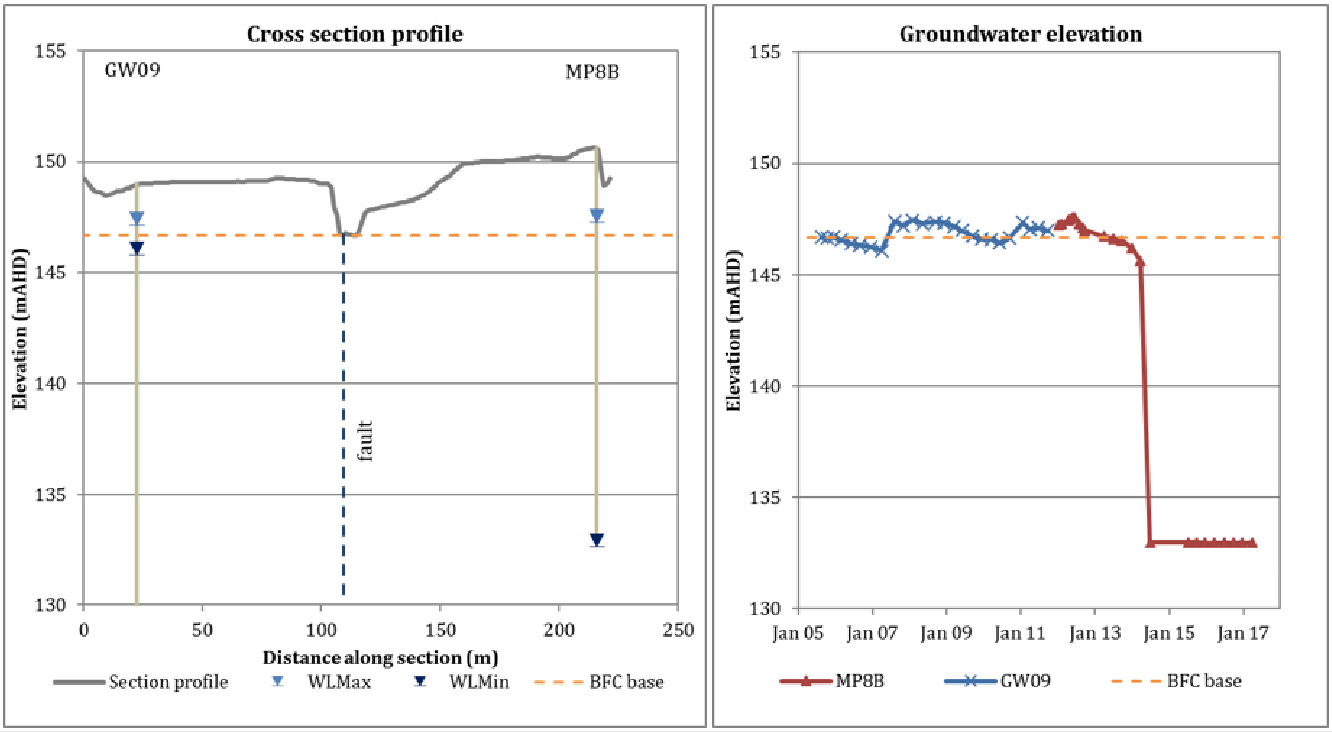
Graph 2.2 Cross Section 2 of Big Flat Creek fault



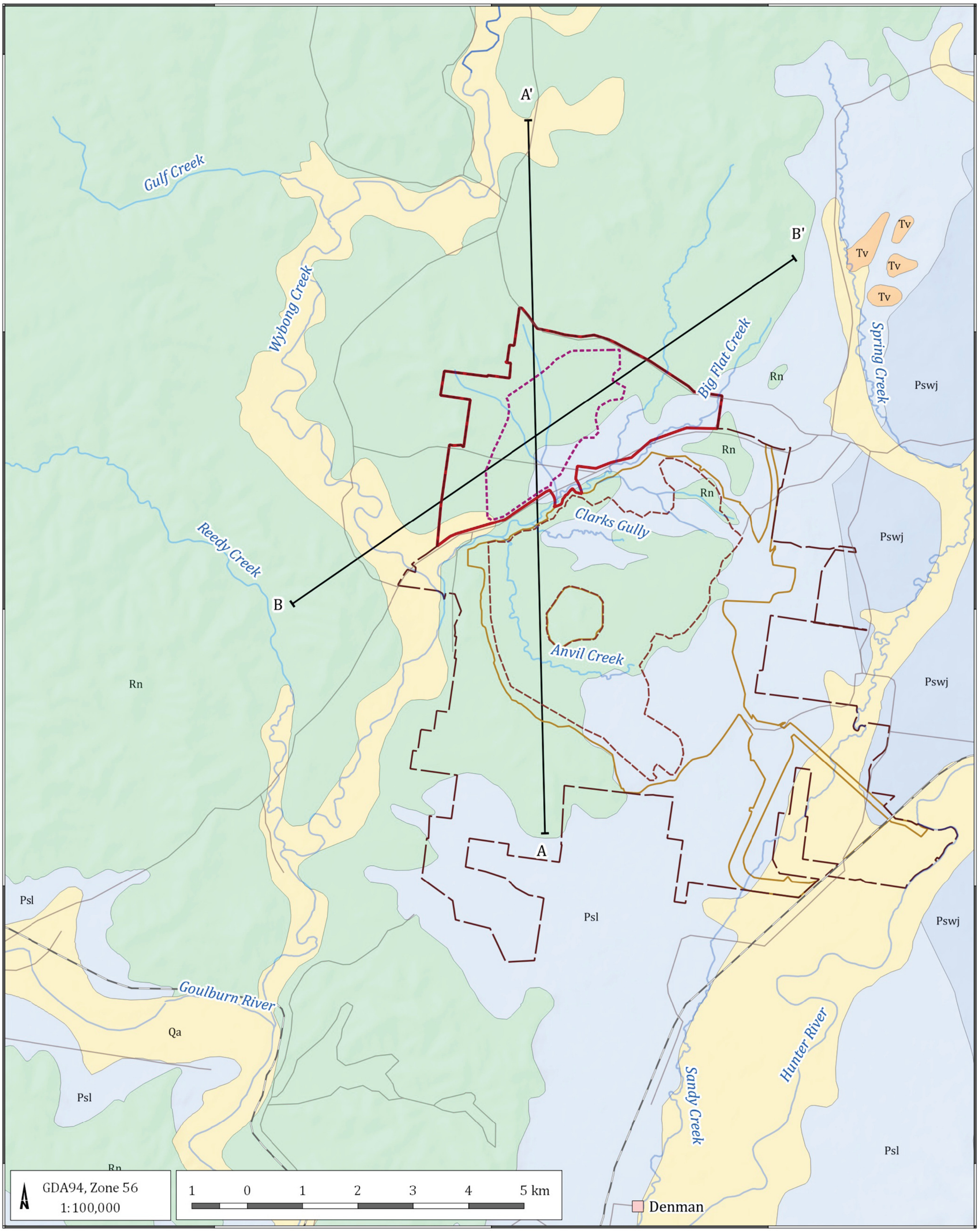
Graph 2.3 Cross Section 4 of Big Flat Creek fault



Graph 2.4 Cross Section 5 of Big Flat Creek fault



Graph 2.5 Cross Section 6 of Big Flat Creek fault



LEGEND

- Populated place
- MCCO Project Area
- MCCO Additional Project area
- Approved Mangoola Coal Mining Area
- Approved Mangoola Coal Mine Disturbance Area
- Proposed Additional Mining Area
- Road
- Rail
- Drainage

Surface geology

(Hunter Coalfield Regional 1:100k Geology map)

- Qa - Quaternary Alluvium
- Tv - Tertiary Basalt
- Rn - Triassic Narrabeen Group
- Psl - Permian Newcastle Coal Measures
- Pswj - Permian Denman Fmt, Jerrys Plains Subgroup
- Cross section lines

Image Source: AGE (2019)

FIGURE 2.5

Location of Conceptualised Cross Sections for the MCCO Project

File Name (A4): R25/4004_456.dgn
20200214 9.51

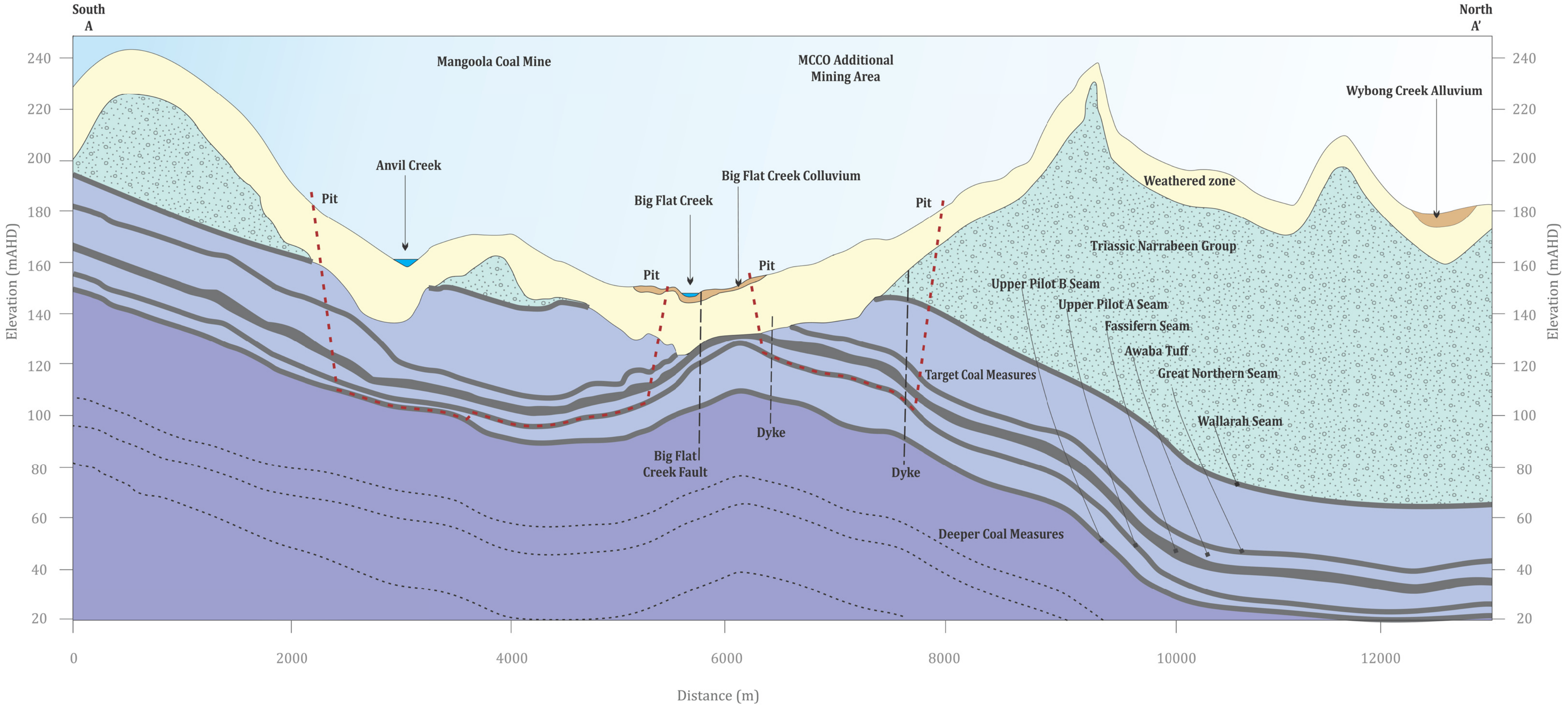


FIGURE 2.6

Conceptualised North-South Geological Cross Section

Image Source: AGE (2020)

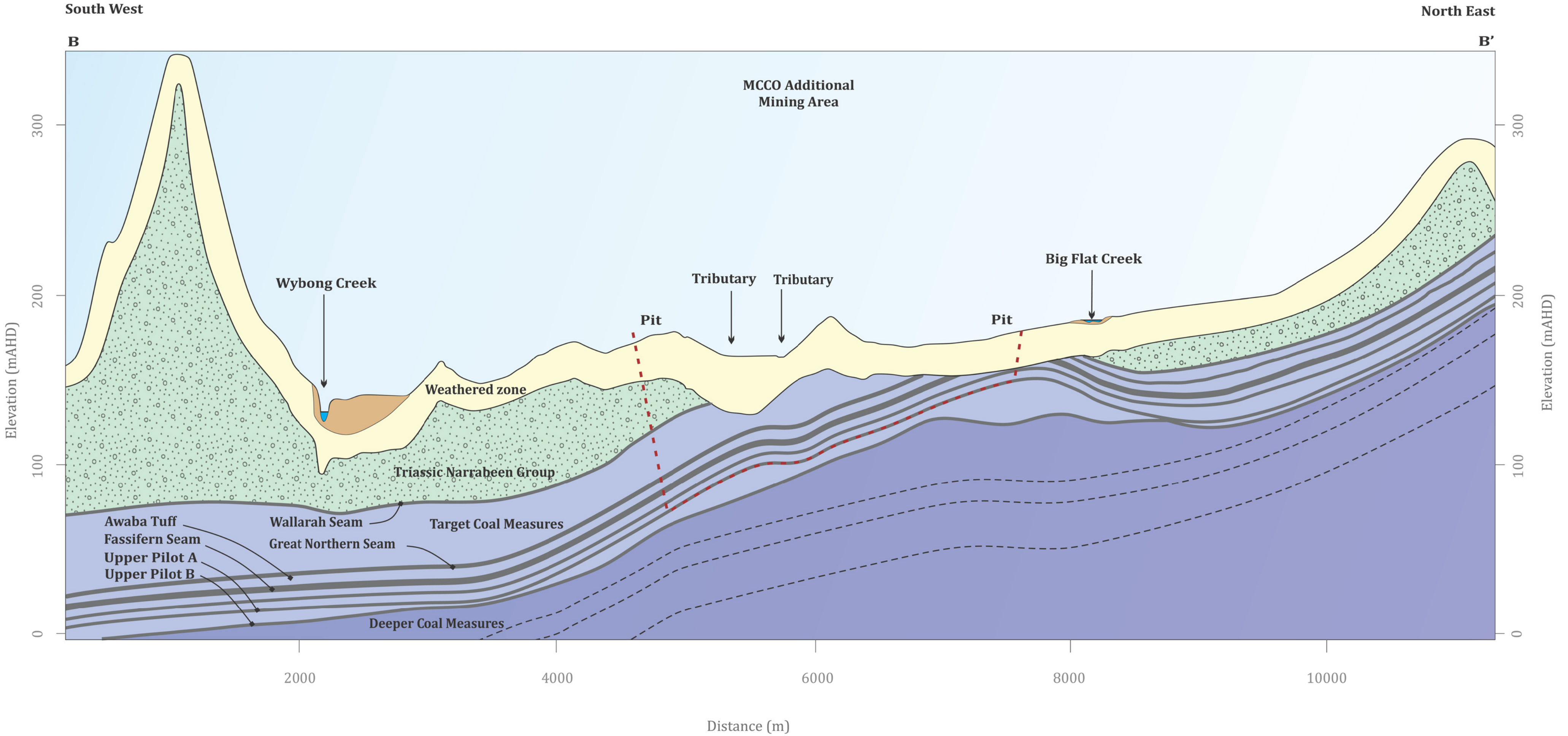


FIGURE 2.7

Conceptualised South-West - North-East Geological Cross Section

Image Source: AGE (2020)

File Name (A4): R25/4004_450.dgn
20200213 10.14

Comment 28. Additionally, some information in the groundwater assessment should be more clearly presented.

a. Maps of groundwater drawdown should be provided for the 0.2m contour, since small changes in groundwater levels may impact some GDEs, especially from a 'worst-case' impact perspective. These maps should also show uncertainty bounds for this contour. The EIS only presents drawdown to 1 m (Umwelt 2019c, pp. 42–43) and the uncertainty analysis reports confidence intervals for 2 m of drawdown (AGE Consultants 2019, Appendix A, pp. 53–54).

The areas where the modelling indicates potential for incremental drawdown from the MCCO Project to exceed 0.2 m in alluvium, colluvium and regolith layers are presented in **Figure 2.8**. The areas of drawdown were filtered to remove any areas where the water table was greater than 10 m below the surface, and remove scenarios where drawdown was ranked as unlikely or very unlikely. This incremental 0.2 m drawdown contour mapping has been used in response to the IESC comments on GDEs (see response to Comment 37).

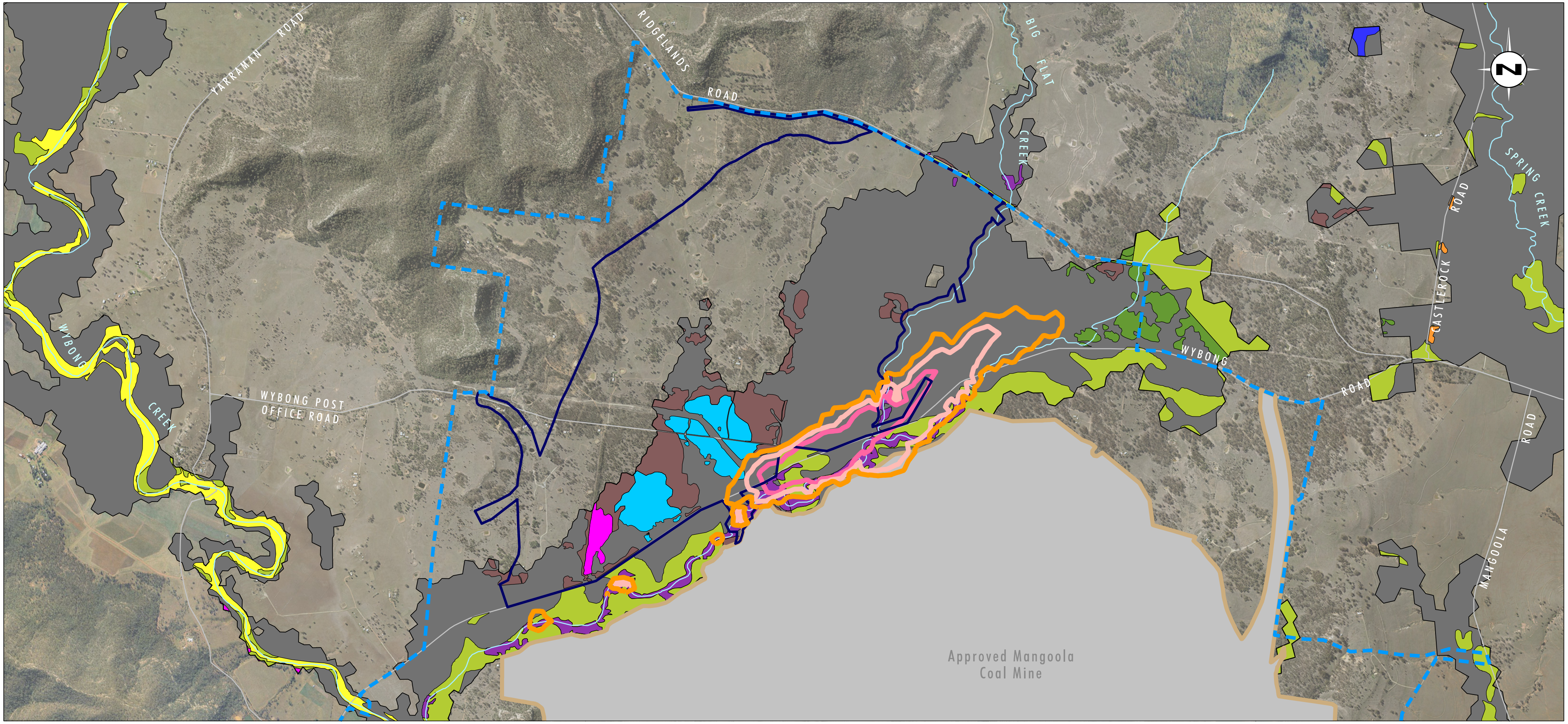


Image Source: Glencore (April 2018)
Data Source: Glencore (2019), AGE (2019)

0 0.5 1.0 2.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Disturbance Area
- Groundwater Within 10m of Surface

Groundwater Drawdown Contours Layer 1 (metres):
- Predicted Maximum Drawdown - 0.2m
- Predicted Maximum Drawdown - 1m
- Predicted Maximum Drawdown - 2m

Low Likely Level of Groundwater Dependence:
- HU654/PCT1310 - White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley
- HU817/PCT1603 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- HU826/PCT1612 - Eucalyptus crebra/ Eucalyptus punctata/ Notelaea microcarpa woodland of Central Hunter
- HU869/PCT1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin
- HU905/PCT1691 - Eucalyptus crebra/ Eucalyptus moluccana grassy woodland of the central and upper Hunter
- HU906/PCT1692 - Bull Oak Grassy Woodland of the Central Hunter Valley

Moderate Likely Level of Groundwater Dependence:
- HU812/PCT1598 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
- HU821/PCT1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter
- HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley

High Likely Level of Groundwater Dependence:
- HU928/PCT1714 - Eucalyptus camaldulensis/ Casuarina cunninghamiana grassy riparian woodland of the Hunter Valley

FIGURE 2.8

Potential GDE's and Predicted Maximum Groundwater Drawdown Due to the MCCO Project Layer 1 (alluvium, colluvium, regolith)

File Name (A4): R25/4004_451.dgn
20200213 10.15

Comment 29. The proponent only provides groundwater quality monitoring data for one month – September, 2017. The IESC cannot determine whether these data are typical of the groundwater quality. These data show exceedances of water quality guideline values for several metals in at least some of the bores – zinc, copper and aluminium at the majority of monitored sites; antimony, arsenic, chromium, lead, manganese, molybdenum, nickel and selenium at some locations (AGE Consultants 2019, Appendix D). This suggests that water from the pit water dam may add metal contaminants to the Hunter River, if not treated prior to discharge. For nutrients, there were exceedances for ammonia and nitrite against aquatic ecosystem protection guidelines, as well as total nitrogen and total phosphorus exceedances against long term irrigation guidelines. The implications for these exceedances were not discussed.

Mangoola implemented a detailed groundwater quality monitoring program during preparation of the EIS. In addition to the regular groundwater monitoring regime, groundwater samples were collected approximately every two weeks between September 2017 and January 2018. A total of nine separate rounds of water sample collection and analysis were undertaken. The samples were analysed for physiochemical indicators, major ions, trace elements, nutrients and petroleum hydrocarbons. The results of the water quality analyses are provided in the tables included in **Appendix 3**. The tables highlight where water quality results exceed ANZECC guidelines for drinking water, irrigation, stock and aquatic ecosystems. Petroleum hydrocarbons were not detected in any samples and so the analysis of these parameters was not continued below the third round of testing.

The laboratory results show only limited variability and demonstrate that the single round of data provided within the EIS was indicative of typical groundwater quality. The highlighting in the charts indicates salinity, major ions, nutrients and some trace metals can be present in samples at concentrations exceeding the ANZECC guideline limits for aquatic ecosystems, irrigation, drinking water and stock.

Whilst groundwater is commonly enriched in major and minor elements and some nutrients it does not represent a large proportion of the water pumped from the mining areas and is not discharged off-site. Water balance model results (HEC [2019] Section 3.3.5.1) predict that groundwater inflow would comprise a minor component of system inflows on average. During low rainfall periods, when the relative contribution of groundwater increases, licensed discharge from the PWD would not be required. Licensed discharge would only be required following extended periods of wet weather. Following such periods, any elevated constituents within groundwater would be highly diluted by rainfall runoff, lowering concentrations in the PWD. It is therefore likely that any elevated environmentally significant constituents in groundwater would have a negligible effect on the Hunter River. As discussed previously, no changes to the approved discharge facility are proposed as part of the MCCO Project.

Water balance model results (HEC [2019] Section 3.3.5.1) predict that groundwater inflow would comprise a minor component of system inflows on average. During low rainfall periods, when the relative contribution of groundwater increases, licensed discharge from the PWD would not be required and no licensed discharge has occurred from the mine to date. Licensed discharge would only be required following extended periods of wet weather. Following such periods, any elevated metals concentrations from groundwater would be highly diluted by rainfall runoff, lowering concentrations in the PWD. A similar assessment applies for nutrients. It is therefore likely that any elevated environmentally significant constituents in groundwater would have a negligible effect on the Hunter River. Again, it is noted that this discharge facility is already approved and no changes to this approved facility are proposed.

Comment 30. The numerical groundwater model includes both the existing coal mine and the project. The IESC agrees that it is unlikely that the extent of groundwater drawdown for the project will overlap with that of other existing mines and that this approach is appropriate. The results of the groundwater model are presented for two scenarios: the cumulative scenario, with the existing coal mine plus the project; and the incremental scenario, with cumulative impacts less those attributable to the existing coal mine. This presentation of results allows the reader to appropriately assess both cumulative and incremental impacts.

Noted.

Comment 31. Greater contextual information on historical cumulative impacts to the groundwater resource, and to GDEs, would provide useful background to understand the setting of the project's cumulative impacts. Information would ideally be provided on the likely former extent of locally-occurring GDEs and on regional historical impacts to the groundwater regime (including surface water-groundwater interactions), groundwater quantity and water quality, including the ongoing extensive mining and agricultural activity.

Historical clearing mapping of the model area available through the DAWE website (NVIS v5.1) indicates that natural vegetation cover would most likely have been Eucalypt Open Forest on the steeper hills and Eucalypt Woodland in the lower slopes and over the now cleared areas, including along Big Flat Creek and Wybong Creek.

Clearing of the native vegetation would have historically changed the hydrological and hydrogeological regimes across the area by altering the runoff and recharge characteristics within the catchment. However, as these conditions have been present for many decades a new post-clearing equilibrium is expected to have evolved.

Prior to development of the approved Mangoola Coal Mine the pre-mining land uses in the Mangoola mine lease areas were primarily cropping and grazing of the flatter lands, with residual native vegetation remaining on the hills and fringing the creeks. Therefore, the former extent of potential GDEs is likely to have been unchanged for many years prior to the Mangoola Coal Mine being approved.

Prior to the Mangoola Coal Mine being approved, there were no large point source anthropogenic stresses that would impact surface water and groundwater resources within the catchment. Small scale farm dams are present in a number of paddocks within the MCCO Project Area to support grazing animals, and there were a limited number of groundwater bores installed in areas where the water quality is suitable for basic water rights (stock and domestic use). A small number of irrigation licences are located within the Wybong Creek alluvium, however, these would likely have had a negligible impact on the water resources within the MCCO Project Area.

The Project Approval for the Mangoola Coal Mine (formerly known as the Anvil Hill Project) was granted in 2007. The initial groundwater assessment for the mine (MER, 2006) indicated that mining would result in a zone of depressurisation in the coal seams that extended approximately 2 km to the west of the open cut mining area. Subsequent reports and numerical modelling have confirmed that the spatial location and extent of predicted impacts have remained similar to the initial predictions. The depressurisation observed across the groundwater monitoring network to date is generally developing in accordance with the modelled predictions, that is west and north-west in the more permeable geological layers, although there have been localised variations due to the heterogeneous nature of the subsurface.

Historical stresses to the groundwater system generated as a result of mining at the approved Mangoola Coal Mine are presented throughout Section 5 of the MCCO Project EIS Groundwater Report and summarised in the conceptualisation in Section 5.5.

There are several sections of the MCCO EIS groundwater report that specifically detail changes along Big Flat Creek. These include:

- Section 5.2.2.3, which discusses changes in groundwater level along several cross sections perpendicular to Big Flat Creek. In particular, cross section 4 and cross section 6 which are in the vicinity of two of the potential GDEs discussed in Section 5.4.3. The hydrographs indicate that the shallow groundwater levels have reduced by several metres since 2014, with mining impacts being the most likely reason for the decline.

- Section 5.3.1, which discusses the changes in EC recorded at several monitoring bores being impacted by mining, some of which are close to Big Flat Creek.

As mentioned above the locations and extent of remnant GDEs within the vicinity of the Mangoola Coal Mine are unlikely to have significantly changed in the years immediately prior to the mine being approved. Monitoring by Mangoola Coal at monitoring site RTR-SPR-17, a location within one of the potential GDE areas along Big Flat Creek, has not identified any potential dieback that could be associated with lowering of the shallow groundwater table, despite water levels in this area being affected by approved operations and associated dewatering for several years.

The Mangoola Coal Mine monitoring bore data does not show any mining related drawdown progressing as far as Wybong Creek. Although water levels within the Wybong Creek and Wybong Creek alluvium have fallen in recent times the entire region has been in a prolonged drought since approximately Q3 2017, and any changes observed to potential GDEs along Wybong Creek would therefore most likely be a result of climatic stress.

There are no other large-scale mining or agricultural operations in the area that could contribute to historical cumulative impacts.

2.4 Water-dependent Ecosystems

Question 7 – *"Have the impacts of the project on surface water and groundwater dependent ecosystems (including stygofauna) been adequately described and assessed?"*

> **Comment 32**. The documentation includes useful information for the assessment of potential impacts to water-dependent ecosystems. However, the information is not well integrated and there are major gaps in some areas. This means that some potential impacts are likely to be incompletely described or understated. More detail is provided below in paragraphs 37–39.

As previously discussed in response to Comment 2 and Comment 7, it is considered that an appropriate and conservative assessment of potential impacts on GDEs was undertaken for the MCCO Project and further clarity regarding the assessment undertaken was provided in these earlier responses. An integrated and targeted assessment of potential impacts on GDEs was provided in Section 6.10 of the MCCO Project EIS and supporting technical information was provided in detailed specialist assessments completed for groundwater, biodiversity and surface water, along with a field stygofauna assessment. An appropriate approach was undertaken in identifying all potential GDEs within and in proximity to the MCCO Project. The potential direct and indirect impacts from the MCCO Project including those arising from ecohydrological causal pathways have been identified and assessed within the MCCO Project EIS. The level of assessment undertaken for GDEs was suitably scaled to reflect the relatively low level of impacts predicted on GDEs from the MCCO Project.

The original GDE assessment compiled for the MCCO Project EIS considered the requirements of the *Draft Assessing Groundwater-Dependent Ecosystems: IESC Information Guidelines Explanatory Note* (Draft Explanatory Note) (Doody, Hancock and Pritchard, 2018). The IESC was seeking comment on the Draft Explanatory Note at the time of the MCCO Project EIS submission and as such, the guidance provided in the Draft Explanatory Note was not considered final, however, was considered during the preparation of the EIS.

Comment 33. Changes to the local surface water regime are expected to impact on water-dependent species. As discussed in response to question 2, comprehensive information on planned water discharges has not been provided, so the IESC cannot assess the potential impacts on the downstream environment.

A detailed response to the IESC comments relating to surface water impacts was provided above in **Section 2.2**. As an outcome of this further work, no new or different impacts on water-dependent species have been identified beyond those assessed in the EIS.

As previously discussed in response to Comment 14 and 15, discharge from the PWD to the Hunter River under the provisions of the HRSTS is already permitted as part of the existing approved operations. Presently, no infrastructure exists for controlled discharge from the PWD to the Hunter River via the HRSTS. However, Mangoola has a TARP in place that will initiate construction of the discharge system from the PWD to the Hunter River if the total site water inventory exceeds a trigger value. A Mangoola operational water management system TARP will govern when water should be discharged from the PWD to the Hunter River in accordance with the HRSTS once the release infrastructure is in place.

The only other discharge locations associated with the MCCO Project are periodic overflows (spillway flows) from sediment dams to Big Flat Creek. The sediment dams will receive runoff from overburden emplacements (active and undergoing rehabilitation) and pre-strip areas rather than active mine areas. The sediment dams proposed for the MCCO Project would be similar to existing sediment dams which are part of the approved Mangoola Coal Mine. These sediment dams would be integrated into the mine water management system, with pumped transfer of any accumulated water to the existing PWD in order to reinstate sediment dam storage capacity within 5 days of a rainfall event during their operational lifetime.

Once rehabilitation has successfully established on mine landforms and the sediment dam catchment areas have stabilised, sediment controls would no longer be necessary and the rehabilitated area runoff can be returned to the existing catchment. This typically occurs when vegetation ground coverage exceeds 70% of the surface area and water quality monitoring shows a similar runoff quality to that of the natural catchment.

During any unlikely overflow events, the concentration of environmentally significant constituents in the sediment dams is likely to be low during such events due to considerable dilution. Furthermore, the volume of overflow from sediment dams, should it occur, would be small in comparison to the overall flow in Big Flat Creek during such an event. Therefore, the likelihood of any impact of sediment dam spillway flows on downstream water quality is assessed by HEC to be low.

No spills from any other (non sediment dam) storages are forecast and there are no spills forecast from dams containing mine water.

Comment 34. There is the potential for the final landform to cause impacts via altered surface runoff. This is discussed further in response to question 8. The IESC notes that there will be a discharge point with the drainage channel in the northern part of the final landform into Big Flat Creek, and the implications of this discharge point on the water quality, biota and ecological processes downstream should be fully assessed.

Final void water balance modelling detailed in HEC (2019) has indicated that there will be no discharge from the final void in the MCCO Additional Mining Area, with the equilibrium water level more than 30 m below spill level. Equilibrium levels would be reached slowly over a period of more than two hundred years. Therefore, discharge via the “drainage channel in the northern part of the final landform” would comprise runoff from upslope areas undisturbed by mining activity (permanently diverted around the final landform), with return of this upslope drainage to Big Flat Creek. The diversion and outfall would be designed with erosion protection to promote long term stability. Therefore, it is expected that the water quality within Big Flat Creek would be unaffected by this long term diversion.

Comment 35. Further information on impacts on streamflow is provided in paragraph (Comment) 13.

Refer to response to Comment 13.

Comment 36. The magnitude of incremental impacts predicted to aquatic ecological systems is not large and these may be managed by appropriate monitoring and adaptive management. Further consideration of these changes to the catchment area during operational stages of the proposed project could be included in the ecohydrological conceptual model. Illustrating potential causal pathways and mechanisms of effects of altered surface flows, groundwater exchanges and in-stream water quality would help the proponent justify strategies proposed to manage and mitigate potential impacts (also see response to question 8).

As previously discussed in response to Comment 2, the MCCO Project EIS includes detailed assessments of impacts on biodiversity and water resources and considers the interactions between water impacts and potential consequential impacts on biodiversity for water-dependent ecological assets. This includes:

- BAR – prepared in accordance with the NSW FBA which considers both direct and indirect impacts due to impacts on water and riparian vegetation
- Aquatic Ecology Assessment – which considers impacts on aquatic ecology due to the MCCO Project and is included as an appendix to the BAR
- Groundwater Dependent Ecosystem Assessment – which identifies potential GDEs and assesses the impact of the MCCO project on these potential GDEs
- Stygofauna Assessment – which included survey of and assessment of impacts on Stygofauna
- GIA – which assessed the impacts of the MCCO Project on groundwater resources and consequential impacts on biodiversity such as impacts on GDEs
- SWA – which assessed the impacts of the MCCO Project on surface water
- Assessment on Commonwealth Matters – which addressed the DAWE specific assessment requirements in the SEARs with a particular focus on ecohydrological impacts on listed threatened flora species and communities under the EPBC Act.

These assessments included examining and assessing all of the potential impacts identified in the IESC comment. Therefore, all of the matters identified in the comment have been considered and assessed for the MCCO Project.

Comment 37. While the proponent has undertaken aspects of a GDE assessment, there are gaps that mean that impacts may be underestimated. As described in response to question 1, the IESC considers that the proponent has likely underestimated the area of vegetation in the vicinity of the project that is potentially groundwater-dependent. This affects all estimations of likely impacts. The proponent maps vegetation that they classify as groundwater-dependent, overlain with the predicted extent of the 1 m water table drawdown contour. This provides an indication of the extent of potential impacts. However, this initial assessment is not conservative. Sensitive GDEs (especially seedlings and juveniles with shallow roots) could be impacted by drawdown in the water table of <1 m (see paragraph 28). Additionally, this overlay is only provided for the basecase groundwater model predictions. The proponent should provide an overlay of vegetation types together with the 0.2 m water table drawdown contour for both the basecase and uncertainty scenarios (cumulative and project only). This would provide a good basis for further analysis of the potential risks to GDEs.

As previously discussed in responses to Comment 1 and Comment 7, the GDE assessment provided in Section 6.10 of the MCCO Project EIS took a conservative approach in identifying all potential GDEs within and in proximity to the MCCO Project and covered a broad assessment area consistent with the overall assessment area for the GIA. The GIA and GDE assessment was selected to extend beyond the extent of predicted groundwater impacts.

As discussed in the responses to Comment 7 available information relating to GDEs from regional studies and previous local studies were used to identify GDEs in the assessment area, along with the following local information sources:

- aerial photography and topographic LIDAR data of the MCCO Project Area
- geology, geomorphology and soil mapping at the local scale (from Soil Assessment and GIA, Appendices 19 and 12, respectively of the MCCO Project EIS)
- hydrological data for the streams (Big Flat Creek, Wybong Creek) (from the SWA, Appendix 11 of the MCCO Project EIS)
- vegetation mapping (from the BAR, Appendix 13 of the MCCO Project EIS)
- definition of aquifers, depths and connectivity (from the GIA (Appendix 12 of the MCCO Project EIS) see Sections 4.2 and 4.3)
- mapping of locations where groundwater depth is less than 10 metres (in relation to potential terrestrial GDEs only, outside alluvial areas). The Explanatory Note (IESC 2019) states that terrestrial vegetation located in areas with shallow groundwater (less than 10 metres below the surface) are likely to be GDEs, as the plants can easily reach and extract groundwater
- field assessments of ecological communities within the MCCO Additional Project Area
- stygofauna assessment (Section 6.10.2.3 of the MCCO Project EIS and Appendix 14 of the MCCO Project EIS).

As discussed in the response to Comment 7, as an outcome of this process a number of GDEs and potential GDEs were identified in the GDE assessment area (refer to **Table 2.3**). Based on the findings of the GIA and the surface water assessment, no impacts are predicted on the identified aquatic GDEs (including the terrestrial vegetation occurring on the Wybong Creek and Goulburn River alluvial zones) or subterranean GDEs. Some impacts were predicted to some of the terrestrial GDEs as discussed below.

As discussed in Section 6.8.3 of the MCCO Project EIS, the MCCO Project will result in drawdown of groundwater within the vicinity of the MCCO Project. With regard to GDEs, the predicted drawdowns of relevance are those in layer 1 of the groundwater model which relates to drawdown in alluvium, colluvium and regolith (affecting saturated zone, capillary zone and unsaturated zones). As part of a conservative assessment of potential drawdown impacts, layer 2 which relates to drawdown in shallow weathered bedrock (saturated zone) was also considered but is unlikely to support GDEs due to the relative depth of this layer in the groundwater model.

The 1 m or greater drawdown contour was chosen to be modelled for potential drawdown impacts on GDEs due to the relative accuracy of this contour measurement at the site wide scale of the conceptual groundwater model. Furthermore, it was seen that the magnitude of impact (i.e. a 1 m drawdown) was significant in terms of long-term impacts on GDEs within and in proximity to the MCCO Project. The extent of 1 m modelled drawdown contours in Layer 1, resulting from mining of the MCCO Additional Mining Area, are shown in relation to the distribution of potential GDEs in **Figure 2.8**.

As shown on **Figure 2.8**, outside of the MCCO Additional Disturbance Area the predicted drawdowns are1 m to 2 m and occur in the vicinity of Big Flat Creek. The predicted drawdowns affect areas of:

- HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley which as a riparian community is considered likely to have a moderate level of dependence on groundwater
- HU905/PCT1691 - *Eucalyptus crebra*/*Eucalyptus moluccana* grassy woodland of the central and upper Hunter which is considered likely to have a low level of dependence on groundwater.

These PCTs which comprise terrestrial GDEs have a low to moderate potential to be dependent on shallow groundwater resources during periods of reduced surface water flow. Terrestrial GDEs in the vicinity of Big Flat Creek that are outside the MCCO Additional Disturbance Area are not proposed to be cleared as part of the MCCO Project. Furthermore, Mangoola Coal Mine undertakes annual ecosystem monitoring for one potential GDE located along Big Flat Creek. It is proposed that this monitoring will continue for the MCCO Project to identify if there are any observable negative impacts on the flora that can be attributed to groundwater depressurisation caused by mining.

As requested by the IESC, revised incremental 0.2 m drawdown contour mapping has been provided as part of this response (refer to **Figure 2.8**).The revised incremental 0.2 m contour drawdown mapping has been used in this response document to provide a sensitivity analysis of the impacts predicted using the 1 m contours.

It should be noted that AGE has advised that the revised incremental 0.2 m drawdown contour mapping is considered inaccurate at the site-wide scale and therefore it has been used to provide a sensitivity analysis only.

The incremental 0.2 m drawdown contour only encapsulates one additional PCT that has been identified as a potential terrestrial GDE when compared to the original 1 m drawdown contour assessment undertaken. The additional PCT triggered is a small patch (0.1 ha) of PCT 1603 – (*Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter*). As such, the use of the 0.2 m drawdown contours is not considered to materially change the assessment findings of the original drawdown assessment undertaken using 1 m incremental drawdown contours.

Comment 38. The proponent has not described the impacts of direct clearing on groundwater-dependent vegetation. This should also be included as part of the assessment to GDEs.

As discussed in Section 6.10.3 of the MCCO Project EIS, the MCCO Project will result in clearing of native vegetation within the MCCO Additional Disturbance Area. This will include some woodland/forest vegetation that may intermittently use shallow groundwater and was therefore identified as a potential terrestrial GDE. The extent of clearing proposed of the terrestrial vegetation identified as potential GDEs within the MCCO Additional Disturbance Area is shown on **Figure 2.8**. Whilst this terrestrial vegetation will be cleared, it will be offset as per NSW policy as discussed below and the area will be rehabilitated and revegetated with native woodland vegetation post mining.

The direct impact of clearing of terrestrial vegetation for the MCCO Project has been assessed and will be offset in accordance with the NSW FBA. The offset strategy will contribute to and improve conservation outcomes in the local area and region.

Glencore has a strong record in preparing and implementing biodiversity offset strategies that address significant biodiversity matters and adequately counterbalance impacts on them. The proposed offset strategy for the MCCO Project will result in significant conservation areas being established in both the local area and region, contributing to long-term conservation and biological diversity outcomes. The proposed local conservation areas will build on the existing conservation areas already established by Mangoola, adding to the existing conservation network.

Comment 40. The proponent has adequately assessed stygofauna, consisting of:

a). a field-based stygofauna assessment, in which 11 bores were sampled. No stygofauna taxa were identified. Two taxa, not considered to be stygofauna were identified in four bores. These were Oligochaeta (worms) and Oribatida (soil mites), both of which are considered to have an association with soil habitats rather than aquatic systems (Eco Logical Australia 2019); and

b). a risk assessment of impacts to stygofauna (Eco Logical Australia 2019, section 7). The proponent also considers that local groundwater conditions, within the colluvium near the project area are considered to be poor habitat for stygofauna because they lack permanent water. The proponent notes that the Wybong Creek alluvium could contain stygofauna originating in the Goulburn Creek alluvium (though the two bores sampled in this area did not reveal any stygofauna). However, the alluvium in this area closest to the project is thin, and the project contributes relatively little to the cumulative 1 m of drawdown predicted in this area.

Noted.

2.5 Avoidance, Mitigation and Monitoring

Question 8 – *"Are there any additional mitigation, monitoring, management or offsetting measures that should be considered by decision makers to address the residual impacts of the project on water resources in conditions of consent?"*

Comment 41. The proponent proposes that management and mitigation will be achieved through a Surface Water and Groundwater Response Plan. A flow-chart of the trigger-action-response plan (TARP) is provided in AGE (2019, pp. 134–36). The plan is for the existing coal mine, but it will be updated for the project. However, it is unclear whether any changes other than an expansion of the monitoring network are proposed. Under the current plan, trigger exceedances lead to investigations to confirm whether the exceedance is mining-related and has caused environmental harm. If these conditions are met, unspecified mitigation measures will be implemented. The full plans for the existing coal mine (not included in the EIS: Glencore 2014) also fail to list specific mitigation measures that may be employed. To provide confidence in the ability of this plan to guide the reduction of impacts, the proponent should propose and commit to specific effective and practicable mitigation measures (and provide evidence (data or literature) to support these suggested strategies).

The Surface and Groundwater Response Plan for Mangoola Coal Mine has been developed and implemented as required by the existing Project Approval (PA 06_0014). This plan will be updated if the MCCO Project is approved. The plan will be updated in consultation with the NSW government and to the approval of DPIE and published on the Mangoola website. The additional MCCO Project specific groundwater management, mitigation and monitoring measures that will be incorporated into the updated management plan were outlined in the EIS. This is the normal process in NSW where commitments are made in the EIS, however, the management plans that incorporate these commitments are completed post approval of the project (in accordance with specific conditions of consent) but typically prior to implementation.

Mangoola commit that the following effective and achievable mitigation measures will be included in the updated plan:

- retaining sufficient groundwater and surface water licences to account for the water take from each water sharing plan areas during active mining and post mining

- make good provisions with landholders whose bores could be impacted by more than the minimal impact considerations noted in the Aquifer Interference Policy

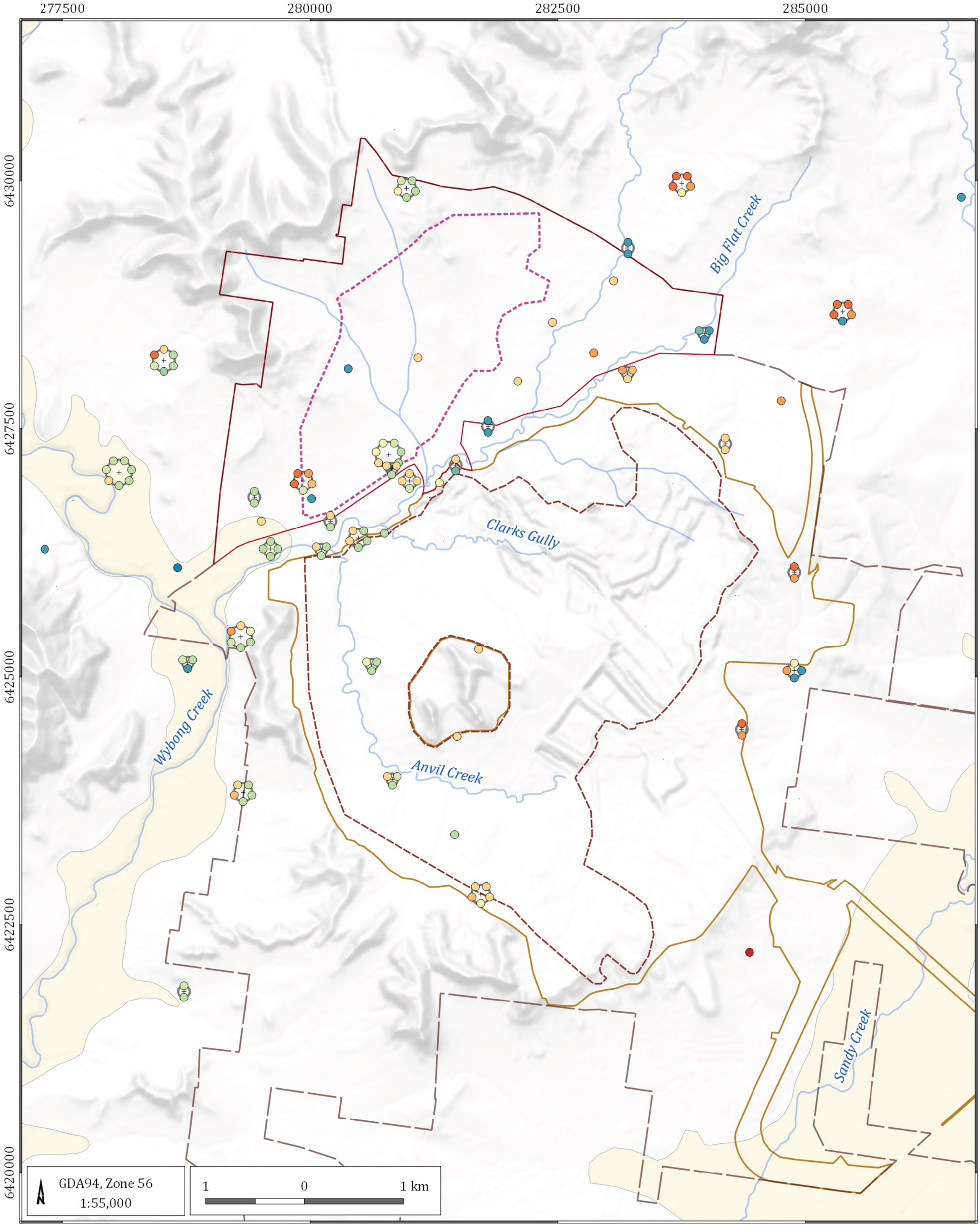
- ongoing adaptive management based on collecting and reviewing monitoring data to ensure that any changes to baseline are identified early. This has the benefit of reducing the potential magnitude of any unforeseen impacts so they can be more easily managed and mitigated. The most effective mitigation measures will depend on the type of unforeseen impact identified and will be unique to each situation. Therefore, any mitigation plans required will be discussed and agreed with the relevant government authorities prior to commencing.

A number of groundwater monitoring sites have already been installed around the proposed MCCO Additional Mining Area to assess baseline conditions in advance of any potential developments occurring. If the MCCO Project is approved it is proposed that several of these sites are added to the MCCO Groundwater Monitoring Plan (GWMP). Based on the data reviewed as part of this document, and predicted impacts from mining the MCCO Additional Mining Area it is also recommended that a number of new monitoring bores are installed to confirm the VWP pressure changes, and monitor for any depressurisation near to the Wybong Creek alluvium and associated GDEs. A figure showing the existing and proposed monitoring bores for the MCCO Project is included in the response to Comment 43 below.

Comment 42. Additional information should be provided on the existing and proposed groundwater monitoring network. To assist with assessment of coverage of the monitoring network, a map should be provided that shows all bores coded by target aquifer. Details of bore construction should be included in the assessment documentation. The IESC notes that the groundwater monitoring plan for the existing project (Glencore 2014), although not part of the assessment documentation, does include target aquifers but not full construction details.

Figure 2.9 shows the MCCO Project GWMP monitoring locations coloured by target aquifer. Additional information on bore details are presented in Appendix A-1 and Appendix C of the MCCO EIS GIA (which is Appendix 12 of the EIS).

umwelt



LEGEND

- MCCO Project Area
- MCCO Additional Project area
- Approved Mangoola Coal Mine Disturbance Area
- Approved Mangoola Coal Mining Area
- Proposed Additional Mining Area
- Alluvium
- Drainage

Bore layer

- Alluvium
- Moderately weathered conglomerate
- Weakly weathered conglomerate
- Unweathered conglomerate
- Great Northern seam
- Awaba Tuff
- Fassifern and Upper Pilot A seam
- Interburden
- Upper Pilot B seam
- Interburden including Pilot seam
- Hartley Hill seams
- Interburden including Australasian and Montrose seams

FIGURE 2.9

Targeted Aquifers for Proposed MCCO GWMP Monitoring Locations

Image Source: AGE (2019)

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Comment 43. The proponent proposes four additional monitoring bores along Wybong Creek. This increase in coverage is commended, but without details of the target aquifers it is difficult to evaluate how effective this will be at detecting impacts. Ideally, bores would be nested, with groundwater measurement in deeper aquifers providing warning of potential future impact to the water table.

The Groundwater Impact Assessment AGE (2019) prepared for the MCCO Project EIS included a figure showing the locations of existing and proposed monitoring bores. This figure (Figure 8.1 in AGE, 2019) is reproduced as **Figure 2.10**. The figure shows how the monitoring bores are distributed in a zone around the MCCO Project, and within the project footprint where drawdown is predicted to occur. The existing network allows the response of the groundwater regime to the MCCO Project to be measured and monitored over time. In addition to the existing monitoring bore network five additional bores will be installed. The locations of the proposed bores are shown using purple dots on **Figure 2.10** and are identified as Wybong 1, Sandy 1, GWMP1, GWMP2 and GWMP3.

Two of the proposed new bore locations (Wybong 1 and Sandy 1) have already been committed to by the existing Mangoola Coal Mine and would be available to monitor ongoing operations of the existing approved operations and MCCO Project. Proposed construction details for these two sites are as follows, although exact construction depths will be adjusted depending on conditions encountered.

Wybong 1

The commitment is to monitor the Wybong Creek alluvium and the shallow coal measures. The new bore will be installed close to the centre of the Wybong Creek alluvial channel to the west of the mine as shown on **Figure 2.10**. Drawdown is not predicted in this area from the MCCO Project or approved operations and this bore serves to monitor downstream conditions within the Wybong Creek alluvium. There are already several monitoring sites along Big Flat Creek where the Wybong Creek alluvium transitions into Big Flat Creek colluvium where the potential for cumulative drawdown is predicted.

A group of three nested monitoring bores will be installed, targeting the following units at the approximate depths:

- Alluvium - 15-20 metres below ground level (mbgl)
- Unweathered conglomerate - ~ 40 mbgl
- Great Northern Seam - ~ 50 mbgl

The deepest site will be installed first to confirm the geology and identify the target depths for the shallow bores.

Sandy 1

The proposed site is located to the south-east of the Mangoola Coal Mine, between the mine and Sandy Creek alluvium. The proposed location is close to the subcrop line of the Montrose seam, which is stratigraphically lower than the coal measures being targeted at Mangoola. Although there is no drawdown predicted to develop in this direction due to the subcropping of the geological units being mined, the Sandy 1 site is designed to confirm this prediction. It is proposed that the site is completed as a pair of standpipe monitoring bores, with screened depths of ~35 mbgl, and ~70 mbgl. The exact depths of the screened intervals will be confirmed once the deeper bore has been drilled, so that the screens can be positioned within 'hard rock' units such as sandstones and conglomerates rather than coal seams.

GWMP1, GWMP2 and GWMP3

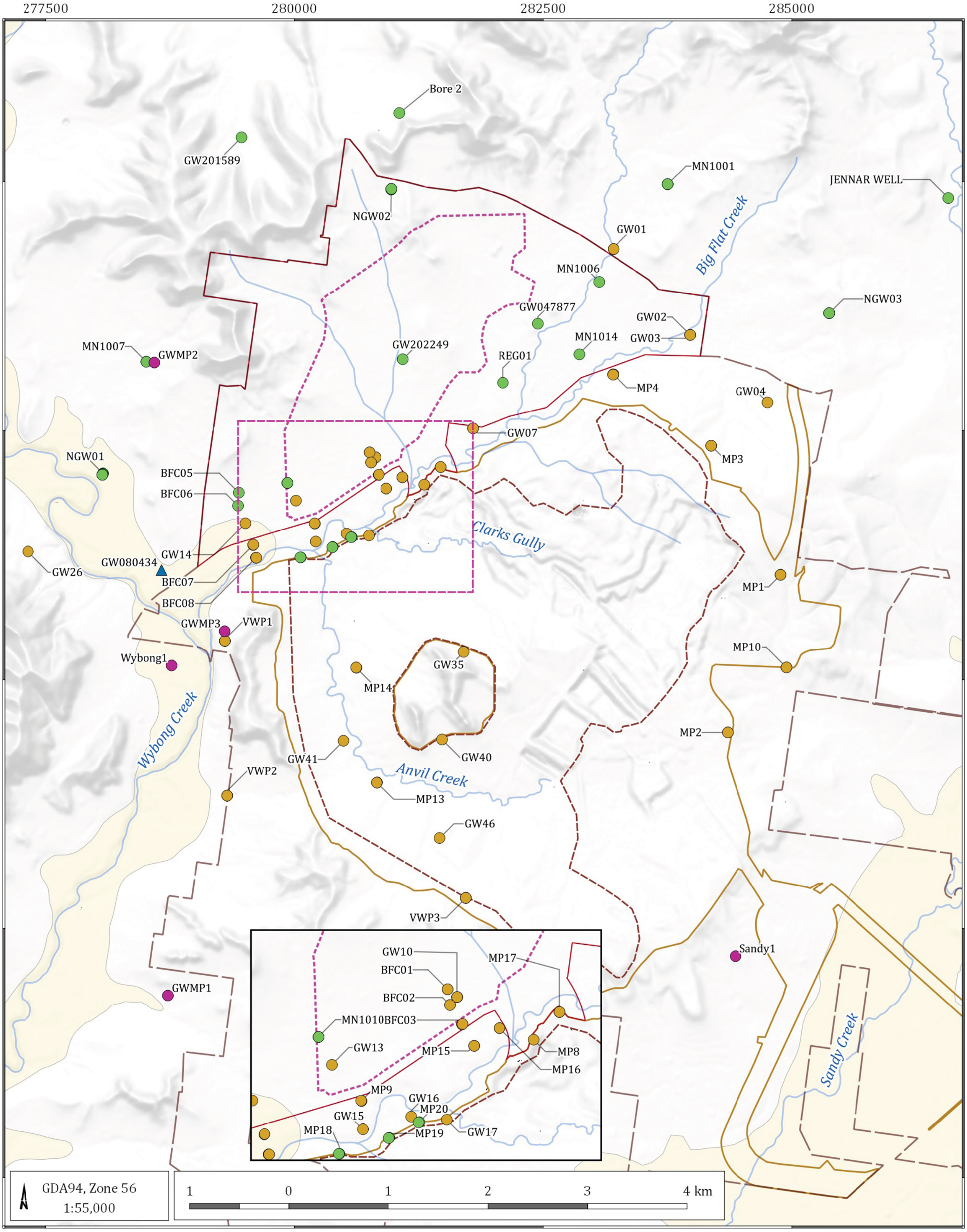
Three new sites have been proposed as part of the MCCO Project being GWMP1, GWMP2 and GWMP3. If the MCCO Project is approved these new bores will be constructed and, as described in Comment 41, added to the cumulative MCCO GWMP.

Site GWMP1 is proposed to infill a gap in the monitoring network to the southwest of the Mangoola Coal Mine. The site is located in an area which is predicted to experience drawdown in the coal seam as mining progresses. A pair of standpipe bores is proposed, approximate depths are:

- Unweathered conglomerate - ~ 20 mbgl
- Great Northern Seam - ~ 30 mbgl

GWMP2 and GWMP3 are designed to validate data collected at vibrating wire piezometer (VWP) sites. It is proposed that a single monitoring bore be installed in the Great Northern seam at each of these two locations to compare with the VWP data that will continue to be collected and also allow for water quality sampling if required. Approximate depths will be:

- GWMP2 – co-located with MN1007, Great Northern Seam ~ 140 mbgl
- GWMP3 – co-located with VW1, Great Northern Seam ~ 69 mbgl.



LEGEND

- MCCO Project Area
- MCCO Additional Project area
- Approved Mangoola Coal Mine Disturbance Area
- Approved Mangoola Coal Mining Area
- Proposed Additional Mining Area
- Alluvium
- Drainage

Proposed MCCO monitoring locations

- 2014 GWMP - active
- 2019 GWMP - active
- 2019 GWMP - new sites
- Government site

FIGURE 2.10

Proposed MCCO GWMP Monitoring Locations

Image Source: AGE (2019)

Comment 44. As discussed in paragraph (Comment) 29, the proponent has only undertaken one round of groundwater monitoring (September 2017) that includes a broad suite of metal and nutrient analytes, and these were measured at only 8 sites. The results are presented (AGE Consultants 2019, Appendix D), but not discussed in the assessment documentation. A discussion of the implications of these results should be provided. The proponent indicates an intention to introduce monitoring of a broad suite of metals in groundwater, but has not specified to which bores this new monitoring will apply (AGE Consultants 2019, p. 131). Recent monitoring has identified several metals with concentrations above default guideline values (zinc, copper and aluminium at most sites; antimony, arsenic, chromium, copper, lead, manganese, molybdenum, nickel and selenium at some sites). Given this, it is important that sufficient bores are monitored for groundwater quality to identify causes and trends in groundwater quality. Baseline data must be collected to enable impacts from the project to be identified. It is also not clear why the proponent proposes to assess groundwater quality against recreational water quality guidelines (AGE Consultants 2019, p. 131).

As noted in response to IESC Comment 29, Mangoola implemented a detailed groundwater quality monitoring program during preparation of the MCCO Project EIS. Groundwater samples were collected approximately every two weeks between September 2017 and January 2018. A total of nine separate rounds of water sample collection and analysis were undertaken at eight bore sites. The samples were analysed every fortnight for physiochemical indicators, major ions, trace elements, nutrients and petroleum hydrocarbons. Petroleum hydrocarbons were not detected in any samples and so analysis of these parameters was not continued beyond the third round of testing. The results of the water quality analyses are provided in the tables included in **Appendix 3**. The tables highlight where water quality results exceed ANZECC guidelines for drinking water, irrigation, stock and aquatic ecosystems.

The metals analysis presented in **Appendix 3** for comparison with ANZECC guidelines is total metals, i.e. the sum of metals dissolved in the water plus any particulates in the water. Samples taken using pumps within bores commonly enhance turbulent flows which artificially increase the particulate load in the samples compared to natural bedrock flows. However, there are no ANZECC guidelines for dissolved metals, hence the comparison is with total metals analysis.

The laboratory results show only limited variability and demonstrate that the single round of data provided within the EIS was indicative of typical groundwater quality. The highlighting in the charts presented in **Appendix 3** indicates salinity, major ions, nutrients and some trace metals can be present in samples at concentrations exceeding the ANZECC guideline limits for aquatic ecosystems, irrigation, drinking water and aquatic ecosystems. However, the concentrations of major and minor ions and trace elements in groundwater is not necessarily an indicator of anthropogenic contamination, but most commonly an outcome of the enrichment of rainfall due to evapo-concentration at the surface before rainfall flows to the underlying water table. As noted in the response to Comment 29 this natural enrichment of ions and trace elements is a natural process to which the local environment is adopted. The quality of groundwater entering the mining areas has no direct implications for the surrounding environment as it is relatively limited in volume. Any groundwater that requires pumping from mining areas is diluted within the surface water storages on site. The water table occurs below the base of Big Flat Creek and therefore groundwater does not form a source of baseflow, so again there are no direct implications for the surrounding environment due to the quality of groundwater.

Whilst the quality of groundwater in the monitoring bores, typically exceeds the ANZECC guidelines for irrigation, and potable consumption the natural salinity prevents any use for these purposes. Therefore, application of these ANZECC guidelines is of little benefit. Big Flat Creek is also not well connected to the water table so application of the aquatic ecosystem guidelines is also not appropriate. The GIA for the MCCO Project EIS suggested comparing groundwater quality to ANZECC guideline values for recreational water use, as people could interact with groundwater discharging to the future final voids and also potentially to more distant surface water bodies such as Wybong Creek, although again groundwater would be diluted by surface water flows in this instance.

The EIS committed to introduce monitoring of a broad suite of metals in groundwater. Should the MCCO Project receive approval the most appropriate bores to be monitored will be determined in consultation with stakeholders when the Water Management Plan is updated. The eight bores monitored during 2017 and 2018 will be suitable bores as a baseline dataset has been collected.

Comment 45. The proponent, while stating that the average annual reduction of 320 ML in flow represents a small and indiscernible impact to the flow in Wybong creek, suggests a possible mitigation option of a permanent retirement of this volume of water access licences from the Wybong Creek Water source within the Hunter Unregulated and Alluvial Water Sources (HEC 2019, p. 77). This would likely be an effective mitigation measure for ecological impacts to Wybong Creek. It would not mitigate impacts to Big Flat Creek and will permanently reduce the number of licences available for other uses.

Comments regarding Wybong Creek are noted. As described in Section 2.4 and Figure 4 of HEC (2019) there are no surface water users on Big Flat Creek downstream of the MCCO Additional Project Area and therefore there would be no effect on licensed water users on Big Flat Creek (Mangoola own the only surface water licences on Big Flat Creek upstream of the MCCO Additional Project Area). It is noted that once retired, it is correct that the licences would not be available for potential future users.

The impact of catchment changes on the flow regime in Big Flat Creek has been assessed with reference to the inferred flow duration behaviour of the creek in Section 3.2.4.1 of HEC (2019). For example, the prevalence of effectively zero flow has been estimated to increase by only 1.8% of days. The predicted changes are small and not considered material given the ephemeral nature of Big Flat Creek.

Comment 46. The proponent intends to monitor surface water quality, channel stability, the water management system and discharge water in accordance with their existing surface water monitoring plan, which they will update to include the proposed project (HEC 2019, p. 106). This document was not provided as part of the EIS. Details of how this plan will be updated for the project have not been provided. The proponent also states that they intend to produce a construction phase Erosion and Sediment Control Plan to manage the construction works adjacent to the Big Flat Creek. These details should be provided so that their likely benefits can be assessed.

As discussed in the response to Comment 41, the additional MCCO Project specific water management, mitigation and monitoring measures that will be incorporated into the updated management plan were outlined in the EIS. This is the normal process in NSW where commitments are made in the EIS, however, the detailed management plans that assist with the implementation of these commitments are completed post approval of the project (in accordance with specific conditions of consent) but typically prior to implementation. It is usual practice that any such plans will require approval of the Secretary of DPIE. It is for this reason and in accordance with the development assessment and approval process in NSW that the detailed management plans for the MCCO Project were not prepared as part of the EIS. The relevant commitments to management, mitigation and monitoring measures were, however, outlined in the EIS for consideration by the determining authority.

The existing Mangoola Coal Mine Surface Water Monitoring Plan (SWMP) which is in place for the existing mining operation has been developed and implemented as required by the existing project approval (PA 06_0014) and is available online at:

https://www.mangoolamine.com.au/en/publications/Pages/management-plans.aspx.

As required by Condition 30 of PA 06_0014 this plan was developed in consultation with the NSW EPA and the DPI Water and approved by the DPIE. Recommendations for monitoring for the MCCO Project are contained in Section 5.0 of HEC (2019) and these changes will be incorporated into the revised Surface Water Monitoring Plan to be developed as part of the implementation of the MCCO Project.

It is standard practice in NSW to develop a construction phase Erosion and Sediment Control Plan post approval and following detailed project design, once detailed engineering plans and infrastructure details have been developed, together with details of construction sequencing and the scale of earthmoving equipment that is proposed. The Erosion and Sediment Control Plan would be developed once these details are known and in accordance with the 'Blue Book'.

Comment 47. It is unclear from the assessment documentation whether the proponent plans to continue monitoring the stream biota as has been undertaken for the existing mine. This stream monitoring program, including judiciously chosen control sites, presented in Umwelt (2019c, Appendix F) is well designed to detect impacts and to distinguish these from natural variability. The IESC recommends that this monitoring should be continued for the project, and that refinement of site-specific guideline values and appropriate mitigation strategies be incorporated in the routine assessment of results after each sampling round.

Mangoola commit to continue to stream health monitoring in accordance with the existing SWMP. The stream health monitoring program will include monitoring of macroinvertebrate assemblages and riparian vegetation along Big Flat Creek, Wybong Creek and Sandy Creek.

The existing SWMP will be updated to include the MCCO Project and will include details in regards to the ongoing stream health monitoring program.

Comment 48. As discussed in response to questions 2 and 3, the proponent has not clearly identified expected discharge quality (particularly in relation to metal contaminants). This lack of provided information limits the IESC's capacity to critically appraise the appropriateness of the proposed mitigation or monitoring. IESC notes that aluminium is not included in the proposed monitoring suite of parameters for surface water monitoring sites (Table 28, Appendix 11). Given the frequent exceedances for aluminium both upstream and downstream, aluminium should be included. In addition, the proposed monitoring of the water management dams on site (Table 28, Appendix 11) does not include any monitoring of metals. Metals (both total and dissolved) should be included, as these storages, especially the Pit Water Dam, may discharge to the Hunter River in future.

As discussed previously, the discharge facility is already approved and no changes to it are proposed as part of the MCCO Project.

As previously discussed in responses to Comments 15 and 29, aluminium will be included in the proposed monitoring suite of parameters for surface water monitoring sites. If licensed discharge infrastructure for the PWD is constructed in response to the site inventory TARP, annual monitoring of total and dissolved metals would be commenced in the PWD with the first round of monitoring to occur prior to any licensed discharge.

Comment 49. As discussed in response to questions 2 and 3, local groundwater is of poor quality (high salinity, and several nutrient and metal concentrations above guideline values). This may necessitate treatment of water prior to discharge to mitigate impacts to the water quality and biota of the downstream environment. The timing of discharges should be limited to times that minimise impact to the receiving environment. Streambed and bank armouring may be required to prevent localised erosion. Appropriately-designed monitoring, including water quality monitoring, should be undertaken to confirm that water quality and erosion management measures are effective.

As previously discussed in response to Comment 29, licensed discharge would only be required following periods of wet weather and any elevated constituent concentrations in groundwater would be highly diluted by rainfall runoff. All licensed discharges will be subject to the provisions of the HRSTS and EPL 12894. If the water quality in the PWD does not meet these criteria, discharge would not occur or the water would be treated prior to discharge in order to meet these criteria. The discharge outlet will be designed with appropriate rockfill, other armouring or appropriate design to control the potential for erosion. Water quality monitoring in the Hunter River both upstream and downstream is part of the existing Mangoola Coal Mine Surface Water Monitoring Plan and is planned to continue as part of the Project. The ability to undertake controlled discharge from the PWD is part of the approved mine and no change to the approved facility is proposed.

> **Comment 50**. The proponent suggests (HEC 2019, p. 74) that armouring may be required to mitigate erosion in Big Flat Creek associated with infrastructure installation. The nature of this armouring and the circumstances in which it would be installed should be explicitly described.

The preliminary design for the infrastructure installation includes the provision of erosion protection at the inlet and the outlet side of the infrastructure (culverts) in the form of:

- a well graded mixture of durable rip rap (rock) of a density typically 2000 kg/m^3 or greater
- all erosion protection including dumped rock and rock mattresses will be installed over a layer of filter fabric
- the thickness of erosion protection will vary depending on the location and duty of the erosion protection but will be in the order of 500 to 750 mm thick
- the preliminary design length on the inlet side of the infrastructure is for a 6m long rip rap erosion protection, transitioning to a 3m long concrete apron
- the preliminary design length on the outlet side of the infrastructure is for a 3 m long concrete apron, transitioning to a 25 m long rip rap erosion protection
- the cross section shape of the erosion protection at both the inlet and outlet of the infrastructure will take account of the direction of the water flow within the creek and would be in the order of 17 to 25 m wide, dependent on the creek width.

Monitoring of the localised, generally small areas in Big Flat Creek where velocity increases have been predicted would involve monthly visual inspection during periods of creek flow. If areas of erosion became apparent from these inspections, mitigation measures would be implemented. The mitigation measures would include engineering design (e.g. hydraulic analysis) as required, which would be undertaken by a suitably qualified and experienced person. Depending on the nature and severity of the erosion, the measures could include a combination of the following:

- detailed survey of the area to define the modified surface geometry
- stabilising earthworks - e.g. cutting back of steep slopes to a stable angle
- placement of suitably sized rockfill or other revetment to provide erosion resistance
- seeding or planting of endemic vegetation
- fencing the area to exclude stock
- continued monitoring of the area following creek flow events to confirm that erosion was not ongoing.

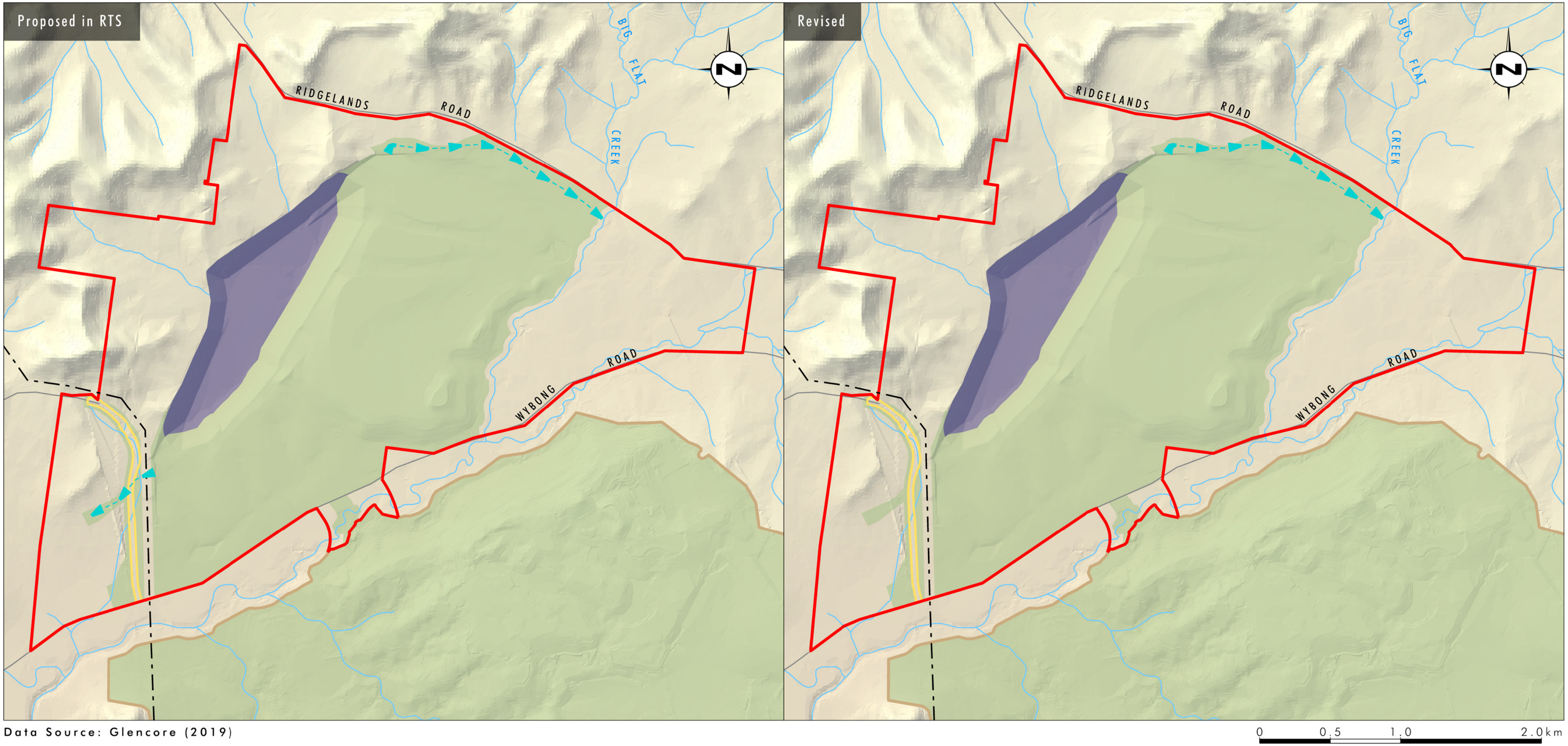
The above would be included in the updated Mangoola Coal Mine Erosion and Sediment Control Plan.

Comment 51. The final landform may alter runoff to adjacent areas with potential impacts on critically endangered species. There are known occurrences of the critically endangered orchid Prasophyllum sp. Wybong near the final landform, particularly to the southwest. The pattern of runoff from the proposed (conceptual) final landform is not entirely clear from the information presented in the assessment documentation (HEC 2019, pp. 64–65). To avoid impacts to these orchids, the final landform should be designed to avoid runoff changes to these sensitive receptors. The IESC also notes that, as it is difficult to identify orchids other than when they are in flower, their distribution may be underestimated. Therefore, additional Prasophyllum sp. Wybong may be identified prior to construction of the final landform and, if so, should be taken into account in the landform's design.

Final landform design will take cognisance of the presence of any additionally identified endangered orchids. A revised final landform was presented in the RTS and this included a small remaining section of the western clean water diversion drain discharging to the southwest of the MCCO Additional Mining Area (refer to **Figure 2.11**). Once mining is completed this diversion will have little or no catchment area and will therefore convey very little flow. It is therefore proposed to remove the end of the diversion to the west of the Wybong PO Road Realignment at the end of the MCCO Project as part of the establishment of the final landform.

Comment 52. In the geochemical assessment, the proponent concludes that most of the tailings are likely to be non-acid forming, with elevated salinity and moderate alkalinity. There are likely to be localised occurrences of potentially-acid-forming material close to outflow points. The alkalinity in the surrounding material is expected, in general, to neutralise the small amounts of acid. The proponent does, however, caution that acid and salinity may have local impacts on the rehabilitated landform and its vegetation (conceptual plan suggests ≥3 m cover above tailings) in the absence of appropriate controls, and recommends that this be considered further during detailed design (EGI 2019, pp. 36–37). The IESC agrees that this should be an important aspect of final landform design.

Noted.



Data Source: Glencore (2019)

Legend

- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Wybong Post Office Road Realignment
- Rehabilitation
- Void
- Clean Water Diversion Drain

FIGURE 2.11

Conceptual Final Landform and Revised Final Drainage

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3.0 Proposed Additional Management Measures

Section 8.0 of the MCCO Project EIS included a summary of all the proposed environmental management and monitoring measures for the MCCO Project. As a result of submissions received on the EIS, Mangoola has also committed to additional environmental management and monitoring measures and refined some of the measures outlined in the EIS and included these in Section 5.0 of the RTS.

As a result of providing this detailed response to the IESC advice Mangoola commits to the following additional measures as discussed in the responses above:

- Mangoola commit to revise the GWMP for the MCCO Project to include new groundwater monitoring sites to monitor the potential impacts of the MCCO Project. The locations of the proposed bores are shown using purple dots on **Figure 2.10** and are identified as Wybong 1, Sandy 1, GWMP1, GWMP2 and GWMP3.

- Mangoola commit to continue stream health monitoring in accordance with the existing SWMP which will be updated to include the MCCO Project. The stream health monitoring program will include monitoring of macroinvertebrate assemblages and riparian vegetation along Big Flat Creek, Wybong Creek and Sandy Creek.

- Mangoola commit to continue annual ecosystem monitoring for the currently monitored potential GDE located on Big Flat Creek to identify if there are any observable negative impacts on the flora that can be attributed to groundwater depressurisation caused by mining.

- Once mining is completed in the MCCO Additional Project Area Mangoola will remove the superfluous end of the clean water diversion drain to the west of the Wybong PO Road Realignment as part of the establishment of the final landform.

4.0 References

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APPENDIX 1

Bore Investigation Report MCCO Project

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JT:ak
G1839Z Private Landholder Bore Census
11 December 2019

Attention:
Daniel Sullivan

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

via email
dsullivan@umwelt.com.au

Dear Daniel,

RE: MCCO Project - Private Landholder Bore Assessments

1 Introduction

Mangoola Coal Operations Pty Limited (Mangoola) operates the Mangoola Coal Mine, which is located about 20 km west of Muswellbrook and 10 km north of Denman in the Hunter Valley, NSW. Mangoola is currently responding to submissions on its proposal to extend the mining area to the north of Big Flat Creek known as Mangoola Coal Continued Operations Project (MCCO Project). Three landholders adjacent to the proposed mining area have provided submissions requesting further information on the potential for their water bores to be affected by the MCCO Project. Umwelt (Australia) Pty Limited, who has been engaged to manage the approvals process on behalf of Mangoola, engaged Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) to undertake an assessment of their bores and assist in providing a response to these submissions from the landholders.

2 Objectives and scope of work

The objective of the engagement was to gather further information on the landholder's bores and determine the potential for the bores to be impacted by the MCCO Project. To achieve this objective the scope of work included:

1. Inspecting each bore to gather information on location and usage;
2. Collecting a water sample from each bore for laboratory analysis of water quality; and
3. Using the MCCO numerical modelling to estimate drawdown at the bore,

The results of each of these tasks are described further in the sections below.

3 Private bore inspections

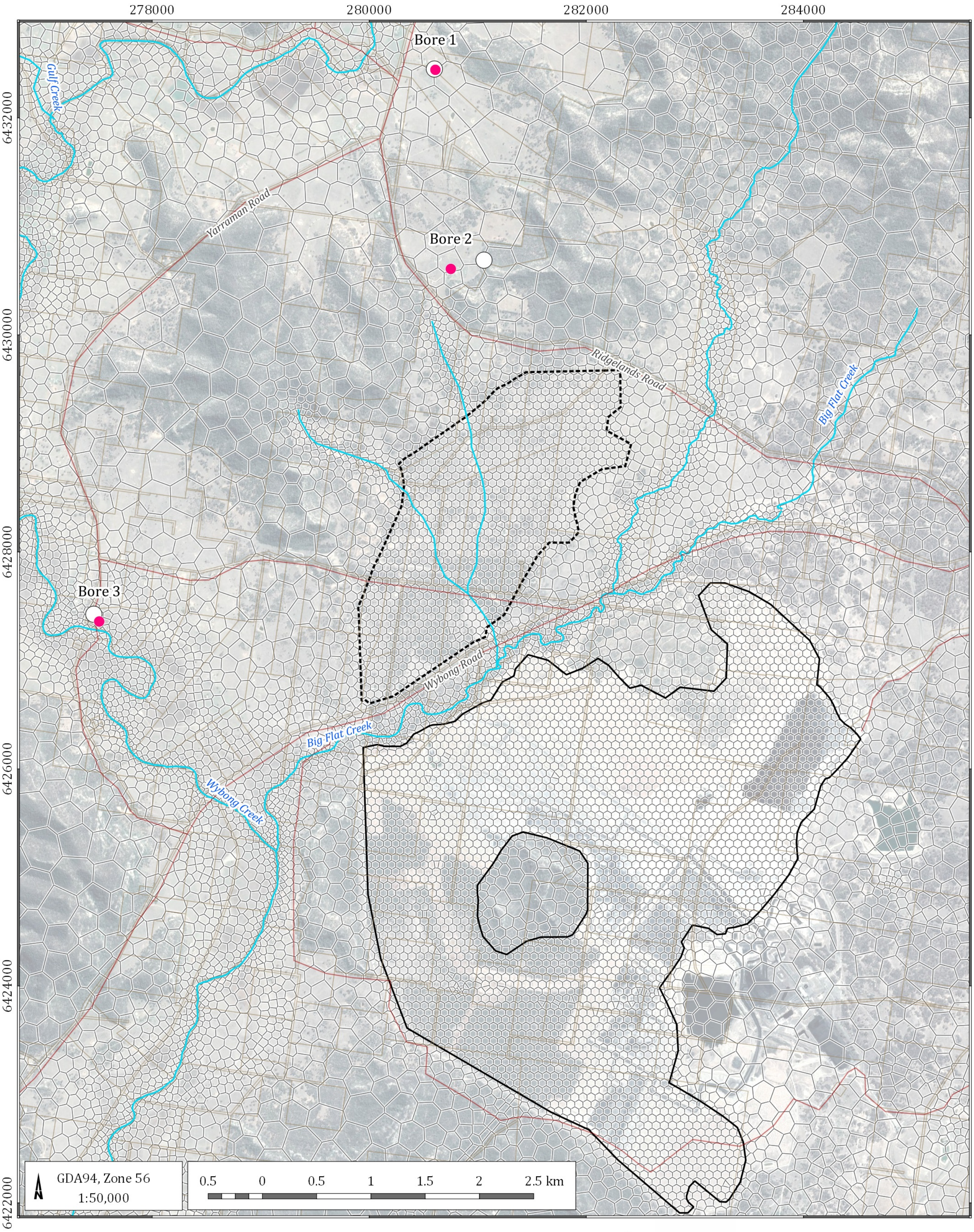
Three property owners provided submissions about the potential for their water bores to be impacted by the MCCO Project as follows:

- Residence 261 - Bore 1;
- Residence 157 - Bore 2; and
- Residence 130 - Bore 3.

A representative of AGE and Mangoola visited each property accompanied by the respective landholders on 23 October 2019. The purpose of the site visits was to:

- locate each bore using a hand-held GPS;
- interview each landholder on the bore details and their water use;
- measure the depth to the water table in each bore and the bore depth; and
- collect a water sample for laboratory analysis.

Information provided by each landholder on their bores is summarised in Table 3.1. The location of each bore, and the location used in the EIS MCCO numerical model are shown on Figure 3.1.



LEGEND

- Inspected bore locations*
- Bore location in MCCO EIS
- Drainage
- Road
- Property boundaries
- MCCO EIS Model Mesh
- Approved Mangoola Coal Mining Area
- Proposed Additional Mining Area

* size of the marker may obscure the exact location of the bore

Mangoola RTS (G1839Z)

Private landholder bore locations

AGE

DATE 02/12/2019

FIGURE No: **3.1**

Source: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.;
G:\Projects\G1839Z_Mangoola RTS\3_GIS\Workspaces\001_Deliverable1\03.01_G1839Z_Private landholder bore locations.qgs

Table 3.1 Private landholder bore information

Bore Information	Bore 1	Bore 2	Bore 3
Property	Residence 261	Residence 157	Residence 130
Easting#	0280609	0280751	0277511
Northing#	6432443	6430608	6427358
Drill Date	2018	2011	Unknown*
Purpose	Stock and domestic	Stock and domestic	Stock and domestic
Total depth (m)	94	85	30
Pump depth (m)	84	80	25
Water level (mbgl)	Unable to measure**	Unable to measure**	14.58
Yield during development (L/s)	1.4	6-7	Unknown^^
Yield (currently)	2^	1.5	Unknown
Pump	Electric submersible	Electric submersible	Windmill
Sampled for laboratory analysis	Yes	Yes	Grab only
Electrical conductivity (µS/cm)	12,720	4,112	3,753
pH	6.86	7.27	7.15
Temperature (Celsius)	20.6	21.1	21.9

Note: *# GDA94, MGA Zone 56*
** Present on property at time of acquisition (1999)*
*** Unable to measure due to sealed headworks*
^ Pumps bore dry (requiring 30 minute recovery – landholder information)
^^ Not enough wind to pump and estimate

4 Water quality analysis

Water samples were pumped from Bores 1 and 2 and stored in laboratory supplied sample bottles for transport to the analytical laboratory. A sample could not be pumped from Bore 3 as there was no wind at the time of the inspection. The results of water quality analyses for Bores 1 and 2 are attached. The laboratory analyses indicate the groundwater from Bore 1 and Bore 2 is not suitable for human consumption based on salinity. The salinity of the water sample from Bore 1 indicates a potential for loss of production and a decline in beef cattle condition and health. Bore 2 is suitable for a wide range of stock watering.

5 Numerical Modelling

Figure 3.1 shows the location of each bore measured with a handheld GPS and the location previously assumed during the MCCO EIS. The figure shows the actual locations are slightly different to those represented in the MCCO EIS numerical model. The updated bores locations were used to recalculate the drawdown at each revised location using the MCCO numerical model. The predicted maximum drawdown at each bore is provided in Table 5.1.

Table 5.1 Private bore predicted cumulative drawdown

Bore ID	Total depth (m)	Pump depth (m)	SWL (mbgl)	Model layer at pump depth	Predicted maximum drawdown (m)	
					MCCO EIS	Updated based on site visit
Bore 1	94	84	N/A (Sealed headworks)	4	-	0.182
Bore 2	85	80	N/A (Sealed headworks)	4	3.1	1.296
Bore 3	30	25	14.58	4	-	0.008

The MCCO EIS assumed Bore 3 was 58 m deep, with the inspection indicating the bore has a depth of 30 m. The bores depth was updated in the MCCO numerical model to occur within model layer 4.

Predicted water levels for each bore over time are provided in Figure 5.1 to Figure 5.3. Predicted groundwater levels are for:

- No approved mining or MCCO Project.
- Approved mining only.
- Both approved mining and MCCO Project.

Two graphs are provided for each bore. The first with the predicted water level compared to the pump depth, and the second at a smaller scale where water level trends are evident.

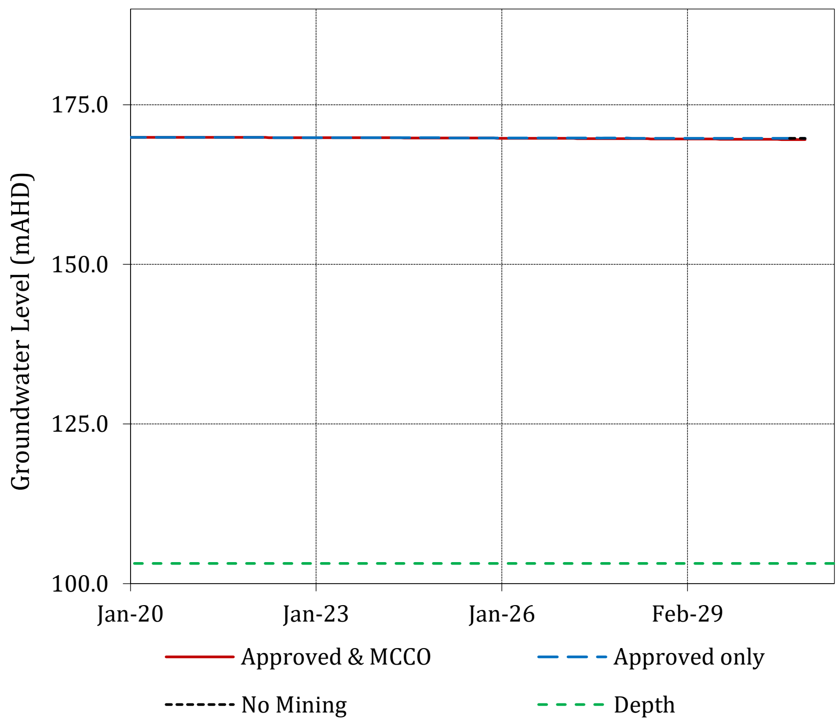


Figure 5.1 Groundwater level for Bore 1

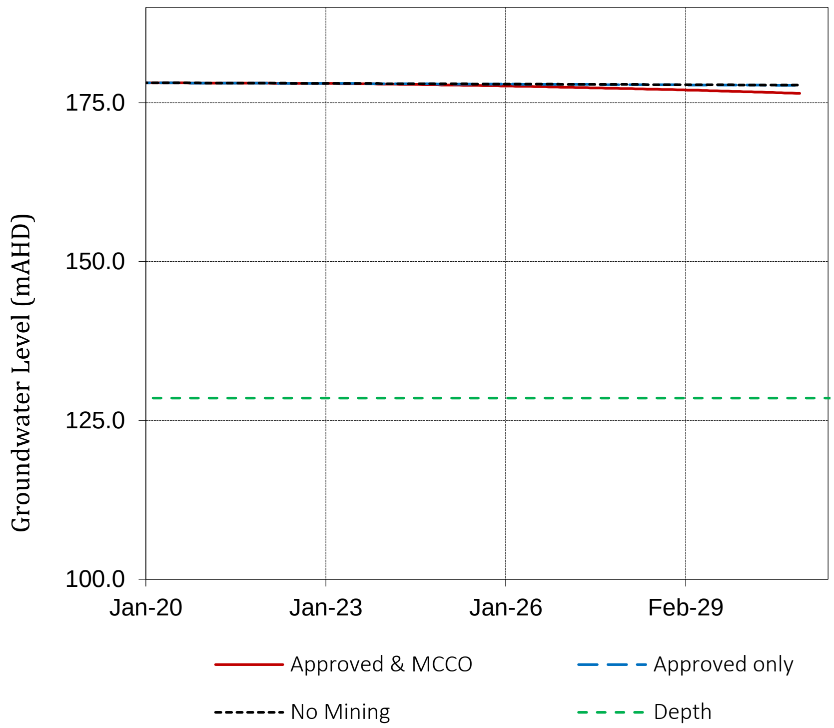


Figure 5.2 Groundwater level for Bore 2

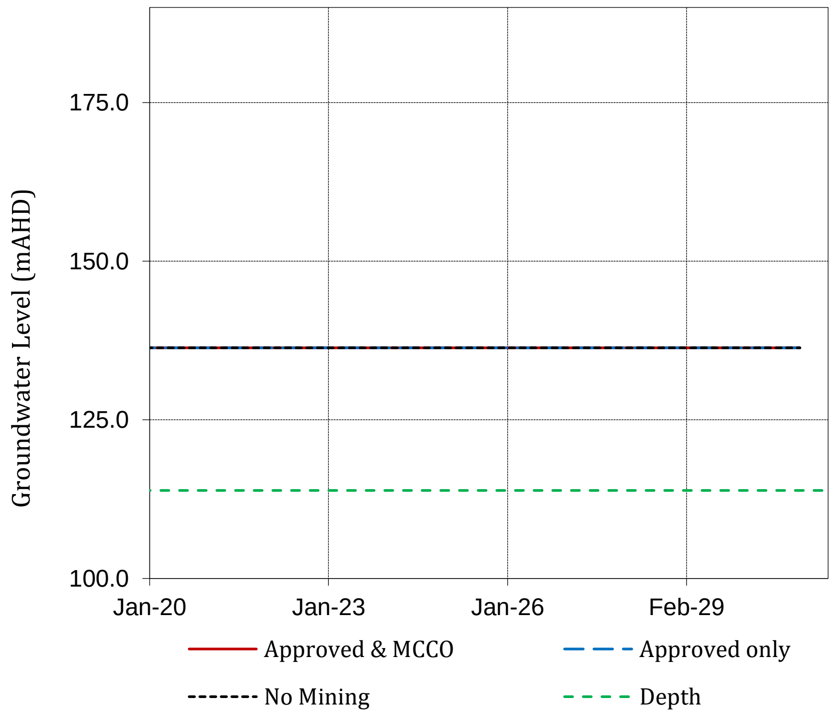


Figure 5.3 Groundwater level for Bore 3

6 Summary and conclusions

The locations of three private bores were determined and updated in the MCCO numerical model. The numerical model predicts water level drawdown will remain less than the 2 m threshold specified within the Aquifer Interference Policy. This means there is no trigger for make good provisions with the landholders. Despite this it is recommended water levels are monitored at each of these bores where access can be arranged to confirm the MCCO model predictions. It is recommended telemetry data loggers are used for the monitoring.

If you have any queries, please do not hesitate to call.

Yours faithfully,

JAMES TOMLIN
Principal Hydrogeologist/Director
Australasian Groundwater and Environmental Consultants Pty Ltd

APPENDIX 2

Water Quality Data for Big Flat Creek sites SW14 and SW15

Physical Parameters and pH

Locations	Statistic	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Turbidity (NTU)
Hunter River downstream of the HRSTS discharge location (SW14)	Median	8.10	495	17	298	16
	Average	8.04	525	42.8	316	34.3
	Minimum	6.4	164	1	106	1.2
	Maximum	9.3	1,343	3,580	1,218	550
	No. Samples	270	270	264	270	134
	% Exceedance†	55%	91%	-	0%	27%
Hunter River downstream of the Sandy Creek confluence (SW15)	Median	8	501	15	291	14
	Average	7.93	541	50.7	315	34.2
	Minimum	6.3	97	0	28	1.1
	Maximum	8.9	2,470	4,800	1,790	550
	No. Samples	272	272	265	272	134
	% Exceedance†	32%	90%	-	0%	25%

† Exceedance of ANZECC (2000) guideline default trigger values or range (for pH)

Total Metals

Locations	Statistic	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron
Hunter River downstream of the HRSTS discharge location (SW14)	Median (mg/L)	0.305	-	<0.001	0.016	-	-
	Average (mg/L)	0.37	-	0.002	0.025	-	-
	Minimum (mg/L)	<0.01	-	<0.001	0.01	-	-
	Maximum (mg/L)	2	<0.001	<0.01	<0.1	<0.001	<0.1
	No. Samples	34	8	41	41	31	16
	% Exceedance†	97%	0%	0%	0%	0%	0%
Hunter River downstream of the Sandy Creek confluence (SW15)	Median (mg/L	0.23	-	<0.001	0.016	-	-
	Average (mg/L)	0.28	-	0.004	0.039	-	-
	Minimum (mg/L)	0.07	-	<0.001	0.01	-	-
	Maximum (mg/L)	0.72	<0.001	0.02	<0.1	<0.001	<0.1
	No. Samples	8	8	17	17	3	17
	% Exceedance†	100%	0%	6%	0%	0%	0%

† Exceedance of ANZECC (2000) guideline default trigger values

Total Metals (Continued)

Locations	Statistic	Cadmium	Chromium	Cobalt	Copper	Iron	Lead
Hunter River downstream of the HRSTS discharge location (SW14)	Median (mg/L)	-	-	-	<0.001	0.33	<0.001
	Average (mg/L)	-	-	-	0.002	0.42	0.002
	Minimum (mg/L)	-	-	-	<0.001	<0.05	<0.001
	Maximum (mg/L)	<0.0001	<0.001	<0.001	<0.01	1.99	<0.01
	No. Samples	38	34	34	41	41	41
	% Exceedance†	0%	0%	0%	27%	0%	12%
Hunter River downstream of the Sandy Creek confluence (SW15)	Median (mg/L)	-	-	-	<0.001	0.33	<0.001
	Average (mg/L)	-	-	-	0.004	0.40	0.004
	Minimum (mg/L)	-	-	-	<0.001	0.12	<0.001
	Maximum (mg/L)	<0.0001	<0.001	<0.001	<0.01	0.86	<0.01
	No. Samples	12	8	8	17	17	17
	% Exceedance†	0%	0%	0%	29%	0%	29%

† Exceedance of ANZECC (2000) guideline default trigger values

Total Metals (Continued)

Locations	Statistic	Manganese	Mercury	Molybdenum	Nickel	Selenium
Hunter River downstream of the HRSTS discharge location (SW14)	Median (mg/L)	0.023	-	-	-	-
	Average (mg/L)	0.026	-	-	-	-
	Minimum (mg/L)	0.003	-	-	-	-
	Maximum (mg/L)	0.066	<0.0001	<0.001	<0.001	<0.01
	No. Samples	41	39	5	7	41
	% Exceedance†	0%	0%	0%	0%	0%
Hunter River downstream of the Sandy Creek confluence (SW15)	Median (mg/L	0.027	-	-	-	-
	Average (mg/L)	0.028	-	-	-	-
	Minimum (mg/L)	0.008	-	-	-	-
	Maximum (mg/L)	0.05	<0.0001	<0.001	<0.001	<0.01
	No. Samples	17	13	5	8	17
	% Exceedance†	0%	0%	0%	0%	0%

† Exceedance of ANZECC (2000) guideline default trigger values

Total Metals (Continued)

Locations	Statistic	Silver	Strontium	Vanadium	Zinc
Hunter River downstream of the HRSTS discharge location (SW14)	Median (mg/L)	<0.001	0.288	-	<0.005
	Average (mg/L)	0.004	0.284	-	0.006
	Minimum (mg/L)	<0.001	0.218	-	<0.005
	Maximum (mg/L)	<0.01	0.33	<0.01	0.04
	No. Samples	16	7	3	41
	% Exceedance†	100%	0%	0%	12%
Hunter River downstream of the Sandy Creek confluence (SW15)	Median (mg/L	<0.001	0.292	-	<0.005
	Average (mg/L)	0.004	0.290	-	0.006
	Minimum (mg/L)	<0.001	0.221	-	<0.005
	Maximum (mg/L)	<0.01	0.358	<0.01	<0.01
	No. Samples	17	8	3	17
	% Exceedance†	100%	0%	0%	29%

† Exceedance of ANZECC (2000) guideline default trigger values

APPENDIX 3

Groundwater Quality Analyses for MCCO Project

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Fresh Water Aquatic (95th)**	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW04	GW04	GW04	GW04	GW04	GW04	GW04	GW04	GW04
Date Sampled				25/09/2017	09/10/2017	26/10/2017	9/11/2017	22/11/2017	5/12/2017	20/12/2017	5/01/2018	18/01/2018	25/09/2017	09/10/2017	26/10/2017	9/11/2017	22/11/2017	5/12/2017	20/12/2017	5/01/2018	18/01/2018
Lithology																					
Field Parameters																					
Field pH	pH units																				
Field Electrical Conductivity (EC)	µS/cm																				
Depth to Groundwater	m TOC																				
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5**	8.46	8.29	8.11	8.3	8.17	8.34	8.21	8.24	8.07	7.81	7.95	7.46	7.66	7.66	7.7	7.53	7.7	7.58
Electrical conductivity	µS/cm	1	**120 - 300**	23300	23100	23800	23400	23500	23400	24200	23600	24300	7660	7620	7900	7780	7830	7760	8010	7860	7980
Total Dissolved Solids (grav) @180°C	mg/L	1.00		15100	14400	15200	13700	16000	15900	16900	14600	15000	4500	4570	4690	3980	4650	4710	4370	4780	4750
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		33	<1	<1	6	<1	21	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		339	468	490	517	503	488	512	601	664	1270	1360	1380	1370	1250	1280	1270	1290	1350
Total Alkalinity as $CaCO_3$	mg/L	1.00		372	468	490	524	503	509	512	601	664	1270	1360	1380	1370	1250	1280	1270	1290	1350
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1		311	304	329	308	316	292	293	266	266	216	213	260	241	248	229	230	220	218
Chloride	mg/L	1		7220	8000	8400	7690	8070	8000	8300	8300	8000	1490	1690	1730	1590	1690	1600	1720	1680	1670
Calcium	mg/L	1		29	30	32	33	36	56	38	41	40	41	40	41	38	38	55	40	39	42
Magnesium	mg/L	1		452	463	461	462	458	509	516	436	451	14	24	15	16	17	15	16	13	16
Sodium	mg/L	1		4330	4500	4510	4560	4530	5150	4770	4270	4490	1560	1810	1760	1710	1760	1820	1740	1440	1720
Potassium	mg/L	1		50	52	50	53	52	62	56	53	52	9	12	10	11	11	10	11	9	11
Total Anions	meq/L	0.01		218	241	254	234	244	242	250	252	244	71.9	79.3	81.8	77.2	77.8	75.5	78.7	77.7	78.6
Total Cations	meq/L	0.01		228	237	237	239	238	270	253	225	236	71.3	83	80.1	77.9	80.1	83.4	79.3	65.9	78.5
Ionic Balance	%	0.01		2.4	0.98	3.38	1.18	1.33	5.54	0.56	5.59	1.82	0.43	2.3	1.05	0.41	1.47	4.99	0.38	8.26	0.07
Nutrients																					
Ammonia as N	mg/L	0.01	**0.9**	0.64	1.17	1.38							4.27	4.55	4.9						
Nitrite as N	mg/L	0.01		0.15	<0.01	<0.01							<0.01	0.05	0.02						
Nitrate as N	mg/L	0.01	**0.7**	<0.01	<0.01	0.03							0.06	0.07	0.04						
Nitrite + Nitrate as N	mg/L	0.01		0.03	<0.01	0.03							0.06	0.12	0.06						
Total Kjeldahl Nitrogen as N	mg/L	0.1		1.2	1.3	1.7							4.6	6.4	5.2						
Total Nitrogen as N	mg/L	0.1		1.2	1.3	1.7							4.7	6.5	5.3						
Total Phosphorus as P	mg/L	0.01		0.02	<0.10	<0.02							0.62	1.08	0.83						
Reactive Phosphorus as P	mg/L	0.01		<0.01	<0.01	<0.01							0.48	0.8	0.73						
Total Metals																					
Aluminium	mg/L	0.01	**0.055**	0.05	0.06	<0.01	0.03	<0.01	<0.01	<0.01	0.01	0.1	0.02	0.08	0.05	0.19	0.01	0.02	<0.01	0.01	0.19
Antimony	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**As (III) 0.024 As (V) 0.013**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.02	0.018	0.022	0.022	0.022	0.026	<0.001	<0.001	<0.001	0.249	0.228	0.252	0.242	0.232	0.24
Beryllium	mg/L	0.001		0.02	0.016	0.025							0.237	0.264	0.246						
Boron	mg/L	0.05	**0.37**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.38	0.4	0.38	0.38	0.39	0.4	0.38	0.44	0.4
Cadmium	mg/L	0.0001	**0.0002**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**CrIII – ID Cr(VI) 0.001**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.0014**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.01	0.001	0.01	<0.001	<0.001	0.002	<0.001	<0.001
Iron	mg/L	0.05	**-**	24.6	10.3	0.64	7.26	6.26	4.51	4.92	6.79	13	0.49	0.99	0.7	2.3	0.35	0.29	0.26	0.17	0.31
Lead	mg/L	0.001	**0.0034**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.001	0.013	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**1.9**	0.509	0.581	0.599	0.693	0.696	0.707	0.608	0.578	0.647	0.076	0.091	0.074	0.089	0.084	0.08	0.08	0.08	0.079
Mercury	mg/L	0.0001	**0.0006**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**-**	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001						
Nickel	mg/L	0.001	**0.011**	<0.001	0.002	0.002	0.001	0.001	<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	**Total – 0.011 SeIIV - ID**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		0.002	<0.001	0.002	<0.001	0.003	0.003	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		2.38	2.74	2.87	3.17	3.18	3.55	3.33	3.13	3.32	2.94	3.06	2.88	2.99	2.87	3.21	2.99	2.93	2.96
Vanadium	mg/L	0.01	**-**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**0.008**	0.024	0.011	<0.005	0.013	0.02	<0.005	<0.005	0.006	0.028	0.006	0.066	0.056	0.242	0.014	0.013	0.031	0.007	0.012
BTEX																					
Benzene	µg/L	1	**900**	<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2	**350**	<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5	**16**	<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting
a NHMRC Health Guidelines for Drinking Water (2015)
b NHMRC Aesthetic Guidelines for Drinking Water (2015)
m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.
\+ NHMRC acid-soluable aluminium concentrations (2015)
\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Fresh Water Aquatic (95th)**	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW33	GW33	GW33	GW33	GW33	GW33	GW33	GW33	GW33
Date Sampled				25/09/2017	09/10/2017	24/10/2017	8/11/2017	22/11/2017	4/12/2017	20/12/2017	5/01/2018	19/01/2018	27/09/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/01/2018	19/01/2018
Lithology																					
Field Parameters																					
Field pH	pH units																				
Field Electrical Conductivity (EC)	µS/cm																				
Depth to Groundwater	m TOC																				
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5**	7.81	8.02	7.89	7.69	7.65	7.7	7.55	7.69	7.62	7.7	7.73	7.27	7.41	7.39	7.56	7.31	7.46	7.31
Electrical conductivity	µS/cm	1	**120 - 300**	7660	5060	5570	5280	5320	5240	5710	5360	5420	16300	16000	16500	16200	16400	16400	16900	16800	17000
Total Dissolved Solids (grav) @180°C	mg/L	1.00		4500	2860	2980	3150	3000	3010	3400	3010	2780	13700	10600	11500	9500	11700	12100	11400	12500	11000
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		1270	851	784	838	766	762	792	716	858	1020	1110	1110	1110	1030	1060	967	1070	1110
Total Alkalinity as $CaCO_3$	mg/L	1.00		1270	851	784	838	766	762	792	716	858	1020	1110	1110	1110	1030	1060	967	1070	1110
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1		216	1	1	3	2	2	4	1	3	419	513	541	587	599	590	700	732	515
Chloride	mg/L	1		1490	1220	1200	1230	1270	1250	1380	1280	1290	4750	5020	5630	5060	5380	5380	5550	5390	5090
Calcium	mg/L	1		41	70	71	66	69	92	73	68	72	176	202	208	198	204	240	223	214	208
Magnesium	mg/L	1		14	68	60	64	66	77	74	64	65	654	769	812	774	780	796	955	739	726
Sodium	mg/L	1		1560	1010	939	941	1000	1100	1050	916	965	1870	2170	2280	2160	2230	2330	2460	2060	2130
Potassium	mg/L	1		9	16	16	15	16	17	17	15	16	71	80	82	80	82	90	88	78	81
Total Anions	meq/L	0.01		71.9	51.4	49.5	51.5	51.2	50.5	54.8	50.4	53.6	163	174	192	177	185	185	190	189	176
Total Cations	meq/L	0.01		71.3	53.4	49.7	49.9	52.8	59.2	55.8	48.9	51.3	146	170	178	170	173	181	199	163	165
Ionic Balance	%	0.01		0.43	1.9	0.2	1.6	1.55	7.91	0.91	1.56	2.16	5.61	1.35	3.72	2.18	3.16	1.12	2.19	7.27	3.41
Nutrients																					
Ammonia as N	mg/L	0.01	**0.9**	4.27	1.62	1.74							0.02	0.03	0.04						
Nitrite as N	mg/L	0.01		<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Nitrate as N	mg/L	0.01	**0.7**	0.06	0.07	0.02							0.04	0.01	0.05						
Nitrite + Nitrate as N	mg/L	0.01		0.06	0.07	0.02							0.04	0.01	0.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1		4.6	1.7	2.2							0.2	<0.2	<0.2						
Total Nitrogen as N	mg/L	0.1		4.7	1.8	2.2							0.2	<0.2	<0.2						
Total Phosphorus as P	mg/L	0.01		0.62	0.05	0.07							0.18	0.09	0.05						
Reactive Phosphorus as P	mg/L	0.01		0.48	<0.01	<0.01							0.02	<0.01	0.03						
Total Metals																					
Aluminium	mg/L	0.01	**0.055**	0.2	0.49	2.37	1.66	0.54	0.24	0.19	0.28	0.91	0.35	0.32	0.87	4.86	0.17	0.16	0.28	0.38	3.43
Antimony	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**As (III) 0.024 As (V) 0.013**	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.002	0.002	0.002	0.001	0.002	0.001	0.002	0.004
Barium	mg/L	0.001		<0.001	<0.001	<0.001	1.28	1.18	1.16	1.16	1.14	1.19	<0.001	<0.001	<0.001	0.149	0.139	0.133	0.141	0.145	0.145
Beryllium	mg/L	0.001		1.14	1.16	1.23							0.127	0.131	0.135						
Boron	mg/L	0.05	**0.37**	0.18	0.19	0.16	0.17	0.18	0.19	0.18	0.18	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	**0.0002**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**CrIII – ID Cr(VI) 0.001**	0.001	0.002	0.005	0.006	0.002	0.002	0.023	0.002	0.005	<0.001	<0.001	0.002	0.008	<0.001	<0.001	<0.001	0.001	0.013
Cobalt	mg/L	0.001		<0.001	0.001	0.002	0.002	<0.001	0.001	0.001	<0.001	0.001	0.003	0.004	0.004	0.006	0.003	0.004	0.004	0.004	0.006
Copper	mg/L	0.001	**0.0014**	0.006	0.018	0.022	0.024	0.009	0.004	0.004	0.005	0.014	0.013	0.017	0.013	0.049	0.009	0.014	0.011	0.015	0.055
Iron	mg/L	0.05	**-**	0.9	1.12	3.08	3.91	1.48	0.99	1.05	0.97	1.72	3.16	1.89	2.37	8.16	0.95	0.73	1.01	2.76	9.75
Lead	mg/L	0.001	**0.0034**	0.003	0.02	0.006	0.008	0.002	0.002	0.002	0.002	0.003	<0.001	0.001	0.001	0.005	<0.001	0.001	<0.001	0.002	0.008
Manganese	mg/L	0.001	**1.9**	0.208	0.23	0.268	0.279	0.231	0.252	0.25	0.214	0.267	0.099	0.112	0.116	0.156	0.136	0.131	0.152	0.167	0.166
Mercury	mg/L	0.0001	**0.0006**	<0.0001	<0.0001	0.0001						0.0002	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**-**	0.001	<0.001	<0.001							<0.001	<0.001	<0.001						
Nickel	mg/L	0.001	**0.011**	0.002	0.006	0.007	0.014	0.006	0.008	0.02	0.003	0.01	0.005	0.006	0.006	0.012	0.006	0.006	0.005	0.007	0.012
Selenium	mg/L	0.01	**Total – 0.011 SeIIV - ID**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		2.75	2.77	3	2.93	2.81	3	2.82	2.68	2.92	6.33	6.56	6.34	6.57	6.35	6.95	6.62	6.43	6.58
Vanadium	mg/L	0.01	**-**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**0.008**	0.098	0.109	0.226	0.151	0.062	0.062	0.049	0.1	0.11	0.013	0.018	0.02	0.051	0.014	0.019	0.015	0.022	0.044
BTEX																					
Benzene	µg/L	1	**900**	<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2	**350**	<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5	**16**	<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			Fresh Water Aquatic (95th)	GW46	GW46	GW46	GW46	GW46	GW46	GW46	GW46	GW46	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B
Date Sampled				27/09/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/01/2018	19/01/2018	26/09/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	21/12/2017	4/01/2018	18/01/2018
Lithology																					
Field Parameters																					
Field pH	pH units																				
Field Electrical Conductivity (EC)	µS/cm																				
Depth to Groundwater	m TOC																				
Physical Parameters																					
pH	pH Units	0.1	6.5 - 8.5	7.54	7.78	7.28	7.44	7.41	7.45	7.25	7.39	7.3	7.9	8.05	7.7	7.83	7.75	7.79	7.65	7.83	7.84
Electrical conductivity	µS/cm	1	120 - 300	7470	7360	7780	7610	7700	7600	7900	7730	7840	4290	4370	4610	4500	4540	4560	4660	4560	4540
Total Dissolved Solids (grav) @180°C	mg/L	1.00		5270	4600	5030	4070	5160	4470	4510	4830	4580	3240	2820	3210	3610	3590	3260	3140	2810	2520
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		845	1020	995	1010	905	837	908	923	972	368	446	439	440	402	371	391	401	423
Total Alkalinity as $CaCO_3$	mg/L	1.00		845	1020	995	1010	905	837	908	923	972	368	446	439	440	402	371	391	401	423
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1		144	142	211	166	180	160	177	180	179	38	47	329	41	43	38	40	37	35
Chloride	mg/L	1		1690	2060	2490	1870	2230	1920	1990	2200	2140	1110	1280	1320	1210	1270	1260	1280	1270	1250
Calcium	mg/L	1		106	112	106	108	111	129	120	116	113	152	174	159	163	164	192	168	164	163
Magnesium	mg/L	1		426	444	441	440	442	452	521	463	413	302	358	337	346	341	361	350	330	317
Sodium	mg/L	1		814	841	845	827	851	878	927	883	801	210	212	207	207	209	221	214	203	199
Potassium	mg/L	1		48	50	48	48	50	50	54	52	48	9	8	8	8	8	8	8	7	8
Total Anions	meq/L	0.01		67.6	81.4	94.5	76.4	84.7	74.2	78	84.2	83.5	39.4	46	52.8	43.8	44.8	43.7	44.8	44.6	44.4
Total Cations	meq/L	0.01		77	80	79.6	78.8	80.2	83.1	90.6	83.6	75.7	41.8	47.6	44.9	45.8	45.5	49.1	46.7	44.4	43.1
Ionic Balance	%	0.01		6.52	0.9	8.58	1.56	2.74	5.65	7.48	0.37	4.91	2.89	1.68	8.16	2.28	0.88	5.78	2.13	0.28	1.55
Nutrients																					
Ammonia as N	mg/L	0.01	0.9	3.34	3.32	3.36							0.13	0.07	0.04						
Nitrite as N	mg/L	0.01		0.09	<0.01	0.03							0.06	<0.01	<0.01						
Nitrate as N	mg/L	0.01	0.7	<0.01	0.02	0.05							0.04	0.02	0.09						
Nitrite + Nitrate as N	mg/L	0.01		0.08	0.02	0.08							0.1	0.02	0.09						
Total Kjeldahl Nitrogen as N	mg/L	0.1		3.6	3.6	3.6							0.3	0.1	0.1						
Total Nitrogen as N	mg/L	0.1		3.7	3.6	3.7							0.4	0.1	0.2						
Total Phosphorus as P	mg/L	0.01		0.32	0.11	0.33							0.11	0.15	0.16						
Reactive Phosphorus as P	mg/L	0.01		<0.01	<0.01	<0.01							0.08	0.07	0.11						
Total Metals																					
Aluminium	mg/L	0.01	0.055	0.06	0.02	0.24	0.02	<0.01	0.04	<0.01	0.06	0.06	1.21	0.24	0.36	0.41	0.36	0.04	0.05	0.2	0.19
Antimony	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	As (III) 0.024 As (V) 0.013	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.004	0.005	0.004	0.005	0.006	0.005	0.004	0.005
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.275	0.279	0.294	0.284	0.27	0.287	<0.001	<0.001	<0.001	0.133	0.142	0.144	0.131	0.132	0.138
Beryllium	mg/L	0.001		0.292	0.286	0.298							0.164	0.136	0.135						
Boron	mg/L	0.05	0.37	0.06	0.06	0.06	<0.05	0.06	0.07	0.06	0.06	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	CrIII – ID Cr(VI) 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001		<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.0014	<0.001	<0.001	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.189	0.014	0.008	0.014	0.015	0.004	0.012	0.01	0.009
Iron	mg/L	0.05	-	16.5	13.7	16.6	14.9	14.5	18.7	14.8	14.5	15.5	1.64	1.04	1.02	1.14	1.63	1.84	0.82	0.94	0.85
Lead	mg/L	0.001	0.0034	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.009	0.002	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	1.9	0.505	0.526	0.573	0.553	0.561	0.62	0.573	0.564	0.604	0.804	0.656	0.723	0.735	0.692	0.732	0.744	0.721	0.726
Mercury	mg/L	0.0001	0.0006	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	-	<0.001	<0.001	<0.001							0.002	<0.001	<0.001						
Nickel	mg/L	0.001	0.011	<0.001	<0.001	0.002	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.011	0.004	<0.001	0.002	0.004	0.002	0.001	0.001	0.001
Selenium	mg/L	0.01	Total – 0.011 SeIIV - ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		3.05	3.15	3.11	3.09	3.13	3.37	3.24	3.04	3.2	2.09	2.27	2.1	2.12	2.16	2.27	2.11	2.06	2.21
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	0.008	0.006	0.008	0.012	<0.005	<0.005	0.007	<0.005	0.007	0.009	0.024	0.017	0.007	0.01	0.017	0.006	<0.005	0.01	0.006
BTEX																					
Benzene	µg/L	1	900	<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2	350	<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5	16	<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			Fresh Water Aquatic (95th)	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B
Date Sampled				26/09/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	21/12/2017	4/01/2018	18/01/2018	26/09/2017	09/10/2017	27/10/2017	9/11/2017	24/11/2017	5/12/2017	22/12/2017	5/01/2018	18/01/2018
Lithology																					
Field Parameters																					
Field pH	pH units																				
Field Electrical Conductivity (EC)	µS/cm																				
Depth to Groundwater	m TOC																				
Physical Parameters																					
pH	pH Units	0.1	6.5 - 8.5	7.67	7.8	7.45	7.61	7.52	7.54	7.42	7.64	7.62	7.84	7.75	7.46	7.57	7.5	7.54	7.4	7.6	7.58
Electrical conductivity	µS/cm	1	120 - 300	7360	7270	7620	7500	7590	7620	7790	7730	8020	3970	5130	5350	5230	5230	5110	5240	5110	5070
Total Dissolved Solids (grav) @180°C	mg/L	1.00		4410	4830	5250	4440	5460	5210	5260	5030	5180	2830	3130	3190	3390	3620	3400	3580	3180	2820
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		522	573	595	579	525	527	512	519	568	331	394	395	389	353	322	312	332	376
Total Alkalinity as $CaCO_3$	mg/L	1.00		522	573	595	579	525	527	512	519	568	331	394	395	389	353	322	312	332	376
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1		120	132	137	122	141	134	134	132	146	36	109	117	113	130	122	119	117	119
Chloride	mg/L	1		1850	2260	2620	1980	2400	2420	2520	2410	2280	994	1460	1480	1360	1410	1360	1400	1390	1410
Calcium	mg/L	1		229	249	231	236	239	284	250	255	255	222	216	151	135	135	172	129	135	130
Magnesium	mg/L	1		317	349	326	338	338	357	364	350	335	138	183	174	194	189	199	184	169	166
Sodium	mg/L	1		757	825	786	802	824	883	894	836	816	403	554	616	648	645	688	626	581	588
Potassium	mg/L	1		8	8	8	8	8	8	9	9	8	11	13	12	14	12	13	12	12	12
Total Anions	meq/L	0.01		65.1	77.9	88.6	70	81.1	81.6	84.1	81.1	78.7	35.4	51.3	52.1	48.5	49.5	47.3	48.2	48.3	49.8
Total Cations	meq/L	0.01		70.6	77.2	72.8	74.7	75.8	82.2	81.6	78.1	76	40.2	50.3	49	51.2	50.6	55.2	49.1	46.2	46
Ionic Balance	%	0.01		4.08	0.46	9.85	3.26	3.4	0.36	1.54	1.87	1.75	6.4	1.04	3.09	2.77	1.12	7.68	0.94	2.17	3.9
Nutrients																					
Ammonia as N	mg/L	0.01	0.9	<0.01	<0.01	<0.01							0.05	0.48	0.7						
Nitrite as N	mg/L	0.01		<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Nitrate as N	mg/L	0.01	0.7	1.17	0.95	1.14							0.05	0.01	0.06						
Nitrite + Nitrate as N	mg/L	0.01		1.17	0.95	1.14							0.05	0.01	0.06						
Total Kjeldahl Nitrogen as N	mg/L	0.1		0.7	<0.1	0.1							1.6	0.8	0.7						
Total Nitrogen as N	mg/L	0.1		1.9	1	1.2							1.6	0.8	0.8						
Total Phosphorus as P	mg/L	0.01		0.47	0.12	0.14							0.1	0.08	0.12						
Reactive Phosphorus as P	mg/L	0.01		0.09	0.08	0.13							<0.01	<0.01	<0.01						
Total Metals																					
Aluminium	mg/L	0.01	0.055	7.66	4.82	5.33	3.36	2.56	0.18	0.43	4	1.02	0.14	0.15	0.19	0.12	0.05	0.02	<0.01	0.09	1.38
Antimony	mg/L	0.001		<0.001	0.007	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	As (III) 0.024 As (V) 0.013	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.004	0.006	0.005	0.008	0.007	0.005	0.006
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.078	0.086	0.068	0.092	0.092	0.067	<0.001	<0.001	<0.001	0.368	0.363	0.359	0.342	0.326	0.341
Beryllium	mg/L	0.001		0.099	0.087	0.095							0.422	0.46	0.402						
Boron	mg/L	0.05	0.37	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.08	0.08	0.07	0.08	0.09	0.07	0.08	0.08
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	CrIII – ID Cr(VI) 0.001	0.032	0.02	0.022	0.012	0.014	0.002	0.003	0.014	0.002	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Cobalt	mg/L	0.001		0.015	0.01	0.006	0.007	0.004	0.001	0.002	0.008	0.001	0.004	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.003
Copper	mg/L	0.001	0.0014	0.017	0.021	0.013	0.015	0.012	0.008	0.009	0.015	0.004	0.02	0.038	0.032	0.048	0.012	0.009	0.007	0.004	0.01
Iron	mg/L	0.05	-	10.5	6.89	7.08	4.88	3.75	0.41	0.97	5.24	1.27	0.55	0.94	1.88	2.46	2	3.23	2.8	2.19	3.4
Lead	mg/L	0.001	0.0034	0.003	0.008	0.003	0.004	0.002	<0.001	0.001	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	1.9	0.253	0.132	0.119	0.123	0.088	0.028	0.059	0.137	0.031	2.05	2.98	3.2	3.17	3.16	3.2	2.78	2.71	2.98
Mercury	mg/L	0.0001	0.0006	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	-	0.001	0.001	<0.001							<0.001	<0.001	0.002						
Nickel	mg/L	0.001	0.011	0.017	0.011	0.01	0.008	0.009	0.003	0.005	0.01	0.003	0.036	0.03	0.008	0.005	0.004	0.004	0.003	0.005	0.006
Selenium	mg/L	0.01	Total – 0.011 SeIIV - ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		3.91	3.95	3.91	3.93	4	4.08	3.93	3.88	4.24	3.9	5.29	5.72	5.83	5.8	5.81	5.54	5.33	5.52
Vanadium	mg/L	0.01	-	0.02	0.02	0.02							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	0.008	0.026	0.02	0.021	0.011	0.014	<0.005	0.014	0.018	<0.005	0.011	0.021	0.01	0.009	<0.005	0.007	<0.005	0.007	0.016
BTEX																					
Benzene	µg/L	1	900	<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2	350	<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5	16	<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100						

Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

AGE

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			Fresh Water Aquatic (95th)	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006
Date Sampled				29/09/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	22/12/2017	4/01/2018	18/01/2018	29/09/2017	09/10/2017	27/10/2017	8/11/2017	23/11/2017	4/12/2017	22/12/2017	6/01/2018	18/01/2018
Lithology																					
Field Parameters																					
Field pH	pH units																				
Field Electrical Conductivity (EC)	µS/cm																				
Depth to Groundwater	m TOC																				
Physical Parameters																					
pH	pH Units	0.1	6.5 - 8.5	7.34	7.34	7	6.96	7.13	7.1	6.96	7.08	7.02	8.02	7.93	7.54	7.76	7.7	7.65	7.52	7.75	7.69
Electrical conductivity	µS/cm	1	120 - 300	5970	5970	6320	6210	6290	6240	6470	6340	6350	3410	3360	3520	3460	3480	3470	3550	3520	3560
Total Dissolved Solids (grav) @180°C	mg/L	1.00		3510	3510	3730	3720	4020	3810	3940	3810	3860	1930	1750	1790	2000	2030	2020	2190	1850	1790
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		728	728	730	720	650	652	648	650	711	589	633	620	614	546	570	537	541	605
Total Alkalinity as $CaCO_3$	mg/L	1.00		728	728	730	720	650	652	648	650	711	589	633	620	614	546	570	537	541	605
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1		392	392	440	461	466	402	416	510	443	50	51	54	55	64	62	<1	58	43
Chloride	mg/L	1		1460	1460	1460	1350	1420	1380	1450	1490	1480	719	804	821	780	796	801	823	808	811
Calcium	mg/L	1		232	232	229	225	229	273	237	233	239	104	106	105	101	102	138	108	112	110
Magnesium	mg/L	1		85	85	84	83	85	89	89	83	82	37	41	40	39	40	43	41	38	40
Sodium	mg/L	1		977	977	1020	997	1010	1030	1060	938	968	522	580	590	591	590	611	600	536	570
Potassium	mg/L	1		29	29	39	34	41	40	39	38	38	19	16	17	18	16	16	17	16	17
Total Anions	meq/L	0.01		63.9	63.9	64.9	62.1	62.7	60.3	62.5	65.6	65.2	33.1	36.4	36.7	35.4	34.7	35.3	33.9	34.8	35.9
Total Cations	meq/L	0.01		61.8	61.8	63.7	62.3	63.4	66.8	66.2	60.2	61.8	31.4	34.3	34.6	34.4	34.4	37.4	35.3	32.4	34
Ionic Balance	%	0.01		1.66	1.66	0.95	0.18	0.52	5.07	2.91	4.3	2.7	2.58	2.95	2.86	1.43	0.35	2.94	1.95	3.52	2.65
Nutrients																					
Ammonia as N	mg/L	0.01	0.9	3.35	3.35	3.43							0.02	1.78	1.04						
Nitrite as N	mg/L	0.01		0.01	0.01	0.03							0.03	0.08	0.8						
Nitrate as N	mg/L	0.01	0.7	0.02	0.02	0.04							2.55	0.09	0.25						
Nitrite + Nitrate as N	mg/L	0.01		0.03	0.03	0.07							2.58	0.17	1.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1		3.4	3.4	3.5							1	1.5	1.1						
Total Nitrogen as N	mg/L	0.1		3.4	3.4	3.6							3.6	1.7	2.2						
Total Phosphorus as P	mg/L	0.01		0.02	0.02	0.04							0.13	0.01	0.03						
Reactive Phosphorus as P	mg/L	0.01		<0.01	<0.01	<0.01							0.03	<0.01	0.02						
Total Metals																					
Aluminium	mg/L	0.01	0.055	0.11	0.1	0.18	0.48	0.03	0.08	0.08	7.74	0.22	0.78	0.13	0.24	0.46	0.06	0.02	<0.01	0.04	0.22
Antimony	mg/L	0.001		<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	As (III) 0.024 As (V) 0.013	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.046	0.037	0.038	0.065	0.074	0.04	<0.001	<0.001	<0.001	0.241	0.238	0.233	0.232	0.22	0.235
Beryllium	mg/L	0.001		0.04	0.045	0.041							0.238	0.238	0.234						
Boron	mg/L	0.05	0.37	0.12	0.13	0.12	0.12	0.12	0.13	0.11	0.13	0.13	0.12	0.13	0.13	0.11	0.12	0.13	0.11	0.12	0.12
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	CrIII – ID Cr(VI) 0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.013	<0.001	0.002	0.005	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002
Cobalt	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.0014	0.012	0.007	0.011	0.026	0.01	0.005	0.017	0.018	0.008	0.068	0.02	0.02	0.024	0.024	0.015	0.022	0.024	0.026
Iron	mg/L	0.05	-	2.78	3.9	2.58	3.28	1.26	1.18	2.49	8.76	1.28	1.06	0.55	0.54	0.92	0.3	0.11	0.07	0.15	0.45
Lead	mg/L	0.001	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/L	0.001	1.9	0.214	0.221	0.233	0.22	0.215	0.237	0.233	0.39	0.216	0.041	0.07	0.052	0.071	0.047	0.036	0.033	0.033	0.046
Mercury	mg/L	0.0001	0.0006	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	-	<0.001	<0.001	<0.001							0.008	<0.001	0.001						
Nickel	mg/L	0.001	0.011	<0.001	0.002	0.001	0.001	0.001	0.002	0.005	0.013	0.001	0.009	0.006	0.007	0.007	0.004	0.004	0.002	0.004	0.006
Selenium	mg/L	0.01	Total – 0.011 SeIIV - ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		8.01	7.98	7.96	8.11	7.77	8.26	8.18	7.81	8.19	6.55	6.63	6.67	6.72	6.63	6.92	6.79	6.59	6.87
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	0.008	0.028	0.015	0.007	0.008	0.011	0.006	0.03	0.024	<0.005	0.018	0.017	0.011	0.015	0.013	0.006	0.006	0.007	0.021
BTEX																					
Benzene	µg/L	1	900	<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2	350	<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5	16	<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100						

Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			Fresh Water Aquatic (95th)	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)
Date Sampled				26/09/2017	09/10/2017	27/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	6/01/2018	18/01/2018	26/09/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	6/01/2018	18/01/2018
Lithology																					
Field Parameters																					
Field pH	pH units																				
Field Electrical Conductivity (EC)	µS/cm																				
Depth to Groundwater	m TOC																				
Physical Parameters																					
pH	pH Units	0.1	6.5 - 8.5	11.4	11.3	11.6	11.6	11.4	11.5	11.3	11.4	11.4	11.8	11.7	11.8	11.9	11.7	11.8	11.6	11.7	11.7
Electrical conductivity	µS/cm	1	120 - 300	7330	7050	7870	7690	7810	7790	8070	7910	7890	6040	5640	6680	6360	6210	6300	6460	6130	5990
Total Dissolved Solids (grav) @180°C	mg/L	1.00		3950	3900	4000	3970	4190	4100	4000	4010	4120	3330	2800	3310	3260	3130	2790	2580	2670	3040
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		247	174	354	311	278	284	292	242	240	460	384	466	559	455	479	467	391	354
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		360	466	304	343	304	294	284	264	371	145	138	83	79	84	98	104	126	199
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Alkalinity as $CaCO_3$	mg/L	1.00		607	640	658	654	582	578	576	506	610	605	522	549	638	540	577	571	517	552
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1		86	101	107	95	117	110	108	109	116	315	361	397	403	437	376	399	439	380
Chloride	mg/L	1		1870	1770	1710	1670	1800	1720	1840	1840	1860	912	1010	960	948	1000	1000	1030	1010	980
Calcium	mg/L	1		7	8	8	8	9	12	9	9	10	65	104	96	88	2	77	50	41	39
Magnesium	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sodium	mg/L	1		1260	1410	1410	1410	1420	1520	1510	1330	1400	939	968	953	973	1020	1060	1010	900	955
Potassium	mg/L	1		84	93	87	90	87	101	91	86	85	75	76	76	77	81	87	78	72	75
Total Anions	meq/L	0.01		66.7	64.8	63.6	62.2	64.8	62.4	65.7	64.3	67.1	44.4	46.4	46.3	47.9	48.1	47.6	48.8	48	46.6
Total Cations	meq/L	0.01		57.3	64.1	64	64	64.4	69.3	68.4	60.5	63.6	46	49.2	48.2	48.7	46.5	52.2	48.4	43	45.4
Ionic Balance	%	0.01		7.55	0.55	0.27	1.49	0.31	5.27	2.08	3.03	2.68	1.81	2.93	1.98	0.83	1.65	4.62	0.36	5.41	1.28
Nutrients																					
Ammonia as N	mg/L	0.01	0.9	7.8	9.6	7.86							1	0.97	1.04						
Nitrite as N	mg/L	0.01		<0.01	<0.01	<0.01							0.02	<0.01	<0.01						
Nitrate as N	mg/L	0.01	0.7	0.04	0.04	0.05							0.01	0.02	0.01						
Nitrite + Nitrate as N	mg/L	0.01		0.04	0.04	0.05							0.03	0.02	0.01						
Total Kjeldahl Nitrogen as N	mg/L	0.1		14.2	11.9	9.9							3.5	2.3	3.2						
Total Nitrogen as N	mg/L	0.1		14.2	11.9	10							3.5	2.3	3.2						
Total Phosphorus as P	mg/L	0.01		0.56	0.56	0.26							0.74	0.58	0.83						
Reactive Phosphorus as P	mg/L	0.01		0.6	0.29	0.2							<0.01	<0.01	<0.01						
Total Metals																					
Aluminium	mg/L	0.01	0.055	2.62	2.41	2.82	2.6	2.43	2.37	2.47	2.27	2.48	0.16	0.09	0.07	0.76	0.21	0.16	0.19	0.41	0.54
Antimony	mg/L	0.001		0.002	0.003	0.004	0.002	0.002	0.002	0.002	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	As (III) 0.024 As (V) 0.013	0.006	0.007	0.006	0.007	0.007	0.007	0.007	0.007	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.038	0.033	0.032	0.032	0.03	0.036	<0.001	<0.001	<0.001	0.185	0.12	0.116	0.115	0.104	0.126
Beryllium	mg/L	0.001		0.037	0.034	0.035							0.15	0.132	0.133						
Boron	mg/L	0.05	0.37	0.12	0.12	0.12	0.11	0.12	0.13	0.12	0.12	0.13	0.06	0.06	<0.05	0.06	0.06	0.08	0.07	0.07	0.08
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001							0.0002	<0.0001	0.0001						
Chromium	mg/L	0.001	CrIII – ID Cr(VI) 0.001	<0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.003	0.002	0.001	0.004	0.002	0.002	0.002	0.002	0.004
Cobalt	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.0014	0.038	0.01	0.026	0.016	0.022	0.009	0.006	0.042	0.063	0.002	<0.001	<0.001	0.007	<0.001	<0.001	0.001	<0.001	0.002
Iron	mg/L	0.05	-	0.25	0.36	0.57	0.36	0.37	0.11	0.1	0.39	0.35	0.32	<0.001	0.06	1.86	0.37	0.12	0.24	0.61	0.71
Lead	mg/L	0.001	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	1.9	0.01	0.01	0.017	0.012	0.008	0.008	0.004	0.007	0.012	0.007	<0.001	<0.001	0.039	0.008	0.005	0.011	0.014	0.024
Mercury	mg/L	0.0001	0.0006	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	-	0.12	0.11	0.116							0.499	0.479	0.524						
Nickel	mg/L	0.001	0.011	0.025	0.024	0.02	0.025	0.023	0.026	0.022	0.023	0.023	0.009	0.009	0.008	0.012	0.01	0.009	0.008	0.01	0.01
Selenium	mg/L	0.01	Total – 0.011 SeIIV - ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		0.321	0.364	0.338	0.36	0.363	0.372	0.365	0.36	0.357	2.06	1.97	2.06	2.1	1.75	1.79	1.7	1.49	1.6
Vanadium	mg/L	0.01	-	0.01	0.01	0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	0.008	0.026	0.026	0.023	0.016	0.008	0.017	0.007	0.009	0.016	0.021	<0.005	<0.005	0.047	0.011	0.006	0.011	0.015	0.021
BTEX																					
Benzene	µg/L	1	900	<1	<1	<1							----	<1	<1						
Toluene	µg/L	2		<2	<2	<2							----	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							----	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							----	<2	<2						
ortho-Xylene	µg/L	2	350	<2	<2	<2							----	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							----	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							----	<1	<1						
Naphthalene	µg/L	5	16	<5	<5	<5							----	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2)	µg/L	100		<100	<100	<100							----	<100	<100						

Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	ANZECC GUIDELINES																				
Sample Location																							
Lab Number			Fresh Water Aquatic (95th)	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18B	MP18B	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A
Date Sampled				27/09/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/01/2018	19/01/2018	27/09/2017	27/10/2017	27/09/2017	10/10/2017	26/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/01/2018	19/01/2018
Lithology																							
Field Parameters																							
Field pH	pH units																						
Field Electrical Conductivity (EC)	µS/cm																						
Depth to Groundwater	m TOC																						
Physical Parameters																							
pH	pH Units	0.1	6.5 - 8.5	7.6	7.24	7.6	7.36	7.35	7.4	7.23	7.42	7.36	7.7	7.4	7.7	7.83	7.33	7.53	7.49	7.65	7.3	7.48	7.54
Electrical conductivity	µS/cm	1	120 - 300	12500	12500	12200	12200	12300	12200	12400	12200	12500	22800	23000	15200	14900	15200	14900	15000	14900	14600	14200	14000
Total Dissolved Solids (grav) @180°C	mg/L	1.00		5900	7990	7670	8000	7810	8030	7400	6630	7650	14300	17200	7490	9330	9480	9300	8550	9620	8810	6710	8120
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		851	924	934	926	839	790	829	726	904	1080	1170	1100	1170	1110	1060	974	1120	1120	1000	1210
Total Alkalinity as $CaCO_3$	mg/L	1.00		851	924	934	926	839	790	829	726	904	1080	1170	1100	1170	1110	1060	974	1120	1120	1000	1210
Major Ions																							
Sulfate as SO_4 - Turbidimetric	mg/L	1		258	318	257	305	314	284	291	299	286	810	894	152	248	314	309	319	267	254	255	215
Chloride	mg/L	1		3620	3740	3770	3830	4000	3860	4030	3830	3770	6570	7690	1700	4700	4960	4690	4870	4800	4780	4430	3850
Calcium	mg/L	1		203	194	199	198	198	244	203	181	204	140	140	119	147	149	146	145	171	147	137	137
Magnesium	mg/L	1		441	453	448	459	451	480	466	408	422	817	937	489	505	531	473	507	514	555	416	417
Sodium	mg/L	1		1670	1740	1740	1750	1760	1930	1750	1570	1690	3460	3960	915	2360	2480	2360	2450	2480	2610	2070	2190
Potassium	mg/L	1		29	30	30	30	31	32	30	28	30	76	84	56	40	42	41	42	40	42	35	40
Total Anions	meq/L	0.01		124	130	130	133	136	130	136	129	130	224	259	73.1	161	169	160	163	163	162	150	137
Total Cations	meq/L	0.01		120	123	123	124	124	136	125	112	119	227	258	87.4	152	160	150	157	160	168	132	137
Ionic Balance	%	0.01		1.92	2.82	2.8	3.24	4.52	2.2	4.18	7.13	4.48	0.64	0.08	8.92	2.72	2.6	3.22	2.15	1.12	1.55	6.46	0.07
Nutrients																							
Ammonia as N	mg/L	0.01	0.9	0.32	0.32	0.29							0.21	0.14	0.07	0.36	0.43						
Nitrite as N	mg/L	0.01		<0.01	0.02	0.02							<0.01	<0.01	<0.01	0.02	0.01						
Nitrate as N	mg/L	0.01	0.7	0.06	0.07	0.02							0.16	0.03	0.43	0.18	0.1						
Nitrite + Nitrate as N	mg/L	0.01		0.06	0.09	0.04							0.16	0.03	0.43	0.2	0.11						
Total Kjeldahl Nitrogen as N	mg/L	0.1		0.5	0.4	0.8							4.5	9.9	0.4	<0.5	0.7						
Total Nitrogen as N	mg/L	0.1		0.6	0.5	0.8							4.7	9.9	0.8	<0.5	0.8						
Total Phosphorus as P	mg/L	0.01		0.15	0.08	0.09							2.3	6.56	1.18	1.05	0.09						
Reactive Phosphorus as P	mg/L	0.01		<0.01	<0.01	<0.01							0.07	0.03	0.02	<0.01	0.02						
Total Metals																							
Aluminium	mg/L	0.01	0.055	0.22	0.3	0.12	0.24	0.08	0.02	<0.01	<0.01	0.27	108	261	0.42	0.14	2.93	0.31	0.15	0.06	0.05	0.17	1.01
Antimony	mg/L	0.001		0.003	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Arsenic	mg/L	0.001	As (III) 0.024 As (V) 0.013	0.004	0.004	0.003	0.003	0.002	0.003	0.002	0.001	0.003	0.026	0.078	0.015	*0.021*	*0.008*	*0.008*	*0.001*	*0.004*	*0.003*	*0.006*	*0.004*
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.315	0.223	0.184	0.249	0.16	0.286	0.008	0.02	<0.001	<0.001	<0.001	0.422	0.388	0.244	0.33	0.377	0.772
Beryllium	mg/L	0.001		0.375	0.449	0.308							5.24	2.64	0.333	0.282	2.8						
Boron	mg/L	0.05	0.37	0.08	0.08	0.08	0.07	0.07	0.08	0.07	0.06	0.08	0.08	0.1	0.11	0.12	0.12	0.1	0.12	0.13	0.12	0.16	0.12
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001							0.0002	0.0003	<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	CrIII – ID Cr(VI) 0.001	<0.001	0.003	0.008	0.003	<0.001	<0.001	<0.001	<0.001	0.001	0.215	0.538	0.002	0.004	0.004	0.004	<0.001	0.004	0.002	<0.001	0.003
Cobalt	mg/L	0.001		<0.001	0.002	<0.001	0.002	0.002	0.002	<0.001	<0.001	0.001	0.061	0.163	<0.001	0.001	0.002	0.001	<0.001	<0.001	<0.001	0.184	<0.001
Copper	mg/L	0.001	0.0014	0.006	0.006	0.01	0.014	0.072	0.055	0.172	0.046	0.132	0.374	0.58	0.002	0.007	0.006	0.007	0.002	0.03	0.003	0.028	0.007
Iron	mg/L	0.05	-	8.58	6.08	5.16	7.54	3.59	3.54	4.62	1.74	4.05	137	351	20	20.5	10.6	11.8	1.95	4.71	3.84	2.33	5.39
Lead	mg/L	0.001	0.0034	<0.001	<0.001	0.004	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.064	0.186	<0.001	0.002	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Manganese	mg/L	0.001	1.9	0.194	0.213	0.196	0.234	0.21	0.213	0.209	0.202	0.257	0.358	0.857	0.162	0.259	0.217	0.23	0.179	0.192	0.182	0.166	0.187
Mercury	mg/L	0.0001	0.0006	<0.0001	0.0004	<0.0001						<0.0001	0.0002	0.0005	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	-	0.002	0.007	0.001							<0.001	<0.001	0.003	0.004	0.005						
Nickel	mg/L	0.001	0.011	0.001	0.17	0.007	0.258	0.227	0.209	0.185	0.161	0.146	0.121	0.413	<0.001	0.003	0.013	0.025	0.005	0.005	0.002	1.55	0.006
Selenium	mg/L	0.01	Total – 0.011 SeIV - ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	0.26	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.002
Strontium	mg/L	0.001		5.9	6.06	6.17	6	5.96	6.15	6.14	5.82	6.16	7.75	8.14	6.51	6.74	6.8	6.08	6.51	6.94	6.7	6.38	5.61
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							0.34	0.86	<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	0.008	0.024	0.032	0.035	0.029	0.011	0.013	0.008	0.012	0.031	0.204	0.546	0.007	0.037	0.062	0.024	0.006	0.018	0.016	0.016	0.05
BTEX																							
Benzene	µg/L	1	900	<1	<1	<1							<1	<1	<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
ortho-Xylene	µg/L	2	350	<2	<2	<2							<2	<2	<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1	<1	<1						
Naphthalene	µg/L	5	16	<5	<5	<5							<5	<5	<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																							
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
Total Recoverable Hydrocarbons																							
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						

\# Limit of Reporting
a NHMRC Health Guidelines for Drinking Water (2015)
b NHMRC Aesthetic Guidelines for Drinking Water (2015)
m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.
\+ NHMRC acid-soluable aluminium concentrations (2015)
\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																	
Sample Location																				
Lab Number			Fresh Water Aquatic (95th)	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2
Date Sampled				27/09/2017	10/10/2017	26/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/01/2018	19/01/2018	25/09/2017	09/10/2017	26/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/01/2018
Lithology																				
Field Parameters																				
Field pH	pH units																			
Field Electrical Conductivity (EC)	µS/cm																			
Depth to Groundwater	m TOC																			
Physical Parameters																				
pH	pH Units	0.1	6.5 - 8.5	7.84	8.08	7.41	7.56	7.59	7.68	7.43	7.57	7.6	7.31	6.86	6.97	6.94	6.92	7.01	6.85	7
Electrical conductivity	µS/cm	1	120 - 300	11800	12100	13300	14000	14400	15100	15800	15900	16400	450	533	638	605	664	752	890	839
Total Dissolved Solids (grav) @180°C	mg/L	1.00		6030	6520	7730	8220	7950	8990	8610	9140	9470	472	722	1230	1650	1980	2060	1440	1370
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		1760	1920	1820	1790	1610	1390	1530	1350	1600	40	43	50	49	45	45	47	45
Total Alkalinity as $CaCO_3$	mg/L	1.00		1760	1920	1820	1790	1610	1390	1530	1350	1600	40	43	50	49	45	45	47	45
Major Ions																				
Sulfate as SO_4 - Turbidimetric	mg/L	1		85	123	178	199	244	263	298	315	298	39	34	40	54	44	39	36	36
Chloride	mg/L	1		2910	3260	3880	4000	4380	4570	4850	4800	5040	43	65	124	119	132	176	222	194
Calcium	mg/L	1		81	79	100	96	119	148	128	133	131	1	2	2	6	2	1	7	2
Magnesium	mg/L	1		116	150	222	233	314	302	349	308	299	4	4	6	19	8	4	19	9
Sodium	mg/L	1		2340	2530	2740	2690	2990	3070	3120	2770	2770	77	93	109	114	120	137	147	148
Potassium	mg/L	1		24	27	29	29	31	31	33	30	32	4	4	5	8	6	4	9	7
Total Anions	meq/L	0.01		119	133	150	153	161	162	174	169	180	2.82	4.23	5.33	5.46	5.54	6.68	7.95	7.12
Total Cations	meq/L	0.01		116	127	143	142	163	166	172	153	152	3.83	4.58	5.46	7.03	6.13	6.44	8.54	7.46
Ionic Balance	%	0.01		1.29	2.25	2.16	3.74	0.56	1.34	0.56	4.87	8.38	15.1	3.99	1.23	12.5	5.08	1.79	3.56	2.3
Nutrients																				
Ammonia as N	mg/L	0.01	0.9	2.51	3.3	2.25							<0.01	0.02	0.02					
Nitrite as N	mg/L	0.01		0.06	<0.01	<0.01							0.02	<0.01	<0.01					
Nitrate as N	mg/L	0.01	0.7	0.45	0.03	0.02							12.4	11.6	11.5					
Nitrite + Nitrate as N	mg/L	0.01		0.51	0.03	0.02							12.4	11.6	11.5					
Total Kjeldahl Nitrogen as N	mg/L	0.1		3.5	4	2.8							5	2.6	2.7					
Total Nitrogen as N	mg/L	0.1		4	4	2.8							17.4	14.2	14.2					
Total Phosphorus as P	mg/L	0.01		0.23	0.17	0.11							0.93	0.24	0.89					
Reactive Phosphorus as P	mg/L	0.01		<0.01	<0.01	<0.01							<0.01	0.01	0.01					
Total Metals																				
Aluminium	mg/L	0.01	0.055	0.45	0.13	0.52	0.81	0.24	0.07	0.09	0.71	0.68	69.1	2.78	120	15.1	59.7	117	8.09	89.6
Antimony	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	As (III) 0.024 As (V) 0.013	0.002	0.002	0.002	0.002	0.001	0.002	<0.001	0.001	0.002	0.004	<0.001	0.009	0.002	0.005	0.011	0.002	0.005
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.799	0.807	0.336	0.309	0.961	0.734	0.003	<0.001	0.006	0.071	0.099	0.25	0.069	0.149
Beryllium	mg/L	0.001		1.26	0.518	1.94							0.098	0.028	0.17					
Boron	mg/L	0.05	0.37	0.48	0.44	0.35	0.38	0.3	0.34	0.3	0.28	0.29	0.09	0.11	0.12	0.1	0.09	0.14	0.08	0.1
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001					
Chromium	mg/L	0.001	CrIII – ID Cr(VI) 0.001	0.001	0.001	0.005	0.007	0.002	0.002	0.001	0.005	0.007	0.131	0.005	0.238	0.025	0.122	0.357	0.017	0.172
Cobalt	mg/L	0.001		0.001	0.002	0.002	0.004	<0.001	0.003	<0.001	0.003	0.002	0.035	0.012	0.054	0.031	0.029	0.08	0.024	0.043
Copper	mg/L	0.001	0.0014	0.012	0.014	0.006	0.009	0.01	0.008	0.017	0.028	0.018	0.08	0.021	0.125	0.045	0.071	0.185	0.047	0.105
Iron	mg/L	0.05	-	3.46	2.67	6.66	13.3	4.08	5.06	2.32	5.04	3.79	59.1	2.79	101	12.3	46.9	112	8.35	68
Lead	mg/L	0.001	0.0034	0.002	0.001	<0.001	0.04	<0.001	<0.001	<0.001	0.002	0.003	0.027	0.008	0.05	0.017	0.024	0.066	0.016	0.035
Manganese	mg/L	0.001	1.9	0.092	0.139	0.116	0.216	0.109	0.178	0.12	0.145	0.184	0.316	0.146	0.511	0.346	0.298	0.73	0.302	0.442
Mercury	mg/L	0.0001	0.0006	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	0.0001					
Molybdenum	mg/L	0.001	-	<0.001	0.001	0.011							<0.001	<0.001	<0.001					
Nickel	mg/L	0.001	0.011	0.005	0.01	0.03	0.065	0.129	0.118	0.128	0.166	0.14	0.071	0.008	0.112	0.024	0.058	0.174	0.022	0.086
Selenium	mg/L	0.01	Total – 0.011 SeIV - ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	0.01	0.02	<0.01	0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		6.78	6.71	7.54	7.02	7.57	7.71	7.65	7.29	7.88	0.147	0.131	0.255	0.208	0.136	0.321	0.26	0.232
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							0.08	0.02	0.16					
Zinc	mg/L	0.005	0.008	0.025	0.039	0.03	0.044	0.006	0.012	0.016	0.038	0.078	0.154	0.026	0.258	0.06	0.127	0.361	0.103	0.24
BTEX																				
Benzene	µg/L	1	900	<1	<1	<1							<1	<1	<1					
Toluene	µg/L	2		<2	<2	40							<2	<2	<2					
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2					
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2					
ortho-Xylene	µg/L	2	350	<2	<2	<2							<2	<2	<2					
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2					
Sum of BTEX	µg/L	1		<1	<1	40							<1	<1	<1					
Naphthalene	µg/L	5	16	<5	<5	<5							<5	<5	<5					
Total Petroleum Hydrocarbons (Silica gel cleanup)																				
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
Total Recoverable Hydrocarbons																				
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100					

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	ANZECC GUIDELINES																		
Sample Location			Fresh Water Aquatic (95th)																		
Lab Number				GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2
Date Sampled				25/09/2017	09/10/2017	26/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/01/2018	19/01/2018	25/09/2017	09/10/2017	30/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/01/2018	18/01/2018
Lithology																					
Field Parameters																					
Field pH	pH units																				
Field Electrical Conductivity (EC)	µS/cm																				
Depth to Groundwater	m TOC																				
Physical Parameters																					
pH	pH Units	0.1	6.5 - 8.5	7.48	7.63	7.38	7.49	7.47	7.55	7.38	7.58	7.52	7.92	8.12	7.61	7.76	7.68	7.7	7.59	7.77	7.7
Electrical conductivity	µS/cm	1	120 - 300	795	892	13500	12400	12400	13100	14000	14000	14400	8310	8000	9020	9060	9230	9430	9970	9820	10000
Total Dissolved Solids (grav) @180°C	mg/L	1.00		420	566	8680	8060	6540	8960	9600	8960	8550	3660	4620	5110	5150	4780	5310	5940	5460	5650
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		96	116	706	659	606	613	666	629	736	1160	1280	1210	1210	1070	1050	1100	1100	1200
Total Alkalinity as $CaCO_3$	mg/L	1.00		96	116	706	659	606	613	666	629	736	1160	1280	1210	1210	1070	1050	1100	1100	1200
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1		36	42	193	170	182	172	190	192	194	26	30	54	52	66	69	75	74	68
Chloride	mg/L	1		142	243	4600	4060	4200	4330	4760	4670	4240	1830	2160	2260	2560	2680	2730	2970	2800	2570
Calcium	mg/L	1		5	6	112	103	103	129	124	130	124	71	68	84	74	84	112	99	114	106
Magnesium	mg/L	1		15	16	542	507	480	512	622	585	520	106	110	129	128	142	142	169	156	147
Sodium	mg/L	1		125	141	1880	1730	1700	1790	2120	2030	1830	1500	1500	1730	1590	1720	1690	1920	1740	1710
Potassium	mg/L	1		6	6	56	53	52	53	63	66	60	24	25	26	26	28	26	31	29	29
Total Anions	meq/L	0.01		6.67	10	148	131	134	138	152	148	138	75.3	87.1	89	97.5	98.4	99.4	107	102	97.9
Total Cations	meq/L	0.01		7.07	7.9	133	123	120	128	151	145	130	78.1	78.3	90.7	84	91.4	91.4	103	95	92.5
Ionic Balance	%	0.01		2.92	11.9	5.15	3.05	5.68	3.83	0.11	1.26	3.06	1.82	5.32	0.93	7.39	3.66	4.18	1.98	3.82	2.82
Nutrients																					
Ammonia as N	mg/L	0.01	0.9	0.34	0.18	0.14							2.13	2.35	1.94						
Nitrite as N	mg/L	0.01		0.12	0.15	0.02							0.33	0.1	0.13						
Nitrate as N	mg/L	0.01	0.7	<0.10	0.51	0.05							<0.01	0.08	<0.01						
Nitrite + Nitrate as N	mg/L	0.01		0.11	0.66	0.07							0.04	0.18	0.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1		1.6	0.6	0.2							2.9	3	2.4						
Total Nitrogen as N	mg/L	0.1		1.7	1.3	0.3							2.9	3.2	2.4						
Total Phosphorus as P	mg/L	0.01		0.14	0.16	0.08							0.37	0.2	0.16						
Reactive Phosphorus as P	mg/L	0.01		0.08	<0.01	<0.01							0.16	0.17	0.13						
Total Metals																					
Aluminium	mg/L	0.01	0.055	1.14	0.16	0.84	0.66	0.74	1.04	0.58	1.12	0.65	1.39	0.25	0.73	0.24	0.22	0.44	0.97	0.26	1.58
Antimony	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	As (III) 0.024 As (V) 0.013	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.144	0.163	0.165	0.172	0.139	0.184	<0.001	<0.001	<0.001	0.614	0.601	0.603	0.659	0.603	0.693
Beryllium	mg/L	0.001		0.054	0.061	0.141							0.583	0.565	0.608						
Boron	mg/L	0.05	0.37	0.08	0.08	0.05	<0.05	0.05	0.06	0.05	<0.05	0.07	0.26	0.26	0.26	0.24	0.24	0.24	0.24	0.24	0.24
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	CrIII – ID Cr(VI) 0.001	0.003	0.002	0.002	0.002	0.002	0.003	0.002	0.003	0.004	0.005	0.002	0.002	<0.001	0.002	0.002	0.003	0.001	0.006
Cobalt	mg/L	0.001		0.004	0.002	0.004	0.004	0.004	0.004	0.003	0.002	0.004	0.002	<0.001	0.002	<0.001	<0.001	<0.001	0.003	0.001	0.002
Copper	mg/L	0.001	0.0014	0.009	0.007	0.005	0.005	0.006	0.007	0.008	0.007	0.014	0.012	0.003	0.007	0.002	0.002	0.002	0.013	0.001	0.019
Iron	mg/L	0.05	-	2.47	1.4	2.51	2.39	2.56	2.79	1.69	1.67	1.83	2.38	0.72	1.78	1.08	1.16	1.23	1.92	0.71	1.94
Lead	mg/L	0.001	0.0034	0.004	0.003	0.001	0.002	0.003	0.002	0.003	0.002	0.002	0.006	0.002	0.003	0.002	0.003	<0.001	0.008	<0.001	0.003
Manganese	mg/L	0.001	1.9	0.064	0.051	0.163	0.175	0.197	0.188	0.138	0.103	0.223	0.284	0.319	0.248	0.267	0.272	0.281	0.368	0.265	0.34
Mercury	mg/L	0.0001	0.0006	<0.0001	<0.0001	<0.0001						0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	-	<0.001	<0.001	<0.001							0.001	<0.001	0.002						
Nickel	mg/L	0.001	0.011	0.009	0.008	0.006	0.009	0.01	0.012	0.012	0.014	0.014	0.006	0.006	0.006	0.003	0.004	0.005	0.009	0.004	0.015
Selenium	mg/L	0.01	Total – 0.011 SeIV - ID	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		0.188	0.235	4.33	4.2	4.12	4.75	4.5	4.57	4.96	5.52	5.48	6.45	6.63	6.66	7.08	7.46	7.03	7.56
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	0.008	0.096	0.07	0.042	0.06	0.077	0.062	0.08	0.122	0.115	0.173	0.066	0.083	0.067	0.067	0.033	0.197	0.022	0.149
BTEX																					
Benzene	µg/L	1	900	<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2	350	<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5	16	<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			Fresh Water Aquatic (95th)	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249
Date Sampled				26/09/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	5/01/2018	18/01/2018	26/09/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	5/12/2017	21/12/2017	5/01/2018	18/01/2018
Lithology																					
Field Parameters																					
Field pH	pH units																				
Field Electrical Conductivity (EC)	µS/cm																				
Depth to Groundwater	m TOC																				
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5**	7.81	7.92	7.74	7.63	7.55	7.65	7.44	7.64	7.66	7.81	8.13	8.06	8.11	7.99	8.06	7.92	8.1	8.17
Electrical conductivity	µS/cm	1	**120 - 300**	5380	5230	5630	5020	5140	5000	5260	5050	5080	5380	2320	2450	2340	2450	2450	2550	2530	2580
Total Dissolved Solids (grav) @180°C	mg/L	1.00		3320	2590	3090	2960	2910	3060	3020	2840	2680	3320	1150	1380	1270	1240	1420	1360	1330	1320
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00		544	576	458	412	415	348	412	366	380	544	373	340	377	347	355	356	315	382
Total Alkalinity as $CaCO_3$	mg/L	1.00		544	576	458	412	415	348	412	366	380	544	373	340	377	347	355	356	315	382
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1		146	134	139	166	168	162	154	157	164	146	15	12	16	19	17	16	15	15
Chloride	mg/L	1		1560	1390	1300	1240	1340	1290	1350	1340	1310	1560	571	560	574	606	608	634	620	600
Calcium	mg/L	1		22	19	22	14	16	27	17	35	20	22	37	39	36	37	54	38	40	41
Magnesium	mg/L	1		181	176	163	176	180	197	186	155	170	181	25	23	24	25	30	25	25	26
Sodium	mg/L	1		857	819	775	720	743	816	703	662	688	857	432	405	430	438	513	440	417	439
Potassium	mg/L	1		39	36	34	33	33	34	32	28	32	39	10	10	11	11	12	11	11	11
Total Anions	meq/L	0.01		57.9	53.5	48.7	46.7	49.6	46.7	49.5	48.4	48	57.9	23.9	22.8	24	24.4	24.6	25.3	24.1	24.9
Total Cations	meq/L	0.01		54.3	52	49.1	47.3	48.8	53.9	47.6	44	45.7	54.3	23	21.7	22.8	23.2	27.8	23.4	22.5	23.6
Ionic Balance	%	0.01		3.25	1.45	0.38	0.72	0.83	7.16	2.02	4.72	2.38	3.25	1.97	2.53	2.78	2.49	6.08	4.02	3.48	2.7
Nutrients																					
Ammonia as N	mg/L	0.01	**0.9**	0.08	0.08	0.13							0.08	0.02	0.08						
Nitrite as N	mg/L	0.01		<0.10	<0.01	<0.01							<0.10	<0.01	<0.01						
Nitrate as N	mg/L	0.01	**0.7**	<0.10	0.04	0.07							<0.10	1.62	1.89						
Nitrite + Nitrate as N	mg/L	0.01		<0.10	0.04	0.07							<0.10	1.62	1.89						
Total Kjeldahl Nitrogen as N	mg/L	0.1		0.2	<0.1	0.4							0.2	0.2	0.4						
Total Nitrogen as N	mg/L	0.1		0.2	<0.1	0.5							0.2	1.8	2.3						
Total Phosphorus as P	mg/L	0.01		0.02	0.01	0.02							0.02	0.17	0.24						
Reactive Phosphorus as P	mg/L	0.01		0.07	0.01	0.01							0.07	0.19	0.18						
Total Metals																					
Aluminium	mg/L	0.01	**0.055**	0.1	0.01	0.03	<0.01	<0.01	0.02	0.01	0.02	0.03	0.69	0.06	0.19	0.18	0.14	0.04	0.06	0.07	0.09
Antimony	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**As (III) 0.024 As (V) 0.013**	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	0.002	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001
Barium	mg/L	0.001		<0.001	<0.001	<0.001	0.05	0.051	0.064	0.092	0.081	0.064	<0.001	<0.001	<0.001	0.206	0.202	0.21	0.205	0.187	0.216
Beryllium	mg/L	0.001		0.066	0.064	0.069							0.216	0.203	0.211						
Boron	mg/L	0.05	**0.37**	0.08	0.09	0.06	0.08	0.1	0.1	0.09	0.08	0.1	0.09	0.1	0.08	0.09	0.1	0.11	0.11	0.09	0.11
Cadmium	mg/L	0.0001	**0.0002**	<0.0001	<0.0001	<0.0001							0.0002	0.0001	0.0002						
Chromium	mg/L	0.001	**CrIII – ID Cr(VI) 0.001**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.0014**	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.003	0.001	0.003	0.002	<0.001	0.001	0.002	0.002	0.002
Iron	mg/L	0.05	**-**	0.15	<0.05	0.06	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	0.36	0.07	0.22	0.28	0.16	<0.05	0.08	0.09	0.13
Lead	mg/L	0.001	**0.0034**	0.006	0.003	0.006	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.019	0.01	0.018	0.013	0.005	0.004	0.005	0.004	0.006
Manganese	mg/L	0.001	**1.9**	0.032	0.025	0.026	0.01	0.006	0.013	0.03	0.021	0.008	0.021	0.017	0.021	0.016	0.012	0.009	0.007	0.005	0.008
Mercury	mg/L	0.0001	**0.0006**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**-**	0.002	0.002	0.008							0.003	0.003	0.004						
Nickel	mg/L	0.001	**0.011**	0.001	<0.001	<0.001	0.002	0.002	0.002	0.001	<0.001	0.001	0.024	0.016	0.017	0.016	0.016	0.017	0.016	0.013	0.014
Selenium	mg/L	0.01	**Total – 0.011 SeIIV - ID**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		0.942	0.926	1.02	0.666	0.653	0.798	1.17	1.06	0.757	1.79	1.94	2.07	1.9	1.94	2.1	2.05	1.91	2.12
Vanadium	mg/L	0.01	**-**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**0.008**	0.008	0.006	0.008	<0.005	<0.005	0.006	<0.005	0.006	0.009	0.108	0.089	0.103	0.091	0.078	0.08	0.074	0.068	0.072
BTEX																					
Benzene	µg/L	1	**900**	<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2	**350**	<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5	**16**	<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalene (F2	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	NHMRC																		
Sample Location																					
Lab Number			**Drinking Water**	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW04	GW04	GW04	GW04	GW04	GW04	GW04	GW04	GW04
Date Sampled				25/09/2017	09/10/2017	26/10/2017	9/11/2017	22/11/2017	5/12/2017	20/12/2017	5/1/2018	18/1/2018	25/09/2017	09/10/2017	26/10/2017	9/11/2017	22/11/2017	5/12/2017	20/12/2017	5/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5[b]**	8.46	8.29	8.11	8.3	8.17	8.34	8.21	8.24	8.07	7.81	7.95	7.46	7.66	7.66	7.7	7.53	7.7	7.58
Electrical conductivity	µS/cm	1	-	23300	23100	23800	23400	23500	23400	24200	23600	24300	7660	7620	7900	7780	7830	7760	8010	7860	7980
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	15100	14400	15200	13700	16000	15900	16900	14600	15000	4500	4570	4690	3980	4650	4710	4370	4780	4750
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	33	<1	<1	6	<1	21	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	339	468	490	517	503	488	512	601	664	1270	1360	1380	1370	1250	1280	1270	1290	1350
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	372	468	490	524	503	509	512	601	664	1270	1360	1380	1370	1250	1280	1270	1290	1350
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	311	304	329	308	316	292	293	266	266	216	213	260	241	248	229	230	220	218
Chloride	mg/L	1	**250[b]**	7220	8000	8400	7690	8070	8000	8300	8300	8000	1490	1690	1730	1590	1690	1600	1720	1680	1670
Calcium	mg/L	1	-	29	30	32	33	36	56	38	41	40	41	40	41	38	38	55	40	39	42
Magnesium	mg/L	1	-	452	463	461	462	458	509	516	436	451	14	24	15	16	17	15	16	13	16
Sodium	mg/L	1	**180[b]**	4330	4500	4510	4560	4530	5150	4770	4270	4490	1560	1810	1760	1710	1760	1820	1740	1440	1720
Potassium	mg/L	1	-	50	52	50	53	52	62	56	53	52	9	12	10	11	11	10	11	9	11
Total Anions	meq/L	0.01	-	218	241	254	234	244	242	250	252	244	71.9	79.3	81.8	77.2	77.8	75.5	78.7	77.7	78.6
Total Cations	meq/L	0.01	-	228	237	237	239	238	270	253	225	236	71.3	83	80.1	77.9	80.1	83.4	79.3	65.9	78.5
Ionic Balance	%	0.01	-	2.4	0.98	3.38	1.18	1.33	5.54	0.56	5.59	1.82	0.43	2.3	1.05	0.41	1.47	4.99	0.38	8.26	0.07
Nutrients																					
Ammonia as N	mg/L	0.01	**0.5[b]**	0.64	1.17	1.38							4.27	4.55	4.9						
Nitrite as N	mg/L	0.01	**3[a]**	0.15	<0.01	<0.01							<0.01	0.05	0.02						
Nitrate as N	mg/L	0.01	**50[a]**	<0.01	<0.01	0.03							0.06	0.07	0.04						
Nitrite + Nitrate as N	mg/L	0.01	-	0.03	<0.01	0.03							0.06	0.12	0.06						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	1.2	1.3	1.7							4.6	6.4	5.2						
Total Nitrogen as N	mg/L	0.1	-	1.2	1.3	1.7							4.7	6.5	5.3						
Total Phosphorus as P	mg/L	0.01	-	0.02	<0.10	<0.02							0.62	1.08	0.83						
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							0.48	0.8	0.73						
Total Metals																					
Aluminium	mg/L	0.01	**0.2[b+]**	0.05	0.06	<0.01	0.03	<0.01	<0.01	<0.01	0.01	0.1	0.02	0.08	0.05	0.19	0.01	0.02	<0.01	0.01	0.19
Antimony	mg/L	0.001	**0.003[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.02	0.018	0.022	0.022	0.022	0.026	<0.001	<0.001	<0.001	0.249	0.228	0.252	0.242	0.232	0.24
Beryllium	mg/L	0.001	**0.06[a]**	0.02	0.016	0.025							0.237	0.264	0.246						
Boron	mg/L	0.05	**4[a]**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.38	0.4	0.38	0.38	0.39	0.4	0.38	0.44	0.4
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**0.05[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**2[a] / 1[b]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.01	0.001	0.01	<0.001	<0.001	0.002	<0.001	<0.001
Iron	mg/L	0.05	**0.3[b]**	24.6	10.3	0.64	7.26	6.26	4.51	4.92	6.79	13	0.49	0.99	0.7	2.3	0.35	0.29	0.26	0.17	0.31
Lead	mg/L	0.001	**0.01[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.001	0.013	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.509	0.581	0.599	0.693	0.696	0.707	0.608	0.578	0.647	0.076	0.091	0.074	0.089	0.084	0.08	0.08	0.08	0.079
Mercury	mg/L	0.0001		<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001						
Nickel	mg/L	0.001	**0.02[a]**	<0.001	0.002	0.002	0.001	0.001	<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	0.002	<0.001	0.002	<0.001	0.003	0.003	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	2.38	2.74	2.87	3.17	3.18	3.55	3.33	3.13	3.32	2.94	3.06	2.88	2.99	2.87	3.21	2.99	2.93	2.96
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.024	0.011	<0.005	0.013	0.02	<0.005	<0.005	0.006	0.028	0.006	0.066	0.056	0.242	0.014	0.013	0.031	0.007	0.012
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

AGE

G1839Z

Parameter	Units	LOR#	NHMRC																		
Sample Location																					
Lab Number			**Drinking Water**	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW33	GW33	GW33	GW33	GW33	GW33	GW33	GW33	GW33
Date Sampled				25/09/2017	09/10/2017	24/10/2017	8/11/2017	22/11/2017	4/12/2017	20/12/2017	5/1/2018	19/1/2018	27/9/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5[b]**	7.81	8.02	7.89	7.69	7.65	7.7	7.55	7.69	7.62	7.7	7.73	7.27	7.41	7.39	7.56	7.31	7.46	7.31
Electrical conductivity	µS/cm	1	-	7660	5060	5570	5280	5320	5240	5710	5360	5420	16300	16000	16500	16200	16400	16400	16900	16800	17000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	4500	2860	2980	3150	3000	3010	3400	3010	2780	13700	10600	11500	9500	11700	12100	11400	12500	11000
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	1270	851	784	838	766	762	792	716	858	1020	1110	1110	1110	1030	1060	967	1070	1110
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	1270	851	784	838	766	762	792	716	858	1020	1110	1110	1110	1030	1060	967	1070	1110
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	216	1	1	3	2	2	4	1	3	419	513	541	587	599	590	700	732	515
Chloride	mg/L	1	**250[b]**	1490	1220	1200	1230	1270	1250	1380	1280	1290	4750	5020	5630	5060	5380	5380	5550	5390	5090
Calcium	mg/L	1	-	41	70	71	66	69	92	73	68	72	176	202	208	198	204	240	223	214	208
Magnesium	mg/L	1	-	14	68	60	64	66	77	74	64	65	654	769	812	774	780	796	955	739	726
Sodium	mg/L	1	**180[b]**	1560	1010	939	941	1000	1100	1050	916	965	1870	2170	2280	2160	2230	2330	2460	2060	2130
Potassium	mg/L	1	-	9	16	16	15	16	17	17	15	16	71	80	82	80	82	90	88	78	81
Total Anions	meq/L	0.01	-	71.9	51.4	49.5	51.5	51.2	50.5	54.8	50.4	53.6	163	174	192	177	185	185	190	189	176
Total Cations	meq/L	0.01	-	71.3	53.4	49.7	49.9	52.8	59.2	55.8	48.9	51.3	146	170	178	170	173	181	199	163	165
Ionic Balance	%	0.01	-	0.43	1.9	0.2	1.6	1.55	7.91	0.91	1.56	2.16	5.61	1.35	3.72	2.18	3.16	1.12	2.19	7.27	3.41
Nutrients																					
Ammonia as N	mg/L	0.01	**0.5[b]**	4.27	1.62	1.74							0.02	0.03	0.04						
Nitrite as N	mg/L	0.01	**3[a]**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Nitrate as N	mg/L	0.01	**50[a]**	0.06	0.07	0.02							0.04	0.01	0.05						
Nitrite + Nitrate as N	mg/L	0.01	-	0.06	0.07	0.02							0.04	0.01	0.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	4.6	1.7	2.2							0.2	<0.2	<0.2						
Total Nitrogen as N	mg/L	0.1	-	4.7	1.8	2.2							0.2	<0.2	<0.2						
Total Phosphorus as P	mg/L	0.01	-	0.62	0.05	0.07							0.18	0.09	0.05						
Reactive Phosphorus as P	mg/L	0.01	-	0.48	<0.01	<0.01							0.02	<0.01	0.03						
Total Metals																					
Aluminium	mg/L	0.01	**0.2[b +]**	0.2	0.49	2.37	1.66	0.54	0.24	0.19	0.28	0.91	0.35	0.32	0.87	4.86	0.17	0.16	0.28	0.38	3.43
Antimony	mg/L	0.001	**0.003[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.002	0.002	0.002	0.001	0.002	0.001	0.002	0.004
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	1.28	1.18	1.16	1.16	1.14	1.19	<0.001	<0.001	<0.001	0.149	0.139	0.133	0.141	0.145	0.145
Beryllium	mg/L	0.001	**0.06[a]**	1.14	1.16	1.23							0.127	0.131	0.135						
Boron	mg/L	0.05	**4[a]**	0.18	0.19	0.16	0.17	0.18	0.19	0.18	0.18	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**0.05[a]**	0.001	0.002	0.005	0.006	0.002	0.002	0.023	0.002	0.005	<0.001	<0.001	0.002	0.008	<0.001	<0.001	<0.001	0.001	0.013
Cobalt	mg/L	0.001	-	<0.001	0.001	0.002	0.002	<0.001	0.001	0.001	<0.001	0.001	0.003	0.004	0.004	0.006	0.003	0.004	0.004	0.004	0.006
Copper	mg/L	0.001	**2[a] / 1[b]**	0.006	0.018	0.022	0.024	0.009	0.004	0.004	0.005	0.014	0.013	0.017	0.013	0.049	0.009	0.014	0.011	0.015	0.055
Iron	mg/L	0.05	**0.3[b]**	0.9	1.12	3.08	3.91	1.48	0.99	1.05	0.97	1.72	3.16	1.89	2.37	8.16	0.95	0.73	1.01	2.76	9.75
Lead	mg/L	0.001	**0.01[a]**	0.003	0.02	0.006	0.008	0.002	0.002	0.002	0.002	0.003	<0.001	0.001	0.001	0.005	<0.001	0.001	<0.001	0.002	0.008
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.208	0.23	0.268	0.279	0.231	0.252	0.25	0.214	0.267	0.099	0.112	0.116	0.156	0.136	0.131	0.152	0.167	0.166
Mercury	mg/L	0.0001		<0.0001	<0.0001	0.0001						0.0002	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	0.001	<0.001	<0.001							<0.001	<0.001	<0.001						
Nickel	mg/L	0.001	**0.02[a]**	0.002	0.006	0.007	0.014	0.006	0.008	0.02	0.003	0.01	0.005	0.006	0.006	0.012	0.006	0.006	0.005	0.007	0.012
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	2.75	2.77	3	2.93	2.81	3	2.82	2.68	2.92	6.33	6.56	6.34	6.57	6.35	6.95	6.62	6.43	6.58
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.098	0.109	0.226	0.151	0.062	0.062	0.049	0.1	0.11	0.013	0.018	0.02	0.051	0.014	0.019	0.015	0.022	0.044
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	NHMRC																		
Sample Location																					
Lab Number			Drinking Water	GW46	GW46	GW46	GW46	GW46	GW46	GW46	GW46	GW46	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B
Date Sampled				27/9/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	26/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	21/12/2017	4/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5[b]**	7.54	7.78	7.28	7.44	7.41	7.45	7.25	7.39	7.3	7.9	8.05	7.7	7.83	7.75	7.79	7.65	7.83	7.84
Electrical conductivity	µS/cm	1	-	7470	7360	7780	7610	7700	7600	7900	7730	7840	4290	4370	4610	4500	4540	4560	4660	4560	4540
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	5270	4600	5030	4070	5160	4470	4510	4830	4580	3240	2820	3210	3610	3590	3260	3140	2810	2520
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	845	1020	995	1010	905	837	908	923	972	368	446	439	440	402	371	391	401	423
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	845	1020	995	1010	905	837	908	923	972	368	446	439	440	402	371	391	401	423
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	144	142	211	166	180	160	177	180	179	38	47	329	41	43	38	40	37	35
Chloride	mg/L	1	**250[b]**	1690	2060	2490	1870	2230	1920	1990	2200	2140	1110	1280	1320	1210	1270	1260	1280	1270	1250
Calcium	mg/L	1	-	106	112	106	108	111	129	120	116	113	152	174	159	163	164	192	168	164	163
Magnesium	mg/L	1	-	426	444	441	440	442	452	521	463	413	302	358	337	346	341	361	350	330	317
Sodium	mg/L	1	**180[b]**	814	841	845	827	851	878	927	883	801	210	212	207	207	209	221	214	203	199
Potassium	mg/L	1	-	48	50	48	48	50	50	54	52	48	9	8	8	8	8	8	8	7	8
Total Anions	meq/L	0.01	-	67.6	81.4	94.5	76.4	84.7	74.2	78	84.2	83.5	39.4	46	52.8	43.8	44.8	43.7	44.8	44.6	44.4
Total Cations	meq/L	0.01	-	77	80	79.6	78.8	80.2	83.1	90.6	83.6	75.7	41.8	47.6	44.9	45.8	45.5	49.1	46.7	44.4	43.1
Ionic Balance	%	0.01	-	6.52	0.9	8.58	1.56	2.74	5.65	7.48	0.37	4.91	2.89	1.68	8.16	2.28	0.88	5.78	2.13	0.28	1.55
Nutrients																					
Ammonia as N	mg/L	0.01	**0.5[b]**	3.34	3.32	3.36							0.13	0.07	0.04						
Nitrite as N	mg/L	0.01	**3[a]**	0.09	<0.01	0.03							0.06	<0.01	<0.01						
Nitrate as N	mg/L	0.01	**50[a]**	<0.01	0.02	0.05							0.04	0.02	0.09						
Nitrite + Nitrate as N	mg/L	0.01	-	0.08	0.02	0.08							0.1	0.02	0.09						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	3.6	3.6	3.6							0.3	0.1	0.1						
Total Nitrogen as N	mg/L	0.1	-	3.7	3.6	3.7							0.4	0.1	0.2						
Total Phosphorus as P	mg/L	0.01	-	0.32	0.11	0.33							0.11	0.15	0.16						
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							0.08	0.07	0.11						
Total Metals																					
Aluminium	mg/L	0.01	**0.2[b+]**	0.06	0.02	0.24	0.02	<0.01	0.04	<0.01	0.06	0.06	1.21	0.24	0.36	0.41	0.36	0.04	0.05	0.2	0.19
Antimony	mg/L	0.001	**0.003[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.004	0.005	0.004	0.005	0.006	0.005	0.004	0.005
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.275	0.279	0.294	0.284	0.27	0.287	<0.001	<0.001	<0.001	0.133	0.142	0.144	0.131	0.132	0.138
Beryllium	mg/L	0.001	**0.06[a]**	0.292	0.286	0.298							0.164	0.136	0.135						
Boron	mg/L	0.05	**4[a]**	0.06	0.06	0.06	<0.05	0.06	0.07	0.06	0.06	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**0.05[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	-	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**2[a] / 1[b]**	<0.001	<0.001	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.189	0.014	0.008	0.014	0.015	0.004	0.012	0.01	0.009
Iron	mg/L	0.05	**0.3[b]**	16.5	13.7	16.6	14.9	14.5	18.7	14.8	14.5	15.5	1.64	1.04	1.02	1.14	1.63	1.84	0.82	0.94	0.85
Lead	mg/L	0.001	**0.01[a]**	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.009	0.002	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.505	0.526	0.573	0.553	0.561	0.62	0.573	0.564	0.604	0.804	0.656	0.723	0.735	0.692	0.732	0.744	0.721	0.726
Mercury	mg/L	0.0001		<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	<0.001	<0.001	<0.001							0.002	<0.001	<0.001						
Nickel	mg/L	0.001	**0.02[a]**	<0.001	<0.001	0.002	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.011	0.004	<0.001	0.002	0.004	0.002	0.001	0.001	0.001
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	3.05	3.15	3.11	3.09	3.13	3.37	3.24	3.04	3.2	2.09	2.27	2.1	2.12	2.16	2.27	2.11	2.06	2.21
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.006	0.008	0.012	<0.005	<0.005	0.007	<0.005	0.007	0.009	0.024	0.017	0.007	0.01	0.017	0.006	<0.005	0.01	0.006
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	NHMRC																		
Sample Location																					
Lab Number			**Drinking Water**	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B
Date Sampled				26/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	21/12/2017	4/1/2018	18/1/2018	26/9/2017	09/10/2017	27/10/2017	9/11/2017	24/11/2017	5/12/2017	22/12/2017	5/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5[b]**	7.67	7.8	7.45	7.61	7.52	7.54	7.42	7.64	7.62	7.84	7.75	7.46	7.57	7.5	7.54	7.4	7.6	7.58
Electrical conductivity	µS/cm	1	-	7360	7270	7620	7500	7590	7620	7790	7730	8020	3970	5130	5350	5230	5230	5110	5240	5110	5070
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	4410	4830	5250	4440	5460	5210	5260	5030	5180	2830	3130	3190	3390	3620	3400	3580	3180	2820
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	522	573	595	579	525	527	512	519	568	331	394	395	389	353	322	312	332	376
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	522	573	595	579	525	527	512	519	568	331	394	395	389	353	322	312	332	376
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	120	132	137	122	141	134	134	132	146	36	109	117	113	130	122	119	117	119
Chloride	mg/L	1	**250[b]**	1850	2260	2620	1980	2400	2420	2520	2410	2280	994	1460	1480	1360	1410	1360	1400	1390	1410
Calcium	mg/L	1	-	229	249	231	236	239	284	250	255	255	222	216	151	135	135	172	129	135	130
Magnesium	mg/L	1	-	317	349	326	338	338	357	364	350	335	138	183	174	194	189	199	184	169	166
Sodium	mg/L	1	**180[b]**	757	825	786	802	824	883	894	836	816	403	554	616	648	645	688	626	581	588
Potassium	mg/L	1	-	8	8	8	8	8	8	9	9	8	11	13	12	14	12	13	12	12	12
Total Anions	meq/L	0.01	-	65.1	77.9	88.6	70	81.1	81.6	84.1	81.1	78.7	35.4	51.3	52.1	48.5	49.5	47.3	48.2	48.3	49.8
Total Cations	meq/L	0.01	-	70.6	77.2	72.8	74.7	75.8	82.2	81.6	78.1	76	40.2	50.3	49	51.2	50.6	55.2	49.1	46.2	46
Ionic Balance	%	0.01	-	4.08	0.46	9.85	3.26	3.4	0.36	1.54	1.87	1.75	6.4	1.04	3.09	2.77	1.12	7.68	0.94	2.17	3.9
Nutrients																					
Ammonia as N	mg/L	0.01	**0.5[b]**	<0.01	<0.01	<0.01							0.05	0.48	0.7						
Nitrite as N	mg/L	0.01	**3[a]**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Nitrate as N	mg/L	0.01	**50[a]**	1.17	0.95	1.14							0.05	0.01	0.06						
Nitrite + Nitrate as N	mg/L	0.01	-	1.17	0.95	1.14							0.05	0.01	0.06						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	0.7	<0.1	0.1							1.6	0.8	0.7						
Total Nitrogen as N	mg/L	0.1	-	1.9	1	1.2							1.6	0.8	0.8						
Total Phosphorus as P	mg/L	0.01	-	0.47	0.12	0.14							0.1	0.08	0.12						
Reactive Phosphorus as P	mg/L	0.01	-	0.09	0.08	0.13							<0.01	<0.01	<0.01						
Total Metals																					
Aluminium	mg/L	0.01	**0.2[b+]**	7.66	4.82	5.33	3.36	2.56	0.18	0.43	4	1.02	0.14	0.15	0.19	0.12	0.05	0.02	<0.01	0.09	1.38
Antimony	mg/L	0.001	**0.003[a]**	<0.001	0.007	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.004	0.006	0.005	0.008	0.007	0.005	0.006
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.078	0.086	0.068	0.092	0.092	0.067	<0.001	<0.001	<0.001	0.368	0.363	0.359	0.342	0.326	0.341
Beryllium	mg/L	0.001	**0.06[a]**	0.099	0.087	0.095							0.422	0.46	0.402						
Boron	mg/L	0.05	**4[a]**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.08	0.08	0.07	0.08	0.09	0.07	0.08	0.08
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**0.05[a]**	0.032	0.02	0.022	0.012	0.014	0.002	0.003	0.014	0.002	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Cobalt	mg/L	0.001	-	0.015	0.01	0.006	0.007	0.004	0.001	0.002	0.008	0.001	0.004	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.003
Copper	mg/L	0.001	**2[a] / 1[b]**	0.017	0.021	0.013	0.015	0.012	0.008	0.009	0.015	0.004	0.02	0.038	0.032	0.048	0.012	0.009	0.007	0.004	0.01
Iron	mg/L	0.05	**0.3[b]**	10.5	6.89	7.08	4.88	3.75	0.41	0.97	5.24	1.27	0.55	0.94	1.88	2.46	2	3.23	2.8	2.19	3.4
Lead	mg/L	0.001	**0.01[a]**	0.003	0.008	0.003	0.004	0.002	<0.001	0.001	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.253	0.132	0.119	0.123	0.088	0.028	0.059	0.137	0.031	2.05	2.98	3.2	3.17	3.16	3.2	2.78	2.71	2.98
Mercury	mg/L	0.0001		<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	0.001	0.001	<0.001							<0.001	<0.001	0.002						
Nickel	mg/L	0.001	**0.02[a]**	0.017	0.011	0.01	0.008	0.009	0.003	0.005	0.01	0.003	0.036	0.03	0.008	0.005	0.004	0.004	0.003	0.005	0.006
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	3.91	3.95	3.91	3.93	4	4.08	3.93	3.88	4.24	3.9	5.29	5.72	5.83	5.8	5.81	5.54	5.33	5.52
Vanadium	mg/L	0.01	-	0.02	0.02	0.02							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.026	0.02	0.021	0.011	0.014	<0.005	0.014	0.018	<0.005	0.011	0.021	0.01	0.009	<0.005	0.007	<0.005	0.007	0.016
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	NHMRC																		
Sample Location																					
Lab Number			Drinking Water	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006
Date Sampled				29/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	22/12/2017	4/1/2018	18/1/2018	29/9/2017	09/10/2017	27/10/2017	8/11/2017	23/11/2017	4/12/2017	22/12/2017	6/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5[b]**	7.34	7.34	7	6.96	7.13	7.1	6.96	7.08	7.02	8.02	7.93	7.54	7.76	7.7	7.65	7.52	7.75	7.69
Electrical conductivity	µS/cm	1	-	5970	5970	6320	6210	6290	6240	6470	6340	6350	3410	3360	3520	3460	3480	3470	3550	3520	3560
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	3510	3510	3730	3720	4020	3810	3940	3810	3860	1930	1750	1790	2000	2030	2020	2190	1850	1790
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	728	728	730	720	650	652	648	650	711	589	633	620	614	546	570	537	541	605
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	728	728	730	720	650	652	648	650	711	589	633	620	614	546	570	537	541	605
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	392	392	440	461	466	402	416	510	443	50	51	54	55	64	62	<1	58	43
Chloride	mg/L	1	**250[b]**	1460	1460	1460	1350	1420	1380	1450	1490	1480	719	804	821	780	796	801	823	808	811
Calcium	mg/L	1	-	232	232	229	225	229	273	237	233	239	104	106	105	101	102	138	108	112	110
Magnesium	mg/L	1	-	85	85	84	83	85	89	89	83	82	37	41	40	39	40	43	41	38	40
Sodium	mg/L	1	**180[b]**	977	977	1020	997	1010	1030	1060	938	968	522	580	590	591	590	611	600	536	570
Potassium	mg/L	1	-	29	29	39	34	41	40	39	38	38	19	16	17	18	16	16	17	16	17
Total Anions	meq/L	0.01	-	63.9	63.9	64.9	62.1	62.7	60.3	62.5	65.6	65.2	33.1	36.4	36.7	35.4	34.7	35.3	33.9	34.8	35.9
Total Cations	meq/L	0.01	-	61.8	61.8	63.7	62.3	63.4	66.8	66.2	60.2	61.8	31.4	34.3	34.6	34.4	34.4	37.4	35.3	32.4	34
Ionic Balance	%	0.01	-	1.66	1.66	0.95	0.18	0.52	5.07	2.91	4.3	2.7	2.58	2.95	2.86	1.43	0.35	2.94	1.95	3.52	2.65
Nutrients																					
Ammonia as N	mg/L	0.01	**0.5[b]**	3.35	3.35	3.43							0.02	1.78	1.04						
Nitrite as N	mg/L	0.01	**3[a]**	0.01	0.01	0.03							0.03	0.08	0.8						
Nitrate as N	mg/L	0.01	**50[a]**	0.02	0.02	0.04							2.55	0.09	0.25						
Nitrite + Nitrate as N	mg/L	0.01	-	0.03	0.03	0.07							2.58	0.17	1.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	3.4	3.4	3.5							1	1.5	1.1						
Total Nitrogen as N	mg/L	0.1	-	3.4	3.4	3.6							3.6	1.7	2.2						
Total Phosphorus as P	mg/L	0.01	-	0.02	0.02	0.04							0.13	0.01	0.03						
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							0.03	<0.01	0.02						
Total Metals																					
Aluminium	mg/L	0.01	**0.2[b+]**	0.11	0.1	0.18	0.48	0.03	0.08	0.08	7.74	0.22	0.78	0.13	0.24	0.46	0.06	0.02	<0.01	0.04	0.22
Antimony	mg/L	0.001	**0.003[a]**	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.046	0.037	0.038	0.065	0.074	0.04	<0.001	<0.001	<0.001	0.241	0.238	0.233	0.232	0.22	0.235
Beryllium	mg/L	0.001	**0.06[a]**	0.04	0.045	0.041							0.238	0.238	0.234						
Boron	mg/L	0.05	**4[a]**	0.12	0.13	0.12	0.12	0.12	0.13	0.11	0.13	0.13	0.12	0.13	0.13	0.11	0.12	0.13	0.11	0.12	0.12
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**0.05[a]**	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.013	<0.001	0.002	0.005	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002
Cobalt	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**2[a] / 1[b]**	0.012	0.007	0.011	0.026	0.01	0.005	0.017	0.018	0.008	0.068	0.02	0.02	0.024	0.024	0.015	0.022	0.024	0.026
Iron	mg/L	0.05	**0.3[b]**	2.78	3.9	2.58	3.28	1.26	1.18	2.49	8.76	1.28	1.06	0.55	0.54	0.92	0.3	0.11	0.07	0.15	0.45
Lead	mg/L	0.001	**0.01[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.214	0.221	0.233	0.22	0.215	0.237	0.233	0.39	0.216	0.041	0.07	0.052	0.071	0.047	0.036	0.033	0.033	0.046
Mercury	mg/L	0.0001		<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	<0.001	<0.001	<0.001							0.008	<0.001	0.001						
Nickel	mg/L	0.001	**0.02[a]**	<0.001	0.002	0.001	0.001	0.001	0.002	0.005	0.013	0.001	0.009	0.006	0.007	0.007	0.004	0.004	0.002	0.004	0.006
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	8.01	7.98	7.96	8.11	7.77	8.26	8.18	7.81	8.19	6.55	6.63	6.67	6.72	6.63	6.92	6.79	6.59	6.87
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.028	0.015	0.007	0.008	0.011	0.006	0.03	0.024	<0.005	0.018	0.017	0.011	0.015	0.013	0.006	0.006	0.007	0.021
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	NHMRC																		
Sample Location																					
Lab Number			**Drinking Water**	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)
Date Sampled				26/9/2017	09/10/2017	27/10/2017	8/11/2017	########	4/12/2017	########	6/1/2018	18/1/2018	26/9/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	6/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5[b]**	11.4	11.3	11.6	11.6	11.4	11.5	11.3	11.4	11.4	11.8	11.7	11.8	11.9	11.7	11.8	11.6	11.7	11.7
Electrical conductivity	µS/cm	1	-	7330	7050	7870	7690	7810	7790	8070	7910	7890	6040	5640	6680	6360	6210	6300	6460	6130	5990
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	3950	3900	4000	3970	4190	4100	4000	4010	4120	3330	2800	3310	3260	3130	2790	2580	2670	3040
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	247	174	354	311	278	284	292	242	240	460	384	466	559	455	479	467	391	354
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	360	466	304	343	304	294	284	264	371	145	138	83	79	84	98	104	126	199
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	607	640	658	654	582	578	576	506	610	605	522	549	638	540	577	571	517	552
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	86	101	107	95	117	110	108	109	116	315	361	397	403	437	376	399	439	380
Chloride	mg/L	1	**250[b]**	1870	1770	1710	1670	1800	1720	1840	1840	1860	912	1010	960	948	1000	1000	1030	1010	980
Calcium	mg/L	1	-	7	8	8	8	9	12	9	9	10	65	104	96	88	2	77	50	41	39
Magnesium	mg/L	1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sodium	mg/L	1	**180[b]**	1260	1410	1410	1410	1420	1520	1510	1330	1400	939	968	953	973	1020	1060	1010	900	955
Potassium	mg/L	1	-	84	93	87	90	87	101	91	86	85	75	76	76	77	81	87	78	72	75
Total Anions	meq/L	0.01	-	66.7	64.8	63.6	62.2	64.8	62.4	65.7	64.3	67.1	44.4	46.4	46.3	47.9	48.1	47.6	48.8	48	46.6
Total Cations	meq/L	0.01	-	57.3	64.1	64	64	64.4	69.3	68.4	60.5	63.6	46	49.2	48.2	48.7	46.5	52.2	48.4	43	45.4
Ionic Balance	%	0.01	-	7.55	0.55	0.27	1.49	0.31	5.27	2.08	3.03	2.68	1.81	2.93	1.98	0.83	1.65	4.62	0.36	5.41	1.28
Nutrients																					
Ammonia as N	mg/L	0.01	**0.5[b]**	7.8	9.6	7.86							1	0.97	1.04						
Nitrite as N	mg/L	0.01	**3[a]**	<0.01	<0.01	<0.01							0.02	<0.01	<0.01						
Nitrate as N	mg/L	0.01	**50[a]**	0.04	0.04	0.05							0.01	0.02	0.01						
Nitrite + Nitrate as N	mg/L	0.01	-	0.04	0.04	0.05							0.03	0.02	0.01						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	14.2	11.9	9.9							3.5	2.3	3.2						
Total Nitrogen as N	mg/L	0.1	-	14.2	11.9	10							3.5	2.3	3.2						
Total Phosphorus as P	mg/L	0.01	-	0.56	0.56	0.26							0.74	0.58	0.83						
Reactive Phosphorus as P	mg/L	0.01	-	0.6	0.29	0.2							<0.01	<0.01	<0.01						
Total Metals																					
Aluminium	mg/L	0.01	**0.2[b +]**	2.62	2.41	2.82	2.6	2.43	2.37	2.47	2.27	2.48	0.16	0.09	0.07	0.76	0.21	0.16	0.19	0.41	0.54
Antimony	mg/L	0.001	**0.003[a]**	0.002	0.003	0.004	0.002	0.002	0.002	0.002	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	0.006	0.007	0.006	0.007	0.007	0.007	0.007	0.007	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.038	0.033	0.032	0.032	0.03	0.036	<0.001	<0.001	<0.001	0.185	0.12	0.116	0.115	0.104	0.126
Beryllium	mg/L	0.001	**0.06[a]**	0.037	0.034	0.035							0.15	0.132	0.133						
Boron	mg/L	0.05	**4[a]**	0.12	0.12	0.12	0.11	0.12	0.13	0.12	0.12	0.13	0.06	0.06	<0.05	0.06	0.06	0.08	0.07	0.07	0.08
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							0.0002	<0.0001	0.0001						
Chromium	mg/L	0.001	**0.05[a]**	<0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.003	0.002	0.001	0.004	0.002	0.002	0.002	0.002	0.004
Cobalt	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**2[a] / 1[b]**	0.038	0.01	0.026	0.016	0.022	0.009	0.006	0.042	0.063	0.002	<0.001	<0.001	0.007	<0.001	<0.001	0.001	<0.001	0.002
Iron	mg/L	0.05	**0.3[b]**	0.25	0.36	0.57	0.36	0.37	0.11	0.1	0.39	0.35	0.32	<0.001	0.06	1.86	0.37	0.12	0.24	0.61	0.71
Lead	mg/L	0.001	**0.01[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.01	0.01	0.017	0.012	0.008	0.008	0.004	0.007	0.012	0.007	<0.001	<0.001	0.039	0.008	0.005	0.011	0.014	0.024
Mercury	mg/L	0.0001		<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	0.12	0.11	0.116							0.499	0.479	0.524						
Nickel	mg/L	0.001	**0.02[a]**	0.025	0.024	0.02	0.025	0.023	0.026	0.022	0.023	0.023	0.009	0.009	0.008	0.012	0.01	0.009	0.008	0.01	0.01
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	0.321	0.364	0.338	0.36	0.363	0.372	0.365	0.36	0.357	2.06	1.97	2.06	2.1	1.75	1.79	1.7	1.49	1.6
Vanadium	mg/L	0.01	-	0.01	0.01	0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.026	0.026	0.023	0.016	0.008	0.017	0.007	0.009	0.016	0.021	<0.005	<0.005	0.047	0.011	0.006	0.011	0.015	0.021
BTEX																					
Benzene	µg/L	1		<1	<1	<1							----	<1	<1						
Toluene	µg/L	2		<2	<2	<2							----	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							----	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							----	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							----	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							----	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							----	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							----	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							----	<100	<100						

\# Limit of Reporting
a NHMRC Health Guidelines for Drinking Water (2015)
b NHMRC Aesthetic Guidelines for Drinking Water (2015)
m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.
\+ NHMRC acid-soluable aluminium concentrations (2015)
\- No value.

G1839Z

Parameter	Units	LOR#	NHMRC																				
Sample Location																							
Lab Number			**Drinking Water**	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18B	MP18B	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A
Date Sampled				27/9/2017	10/10/2017	########	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	27/9/2017	27/10/2017	27/9/2017	10/10/2017	26/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018
Lithology																							
Field Parameters																							
Field pH	pH units		-																				
Field Electrical Conductivity (EC)	μS/cm		-																				
Depth to Groundwater	m TOC		-																				
Physical Parameters																							
pH	pH Units	0.1	**6.5 - 8.5[b]**	7.6	7.24	7.6	7.36	7.35	7.4	7.23	7.42	7.36	7.7	7.4	7.7	7.83	7.33	7.53	7.49	7.65	7.3	7.48	7.54
Electrical conductivity	μS/cm	1	-	12500	12500	12200	12200	12300	12200	12400	12200	12500	22800	23000	15200	14900	15200	14900	15000	14900	14600	14200	14000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	5900	7990	7670	8000	7810	8030	7400	6630	7650	14300	17200	7490	9330	9480	9300	8550	9620	8810	6710	8120
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	851	924	934	926	839	790	829	726	904	1080	1170	1100	1170	1110	1060	974	1120	1120	1000	1210
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	851	924	934	926	839	790	829	726	904	1080	1170	1100	1170	1110	1060	974	1120	1120	1000	1210
Major Ions																							
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	258	318	257	305	314	284	291	299	286	810	894	152	248	314	309	319	267	254	255	215
Chloride	mg/L	1	**250[b]**	3620	3740	3770	3830	4000	3860	4030	3830	3770	6570	7690	1700	4700	4960	4690	4870	4800	4780	4430	3850
Calcium	mg/L	1	-	203	194	199	198	198	244	203	181	204	140	140	119	147	149	146	145	171	147	137	137
Magnesium	mg/L	1	-	441	453	448	459	451	480	466	408	422	817	937	489	505	531	473	507	514	555	416	417
Sodium	mg/L	1	**180[b]**	1670	1740	1740	1750	1760	1930	1750	1570	1690	3460	3960	915	2360	2480	2360	2450	2480	2610	2070	2190
Potassium	mg/L	1	-	29	30	30	30	31	32	30	28	30	76	84	56	40	42	41	42	40	42	35	40
Total Anions	meq/L	0.01	-	124	130	130	133	136	130	136	129	130	224	259	73.1	161	169	160	163	163	162	150	137
Total Cations	meq/L	0.01	-	120	123	123	124	124	136	125	112	119	227	258	87.4	152	160	150	157	160	168	132	137
Ionic Balance	%	0.01	-	1.92	2.82	2.8	3.24	4.52	2.2	4.18	7.13	4.48	0.64	0.08	8.92	2.72	2.6	3.22	2.15	1.12	1.55	6.46	0.07
Nutrients																							
Ammonia as N	mg/L	0.01	**0.5[b]**	0.32	0.32	0.29							0.21	0.14	0.07	0.36	0.43						
Nitrite as N	mg/L	0.01	**3[a]**	<0.01	0.02	0.02							<0.01	<0.01	<0.01	0.02	0.01						
Nitrate as N	mg/L	0.01	**50[a]**	0.06	0.07	0.02							0.16	0.03	0.43	0.18	0.1						
Nitrite + Nitrate as N	mg/L	0.01	-	0.06	0.09	0.04							0.16	0.03	0.43	0.2	0.11						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	0.5	0.4	0.8							4.5	9.9	0.4	<0.5	0.7						
Total Nitrogen as N	mg/L	0.1	-	0.6	0.5	0.8							4.7	9.9	0.8	<0.5	0.8						
Total Phosphorus as P	mg/L	0.01	-	0.15	0.08	0.09							2.3	6.56	1.18	1.05	0.09						
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							0.07	0.03	0.02	<0.01	0.02						
Total Metals																							
Aluminium	mg/L	0.01	**0.2[b +]**	0.22	0.3	0.12	0.24	0.08	0.02	<0.01	<0.01	0.27	108	261	0.42	0.14	2.93	0.31	0.15	0.06	0.05	0.17	1.01
Antimony	mg/L	0.001	**0.003[a]**	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	0.004	0.004	0.003	0.003	0.002	0.003	0.002	0.001	0.003	0.026	0.078	0.015	0.021	0.008	0.008	0.001	0.004	0.003	0.006	0.004
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.315	0.223	0.184	0.249	0.16	0.286	0.008	0.02	<0.001	<0.001	<0.001	0.422	0.388	0.244	0.33	0.377	0.772
Beryllium	mg/L	0.001	**0.06[a]**	0.375	0.449	0.308							5.24	2.64	0.333	0.282	2.8						
Boron	mg/L	0.05	**4[a]**	0.08	0.08	0.08	0.07	0.07	0.08	0.07	0.06	0.08	0.08	0.1	0.11	0.12	0.12	0.1	0.12	0.13	0.12	0.16	0.12
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							0.0002	0.0003	<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**0.05[a]**	<0.001	0.003	0.008	0.003	<0.001	<0.001	<0.001	<0.001	0.001	0.215	0.538	0.002	0.004	0.004	0.004	<0.001	0.004	0.002	<0.001	0.003
Cobalt	mg/L	0.001	-	<0.001	0.002	<0.001	0.002	0.002	0.002	<0.001	<0.001	0.001	0.061	0.163	<0.001	0.001	0.002	0.001	<0.001	<0.001	<0.001	0.184	<0.001
Copper	mg/L	0.001	**2[a] / 1[b]**	0.006	0.006	0.01	0.014	0.072	0.055	0.172	0.046	0.132	0.374	0.58	0.002	0.007	0.006	0.007	0.002	0.03	0.003	0.028	0.007
Iron	mg/L	0.05	**0.3[b]**	8.58	6.08	5.16	7.54	3.59	3.54	4.62	1.74	4.05	137	351	20	20.5	10.6	11.8	1.95	4.71	3.84	2.33	5.39
Lead	mg/L	0.001	**0.01[a]**	<0.001	<0.001	0.004	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.064	0.186	<0.001	0.002	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.194	0.213	0.196	0.234	0.21	0.213	0.209	0.202	0.257	0.358	0.857	0.162	0.259	0.217	0.23	0.179	0.192	0.182	0.166	0.187
Mercury	mg/L	0.0001		<0.0001	0.0004	<0.0001						<0.0001	0.0002	0.0005	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	0.002	0.007	0.001							<0.001	<0.001	0.003	0.004	0.005						
Nickel	mg/L	0.001	**0.02[a]**	0.001	0.17	0.007	0.258	0.227	0.209	0.185	0.161	0.146	0.121	0.413	<0.001	0.003	0.013	0.025	0.005	0.005	0.002	1.55	0.006
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	0.26	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.002
Strontium	mg/L	0.001	-	5.9	6.06	6.17	6	5.96	6.15	6.14	5.82	6.16	7.75	8.14	6.51	6.74	6.8	6.08	6.51	6.94	6.7	6.38	5.61
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							0.34	0.86	<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.024	0.032	0.035	0.029	0.011	0.013	0.008	0.012	0.031	0.204	0.546	0.007	0.037	0.062	0.024	0.006	0.018	0.016	0.016	0.05
BTEX																							
Benzene	μg/L	1		<1	<1	<1							<1	<1	<1	<1	<1						
Toluene	μg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
Ethylbenzene	μg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
meta- & para-Xylene	μg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
ortho-Xylene	μg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
Total Xylenes	μg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
Sum of BTEX	μg/L	1		<1	<1	<1							<1	<1	<1	<1	<1						
Naphthalene	μg/L	5		<5	<5	<5							<5	<5	<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																							
C10 - C14 Fraction (EP071 SG)	μg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	μg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	μg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
Total Recoverable Hydrocarbons																							
>C10 - C16 Fraction (EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	μg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

AGE

G1839Z

Parameter	Units	LOR#	NHMRC																	
Sample Location																				
Lab Number			**Drinking Water**	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2
Date Sampled				27/9/2017	10/10/2017	26/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	25/9/2017	09/10/2017	26/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018
Lithology																				
Field Parameters																				
Field pH	pH units		-																	
Field Electrical Conductivity (EC)	µS/cm		-																	
Depth to Groundwater	m TOC		-																	
Physical Parameters																				
pH	pH Units	0.1	**6.5 - 8.5[b]**	7.84	8.08	7.41	7.56	7.59	7.68	7.43	7.57	7.6	7.31	6.86	6.97	6.94	6.92	7.01	6.85	7
Electrical conductivity	µS/cm	1	-	11800	12100	13300	14000	14400	15100	15800	15900	16400	450	533	638	605	664	752	890	839
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	6030	6520	7730	8220	7950	8990	8610	9140	9470	472	722	1230	1650	1980	2060	1440	1370
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	1760	1920	1820	1790	1610	1390	1530	1350	1600	40	43	50	49	45	45	47	45
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	1760	1920	1820	1790	1610	1390	1530	1350	1600	40	43	50	49	45	45	47	45
Major Ions																				
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	85	123	178	199	244	263	298	315	298	39	34	40	54	44	39	36	36
Chloride	mg/L	1	**250[b]**	2910	3260	3880	4000	4380	4570	4850	4800	5040	43	65	124	119	132	176	222	194
Calcium	mg/L	1	-	81	79	100	96	119	148	128	133	131	1	2	2	6	2	1	7	2
Magnesium	mg/L	1	-	116	150	222	233	314	302	349	308	299	4	4	6	19	8	4	19	9
Sodium	mg/L	1	**180[b]**	2340	2530	2740	2690	2990	3070	3120	2770	2770	77	93	109	114	120	137	147	148
Potassium	mg/L	1	-	24	27	29	29	31	31	33	30	32	4	4	5	8	6	4	9	7
Total Anions	meq/L	0.01	-	119	133	150	153	161	162	174	169	180	2.82	4.23	5.33	5.46	5.54	6.68	7.95	7.12
Total Cations	meq/L	0.01	-	116	127	143	142	163	166	172	153	152	3.83	4.58	5.46	7.03	6.13	6.44	8.54	7.46
Ionic Balance	%	0.01	-	1.29	2.25	2.16	3.74	0.56	1.34	0.56	4.87	8.38	15.1	3.99	1.23	12.5	5.08	1.79	3.56	2.3
Nutrients																				
Ammonia as N	mg/L	0.01	**0.5[b]**	2.51	3.3	2.25							<0.01	0.02	0.02					
Nitrite as N	mg/L	0.01	**3[a]**	0.06	<0.01	<0.01							0.02	<0.01	<0.01					
Nitrate as N	mg/L	0.01	**50[a]**	0.45	0.03	0.02							12.4	11.6	11.5					
Nitrite + Nitrate as N	mg/L	0.01	-	0.51	0.03	0.02							12.4	11.6	11.5					
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	3.5	4	2.8							5	2.6	2.7					
Total Nitrogen as N	mg/L	0.1	-	4	4	2.8							17.4	14.2	14.2					
Total Phosphorus as P	mg/L	0.01	-	0.23	0.17	0.11							0.93	0.24	0.89					
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	0.01	0.01					
Total Metals																				
Aluminium	mg/L	0.01	**0.2[b +]**	0.45	0.13	0.52	0.81	0.24	0.07	0.09	0.71	0.68	69.1	2.78	120	15.1	59.7	117	8.09	89.6
Antimony	mg/L	0.001	**0.003[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	0.002	0.002	0.002	0.002	0.001	0.002	<0.001	0.001	0.002	0.004	<0.001	0.009	0.002	0.005	0.011	0.002	0.005
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.799	0.807	0.336	0.309	0.961	0.734	0.003	<0.001	0.006	0.071	0.099	0.25	0.069	0.149
Beryllium	mg/L	0.001	**0.06[a]**	1.26	0.518	1.94							0.098	0.028	0.17					
Boron	mg/L	0.05	**4[a]**	0.48	0.44	0.35	0.38	0.3	0.34	0.3	0.28	0.29	0.09	0.11	0.12	0.1	0.09	0.14	0.08	0.1
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001					
Chromium	mg/L	0.001	**0.05[a]**	0.001	0.001	0.005	0.007	0.002	0.002	0.001	0.005	0.007	0.131	0.005	0.238	0.025	0.122	0.357	0.017	0.172
Cobalt	mg/L	0.001	-	0.001	0.002	0.002	0.004	<0.001	0.003	<0.001	0.003	0.002	0.035	0.012	0.054	0.031	0.029	0.08	0.024	0.043
Copper	mg/L	0.001	**2[a] / 1[b]**	0.012	0.014	0.006	0.009	0.01	0.008	0.017	0.028	0.018	0.08	0.021	0.125	0.045	0.071	0.185	0.047	0.105
Iron	mg/L	0.05	**0.3[b]**	3.46	2.67	6.66	13.3	4.08	5.06	2.32	5.04	3.79	59.1	2.79	101	12.3	46.9	112	8.35	68
Lead	mg/L	0.001	**0.01[a]**	0.002	0.001	<0.001	0.04	<0.001	<0.001	<0.001	0.002	0.003	0.027	0.008	0.05	0.017	0.024	0.066	0.016	0.035
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.092	0.139	0.116	0.216	0.109	0.178	0.12	0.145	0.184	0.316	0.146	0.511	0.346	0.298	0.73	0.302	0.442
Mercury	mg/L	0.0001		<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	0.0001					
Molybdenum	mg/L	0.001	**0.05[a]**	<0.001	0.001	0.011							<0.001	<0.001	<0.001					
Nickel	mg/L	0.001	**0.02[a]**	0.005	0.01	0.03	0.065	0.129	0.118	0.128	0.166	0.14	0.071	0.008	0.112	0.024	0.058	0.174	0.022	0.086
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	0.01	0.02	<0.01	0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	6.78	6.71	7.54	7.02	7.57	7.71	7.65	7.29	7.88	0.147	0.131	0.255	0.208	0.136	0.321	0.26	0.232
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							0.08	0.02	0.16					
Zinc	mg/L	0.005	**3[b]**	0.025	0.039	0.03	0.044	0.006	0.012	0.016	0.038	0.078	0.154	0.026	0.258	0.06	0.127	0.361	0.103	0.24
BTEX																				
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1					
Toluene	µg/L	2		<2	<2	40							<2	<2	<2					
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2					
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2					
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2					
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2					
Sum of BTEX	µg/L	1		<1	<1	40							<1	<1	<1					
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5					
Total Petroleum Hydrocarbons (Silica gel cleanup)																				
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
Total Recoverable Hydrocarbons																				
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100					

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	NHMRC																		
Sample Location																					
Lab Number			**Drinking Water**	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2
Date Sampled				25/9/2017	09/10/2017	26/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018	19/1/2018	25/9/2017	09/10/2017	30/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	μS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5[b]**	7.48	7.63	7.38	7.49	7.47	7.55	7.38	7.58	7.52	7.92	8.12	7.61	7.76	7.68	7.7	7.59	7.77	7.7
Electrical conductivity	μS/cm	1	-	795	892	13500	12400	12400	13100	14000	14000	14400	8310	8000	9020	9060	9230	9430	9970	9820	10000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	420	566	8680	8060	6540	8960	9600	8960	8550	3660	4620	5110	5150	4780	5310	5940	5460	5650
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	96	116	706	659	606	613	666	629	736	1160	1280	1210	1210	1070	1050	1100	1100	1200
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	96	116	706	659	606	613	666	629	736	1160	1280	1210	1210	1070	1050	1100	1100	1200
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	36	42	193	170	182	172	190	192	194	26	30	54	52	66	69	75	74	68
Chloride	mg/L	1	**250[b]**	142	243	4600	4060	4200	4330	4760	4670	4240	1830	2160	2260	2560	2680	2730	2970	2800	2570
Calcium	mg/L	1	-	5	6	112	103	103	129	124	130	124	71	68	84	74	84	112	99	114	106
Magnesium	mg/L	1	-	15	16	542	507	480	512	622	585	520	106	110	129	128	142	142	169	156	147
Sodium	mg/L	1	**180[b]**	125	141	1880	1730	1700	1790	2120	2030	1830	1500	1500	1730	1590	1720	1690	1920	1740	1710
Potassium	mg/L	1	-	6	6	56	53	52	53	63	66	60	24	25	26	26	28	26	31	29	29
Total Anions	meq/L	0.01	-	6.67	10	148	131	134	138	152	148	138	75.3	87.1	89	97.5	98.4	99.4	107	102	97.9
Total Cations	meq/L	0.01	-	7.07	7.9	133	123	120	128	151	145	130	78.1	78.3	90.7	84	91.4	91.4	103	95	92.5
Ionic Balance	%	0.01	-	2.92	11.9	5.15	3.05	5.68	3.83	0.11	1.26	3.06	1.82	5.32	0.93	7.39	3.66	4.18	1.98	3.82	2.82
Nutrients																					
Ammonia as N	mg/L	0.01	**0.5[b]**	0.34	0.18	0.14							2.13	2.35	1.94						
Nitrite as N	mg/L	0.01	**3[a]**	0.12	0.15	0.02							0.33	0.1	0.13						
Nitrate as N	mg/L	0.01	**50[a]**	<0.10	0.51	0.05							<0.01	0.08	<0.01						
Nitrite + Nitrate as N	mg/L	0.01	-	0.11	0.66	0.07							0.04	0.18	0.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	1.6	0.6	0.2							2.9	3	2.4						
Total Nitrogen as N	mg/L	0.1	-	1.7	1.3	0.3							2.9	3.2	2.4						
Total Phosphorus as P	mg/L	0.01	-	0.14	0.16	0.08							0.37	0.2	0.16						
Reactive Phosphorus as P	mg/L	0.01	-	0.08	<0.01	<0.01							0.16	0.17	0.13						
Total Metals																					
Aluminium	mg/L	0.01	**0.2[b+]**	1.14	0.16	0.84	0.66	0.74	1.04	0.58	1.12	0.65	1.39	0.25	0.73	0.24	0.22	0.44	0.97	0.26	1.58
Antimony	mg/L	0.001	**0.003[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.144	0.163	0.165	0.172	0.139	0.184	<0.001	<0.001	<0.001	0.614	0.601	0.603	0.659	0.603	0.693
Beryllium	mg/L	0.001	**0.06[a]**	0.054	0.061	0.141							0.583	0.565	0.608						
Boron	mg/L	0.05	**4[a]**	0.08	0.08	0.05	<0.05	0.05	0.06	0.05	<0.05	0.07	0.26	0.26	0.26	0.24	0.24	0.24	0.24	0.24	0.24
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**0.05[a]**	0.003	0.002	0.002	0.002	0.002	0.003	0.002	0.003	0.004	0.005	0.002	0.002	<0.001	0.002	0.002	0.003	0.001	0.006
Cobalt	mg/L	0.001	-	0.004	0.002	0.004	0.004	0.004	0.004	0.003	0.002	0.004	0.002	<0.001	0.002	<0.001	<0.001	<0.001	0.003	0.001	0.002
Copper	mg/L	0.001	**2[a] / 1[b]**	0.009	0.007	0.005	0.005	0.006	0.007	0.008	0.007	0.014	0.012	0.003	0.007	0.002	0.002	0.002	0.013	0.001	0.019
Iron	mg/L	0.05	**0.3[b]**	2.47	1.4	2.51	2.39	2.56	2.79	1.69	1.67	1.83	2.38	0.72	1.78	1.08	1.16	1.23	1.92	0.71	1.94
Lead	mg/L	0.001	**0.01[a]**	0.004	0.003	0.001	0.002	0.003	0.002	0.003	0.002	0.002	0.006	0.002	0.003	0.002	0.003	<0.001	0.008	<0.001	0.003
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.064	0.051	0.163	0.175	0.197	0.188	0.138	0.103	0.223	0.284	0.319	0.248	0.267	0.272	0.281	0.368	0.265	0.34
Mercury	mg/L	0.0001		<0.0001	<0.0001	<0.0001						0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	<0.001	<0.001	<0.001							0.001	<0.001	0.002						
Nickel	mg/L	0.001	**0.02[a]**	0.009	0.008	0.006	0.009	0.01	0.012	0.012	0.014	0.014	0.006	0.006	0.006	0.003	0.004	0.005	0.009	0.004	0.015
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	0.188	0.235	4.33	4.2	4.12	4.75	4.5	4.57	4.96	5.52	5.48	6.45	6.63	6.66	7.08	7.46	7.03	7.56
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.096	0.07	0.042	0.06	0.077	0.062	0.08	0.122	0.115	0.173	0.066	0.083	0.067	0.067	0.033	0.197	0.022	0.149
BTEX																					
Benzene	μg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	μg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	μg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	μg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	μg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	μg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	μg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	μg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	μg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	μg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	μg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	μg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	μg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	NHMRC																		
Sample Location																					
Lab Number			**Drinking Water**	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249
Date Sampled				26/9/2017	09/10/2017	24/10/2017	8/11/2017	########	4/12/2017	21/12/2017	5/1/2018	18/1/2018	26/9/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	5/12/2017	21/12/2017	5/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.5 - 8.5[b]**	7.81	7.92	7.74	7.63	7.55	7.65	7.44	7.64	7.66	7.81	8.13	8.06	8.11	7.99	8.06	7.92	8.1	8.17
Electrical conductivity	µS/cm	1	-	5380	5230	5630	5020	5140	5000	5260	5050	5080	5380	2320	2450	2340	2450	2450	2550	2530	2580
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**600[b]**	3320	2590	3090	2960	2910	3060	3020	2840	2680	3320	1150	1380	1270	1240	1420	1360	1330	1320
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	544	576	458	412	415	348	412	366	380	544	373	340	377	347	355	356	315	382
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	544	576	458	412	415	348	412	366	380	544	373	340	377	347	355	356	315	382
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**500[a] / 250[b]**	146	134	139	166	168	162	154	157	164	146	15	12	16	19	17	16	15	15
Chloride	mg/L	1	**250[b]**	1560	1390	1300	1240	1340	1290	1350	1340	1310	1560	571	560	574	606	608	634	620	600
Calcium	mg/L	1	-	22	19	22	14	16	27	17	35	20	22	37	39	36	37	54	38	40	41
Magnesium	mg/L	1	-	181	176	163	176	180	197	186	155	170	181	25	23	24	25	30	25	25	26
Sodium	mg/L	1	**180[b]**	857	819	775	720	743	816	703	662	688	857	432	405	430	438	513	440	417	439
Potassium	mg/L	1	-	39	36	34	33	33	34	32	28	32	39	10	10	11	11	12	11	11	11
Total Anions	meq/L	0.01	-	57.9	53.5	48.7	46.7	49.6	46.7	49.5	48.4	48	57.9	23.9	22.8	24	24.4	24.6	25.3	24.1	24.9
Total Cations	meq/L	0.01	-	54.3	52	49.1	47.3	48.8	53.9	47.6	44	45.7	54.3	23	21.7	22.8	23.2	27.8	23.4	22.5	23.6
Ionic Balance	%	0.01	-	3.25	1.45	0.38	0.72	0.83	7.16	2.02	4.72	2.38	3.25	1.97	2.53	2.78	2.49	6.08	4.02	3.48	2.7
Nutrients																					
Ammonia as N	mg/L	0.01	**0.5[b]**	0.08	0.08	0.13							0.08	0.02	0.08						
Nitrite as N	mg/L	0.01	**3[a]**	<0.10	<0.01	<0.01							<0.10	<0.01	<0.01						
Nitrate as N	mg/L	0.01	**50[a]**	<0.10	0.04	0.07							<0.10	1.62	1.89						
Nitrite + Nitrate as N	mg/L	0.01	-	<0.10	0.04	0.07							<0.10	1.62	1.89						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	0.2	<0.1	0.4							0.2	0.2	0.4						
Total Nitrogen as N	mg/L	0.1	-	0.2	<0.1	0.5							0.2	1.8	2.3						
Total Phosphorus as P	mg/L	0.01	-	0.02	0.01	0.02							0.02	0.17	0.24						
Reactive Phosphorus as P	mg/L	0.01	-	0.07	0.01	0.01							0.07	0.19	0.18						
Total Metals																					
Aluminium	mg/L	0.01	**0.2[b +]**	0.1	0.01	0.03	<0.01	<0.01	0.02	0.01	0.02	0.03	0.69	0.06	0.19	0.18	0.14	0.04	0.06	0.07	0.09
Antimony	mg/L	0.001	**0.003[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.01[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	0.002	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001
Barium	mg/L	0.001	**2[a]**	<0.001	<0.001	<0.001	0.05	0.051	0.064	0.092	0.081	0.064	<0.001	<0.001	<0.001	0.206	0.202	0.21	0.205	0.187	0.216
Beryllium	mg/L	0.001	**0.06[a]**	0.066	0.064	0.069							0.216	0.203	0.211						
Boron	mg/L	0.05	**4[a]**	0.08	0.09	0.06	0.08	0.1	0.1	0.09	0.08	0.1	0.09	0.1	0.08	0.09	0.1	0.11	0.11	0.09	0.11
Cadmium	mg/L	0.0001	**0.002[a]**	<0.0001	<0.0001	<0.0001							0.0002	0.0001	0.0002						
Chromium	mg/L	0.001	**0.05[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**2[a] / 1[b]**	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.003	0.001	0.003	0.002	<0.001	0.001	0.002	0.002	0.002
Iron	mg/L	0.05	**0.3[b]**	0.15	<0.05	0.06	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	0.36	0.07	0.22	0.28	0.16	<0.05	0.08	0.09	0.13
Lead	mg/L	0.001	**0.01[a]**	0.006	0.003	0.006	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.019	0.01	0.018	0.013	0.005	0.004	0.005	0.004	0.006
Manganese	mg/L	0.001	**0.5[a] / 0.1[b]**	0.032	0.025	0.026	0.01	0.006	0.013	0.03	0.021	0.008	0.021	0.017	0.021	0.016	0.012	0.009	0.007	0.005	0.008
Mercury	mg/L	0.0001		<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05[a]**	0.002	0.002	0.008							0.003	0.003	0.004						
Nickel	mg/L	0.001	**0.02[a]**	0.001	<0.001	<0.001	0.002	0.002	0.002	0.001	<0.001	0.001	0.024	0.016	0.017	0.016	0.016	0.017	0.016	0.013	0.014
Selenium	mg/L	0.01	**0.01[a]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	**0.1[a]**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	0.942	0.926	1.02	0.666	0.653	0.798	1.17	1.06	0.757	1.79	1.94	2.07	1.9	1.94	2.1	2.05	1.91	2.12
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**3[b]**	0.008	0.006	0.008	<0.005	<0.005	0.006	<0.005	0.006	0.009	0.108	0.089	0.103	0.091	0.078	0.08	0.074	0.068	0.072
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

AGE

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																			
Sample Location																						
Lab Number			Short term irrigation	Long Term irrigation	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW04	GW04	GW04	GW04	GW04	GW04	GW04	GW04	GW04
Date Sampled					25/09/2017	09/10/2017	26/10/2017	9/11/2017	22/11/2017	5/12/2017	20/12/2017	5/1/2018	18/1/2018	25/09/2017	09/10/2017	26/10/2017	9/11/2017	22/11/2017	5/12/2017	20/12/2017	5/1/2018	18/1/2018
Lithology																						
Field Parameters																						
Field pH	pH units		-																			
Field Electrical Conductivity (EC)	µS/cm		-																			
Depth to Groundwater	m TOC		-																			
Physical Parameters																						
pH	pH Units	0.1	6.0 - 8.5	6.0 - 8.5	8.46	8.29	8.11	8.3	8.17	8.34	8.21	8.24	8.07	7.81	7.95	7.46	7.66	7.66	7.7	7.53	7.7	7.58
Electrical conductivity	µS/cm	1	-		23300	23100	23800	23400	23500	23400	24200	23600	24300	7660	7620	7900	7780	7830	7760	8010	7860	7980
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		15100	14400	15200	13700	16000	15900	16900	14600	15000	4500	4570	4690	3980	4650	4710	4370	4780	4750
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		33	<1	<1	6	<1	21	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		339	468	490	517	503	488	512	601	664	1270	1360	1380	1370	1250	1280	1270	1290	1350
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		372	468	490	524	503	509	512	601	664	1270	1360	1380	1370	1250	1280	1270	1290	1350
Major Ions																						
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		311	304	329	308	316	292	293	266	266	216	213	260	241	248	229	230	220	218
Chloride	mg/L	1		40	7220	8000	8400	7690	8070	8000	8300	8300	8000	1490	1690	1730	1590	1690	1600	1720	1680	1670
Calcium	mg/L	1	-		29	30	32	33	36	56	38	41	40	41	40	41	38	38	55	40	39	42
Magnesium	mg/L	1	-		452	463	461	462	458	509	516	436	451	14	24	15	16	17	15	16	13	16
Sodium	mg/L	1	-		4330	4500	4510	4560	4530	5150	4770	4270	4490	1560	1810	1760	1710	1760	1820	1740	1440	1720
Potassium	mg/L	1	-		50	52	50	53	52	62	56	53	52	9	12	10	11	11	10	11	9	11
Total Anions	meq/L	0.01	-		218	241	254	234	244	242	250	252	244	71.9	79.3	81.8	77.2	77.8	75.5	78.7	77.7	78.6
Total Cations	meq/L	0.01	-		228	237	237	239	238	270	253	225	236	71.3	83	80.1	77.9	80.1	83.4	79.3	65.9	78.5
Ionic Balance	%	0.01	-		2.4	0.98	3.38	1.18	1.33	5.54	0.56	5.59	1.82	0.43	2.3	1.05	0.41	1.47	4.99	0.38	8.26	0.07
Nutrients																						
Ammonia as N	mg/L	0.01	-		0.64	1.17	1.38							4.27	4.55	4.9						
Nitrite as N	mg/L	0.01	-		0.15	<0.01	<0.01							<0.01	0.05	0.02						
Nitrate as N	mg/L	0.01	-		<0.01	<0.01	0.03							0.06	0.07	0.04						
Nitrite + Nitrate as N	mg/L	0.01	-		0.03	<0.01	0.03							0.06	0.12	0.06						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		1.2	1.3	1.7							4.6	6.4	5.2						
Total Nitrogen as N	mg/L	0.1	25 - 125	5	1.2	1.3	1.7							4.7	6.5	5.3						
Total Phosphorus as P	mg/L	0.01	0.8 - 12	0.05	0.02	<0.10	<0.02							0.62	1.08	0.83						
Reactive Phosphorus as P	mg/L	0.01			<0.01	<0.01	<0.01							0.48	0.8	0.73						
Total Metals																						
Aluminium	mg/L	0.01	5		0.05	0.06	<0.01	0.03	<0.01	<0.01	<0.01	0.01	0.1	0.02	0.08	0.05	0.19	0.01	0.02	<0.01	0.01	0.19
Antimony	mg/L	0.001	-		<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	2.0	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.02	0.018	0.022	0.022	0.022	0.026	<0.001	<0.001	<0.001	0.249	0.228	0.252	0.242	0.232	0.24
Beryllium	mg/L	0.001	0.5	0.1	0.02	0.016	0.025							0.237	0.264	0.246						
Boron	mg/L	0.05	refer to guideline	0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.38	0.4	0.38	0.38	0.39	0.4	0.38	0.44	0.4
Cadmium	mg/L	0.0001	0.05	0.01	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	1.0	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.10	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	5.0	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.01	0.001	0.01	<0.001	<0.001	0.002	<0.001	<0.001
Iron	mg/L	0.05	10.0	0.2	24.6	10.3	0.64	7.26	6.26	4.51	4.92	6.79	13	0.49	0.99	0.7	2.3	0.35	0.29	0.26	0.17	0.31
Lead	mg/L	0.001	5.0	2.0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.001	0.013	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	10.0	0.2	0.509	0.581	0.599	0.693	0.696	0.707	0.608	0.578	0.647	0.076	0.091	0.074	0.089	0.084	0.08	0.08	0.08	0.079
Mercury	mg/L	0.0001	0.002	0.002	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	0.05	0.01	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001						
Nickel	mg/L	0.001	2.0	0.2	<0.001	0.002	0.002	0.001	0.001	<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.05	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		-	0.002	<0.001	0.002	<0.001	0.003	0.003	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		-	2.38	2.74	2.87	3.17	3.18	3.55	3.33	3.13	3.32	2.94	3.06	2.88	2.99	2.87	3.21	2.99	2.93	2.96
Vanadium	mg/L	0.01	0.5	0.1	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	2.0	2.0	0.024	0.011	<0.005	0.013	0.02	<0.005	<0.005	0.006	0.028	0.006	0.066	0.056	0.242	0.014	0.013	0.031	0.007	0.012
BTEX																						
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2			<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																						
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																						
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100						

Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

+ NHMRC acid-soluable aluminium concentrations (2015)

- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																			
Sample Location																						
Lab Number			**Short term irrigation**	**Long Term irrigation**	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW33	GW33	GW33	GW33	GW33	GW33	GW33	GW33	GW33
Date Sampled					25/09/2017	09/10/2017	24/10/2017	8/11/2017	22/11/2017	4/12/2017	20/12/2017	5/1/2018	19/1/2018	27/9/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018
Lithology																						
Field Parameters																						
Field pH	pH units		-																			
Field Electrical Conductivity (EC)	µS/cm		-																			
Depth to Groundwater	m TOC		-																			
Physical Parameters																						
pH	pH Units	0.1	**6.0 - 8.5**	**6.0 - 8.5**	7.81	8.02	7.89	7.69	7.65	7.7	7.55	7.69	7.62	7.7	7.73	7.27	7.41	7.39	7.56	7.31	7.46	7.31
Electrical conductivity	µS/cm	1	-		7660	5060	5570	5280	5320	5240	5710	5360	5420	16300	16000	16500	16200	16400	16400	16900	16800	17000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		4500	2860	2980	3150	3000	3010	3400	3010	2780	13700	10600	11500	9500	11700	12100	11400	12500	11000
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		1270	851	784	838	766	762	792	716	858	1020	1110	1110	1110	1030	1060	967	1070	1110
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		1270	851	784	838	766	762	792	716	858	1020	1110	1110	1110	1030	1060	967	1070	1110
Major Ions																						
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		216	1	1	3	2	2	4	1	3	419	513	541	587	599	590	700	732	515
Chloride	mg/L	1		**40**	1490	1220	1200	1230	1270	1250	1380	1280	1290	4750	5020	5630	5060	5380	5380	5550	5390	5090
Calcium	mg/L	1	-		41	70	71	66	69	92	73	68	72	176	202	208	198	204	240	223	214	208
Magnesium	mg/L	1	-		14	68	60	64	66	77	74	64	65	654	769	812	774	780	796	955	739	726
Sodium	mg/L	1	-		1560	1010	939	941	1000	1100	1050	916	965	1870	2170	2280	2160	2230	2330	2460	2060	2130
Potassium	mg/L	1	-		9	16	16	15	16	17	17	15	16	71	80	82	80	82	90	88	78	81
Total Anions	meq/L	0.01	-		71.9	51.4	49.5	51.5	51.2	50.5	54.8	50.4	53.6	163	174	192	177	185	185	190	189	176
Total Cations	meq/L	0.01	-		71.3	53.4	49.7	49.9	52.8	59.2	55.8	48.9	51.3	146	170	178	170	173	181	199	163	165
Ionic Balance	%	0.01	-		0.43	1.9	0.2	1.6	1.55	7.91	0.91	1.56	2.16	5.61	1.35	3.72	2.18	3.16	1.12	2.19	7.27	3.41
Nutrients																						
Ammonia as N	mg/L	0.01	-		4.27	1.62	1.74							0.02	0.03	0.04						
Nitrite as N	mg/L	0.01	-		<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-		0.06	0.07	0.02							0.04	0.01	0.05						
Nitrite + Nitrate as N	mg/L	0.01	-		0.06	0.07	0.02							0.04	0.01	0.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		4.6	1.7	2.2							0.2	<0.2	<0.2						
Total Nitrogen as N	mg/L	0.1	**25 - 125**	**5**	4.7	1.8	2.2							0.2	<0.2	<0.2						
Total Phosphorus as P	mg/L	0.01	**0.8 - 12**	**0.05**	0.62	0.05	0.07							0.18	0.09	0.05						
Reactive Phosphorus as P	mg/L	0.01			0.48	<0.01	<0.01							0.02	<0.01	0.03						
Total Metals																						
Aluminium	mg/L	0.01	**5**		0.2	0.49	2.37	1.66	0.54	0.24	0.19	0.28	0.91	0.35	0.32	0.87	4.86	0.17	0.16	0.28	0.38	3.43
Antimony	mg/L	0.001	-		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**2.0**	**0.1**	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.002	0.002	0.002	0.001	0.002	0.001	0.002	0.004
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	1.28	1.18	1.16	1.16	1.14	1.19	<0.001	<0.001	<0.001	0.149	0.139	0.133	0.141	0.145	0.145
Beryllium	mg/L	0.001	**0.5**	**0.1**	1.14	1.16	1.23							0.127	0.131	0.135						
Boron	mg/L	0.05	**refer to guideline**	**0.5**	0.18	0.19	0.16	0.17	0.18	0.19	0.18	0.18	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	**0.05**	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	**0.1**	0.001	0.002	0.005	0.006	0.002	0.002	0.023	0.002	0.005	<0.001	<0.001	0.002	0.008	<0.001	<0.001	<0.001	0.001	0.013
Cobalt	mg/L	0.001	**0.10**	**0.05**	<0.001	0.001	0.002	0.002	<0.001	0.001	0.001	<0.001	0.001	0.003	0.004	0.004	0.006	0.003	0.004	0.004	0.004	0.006
Copper	mg/L	0.001	**5.0**	**0.2**	0.006	0.018	0.022	0.024	0.009	0.004	0.004	0.005	0.014	0.013	0.017	0.013	0.049	0.009	0.014	0.011	0.015	0.055
Iron	mg/L	0.05	**10.0**	**0.2**	0.9	1.12	3.08	3.91	1.48	0.99	1.05	0.97	1.72	3.16	1.89	2.37	8.16	0.95	0.73	1.01	2.76	9.75
Lead	mg/L	0.001	**5.0**	**2.0**	0.003	0.02	0.006	0.008	0.002	0.002	0.002	0.002	0.003	<0.001	0.001	0.001	0.005	<0.001	0.001	<0.001	0.002	0.008
Manganese	mg/L	0.001	**10.0**	**0.2**	0.208	0.23	0.268	0.279	0.231	0.252	0.25	0.214	0.267	0.099	0.112	0.116	0.156	0.136	0.131	0.152	0.167	0.166
Mercury	mg/L	0.0001	**0.002**	**0.002**	<0.0001	<0.0001	0.0001						0.0002	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05**	**0.01**	0.001	<0.001	<0.001							<0.001	<0.001	<0.001						
Nickel	mg/L	0.001	**2.0**	**0.2**	0.002	0.006	0.007	0.014	0.006	0.008	0.02	0.003	0.01	0.005	0.006	0.006	0.012	0.006	0.006	0.005	0.007	0.012
Selenium	mg/L	0.01	**0.05**	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		-	2.75	2.77	3	2.93	2.81	3	2.82	2.68	2.92	6.33	6.56	6.34	6.57	6.35	6.95	6.62	6.43	6.58
Vanadium	mg/L	0.01	**0.5**	**0.1**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**2.0**	**2.0**	0.098	0.109	0.226	0.151	0.062	0.062	0.049	0.1	0.11	0.013	0.018	0.02	0.051	0.014	0.019	0.015	0.022	0.044
BTEX																						
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2			<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																						
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																						
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	ANZECC GUIDELINES																				
Sample Location																						
Lab Number			**Short term irrigation**	**Long Term irrigation**	GW46	GW46	GW46	GW46	GW46	GW46	GW46	GW46	GW46	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B
Date Sampled					27/9/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	26/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	21/12/2017	4/1/2018	18/1/2018
Lithology																						
Field Parameters																						
Field pH	pH units		-																			
Field Electrical Conductivity (EC)	µS/cm		-																			
Depth to Groundwater	m TOC		-																			
Physical Parameters																						
pH	pH Units	0.1	**6.0 - 8.5**	**6.0 - 8.5**	7.54	7.78	7.28	7.44	7.41	7.45	7.25	7.39	7.3	7.9	8.05	7.7	7.83	7.75	7.79	7.65	7.83	7.84
Electrical conductivity	µS/cm	1	-		7470	7360	7780	7610	7700	7600	7900	7730	7840	4290	4370	4610	4500	4540	4560	4660	4560	4540
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		5270	4600	5030	4070	5160	4470	4510	4830	4580	3240	2820	3210	3610	3590	3260	3140	2810	2520
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		845	1020	995	1010	905	837	908	923	972	368	446	439	440	402	371	391	401	423
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		845	1020	995	1010	905	837	908	923	972	368	446	439	440	402	371	391	401	423
Major Ions																						
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		144	142	211	166	180	160	177	180	179	38	47	329	41	43	38	40	37	35
Chloride	mg/L	1		**40**	1690	2060	2490	1870	2230	1920	1990	2200	2140	1110	1280	1320	1210	1270	1260	1280	1270	1250
Calcium	mg/L	1	-		106	112	106	108	111	129	120	116	113	152	174	159	163	164	192	168	164	163
Magnesium	mg/L	1	-		426	444	441	440	442	452	521	463	413	302	358	337	346	341	361	350	330	317
Sodium	mg/L	1	-		814	841	845	827	851	878	927	883	801	210	212	207	207	209	221	214	203	199
Potassium	mg/L	1	-		48	50	48	48	50	50	54	52	48	9	8	8	8	8	8	8	7	8
Total Anions	meq/L	0.01	-		67.6	81.4	94.5	76.4	84.7	74.2	78	84.2	83.5	39.4	46	52.8	43.8	44.8	43.7	44.8	44.6	44.4
Total Cations	meq/L	0.01	-		77	80	79.6	78.8	80.2	83.1	90.6	83.6	75.7	41.8	47.6	44.9	45.8	45.5	49.1	46.7	44.4	43.1
Ionic Balance	%	0.01	-		6.52	0.9	8.58	1.56	2.74	5.65	7.48	0.37	4.91	2.89	1.68	8.16	2.28	0.88	5.78	2.13	0.28	1.55
Nutrients																						
Ammonia as N	mg/L	0.01	-		3.34	3.32	3.36							0.13	0.07	0.04						
Nitrite as N	mg/L	0.01	-		0.09	<0.01	0.03							0.06	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-		<0.01	0.02	0.05							0.04	0.02	0.09						
Nitrite + Nitrate as N	mg/L	0.01	-		0.08	0.02	0.08							0.1	0.02	0.09						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		3.6	3.6	3.6							0.3	0.1	0.1						
Total Nitrogen as N	mg/L	0.1	**25 - 125**	**5**	3.7	3.6	3.7							0.4	0.1	0.2						
Total Phosphorus as P	mg/L	0.01	**0.8 - 12**	**0.05**	0.32	0.11	0.33							0.11	0.15	0.16						
Reactive Phosphorus as P	mg/L	0.01			<0.01	<0.01	<0.01							0.08	0.07	0.11						
Total Metals																						
Aluminium	mg/L	0.01	**5**		0.06	0.02	0.24	0.02	<0.01	0.04	<0.01	0.06	0.06	1.21	0.24	0.36	0.41	0.36	0.04	0.05	0.2	0.19
Antimony	mg/L	0.001	-		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**2.0**	**0.1**	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.004	0.005	0.004	0.005	0.006	0.005	0.004	0.005
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.275	0.279	0.294	0.284	0.27	0.287	<0.001	<0.001	<0.001	0.133	0.142	0.144	0.131	0.132	0.138
Beryllium	mg/L	0.001	**0.5**	**0.1**	0.292	0.286	0.298							0.164	0.136	0.135						
Boron	mg/L	0.05	**refer to guideline**	**0.5**	0.06	0.06	0.06	<0.05	0.06	0.07	0.06	0.06	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	**0.05**	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	**0.1**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	**0.10**	**0.05**	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**5.0**	**0.2**	<0.001	<0.001	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.189	0.014	0.008	0.014	0.015	0.004	0.012	0.01	0.009
Iron	mg/L	0.05	**10.0**	**0.2**	16.5	13.7	16.6	14.9	14.5	18.7	14.8	14.5	15.5	1.64	1.04	1.02	1.14	1.63	1.84	0.82	0.94	0.85
Lead	mg/L	0.001	**5.0**	**2.0**	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.009	0.002	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**10.0**	**0.2**	0.505	0.526	0.573	0.553	0.561	0.62	0.573	0.564	0.604	0.804	0.656	0.723	0.735	0.692	0.732	0.744	0.721	0.726
Mercury	mg/L	0.0001	**0.002**	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05**	**0.01**	<0.001	<0.001	<0.001							0.002	<0.001	<0.001						
Nickel	mg/L	0.001	**2.0**	**0.2**	<0.001	<0.001	0.002	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.011	0.004	<0.001	0.002	0.004	0.002	0.001	0.001	0.001
Selenium	mg/L	0.01	**0.05**	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		-	3.05	3.15	3.11	3.09	3.13	3.37	3.24	3.04	3.2	2.09	2.27	2.1	2.12	2.16	2.27	2.11	2.06	2.21
Vanadium	mg/L	0.01	**0.5**	**0.1**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**2.0**	**2.0**	0.006	0.008	0.012	<0.005	<0.005	0.007	<0.005	0.007	0.009	0.024	0.017	0.007	0.01	0.017	0.006	<0.005	0.01	0.006
BTEX																						
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2			<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																						
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																						
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																			
Sample Location																						
Lab Number			**Short term irrigation**	**Long Term irrigation**	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B
Date Sampled					26/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	21/12/2017	4/1/2018	18/1/2018	26/9/2017	09/10/2017	27/10/2017	9/11/2017	24/11/2017	5/12/2017	22/12/2017	5/1/2018	18/1/2018
Lithology																						
Field Parameters																						
Field pH	pH units		-																			
Field Electrical Conductivity (EC)	µS/cm		-																			
Depth to Groundwater	m TOC		-																			
Physical Parameters																						
pH	pH Units	0.1	**6.0 - 8.5**	**6.0 - 8.5**	7.67	7.8	7.45	7.61	7.52	7.54	7.42	7.64	7.62	7.84	7.75	7.46	7.57	7.5	7.54	7.4	7.6	7.58
Electrical conductivity	µS/cm	1	-		7360	7270	7620	7500	7590	7620	7790	7730	8020	3970	5130	5350	5230	5230	5110	5240	5110	5070
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		4410	4830	5250	4440	5460	5210	5260	5030	5180	2830	3130	3190	3390	3620	3400	3580	3180	2820
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		522	573	595	579	525	527	512	519	568	331	394	395	389	353	322	312	332	376
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		522	573	595	579	525	527	512	519	568	331	394	395	389	353	322	312	332	376
Major Ions																						
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		120	132	137	122	141	134	134	132	146	36	109	117	113	130	122	119	117	119
Chloride	mg/L	1		**40**	1850	2260	2620	1980	2400	2420	2520	2410	2280	994	1460	1480	1360	1410	1360	1400	1390	1410
Calcium	mg/L	1	-		229	249	231	236	239	284	250	255	255	222	216	151	135	135	172	129	135	130
Magnesium	mg/L	1	-		317	349	326	338	338	357	364	350	335	138	183	174	194	189	199	184	169	166
Sodium	mg/L	1	-		757	825	786	802	824	883	894	836	816	403	554	616	648	645	688	626	581	588
Potassium	mg/L	1	-		8	8	8	8	8	8	9	9	8	11	13	12	14	12	13	12	12	12
Total Anions	meq/L	0.01	-		65.1	77.9	88.6	70	81.1	81.6	84.1	81.1	78.7	35.4	51.3	52.1	48.5	49.5	47.3	48.2	48.3	49.8
Total Cations	meq/L	0.01	-		70.6	77.2	72.8	74.7	75.8	82.2	81.6	78.1	76	40.2	50.3	49	51.2	50.6	55.2	49.1	46.2	46
Ionic Balance	%	0.01	-		4.08	0.46	9.85	3.26	3.4	0.36	1.54	1.87	1.75	6.4	1.04	3.09	2.77	1.12	7.68	0.94	2.17	3.9
Nutrients																						
Ammonia as N	mg/L	0.01	-		<0.01	<0.01	<0.01							0.05	0.48	0.7						
Nitrite as N	mg/L	0.01	-		<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-		1.17	0.95	1.14							0.05	0.01	0.06						
Nitrite + Nitrate as N	mg/L	0.01	-		1.17	0.95	1.14							0.05	0.01	0.06						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		0.7	<0.1	0.1							1.6	0.8	0.7						
Total Nitrogen as N	mg/L	0.1	**25 - 125**	**5**	1.9	1	1.2							1.6	0.8	0.8						
Total Phosphorus as P	mg/L	0.01	**0.8 - 12**	**0.05**	0.47	0.12	0.14							0.1	0.08	0.12						
Reactive Phosphorus as P	mg/L	0.01			0.09	0.08	0.13							<0.01	<0.01	<0.01						
Total Metals																						
Aluminium	mg/L	0.01	**5**		7.66	4.82	5.33	3.36	2.56	0.18	0.43	4	1.02	0.14	0.15	0.19	0.12	0.05	0.02	<0.01	0.09	1.38
Antimony	mg/L	0.001	-		<0.001	0.007	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**2.0**	**0.1**	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.004	0.006	0.005	0.008	0.007	0.005	0.006
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.078	0.086	0.068	0.092	0.092	0.067	<0.001	<0.001	<0.001	0.368	0.363	0.359	0.342	0.326	0.341
Beryllium	mg/L	0.001	**0.5**	**0.1**	0.099	0.087	0.095							0.422	0.46	0.402						
Boron	mg/L	0.05	**refer to guideline**	**0.5**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.08	0.08	0.07	0.08	0.09	0.07	0.08	0.08
Cadmium	mg/L	0.0001	**0.05**	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	**0.1**	0.032	0.02	0.022	0.012	0.014	0.002	0.003	0.014	0.002	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Cobalt	mg/L	0.001	**0.10**	**0.05**	0.015	0.01	0.006	0.007	0.004	0.001	0.002	0.008	0.001	0.004	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.003
Copper	mg/L	0.001	**5.0**	**0.2**	0.017	0.021	0.013	0.015	0.012	0.008	0.009	0.015	0.004	0.02	0.038	0.032	0.048	0.012	0.009	0.007	0.004	0.01
Iron	mg/L	0.05	**10.0**	**0.2**	10.5	6.89	7.08	4.88	3.75	0.41	0.97	5.24	1.27	0.55	0.94	1.88	2.46	2	3.23	2.8	2.19	3.4
Lead	mg/L	0.001	**5.0**	**2.0**	0.003	0.008	0.003	0.004	0.002	<0.001	0.001	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**10.0**	**0.2**	0.253	0.132	0.119	0.123	0.088	0.028	0.059	0.137	0.031	2.05	2.98	3.2	3.17	3.16	3.2	2.78	2.71	2.98
Mercury	mg/L	0.0001	**0.002**	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05**	**0.01**	0.001	0.001	<0.001							<0.001	<0.001	0.002						
Nickel	mg/L	0.001	**2.0**	**0.2**	0.017	0.011	0.01	0.008	0.009	0.003	0.005	0.01	0.003	0.036	0.03	0.008	0.005	0.004	0.004	0.003	0.005	0.006
Selenium	mg/L	0.01	**0.05**	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		**-**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		**-**	3.91	3.95	3.91	3.93	4	4.08	3.93	3.88	4.24	3.9	5.29	5.72	5.83	5.8	5.81	5.54	5.33	5.52
Vanadium	mg/L	0.01	**0.5**	**0.1**	0.02	0.02	0.02							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**2.0**	**2.0**	0.026	0.02	0.021	0.011	0.014	<0.005	0.014	0.018	<0.005	0.011	0.021	0.01	0.009	<0.005	0.007	<0.005	0.007	0.016
BTEX																						
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2			<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																						
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																						
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																				
Sample Location																						
Lab Number			Short term irrigation	Long Term irrigation	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006
Date Sampled					29/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	22/12/2017	4/1/2018	18/1/2018	29/9/2017	09/10/2017	27/10/2017	8/11/2017	23/11/2017	4/12/2017	22/12/2017	6/1/2018	18/1/2018
Lithology																						
Field Parameters																						
Field pH	pH units		-																			
Field Electrical Conductivity (EC)	µS/cm		-																			
Depth to Groundwater	m TOC		-																			
Physical Parameters																						
pH	pH Units	0.1	6.0 - 8.5	6.0 - 8.5	7.34	7.34	7	6.96	7.13	7.1	6.96	7.08	7.02	8.02	7.93	7.54	7.76	7.7	7.65	7.52	7.75	7.69
Electrical conductivity	µS/cm	1	-		5970	5970	6320	6210	6290	6240	6470	6340	6350	3410	3360	3520	3460	3480	3470	3550	3520	3560
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		3510	3510	3730	3720	4020	3810	3940	3810	3860	1930	1750	1790	2000	2030	2020	2190	1850	1790
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		728	728	730	720	650	652	648	650	711	589	633	620	614	546	570	537	541	605
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		728	728	730	720	650	652	648	650	711	589	633	620	614	546	570	537	541	605
Major Ions																						
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		392	392	440	461	466	402	416	510	443	50	51	54	55	64	62	<1	58	43
Chloride	mg/L	1		40	1460	1460	1460	1350	1420	1380	1450	1490	1480	719	804	821	780	796	801	823	808	811
Calcium	mg/L	1	-		232	232	229	225	229	273	237	233	239	104	106	105	101	102	138	108	112	110
Magnesium	mg/L	1	-		85	85	84	83	85	89	89	83	82	37	41	40	39	40	43	41	38	40
Sodium	mg/L	1	-		977	977	1020	997	1010	1030	1060	938	968	522	580	590	591	590	611	600	536	570
Potassium	mg/L	1	-		29	29	39	34	41	40	39	38	38	19	16	17	18	16	16	17	16	17
Total Anions	meq/L	0.01	-		63.9	63.9	64.9	62.1	62.7	60.3	62.5	65.6	65.2	33.1	36.4	36.7	35.4	34.7	35.3	33.9	34.8	35.9
Total Cations	meq/L	0.01	-		61.8	61.8	63.7	62.3	63.4	66.8	66.2	60.2	61.8	31.4	34.3	34.6	34.4	34.4	37.4	35.3	32.4	34
Ionic Balance	%	0.01	-		1.66	1.66	0.95	0.18	0.52	5.07	2.91	4.3	2.7	2.58	2.95	2.86	1.43	0.35	2.94	1.95	3.52	2.65
Nutrients																						
Ammonia as N	mg/L	0.01	-		3.35	3.35	3.43							0.02	1.78	1.04						
Nitrite as N	mg/L	0.01	-		0.01	0.01	0.03							0.03	0.08	0.8						
Nitrate as N	mg/L	0.01	-		0.02	0.02	0.04							2.55	0.09	0.25						
Nitrite + Nitrate as N	mg/L	0.01	-		0.03	0.03	0.07							2.58	0.17	1.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		3.4	3.4	3.5							1	1.5	1.1						
Total Nitrogen as N	mg/L	0.1	25 - 125	5	3.4	3.4	3.6							3.6	1.7	2.2						
Total Phosphorus as P	mg/L	0.01	0.8 - 12	0.05	0.02	0.02	0.04							0.13	0.01	0.03						
Reactive Phosphorus as P	mg/L	0.01			<0.01	<0.01	<0.01							0.03	<0.01	0.02						
Total Metals																						
Aluminium	mg/L	0.01	5		0.11	0.1	0.18	0.48	0.03	0.08	0.08	7.74	0.22	0.78	0.13	0.24	0.46	0.06	0.02	<0.01	0.04	0.22
Antimony	mg/L	0.001	-		<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	2.0	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.046	0.037	0.038	0.065	0.074	0.04	<0.001	<0.001	<0.001	0.241	0.238	0.233	0.232	0.22	0.235
Beryllium	mg/L	0.001	0.5	0.1	0.04	0.045	0.041							0.238	0.238	0.234						
Boron	mg/L	0.05	refer to guideline	0.5	0.12	0.13	0.12	0.12	0.12	0.13	0.11	0.13	0.13	0.12	0.13	0.13	0.11	0.12	0.13	0.11	0.12	0.12
Cadmium	mg/L	0.0001	0.05	0.01	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	1.0	0.1	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.013	<0.001	0.002	0.005	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002
Cobalt	mg/L	0.001	0.10	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	5.0	0.2	0.012	0.007	0.011	0.026	0.01	0.005	0.017	0.018	0.008	0.068	0.02	0.02	0.024	0.024	0.015	0.022	0.024	0.026
Iron	mg/L	0.05	10.0	0.2	2.78	3.9	2.58	3.28	1.26	1.18	2.49	8.76	1.28	1.06	0.55	0.54	0.92	0.3	0.11	0.07	0.15	0.45
Lead	mg/L	0.001	5.0	2.0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/L	0.001	10.0	0.2	0.214	0.221	0.233	0.22	0.215	0.237	0.233	0.39	0.216	0.041	0.07	0.052	0.071	0.047	0.036	0.033	0.033	0.046
Mercury	mg/L	0.0001	0.002	0.002	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	0.05	0.01	<0.001	<0.001	<0.001							0.008	<0.001	0.001						
Nickel	mg/L	0.001	2.0	0.2	<0.001	0.002	0.001	0.001	0.001	0.002	0.005	0.013	0.001	0.009	0.006	0.007	0.007	0.004	0.004	0.002	0.004	0.006
Selenium	mg/L	0.01	0.05	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		-	8.01	7.98	7.96	8.11	7.77	8.26	8.18	7.81	8.19	6.55	6.63	6.67	6.72	6.63	6.92	6.79	6.59	6.87
Vanadium	mg/L	0.01	0.5	0.1	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	2.0	2.0	0.028	0.015	0.007	0.008	0.011	0.006	0.03	0.024	<0.005	0.018	0.017	0.011	0.015	0.013	0.006	0.006	0.007	0.021
BTEX																						
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2			<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																						
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																						
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100						

\# Limit of Reporting
a NHMRC Health Guidelines for Drinking Water (2015)
b NHMRC Aesthetic Guidelines for Drinking Water (2015)
m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.
\+ NHMRC acid-soluable aluminium concentrations (2015)
\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																			
Sample Location																						
Lab Number			**Short term irrigation**	**Long Term irrigation**	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1	MN0011 (REG1	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)
Date Sampled					26/9/2017	09/10/2017	27/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	6/1/2018	18/1/2018	26/9/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	6/1/2018	18/1/2018
Lithology																						
Field Parameters																						
Field pH	pH units		-																			
Field Electrical Conductivity (EC)	µS/cm		-																			
Depth to Groundwater	m TOC		-																			
Physical Parameters																						
pH	pH Units	0.1	**6.0 - 8.5**	**6.0 - 8.5**	11.4	11.3	11.6	11.6	11.4	11.5	11.3	11.4	11.4	11.8	11.7	11.8	11.9	11.7	11.8	11.6	11.7	11.7
Electrical conductivity	µS/cm	1	-		7330	7050	7870	7690	7810	7790	8070	7910	7890	6040	5640	6680	6360	6210	6300	6460	6130	5990
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		3950	3900	4000	3970	4190	4100	4000	4010	4120	3330	2800	3310	3260	3130	2790	2580	2670	3040
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		247	174	354	311	278	284	292	242	240	460	384	466	559	455	479	467	391	354
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		360	466	304	343	304	294	284	264	371	145	138	83	79	84	98	104	126	199
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		607	640	658	654	582	578	576	506	610	605	522	549	638	540	577	571	517	552
Major Ions																						
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		86	101	107	95	117	110	108	109	116	315	361	397	403	437	376	399	439	380
Chloride	mg/L	1		**40**	1870	1770	1710	1670	1800	1720	1840	1840	1860	912	1010	960	948	1000	1000	1030	1010	980
Calcium	mg/L	1	-		7	8	8	8	9	12	9	9	10	65	104	96	88	2	77	50	41	39
Magnesium	mg/L	1	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sodium	mg/L	1	-		1260	1410	1410	1410	1420	1520	1510	1330	1400	939	968	953	973	1020	1060	1010	900	955
Potassium	mg/L	1	-		84	93	87	90	87	101	91	86	85	75	76	76	77	81	87	78	72	75
Total Anions	meq/L	0.01	-		66.7	64.8	63.6	62.2	64.8	62.4	65.7	64.3	67.1	44.4	46.4	46.3	47.9	48.1	47.6	48.8	48	46.6
Total Cations	meq/L	0.01	-		57.3	64.1	64	64	64.4	69.3	68.4	60.5	63.6	46	49.2	48.2	48.7	46.5	52.2	48.4	43	45.4
Ionic Balance	%	0.01	-		7.55	0.55	0.27	1.49	0.31	5.27	2.08	3.03	2.68	1.81	2.93	1.98	0.83	1.65	4.62	0.36	5.41	1.28
Nutrients																						
Ammonia as N	mg/L	0.01	-		7.8	9.6	7.86							1	0.97	1.04						
Nitrite as N	mg/L	0.01	-		<0.01	<0.01	<0.01							0.02	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-		0.04	0.04	0.05							0.01	0.02	0.01						
Nitrite + Nitrate as N	mg/L	0.01	-		0.04	0.04	0.05							0.03	0.02	0.01						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		14.2	11.9	9.9							3.5	2.3	3.2						
Total Nitrogen as N	mg/L	0.1	**25 - 125**	**5**	14.2	11.9	10							3.5	2.3	3.2						
Total Phosphorus as P	mg/L	0.01	**0.8 - 12**	**0.05**	0.56	0.56	0.26							0.74	0.58	0.83						
Reactive Phosphorus as P	mg/L	0.01			0.6	0.29	0.2							<0.01	<0.01	<0.01						
Total Metals																						
Aluminium	mg/L	0.01	**5**		2.62	2.41	2.82	2.6	2.43	2.37	2.47	2.27	2.48	0.16	0.09	0.07	0.76	0.21	0.16	0.19	0.41	0.54
Antimony	mg/L	0.001	-		0.002	0.003	0.004	0.002	0.002	0.002	0.002	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**2.0**	**0.1**	0.006	0.007	0.006	0.007	0.007	0.007	0.007	0.007	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.038	0.033	0.032	0.032	0.03	0.036	<0.001	<0.001	<0.001	0.185	0.12	0.116	0.115	0.104	0.126
Beryllium	mg/L	0.001	**0.5**	**0.1**	0.037	0.034	0.035							0.15	0.132	0.133						
Boron	mg/L	0.05	**refer to guideline**	**0.5**	0.12	0.12	0.12	0.11	0.12	0.13	0.12	0.12	0.13	0.06	0.06	<0.05	0.06	0.06	0.08	0.07	0.07	0.08
Cadmium	mg/L	0.0001	**0.05**	**0.01**	<0.0001	<0.0001	<0.0001							0.0002	<0.0001	0.0001						
Chromium	mg/L	0.001	**1.0**	**0.1**	<0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.003	0.002	0.001	0.004	0.002	0.002	0.002	0.002	0.004
Cobalt	mg/L	0.001	**0.10**	**0.05**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**5.0**	**0.2**	0.038	0.01	0.026	0.016	0.022	0.009	0.006	0.042	0.063	0.002	<0.001	<0.001	0.007	<0.001	<0.001	0.001	<0.001	0.002
Iron	mg/L	0.05	**10.0**	**0.2**	0.25	0.36	0.57	0.36	0.37	0.11	0.1	0.39	0.35	0.32	<0.001	0.06	1.86	0.37	0.12	0.24	0.61	0.71
Lead	mg/L	0.001	**5.0**	**2.0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	**10.0**	**0.2**	0.01	0.01	0.017	0.012	0.008	0.008	0.004	0.007	0.012	0.007	<0.001	<0.001	0.039	0.008	0.005	0.011	0.014	0.024
Mercury	mg/L	0.0001	**0.002**	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05**	**0.01**	0.12	0.11	0.116							0.499	0.479	0.524						
Nickel	mg/L	0.001	**2.0**	**0.2**	0.025	0.024	0.02	0.025	0.023	0.026	0.022	0.023	0.023	0.009	0.009	0.008	0.012	0.01	0.009	0.008	0.01	0.01
Selenium	mg/L	0.01	**0.05**	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		-	0.321	0.364	0.338	0.36	0.363	0.372	0.365	0.36	0.357	2.06	1.97	2.06	2.1	1.75	1.79	1.7	1.49	1.6
Vanadium	mg/L	0.01	**0.5**	**0.1**	0.01	0.01	0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**2.0**	**2.0**	0.026	0.026	0.023	0.016	0.008	0.017	0.007	0.009	0.016	0.021	<0.005	<0.005	0.047	0.011	0.006	0.011	0.015	0.021
BTEX																						
Benzene	µg/L	1			<1	<1	<1							----	<1	<1						
Toluene	µg/L	2			<2	<2	<2							----	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							----	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							----	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							----	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							----	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							----	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							----	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																						
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																						
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							----	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																					
Sample Location																								
Lab Number			**Short term irrigation**	**Long Term irrigation**	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18B	MP18B	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A
Date Sampled					27/9/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	27/9/2017	27/10/2017	27/9/2017	10/10/2017	26/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018
Lithology																								
Field Parameters																								
Field pH	pH units		-																					
Field Electrical Conductivity (EC)	µS/cm		-																					
Depth to Groundwater	m TOC		-																					
Physical Parameters																								
pH	pH Units	0.1	**6.0 - 8.5**	**6.0 - 8.5**	7.6	7.24	7.6	7.36	7.35	7.4	7.23	7.42	7.36	7.7	7.4	7.7	7.83	7.33	7.53	7.49	7.65	7.3	7.48	7.54
Electrical conductivity	µS/cm	1	-		12500	12500	12200	12200	12300	12200	12400	12200	12500	22800	23000	15200	14900	15200	14900	15000	14900	14600	14200	14000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		5900	7990	7670	8000	7810	8030	7400	6630	7650	14300	17200	7490	9330	9480	9300	8550	9620	8810	6710	8120
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		851	924	934	926	839	790	829	726	904	1080	1170	1100	1170	1110	1060	974	1120	1120	1000	1210
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		851	924	934	926	839	790	829	726	904	1080	1170	1100	1170	1110	1060	974	1120	1120	1000	1210
Major Ions																								
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		258	318	257	305	314	284	291	299	286	810	894	152	248	314	309	319	267	254	255	215
Chloride	mg/L	1		**40**	3620	3740	3770	3830	4000	3860	4030	3830	3770	6570	7690	1700	4700	4960	4690	4870	4800	4780	4430	3850
Calcium	mg/L	1	-		203	194	199	198	198	244	203	181	204	140	140	119	147	149	146	145	171	147	137	137
Magnesium	mg/L	1	-		441	453	448	459	451	480	466	408	422	817	937	489	505	531	473	507	514	555	416	417
Sodium	mg/L	1	-		1670	1740	1740	1750	1760	1930	1750	1570	1690	3460	3960	915	2360	2480	2360	2450	2480	2610	2070	2190
Potassium	mg/L	1	-		29	30	30	30	31	32	30	28	30	76	84	56	40	42	41	42	40	42	35	40
Total Anions	meq/L	0.01	-		124	130	130	133	136	130	136	129	130	224	259	73.1	161	169	160	163	163	162	150	137
Total Cations	meq/L	0.01	-		120	123	123	124	124	136	125	112	119	227	258	87.4	152	160	150	157	160	168	132	137
Ionic Balance	%	0.01	-		1.92	2.82	2.8	3.24	4.52	2.2	4.18	7.13	4.48	0.64	0.08	8.92	2.72	2.6	3.22	2.15	1.12	1.55	6.46	0.07
Nutrients																								
Ammonia as N	mg/L	0.01	-		0.32	0.32	0.29							0.21	0.14	0.07	0.36	0.43						
Nitrite as N	mg/L	0.01	-		<0.01	0.02	0.02							<0.01	<0.01	<0.01	0.02	0.01						
Nitrate as N	mg/L	0.01	-		0.06	0.07	0.02							0.16	0.03	0.43	0.18	0.1						
Nitrite + Nitrate as N	mg/L	0.01	-		0.06	0.09	0.04							0.16	0.03	0.43	0.2	0.11						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		0.5	0.4	0.8							4.5	9.9	0.4	<0.5	0.7						
Total Nitrogen as N	mg/L	0.1	**25 - 125**	**5**	0.6	0.5	0.8							4.7	9.9	0.8	<0.5	0.8						
Total Phosphorus as P	mg/L	0.01	**0.8 - 12**	**0.05**	0.15	0.08	0.09							2.3	6.56	1.18	1.05	0.09						
Reactive Phosphorus as P	mg/L	0.01			<0.01	<0.01	<0.01							0.07	0.03	0.02	<0.01	0.02						
Total Metals																								
Aluminium	mg/L	0.01	**5**		0.22	0.3	0.12	0.24	0.08	0.02	<0.01	<0.01	0.27	108	261	0.42	0.14	2.93	0.31	0.15	0.06	0.05	0.17	1.01
Antimony	mg/L	0.001	-		0.003	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Arsenic	mg/L	0.001	**2.0**	**0.1**	0.004	0.004	0.003	0.003	0.002	0.003	0.002	0.001	0.003	0.026	0.078	0.015	0.021	0.008	0.008	0.001	0.004	0.003	0.006	0.004
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.315	0.223	0.184	0.249	0.16	0.286	0.008	0.02	<0.001	<0.001	<0.001	0.422	0.388	0.244	0.33	0.377	0.772
Beryllium	mg/L	0.001	**0.5**	**0.1**	0.375	0.449	0.308							5.24	2.64	0.333	0.282	2.8						
Boron	mg/L	0.05	**refer to guideline**	**0.5**	0.08	0.08	0.08	0.07	0.07	0.08	0.07	0.06	0.08	0.08	0.1	0.11	0.12	0.12	0.1	0.12	0.13	0.12	0.16	0.12
Cadmium	mg/L	0.0001	**0.05**	**0.01**	<0.0001	<0.0001	<0.0001							0.0002	0.0003	<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	**0.1**	<0.001	0.003	0.008	0.003	<0.001	<0.001	<0.001	<0.001	0.001	0.215	0.538	0.002	0.004	0.004	0.004	<0.001	0.004	0.002	<0.001	0.003
Cobalt	mg/L	0.001	**0.10**	**0.05**	<0.001	0.002	<0.001	0.002	0.002	0.002	<0.001	<0.001	0.001	0.061	0.163	<0.001	0.001	0.002	0.001	<0.001	<0.001	<0.001	0.184	<0.001
Copper	mg/L	0.001	**5.0**	**0.2**	0.006	0.006	0.01	0.014	0.072	0.055	0.172	0.046	0.132	0.374	0.58	0.002	0.007	0.006	0.007	0.002	0.03	0.003	0.028	0.007
Iron	mg/L	0.05	**10.0**	**0.2**	8.58	6.08	5.16	7.54	3.59	3.54	4.62	1.74	4.05	137	351	20	20.5	10.6	11.8	1.95	4.71	3.84	2.33	5.39
Lead	mg/L	0.001	**5.0**	**2.0**	<0.001	<0.001	0.004	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.064	0.186	<0.001	0.002	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Manganese	mg/L	0.001	**10.0**	**0.2**	0.194	0.213	0.196	0.234	0.21	0.213	0.209	0.202	0.257	0.358	0.857	0.162	0.259	0.217	0.23	0.179	0.192	0.182	0.166	0.187
Mercury	mg/L	0.0001	**0.002**	**0.002**	<0.0001	0.0004	<0.0001						<0.0001	0.0002	0.0005	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05**	**0.01**	0.002	0.007	0.001							<0.001	<0.001	0.003	0.004	0.005						
Nickel	mg/L	0.001	**2.0**	**0.2**	0.001	0.17	0.007	0.258	0.227	0.209	0.185	0.161	0.146	0.121	0.413	<0.001	0.003	0.013	0.025	0.005	0.005	0.002	1.55	0.006
Selenium	mg/L	0.01	**0.05**	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	0.26	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		-	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.002
Strontium	mg/L	0.001		-	5.9	6.06	6.17	6	5.96	6.15	6.14	5.82	6.16	7.75	8.14	6.51	6.74	6.8	6.08	6.51	6.94	6.7	6.38	5.61
Vanadium	mg/L	0.01	**0.5**	**0.1**	<0.01	<0.01	<0.01							0.34	0.86	<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**2.0**	**2.0**	0.024	0.032	0.035	0.029	0.011	0.013	0.008	0.012	0.031	0.204	0.546	0.007	0.037	0.062	0.024	0.006	0.018	0.016	0.016	0.05
BTEX																								
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1	<1	<1						
Toluene	µg/L	2			<2	<2	<2							<2	<2	<2	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							<1	<1	<1	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																								
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50	<50	<50						
Total Recoverable Hydrocarbons																								
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Short term irrigation**	**Long Term irrigation**	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2
Date Sampled					27/9/2017	10/10/2017	26/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	25/9/2017	09/10/2017	26/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	**6.0 - 8.5**	**6.0 - 8.5**	7.84	8.08	7.41	7.56	7.59	7.68	7.43	7.57	7.6	7.31	6.86	6.97	6.94	6.92	7.01	6.85	7
Electrical conductivity	µS/cm	1	-		11800	12100	13300	14000	14400	15100	15800	15900	16400	450	533	638	605	664	752	890	839
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		6030	6520	7730	8220	7950	8990	8610	9140	9470	472	722	1230	1650	1980	2060	1440	1370
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		1760	1920	1820	1790	1610	1390	1530	1350	1600	40	43	50	49	45	45	47	45
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		1760	1920	1820	1790	1610	1390	1530	1350	1600	40	43	50	49	45	45	47	45
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		85	123	178	199	244	263	298	315	298	39	34	40	54	44	39	36	36
Chloride	mg/L	1		**40**	2910	3260	3880	4000	4380	4570	4850	4800	5040	43	65	124	119	132	176	222	194
Calcium	mg/L	1	-		81	79	100	96	119	148	128	133	131	1	2	2	6	2	1	7	2
Magnesium	mg/L	1	-		116	150	222	233	314	302	349	308	299	4	4	6	19	8	4	19	9
Sodium	mg/L	1	-		2340	2530	2740	2690	2990	3070	3120	2770	2770	77	93	109	114	120	137	147	148
Potassium	mg/L	1	-		24	27	29	29	31	31	33	30	32	4	4	5	8	6	4	9	7
Total Anions	meq/L	0.01	-		119	133	150	153	161	162	174	169	180	2.82	4.23	5.33	5.46	5.54	6.68	7.95	7.12
Total Cations	meq/L	0.01	-		116	127	143	142	163	166	172	153	152	3.83	4.58	5.46	7.03	6.13	6.44	8.54	7.46
Ionic Balance	%	0.01	-		1.29	2.25	2.16	3.74	0.56	1.34	0.56	4.87	8.38	15.1	3.99	1.23	12.5	5.08	1.79	3.56	2.3
Nutrients																					
Ammonia as N	mg/L	0.01	-		2.51	3.3	2.25							<0.01	0.02	0.02					
Nitrite as N	mg/L	0.01	-		0.06	<0.01	<0.01							0.02	<0.01	<0.01					
Nitrate as N	mg/L	0.01	-		0.45	0.03	0.02							12.4	11.6	11.5					
Nitrite + Nitrate as N	mg/L	0.01	-		0.51	0.03	0.02							12.4	11.6	11.5					
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		3.5	4	2.8							5	2.6	2.7					
Total Nitrogen as N	mg/L	0.1	**25 - 125**	**5**	4	4	2.8							17.4	14.2	14.2					
Total Phosphorus as P	mg/L	0.01	**0.8 - 12**	**0.05**	0.23	0.17	0.11							0.93	0.24	0.89					
Reactive Phosphorus as P	mg/L	0.01			<0.01	<0.01	<0.01							<0.01	0.01	0.01					
Total Metals																					
Aluminium	mg/L	0.01	**5**		0.45	0.13	0.52	0.81	0.24	0.07	0.09	0.71	0.68	69.1	2.78	120	15.1	59.7	117	8.09	89.6
Antimony	mg/L	0.001	-		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**2.0**	**0.1**	0.002	0.002	0.002	0.002	0.001	0.002	<0.001	0.001	0.002	0.004	<0.001	0.009	0.002	0.005	0.011	0.002	0.005
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.799	0.807	0.336	0.309	0.961	0.734	0.003	<0.001	0.006	0.071	0.099	0.25	0.069	0.149
Beryllium	mg/L	0.001	**0.5**	**0.1**	1.26	0.518	1.94							0.098	0.028	0.17					
Boron	mg/L	0.05	**refer to guideline**	**0.5**	0.48	0.44	0.35	0.38	0.3	0.34	0.3	0.28	0.29	0.09	0.11	0.12	0.1	0.09	0.14	0.08	0.1
Cadmium	mg/L	0.0001	**0.05**	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001					
Chromium	mg/L	0.001	**1.0**	**0.1**	0.001	0.001	0.005	0.007	0.002	0.002	0.001	0.005	0.007	0.131	0.005	0.238	0.025	0.122	0.357	0.017	0.172
Cobalt	mg/L	0.001	**0.10**	**0.05**	0.001	0.002	0.002	0.004	<0.001	0.003	<0.001	0.003	0.002	0.035	0.012	0.054	0.031	0.029	0.08	0.024	0.043
Copper	mg/L	0.001	**5.0**	**0.2**	0.012	0.014	0.006	0.009	0.01	0.008	0.017	0.028	0.018	0.08	0.021	0.125	0.045	0.071	0.185	0.047	0.105
Iron	mg/L	0.05	**10.0**	**0.2**	3.46	2.67	6.66	13.3	4.08	5.06	2.32	5.04	3.79	59.1	2.79	101	12.3	46.9	112	8.35	68
Lead	mg/L	0.001	**5.0**	**2.0**	0.002	0.001	<0.001	0.04	<0.001	<0.001	<0.001	0.002	0.003	0.027	0.008	0.05	0.017	0.024	0.066	0.016	0.035
Manganese	mg/L	0.001	**10.0**	**0.2**	0.092	0.139	0.116	0.216	0.109	0.178	0.12	0.145	0.184	0.316	0.146	0.511	0.346	0.298	0.73	0.302	0.442
Mercury	mg/L	0.0001	**0.002**	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	0.0001					
Molybdenum	mg/L	0.001	**0.05**	**0.01**	<0.001	0.001	0.011							<0.001	<0.001	<0.001					
Nickel	mg/L	0.001	**2.0**	**0.2**	0.005	0.01	0.03	0.065	0.129	0.118	0.128	0.166	0.14	0.071	0.008	0.112	0.024	0.058	0.174	0.022	0.086
Selenium	mg/L	0.01	**0.05**	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	0.01	0.02	<0.01	0.01
Silver	mg/L	0.001		-	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		-	6.78	6.71	7.54	7.02	7.57	7.71	7.65	7.29	7.88	0.147	0.131	0.255	0.208	0.136	0.321	0.26	0.232
Vanadium	mg/L	0.01	**0.5**	**0.1**	<0.01	<0.01	<0.01							0.08	0.02	0.16					
Zinc	mg/L	0.005	**2.0**	**2.0**	0.025	0.039	0.03	0.044	0.006	0.012	0.016	0.038	0.078	0.154	0.026	0.258	0.06	0.127	0.361	0.103	0.24
BTEX																					
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1					
Toluene	µg/L	2			<2	<2	40							<2	<2	<2					
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2					
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2					
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2					
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2					
Sum of BTEX	µg/L	1			<1	<1	40							<1	<1	<1					
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5					
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50					
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100					
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50					
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50					
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100					
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100					
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100					
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100					
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100					

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																						
Lab Number			**Short term irrigation**	**Long Term irrigation**	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2
Date Sampled					25/9/2017	09/10/201	26/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018	19/1/2018	25/9/2017	09/10/2017	30/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018	18/1/2018
Lithology																						
Field Parameters																						
Field pH	pH units		-																			
Field Electrical Conductivity (EC)	µS/cm		-																			
Depth to Groundwater	m TOC		-																			
Physical Parameters																						
pH	pH Units	0.1	**6.0 - 8.5**	**6.0 - 8.5**	7.48	7.63	7.38	7.49	7.47	7.55	7.38	7.58	7.52	7.92	8.12	7.61	7.76	7.68	7.7	7.59	7.77	7.7
Electrical conductivity	µS/cm	1	-		795	892	13500	12400	12400	13100	14000	14000	14400	8310	8000	9020	9060	9230	9430	9970	9820	10000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		420	566	8680	8060	6540	8960	9600	8960	8550	3660	4620	5110	5150	4780	5310	5940	5460	5650
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		96	116	706	659	606	613	666	629	736	1160	1280	1210	1210	1070	1050	1100	1100	1200
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		96	116	706	659	606	613	666	629	736	1160	1280	1210	1210	1070	1050	1100	1100	1200
Major Ions																						
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		36	42	193	170	182	172	190	192	194	26	30	54	52	66	69	75	74	68
Chloride	mg/L	1		**40**	142	243	4600	4060	4200	4330	4760	4670	4240	1830	2160	2260	2560	2680	2730	2970	2800	2570
Calcium	mg/L	1	-		5	6	112	103	103	129	124	130	124	71	68	84	74	84	112	99	114	106
Magnesium	mg/L	1	-		15	16	542	507	480	512	622	585	520	106	110	129	128	142	142	169	156	147
Sodium	mg/L	1	-		125	141	1880	1730	1700	1790	2120	2030	1830	1500	1500	1730	1590	1720	1690	1920	1740	1710
Potassium	mg/L	1	-		6	6	56	53	52	53	63	66	60	24	25	26	26	28	26	31	29	29
Total Anions	meq/L	0.01	-		6.67	10	148	131	134	138	152	148	138	75.3	87.1	89	97.5	98.4	99.4	107	102	97.9
Total Cations	meq/L	0.01	-		7.07	7.9	133	123	120	128	151	145	130	78.1	78.3	90.7	84	91.4	91.4	103	95	92.5
Ionic Balance	%	0.01	-		2.92	11.9	5.15	3.05	5.68	3.83	0.11	1.26	3.06	1.82	5.32	0.93	7.39	3.66	4.18	1.98	3.82	2.82
Nutrients																						
Ammonia as N	mg/L	0.01	-		0.34	0.18	0.14							2.13	2.35	1.94						
Nitrite as N	mg/L	0.01	-		0.12	0.15	0.02							0.33	0.1	0.13						
Nitrate as N	mg/L	0.01	-		<0.10	0.51	0.05							<0.01	0.08	<0.01						
Nitrite + Nitrate as N	mg/L	0.01	-		0.11	0.66	0.07							0.04	0.18	0.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		1.6	0.6	0.2							2.9	3	2.4						
Total Nitrogen as N	mg/L	0.1	**25 - 125**	**5**	1.7	1.3	0.3							2.9	3.2	2.4						
Total Phosphorus as P	mg/L	0.01	**0.8 - 12**	**0.05**	0.14	0.16	0.08							0.37	0.2	0.16						
Reactive Phosphorus as P	mg/L	0.01			0.08	<0.01	<0.01							0.16	0.17	0.13						
Total Metals																						
Aluminium	mg/L	0.01	**5**		1.14	0.16	0.84	0.66	0.74	1.04	0.58	1.12	0.65	1.39	0.25	0.73	0.24	0.22	0.44	0.97	0.26	1.58
Antimony	mg/L	0.001	-		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**2.0**	**0.1**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.144	0.163	0.165	0.172	0.139	0.184	<0.001	<0.001	<0.001	0.614	0.601	0.603	0.659	0.603	0.693
Beryllium	mg/L	0.001	**0.5**	**0.1**	0.054	0.061	0.141							0.583	0.565	0.608						
Boron	mg/L	0.05	**refer to guideline**	**0.5**	0.08	0.08	0.05	<0.05	0.05	0.06	0.05	<0.05	0.07	0.26	0.26	0.26	0.24	0.24	0.24	0.24	0.24	0.24
Cadmium	mg/L	0.0001	**0.05**	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	**0.1**	0.003	0.002	0.002	0.002	0.002	0.003	0.002	0.003	0.004	0.005	0.002	0.002	<0.001	0.002	0.002	0.003	0.001	0.006
Cobalt	mg/L	0.001	**0.10**	**0.05**	0.004	0.002	0.004	0.004	0.004	0.004	0.003	0.002	0.004	0.002	<0.001	0.002	<0.001	<0.001	<0.001	0.003	0.001	0.002
Copper	mg/L	0.001	**5.0**	**0.2**	0.009	0.007	0.005	0.005	0.006	0.007	0.008	0.007	0.014	0.012	0.003	0.007	0.002	0.002	0.002	0.013	0.001	0.019
Iron	mg/L	0.05	**10.0**	**0.2**	2.47	1.4	2.51	2.39	2.56	2.79	1.69	1.67	1.83	2.38	0.72	1.78	1.08	1.16	1.23	1.92	0.71	1.94
Lead	mg/L	0.001	**5.0**	**2.0**	0.004	0.003	0.001	0.002	0.003	0.002	0.003	0.002	0.002	0.006	0.002	0.003	0.002	0.003	<0.001	0.008	<0.001	0.003
Manganese	mg/L	0.001	**10.0**	**0.2**	0.064	0.051	0.163	0.175	0.197	0.188	0.138	0.103	0.223	0.284	0.319	0.248	0.267	0.272	0.281	0.368	0.265	0.34
Mercury	mg/L	0.0001	**0.002**	**0.002**	<0.0001	<0.0001	<0.0001						0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05**	**0.01**	<0.001	<0.001	<0.001							0.001	<0.001	0.002						
Nickel	mg/L	0.001	**2.0**	**0.2**	0.009	0.008	0.006	0.009	0.01	0.012	0.012	0.014	0.014	0.006	0.006	0.006	0.003	0.004	0.005	0.009	0.004	0.015
Selenium	mg/L	0.01	**0.05**	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		**-**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		**-**	0.188	0.235	4.33	4.2	4.12	4.75	4.5	4.57	4.96	5.52	5.48	6.45	6.63	6.66	7.08	7.46	7.03	7.56
Vanadium	mg/L	0.01	**0.5**	**0.1**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**2.0**	**2.0**	0.096	0.07	0.042	0.06	0.077	0.062	0.08	0.122	0.115	0.173	0.066	0.083	0.067	0.067	0.033	0.197	0.022	0.149
BTEX																						
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2			<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																						
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																						
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100						

\# Limit of Reporting
a NHMRC Health Guidelines for Drinking Water (2015)
b NHMRC Aesthetic Guidelines for Drinking Water (2015)
m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.
\+ NHMRC acid-soluable aluminium concentrations (2015)
\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																			
Sample Location																						
Lab Number			**Short term irrigation**	**Long Term irrigation**	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249
Date Sampled					26/9/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	5/1/2018	18/1/2018	26/9/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	5/12/2017	21/12/2017	5/1/2018	18/1/2018
Lithology																						
Field Parameters																						
Field pH	pH units		-																			
Field Electrical Conductivity (EC)	µS/cm		-																			
Depth to Groundwater	m TOC		-																			
Physical Parameters																						
pH	pH Units	0.1	**6.0 - 8.5**	**6.0 - 8.5**	7.81	7.92	7.74	7.63	7.55	7.65	7.44	7.64	7.66	7.81	8.13	8.06	8.11	7.99	8.06	7.92	8.1	8.17
Electrical conductivity	µS/cm	1	-		5380	5230	5630	5020	5140	5000	5260	5050	5080	5380	2320	2450	2340	2450	2450	2550	2530	2580
Total Dissolved Solids (grav) @180°C	mg/L	1.00	-		3320	2590	3090	2960	2910	3060	3020	2840	2680	3320	1150	1380	1270	1240	1420	1360	1330	1320
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-		544	576	458	412	415	348	412	366	380	544	373	340	377	347	355	356	315	382
Total Alkalinity as $CaCO_3$	mg/L	1.00	-		544	576	458	412	415	348	412	366	380	544	373	340	377	347	355	356	315	382
Major Ions																						
Sulfate as SO_4 - Turbidimetric	mg/L	1	-		146	134	139	166	168	162	154	157	164	146	15	12	16	19	17	16	15	15
Chloride	mg/L	1		**40**	1560	1390	1300	1240	1340	1290	1350	1340	1310	1560	571	560	574	606	608	634	620	600
Calcium	mg/L	1	-		22	19	22	14	16	27	17	35	20	22	37	39	36	37	54	38	40	41
Magnesium	mg/L	1	-		181	176	163	176	180	197	186	155	170	181	25	23	24	25	30	25	25	26
Sodium	mg/L	1	-		857	819	775	720	743	816	703	662	688	857	432	405	430	438	513	440	417	439
Potassium	mg/L	1	-		39	36	34	33	33	34	32	28	32	39	10	10	11	11	12	11	11	11
Total Anions	meq/L	0.01	-		57.9	53.5	48.7	46.7	49.6	46.7	49.5	48.4	48	57.9	23.9	22.8	24	24.4	24.6	25.3	24.1	24.9
Total Cations	meq/L	0.01	-		54.3	52	49.1	47.3	48.8	53.9	47.6	44	45.7	54.3	23	21.7	22.8	23.2	27.8	23.4	22.5	23.6
Ionic Balance	%	0.01	-		3.25	1.45	0.38	0.72	0.83	7.16	2.02	4.72	2.38	3.25	1.97	2.53	2.78	2.49	6.08	4.02	3.48	2.7
Nutrients																						
Ammonia as N	mg/L	0.01	-		0.08	0.08	0.13							0.08	0.02	0.08						
Nitrite as N	mg/L	0.01	-		<0.10	<0.01	<0.01							<0.10	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-		<0.10	0.04	0.07							<0.10	1.62	1.89						
Nitrite + Nitrate as N	mg/L	0.01	-		<0.10	0.04	0.07							<0.10	1.62	1.89						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-		0.2	<0.1	0.4							0.2	0.2	0.4						
Total Nitrogen as N	mg/L	0.1	**25 - 125**	**5**	0.2	<0.1	0.5							0.2	1.8	2.3						
Total Phosphorus as P	mg/L	0.01	**0.8 - 12**	**0.05**	0.02	0.01	0.02							0.02	0.17	0.24						
Reactive Phosphorus as P	mg/L	0.01			0.07	0.01	0.01							0.07	0.19	0.18						
Total Metals																						
Aluminium	mg/L	0.01	**5**		0.1	0.01	0.03	<0.01	<0.01	0.02	0.01	0.02	0.03	0.69	0.06	0.19	0.18	0.14	0.04	0.06	0.07	0.09
Antimony	mg/L	0.001	-		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**2.0**	**0.1**	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	0.002	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001
Barium	mg/L	0.001	-		<0.001	<0.001	<0.001	0.05	0.051	0.064	0.092	0.081	0.064	<0.001	<0.001	<0.001	0.206	0.202	0.21	0.205	0.187	0.216
Beryllium	mg/L	0.001	**0.5**	**0.1**	0.066	0.064	0.069							0.216	0.203	0.211						
Boron	mg/L	0.05	**refer to guideline**	**0.5**	0.08	0.09	0.06	0.08	0.1	0.1	0.09	0.08	0.1	0.09	0.1	0.08	0.09	0.1	0.11	0.11	0.09	0.11
Cadmium	mg/L	0.0001	**0.05**	**0.01**	<0.0001	<0.0001	<0.0001							0.0002	0.0001	0.0002						
Chromium	mg/L	0.001	**1.0**	**0.1**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	**0.10**	**0.05**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**5.0**	**0.2**	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.003	0.001	0.003	0.002	<0.001	0.001	0.002	0.002	0.002
Iron	mg/L	0.05	**10.0**	**0.2**	0.15	<0.05	0.06	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	0.36	0.07	0.22	0.28	0.16	<0.05	0.08	0.09	0.13
Lead	mg/L	0.001	**5.0**	**2.0**	0.006	0.003	0.006	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.019	0.01	0.018	0.013	0.005	0.004	0.005	0.004	0.006
Manganese	mg/L	0.001	**10.0**	**0.2**	0.032	0.025	0.026	0.01	0.006	0.013	0.03	0.021	0.008	0.021	0.017	0.021	0.016	0.012	0.009	0.007	0.005	0.008
Mercury	mg/L	0.0001	**0.002**	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.05**	**0.01**	0.002	0.002	0.008							0.003	0.003	0.004						
Nickel	mg/L	0.001	**2.0**	**0.2**	0.001	<0.001	<0.001	0.002	0.002	0.002	0.001	<0.001	0.001	0.024	0.016	0.017	0.016	0.016	0.017	0.016	0.013	0.014
Selenium	mg/L	0.01	**0.05**	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001		-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001		-	0.942	0.926	1.02	0.666	0.653	0.798	1.17	1.06	0.757	1.79	1.94	2.07	1.9	1.94	2.1	2.05	1.91	2.12
Vanadium	mg/L	0.01	**0.5**	**0.1**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**2.0**	**2.0**	0.008	0.006	0.008	<0.005	<0.005	0.006	<0.005	0.006	0.009	0.108	0.089	0.103	0.091	0.078	0.08	0.074	0.068	0.072
BTEX																						
Benzene	µg/L	1			<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2			<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2			<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2			<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2			<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1			<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5			<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																						
C10 - C14 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50			<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																						
>C10 - C16 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100			<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100			<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Stock Water**	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW02	GW04	GW04	GW04	GW04	GW04	GW04	GW04	GW04	GW04
Date Sampled				25/09/2017	09/10/2017	26/10/2017	9/11/2017	22/11/2017	5/12/2017	20/12/2017	5/1/2018	18/1/2018	25/09/2017	09/10/2017	26/10/2017	9/11/2017	22/11/2017	5/12/2017	20/12/2017	5/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	-	8.46	8.29	8.11	8.3	8.17	8.34	8.21	8.24	8.07	7.81	7.95	7.46	7.66	7.66	7.7	7.53	7.7	7.58
Electrical conductivity	µS/cm	1	-	23300	23100	23800	23400	23500	23400	24200	23600	24300	7660	7620	7900	7780	7830	7760	8010	7860	7980
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	15100	14400	15200	13700	16000	15900	16900	14600	15000	4500	4570	4690	3980	4650	4710	4370	4780	4750
Hydroxide Alkalinity as CaCO$_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO$_3$	mg/L	1.00	-	33	<1	<1	6	<1	21	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO$_3$	mg/L	1.00	-	339	468	490	517	503	488	512	601	664	1270	1360	1380	1370	1250	1280	1270	1290	1350
Total Alkalinity as CaCO$_3$	mg/L	1.00	-	372	468	490	524	503	509	512	601	664	1270	1360	1380	1370	1250	1280	1270	1290	1350
Major Ions																					
Sulfate as SO$_4$ - Turbidimetric	mg/L	1	**1000 - 2000**	311	304	329	308	316	292	293	266	266	216	213	260	241	248	229	230	220	218
Chloride	mg/L	1	-	7220	8000	8400	7690	8070	8000	8300	8300	8000	1490	1690	1730	1590	1690	1600	1720	1680	1670
Calcium	mg/L	1	**1000**	29	30	32	33	36	56	38	41	40	41	40	41	38	38	55	40	39	42
Magnesium	mg/L	1	-	452	463	461	462	458	509	516	436	451	14	24	15	16	17	15	16	13	16
Sodium	mg/L	1	-	4330	4500	4510	4560	4530	5150	4770	4270	4490	1560	1810	1760	1710	1760	1820	1740	1440	1720
Potassium	mg/L	1	-	50	52	50	53	52	62	56	53	52	9	12	10	11	11	10	11	9	11
Total Anions	meq/L	0.01	-	218	241	254	234	244	242	250	252	244	71.9	79.3	81.8	77.2	77.8	75.5	78.7	77.7	78.6
Total Cations	meq/L	0.01	-	228	237	237	239	238	270	253	225	236	71.3	83	80.1	77.9	80.1	83.4	79.3	65.9	78.5
Ionic Balance	%	0.01	-	2.4	0.98	3.38	1.18	1.33	5.54	0.56	5.59	1.82	0.43	2.3	1.05	0.41	1.47	4.99	0.38	8.26	0.07
Nutrients																					
Ammonia as N	mg/L	0.01	-	0.64	1.17	1.38							4.27	4.55	4.9						
Nitrite as N	mg/L	0.01	**30**	0.15	<0.01	<0.01							<0.01	0.05	0.02						
Nitrate as N	mg/L	0.01	-	<0.01	<0.01	0.03							0.06	0.07	0.04						
Nitrite + Nitrate as N	mg/L	0.01	**400**	0.03	<0.01	0.03							0.06	0.12	0.06						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	1.2	1.3	1.7							4.6	6.4	5.2						
Total Nitrogen as N	mg/L	0.1	-	1.2	1.3	1.7							4.7	6.5	5.3						
Total Phosphorus as P	mg/L	0.01	-	0.02	<0.10	<0.02							0.62	1.08	0.83						
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							0.48	0.8	0.73						
Total Metals																					
Aluminium	mg/L	0.01	**5**	0.05	0.06	<0.01	0.03	<0.01	<0.01	<0.01	0.01	0.1	0.02	0.08	0.05	0.19	0.01	0.02	<0.01	0.01	0.19
Antimony	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.02	0.018	0.022	0.022	0.022	0.026	<0.001	<0.001	<0.001	0.249	0.228	0.252	0.242	0.232	0.24
Beryllium	mg/L	0.001	-	0.02	0.016	0.025							0.237	0.264	0.246						
Boron	mg/L	0.05	**5.0**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.38	0.4	0.38	0.38	0.39	0.4	0.38	0.44	0.4
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	**1.0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.5 - 5^**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.01	0.001	0.01	<0.001	<0.001	0.002	<0.001	<0.001
Iron	mg/L	0.05	-	24.6	10.3	0.64	7.26	6.26	4.51	4.92	6.79	13	0.49	0.99	0.7	2.3	0.35	0.29	0.26	0.17	0.31
Lead	mg/L	0.001	**0.1**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.001	0.013	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	-	0.509	0.581	0.599	0.693	0.696	0.707	0.608	0.578	0.647	0.076	0.091	0.074	0.089	0.084	0.08	0.08	0.08	0.079
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	<0.001	<0.001	<0.001							<0.001	<0.001	<0.001						
Nickel	mg/L	0.001	**1**	<0.001	0.002	0.002	0.001	0.001	<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	0.002	<0.001	0.002	<0.001	0.003	0.003	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	2.38	2.74	2.87	3.17	3.18	3.55	3.33	3.13	3.32	2.94	3.06	2.88	2.99	2.87	3.21	2.99	2.93	2.96
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.024	0.011	<0.005	0.013	0.02	<0.005	<0.005	0.006	0.028	0.006	0.066	0.056	0.242	0.014	0.013	0.031	0.007	0.012
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Stock Water**	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW14	GW33	GW33	GW33	GW33	GW33	GW33	GW33	GW33	GW33
Date Sampled				25/09/2017	09/10/2017	24/10/2017	8/11/2017	22/11/2017	4/12/2017	20/12/2017	5/1/2018	19/1/2018	27/9/2017	0/10/201	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	-	7.81	8.02	7.89	7.69	7.65	7.7	7.55	7.69	7.62	7.7	7.73	7.27	7.41	7.39	7.56	7.31	7.46	7.31
Electrical conductivity	µS/cm	1	-	7660	5060	5570	5280	5320	5240	5710	5360	5420	16300	16000	16500	16200	16400	16400	16900	16800	17000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	4500	2860	2980	3150	3000	3010	3400	3010	2780	13700	10600	11500	9500	11700	12100	11400	12500	11000
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	1270	851	784	838	766	762	792	716	858	1020	1110	1110	1110	1030	1060	967	1070	1110
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	1270	851	784	838	766	762	792	716	858	1020	1110	1110	1110	1030	1060	967	1070	1110
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	216	1	1	3	2	2	4	1	3	419	513	541	587	599	590	700	732	515
Chloride	mg/L	1	-	1490	1220	1200	1230	1270	1250	1380	1280	1290	4750	5020	5630	5060	5380	5380	5550	5390	5090
Calcium	mg/L	1	**1000**	41	70	71	66	69	92	73	68	72	176	202	208	198	204	240	223	214	208
Magnesium	mg/L	1	-	14	68	60	64	66	77	74	64	65	654	769	812	774	780	796	955	739	726
Sodium	mg/L	1	-	1560	1010	939	941	1000	1100	1050	916	965	1870	2170	2280	2160	2230	2330	2460	2060	2130
Potassium	mg/L	1	-	9	16	16	15	16	17	17	15	16	71	80	82	80	82	90	88	78	81
Total Anions	meq/L	0.01	-	71.9	51.4	49.5	51.5	51.2	50.5	54.8	50.4	53.6	163	174	192	177	185	185	190	189	176
Total Cations	meq/L	0.01	-	71.3	53.4	49.7	49.9	52.8	59.2	55.8	48.9	51.3	146	170	178	170	173	181	199	163	165
Ionic Balance	%	0.01	-	0.43	1.9	0.2	1.6	1.55	7.91	0.91	1.56	2.16	5.61	1.35	3.72	2.18	3.16	1.12	2.19	7.27	3.41
Nutrients																					
Ammonia as N	mg/L	0.01	-	4.27	1.62	1.74							0.02	0.03	0.04						
Nitrite as N	mg/L	0.01	**30**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-	0.06	0.07	0.02							0.04	0.01	0.05						
Nitrite + Nitrate as N	mg/L	0.01	**400**	0.06	0.07	0.02							0.04	0.01	0.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	4.6	1.7	2.2							0.2	<0.2	<0.2						
Total Nitrogen as N	mg/L	0.1	-	4.7	1.8	2.2							0.2	<0.2	<0.2						
Total Phosphorus as P	mg/L	0.01	-	0.62	0.05	0.07							0.18	0.09	0.05						
Reactive Phosphorus as P	mg/L	0.01	-	0.48	<0.01	<0.01							0.02	<0.01	0.03						
Total Metals																					
Aluminium	mg/L	0.01	**5**	0.2	0.49	2.37	1.66	0.54	0.24	0.19	0.28	0.91	0.35	0.32	0.87	4.86	0.17	0.16	0.28	0.38	3.43
Antimony	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.002	0.002	0.002	0.001	0.002	0.001	0.002	0.004
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	1.28	1.18	1.16	1.16	1.14	1.19	<0.001	<0.001	<0.001	0.149	0.139	0.133	0.141	0.145	0.145
Beryllium	mg/L	0.001	-	1.14	1.16	1.23							0.127	0.131	0.135						
Boron	mg/L	0.05	**5.0**	0.18	0.19	0.16	0.17	0.18	0.19	0.18	0.18	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	0.001	0.002	0.005	0.006	0.002	0.002	0.023	0.002	0.005	<0.001	<0.001	0.002	0.008	<0.001	<0.001	<0.001	0.001	0.013
Cobalt	mg/L	0.001	**1.0**	<0.001	0.001	0.002	0.002	<0.001	0.001	0.001	<0.001	0.001	0.003	0.004	0.004	0.006	0.003	0.004	0.004	0.004	0.006
Copper	mg/L	0.001	**0.5 - 5^**	0.006	0.018	0.022	0.024	0.009	0.004	0.004	0.005	0.014	0.013	0.017	0.013	0.049	0.009	0.014	0.011	0.015	0.055
Iron	mg/L	0.05	-	0.9	1.12	3.08	3.91	1.48	0.99	1.05	0.97	1.72	3.16	1.89	2.37	8.16	0.95	0.73	1.01	2.76	9.75
Lead	mg/L	0.001	**0.1**	0.003	0.02	0.006	0.008	0.002	0.002	0.002	0.002	0.003	<0.001	0.001	0.001	0.005	<0.001	0.001	<0.001	0.002	0.008
Manganese	mg/L	0.001	-	0.208	0.23	0.268	0.279	0.231	0.252	0.25	0.214	0.267	0.099	0.112	0.116	0.156	0.136	0.131	0.152	0.167	0.166
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	0.0001						0.0002	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	0.001	<0.001	<0.001							<0.001	<0.001	<0.001						
Nickel	mg/L	0.001	**1**	0.002	0.006	0.007	0.014	0.006	0.008	0.02	0.003	0.01	0.005	0.006	0.006	0.012	0.006	0.006	0.005	0.007	0.012
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	2.75	2.77	3	2.93	2.81	3	2.82	2.68	2.92	6.33	6.56	6.34	6.57	6.35	6.95	6.62	6.43	6.58
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.098	0.109	0.226	0.151	0.062	0.062	0.049	0.1	0.11	0.013	0.018	0.02	0.051	0.014	0.019	0.015	0.022	0.044
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Stock Water**	GW46	GW46	GW46	GW46	GW46	GW46	GW46	GW46	GW46	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B	NGW01B
Date Sampled				27/9/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	26/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	21/12/2017	4/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	-	7.54	7.78	7.28	7.44	7.41	7.45	7.25	7.39	7.3	7.9	8.05	7.7	7.83	7.75	7.79	7.65	7.83	7.84
Electrical conductivity	µS/cm	1	-	7470	7360	7780	7610	7700	7600	7900	7730	7840	4290	4370	4610	4500	4540	4560	4660	4560	4540
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	5270	4600	5030	4070	5160	4470	4510	4830	4580	3240	2820	3210	3610	3590	3260	3140	2810	2520
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	845	1020	995	1010	905	837	908	923	972	368	446	439	440	402	371	391	401	423
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	845	1020	995	1010	905	837	908	923	972	368	446	439	440	402	371	391	401	423
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	144	142	211	166	180	160	177	180	179	38	47	329	41	43	38	40	37	35
Chloride	mg/L	1	-	1690	2060	2490	1870	2230	1920	1990	2200	2140	1110	1280	1320	1210	1270	1260	1280	1270	1250
Calcium	mg/L	1	**1000**	106	112	106	108	111	129	120	116	113	152	174	159	163	164	192	168	164	163
Magnesium	mg/L	1	-	426	444	441	440	442	452	521	463	413	302	358	337	346	341	361	350	330	317
Sodium	mg/L	1	-	814	841	845	827	851	878	927	883	801	210	212	207	207	209	221	214	203	199
Potassium	mg/L	1	-	48	50	48	48	50	50	54	52	48	9	8	8	8	8	8	8	7	8
Total Anions	meq/L	0.01	-	67.6	81.4	94.5	76.4	84.7	74.2	78	84.2	83.5	39.4	46	52.8	43.8	44.8	43.7	44.8	44.6	44.4
Total Cations	meq/L	0.01	-	77	80	79.6	78.8	80.2	83.1	90.6	83.6	75.7	41.8	47.6	44.9	45.8	45.5	49.1	46.7	44.4	43.1
Ionic Balance	%	0.01	-	6.52	0.9	8.58	1.56	2.74	5.65	7.48	0.37	4.91	2.89	1.68	8.16	2.28	0.88	5.78	2.13	0.28	1.55
Nutrients																					
Ammonia as N	mg/L	0.01	-	3.34	3.32	3.36							0.13	0.07	0.04						
Nitrite as N	mg/L	0.01	**30**	0.09	<0.01	0.03							0.06	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-	<0.01	0.02	0.05							0.04	0.02	0.09						
Nitrite + Nitrate as N	mg/L	0.01	**400**	0.08	0.02	0.08							0.1	0.02	0.09						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	3.6	3.6	3.6							0.3	0.1	0.1						
Total Nitrogen as N	mg/L	0.1	-	3.7	3.6	3.7							0.4	0.1	0.2						
Total Phosphorus as P	mg/L	0.01	-	0.32	0.11	0.33							0.11	0.15	0.16						
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							0.08	0.07	0.11						
Total Metals																					
Aluminium	mg/L	0.01	**5**	0.06	0.02	0.24	0.02	<0.01	0.04	<0.01	0.06	0.06	1.21	0.24	0.36	0.41	0.36	0.04	0.05	0.2	0.19
Antimony	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.004	0.005	0.004	0.005	0.006	0.005	0.004	0.005
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.275	0.279	0.294	0.284	0.27	0.287	<0.001	<0.001	<0.001	0.133	0.142	0.144	0.131	0.132	0.138
Beryllium	mg/L	0.001	-	0.292	0.286	0.298							0.164	0.136	0.135						
Boron	mg/L	0.05	**5.0**	0.06	0.06	0.06	<0.05	0.06	0.07	0.06	0.06	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	**1.0**	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.5 - 5^**	<0.001	<0.001	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.189	0.014	0.008	0.014	0.015	0.004	0.012	0.01	0.009
Iron	mg/L	0.05	-	16.5	13.7	16.6	14.9	14.5	18.7	14.8	14.5	15.5	1.64	1.04	1.02	1.14	1.63	1.84	0.82	0.94	0.85
Lead	mg/L	0.001	**0.1**	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.009	0.002	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	-	0.505	0.526	0.573	0.553	0.561	0.62	0.573	0.564	0.604	0.804	0.656	0.723	0.735	0.692	0.732	0.744	0.721	0.726
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	<0.001	<0.001	<0.001							0.002	<0.001	<0.001						
Nickel	mg/L	0.001	**1**	<0.001	<0.001	0.002	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.011	0.004	<0.001	0.002	0.004	0.002	0.001	0.001	0.001
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	3.05	3.15	3.11	3.09	3.13	3.37	3.24	3.04	3.2	2.09	2.27	2.1	2.12	2.16	2.27	2.11	2.06	2.21
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.006	0.008	0.012	<0.005	<0.005	0.007	<0.005	0.007	0.009	0.024	0.017	0.007	0.01	0.017	0.006	<0.005	0.01	0.006
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Stock Water**	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW01C	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B	NGW02B
Date Sampled				26/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	21/12/2017	4/1/2018	18/1/2018	26/9/2017	09/10/2017	27/10/2017	9/11/2017	24/11/2017	5/12/2017	22/12/2017	5/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	-	7.67	7.8	7.45	7.61	7.52	7.54	7.42	7.64	7.62	7.84	7.75	7.46	7.57	7.5	7.54	7.4	7.6	7.58
Electrical conductivity	µS/cm	1	-	7360	7270	7620	7500	7590	7620	7790	7730	8020	3970	5130	5350	5230	5230	5110	5240	5110	5070
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	4410	4830	5250	4440	5460	5210	5260	5030	5180	2830	3130	3190	3390	3620	3400	3580	3180	2820
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	522	573	595	579	525	527	512	519	568	331	394	395	389	353	322	312	332	376
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	522	573	595	579	525	527	512	519	568	331	394	395	389	353	322	312	332	376
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	120	132	137	122	141	134	134	132	146	36	109	117	113	130	122	119	117	119
Chloride	mg/L	1	-	1850	2260	2620	1980	2400	2420	2520	2410	2280	994	1460	1480	1360	1410	1360	1400	1390	1410
Calcium	mg/L	1	**1000**	229	249	231	236	239	284	250	255	255	222	216	151	135	135	172	129	135	130
Magnesium	mg/L	1	-	317	349	326	338	338	357	364	350	335	138	183	174	194	189	199	184	169	166
Sodium	mg/L	1	-	757	825	786	802	824	883	894	836	816	403	554	616	648	645	688	626	581	588
Potassium	mg/L	1	-	8	8	8	8	8	8	9	9	8	11	13	12	14	12	13	12	12	12
Total Anions	meq/L	0.01	-	65.1	77.9	88.6	70	81.1	81.6	84.1	81.1	78.7	35.4	51.3	52.1	48.5	49.5	47.3	48.2	48.3	49.8
Total Cations	meq/L	0.01	-	70.6	77.2	72.8	74.7	75.8	82.2	81.6	78.1	76	40.2	50.3	49	51.2	50.6	55.2	49.1	46.2	46
Ionic Balance	%	0.01	-	4.08	0.46	9.85	3.26	3.4	0.36	1.54	1.87	1.75	6.4	1.04	3.09	2.77	1.12	7.68	0.94	2.17	3.9
Nutrients																					
Ammonia as N	mg/L	0.01	-	<0.01	<0.01	<0.01							0.05	0.48	0.7						
Nitrite as N	mg/L	0.01	**30**	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-	1.17	0.95	1.14							0.05	0.01	0.06						
Nitrite + Nitrate as N	mg/L	0.01	**400**	1.17	0.95	1.14							0.05	0.01	0.06						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	0.7	<0.1	0.1							1.6	0.8	0.7						
Total Nitrogen as N	mg/L	0.1	-	1.9	1	1.2							1.6	0.8	0.8						
Total Phosphorus as P	mg/L	0.01	-	0.47	0.12	0.14							0.1	0.08	0.12						
Reactive Phosphorus as P	mg/L	0.01	-	0.09	0.08	0.13							<0.01	<0.01	<0.01						
Total Metals																					
Aluminium	mg/L	0.01	**5**	7.66	4.82	5.33	3.36	2.56	0.18	0.43	4	1.02	0.14	0.15	0.19	0.12	0.05	0.02	<0.01	0.09	1.38
Antimony	mg/L	0.001	-	<0.001	0.007	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.004	0.006	0.005	0.008	0.007	0.005	0.006
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.078	0.086	0.068	0.092	0.092	0.067	<0.001	<0.001	<0.001	0.368	0.363	0.359	0.342	0.326	0.341
Beryllium	mg/L	0.001	-	0.099	0.087	0.095							0.422	0.46	0.402						
Boron	mg/L	0.05	**5.0**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.08	0.08	0.07	0.08	0.09	0.07	0.08	0.08
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	0.032	0.02	0.022	0.012	0.014	0.002	0.003	0.014	0.002	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Cobalt	mg/L	0.001	**1.0**	0.015	0.01	0.006	0.007	0.004	0.001	0.002	0.008	0.001	0.004	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.003
Copper	mg/L	0.001	**0.5 - 5^**	0.017	0.021	0.013	0.015	0.012	0.008	0.009	0.015	0.004	0.02	0.038	0.032	0.048	0.012	0.009	0.007	0.004	0.01
Iron	mg/L	0.05	-	10.5	6.89	7.08	4.88	3.75	0.41	0.97	5.24	1.27	0.55	0.94	1.88	2.46	2	3.23	2.8	2.19	3.4
Lead	mg/L	0.001	**0.1**	0.003	0.008	0.003	0.004	0.002	<0.001	0.001	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	-	0.253	0.132	0.119	0.123	0.088	0.028	0.059	0.137	0.031	2.05	2.98	3.2	3.17	3.16	3.2	2.78	2.71	2.98
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	0.001	0.001	<0.001							<0.001	<0.001	0.002						
Nickel	mg/L	0.001	**1**	0.017	0.011	0.01	0.008	0.009	0.003	0.005	0.01	0.003	0.036	0.03	0.008	0.005	0.004	0.004	0.003	0.005	0.006
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	3.91	3.95	3.91	3.93	4	4.08	3.93	3.88	4.24	3.9	5.29	5.72	5.83	5.8	5.81	5.54	5.33	5.52
Vanadium	mg/L	0.01	-	0.02	0.02	0.02							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.026	0.02	0.021	0.011	0.014	<0.005	0.014	0.018	<0.005	0.011	0.021	0.01	0.009	<0.005	0.007	<0.005	0.007	0.016
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

AGE

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Stock Water**	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	NGW03A	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006	MN1006
Date Sampled				29/9/2017	09/10/2017	27/10/2017	9/11/2017	23/11/2017	5/12/2017	22/12/2017	4/1/2018	18/1/2018	29/9/2017	09/10/201	27/10/2017	8/11/2017	23/11/2017	4/12/2017	22/12/2017	6/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	-	7.34	7.34	7	6.96	7.13	7.1	6.96	7.08	7.02	8.02	7.93	7.54	7.76	7.7	7.65	7.52	7.75	7.69
Electrical conductivity	µS/cm	1	-	5970	5970	6320	6210	6290	6240	6470	6340	6350	3410	3360	3520	3460	3480	3470	3550	3520	3560
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	3510	3510	3730	3720	4020	3810	3940	3810	3860	1930	1750	1790	2000	2030	2020	2190	1850	1790
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	728	728	730	720	650	652	648	650	711	589	633	620	614	546	570	537	541	605
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	728	728	730	720	650	652	648	650	711	589	633	620	614	546	570	537	541	605
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	392	392	440	461	466	402	416	510	443	50	51	54	55	64	62	<1	58	43
Chloride	mg/L	1	-	1460	1460	1460	1350	1420	1380	1450	1490	1480	719	804	821	780	796	801	823	808	811
Calcium	mg/L	1	**1000**	232	232	229	225	229	273	237	233	239	104	106	105	101	102	138	108	112	110
Magnesium	mg/L	1	-	85	85	84	83	85	89	89	83	82	37	41	40	39	40	43	41	38	40
Sodium	mg/L	1	-	977	977	1020	997	1010	1030	1060	938	968	522	580	590	591	590	611	600	536	570
Potassium	mg/L	1	-	29	29	39	34	41	40	39	38	38	19	16	17	18	16	16	17	16	17
Total Anions	meq/L	0.01	-	63.9	63.9	64.9	62.1	62.7	60.3	62.5	65.6	65.2	33.1	36.4	36.7	35.4	34.7	35.3	33.9	34.8	35.9
Total Cations	meq/L	0.01	-	61.8	61.8	63.7	62.3	63.4	66.8	66.2	60.2	61.8	31.4	34.3	34.6	34.4	34.4	37.4	35.3	32.4	34
Ionic Balance	%	0.01	-	1.66	1.66	0.95	0.18	0.52	5.07	2.91	4.3	2.7	2.58	2.95	2.86	1.43	0.35	2.94	1.95	3.52	2.65
Nutrients																					
Ammonia as N	mg/L	0.01	-	3.35	3.35	3.43							0.02	1.78	1.04						
Nitrite as N	mg/L	0.01	**30**	0.01	0.01	0.03							0.03	0.08	0.8						
Nitrate as N	mg/L	0.01	-	0.02	0.02	0.04							2.55	0.09	0.25						
Nitrite + Nitrate as N	mg/L	0.01	**400**	0.03	0.03	0.07							2.58	0.17	1.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	3.4	3.4	3.5							1	1.5	1.1						
Total Nitrogen as N	mg/L	0.1	-	3.4	3.4	3.6							3.6	1.7	2.2						
Total Phosphorus as P	mg/L	0.01	-	0.02	0.02	0.04							0.13	0.01	0.03						
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							0.03	<0.01	0.02						
Total Metals																					
Aluminium	mg/L	0.01	**5**	0.11	0.1	0.18	0.48	0.03	0.08	0.08	7.74	0.22	0.78	0.13	0.24	0.46	0.06	0.02	<0.01	0.04	0.22
Antimony	mg/L	0.001	-	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.046	0.037	0.038	0.065	0.074	0.04	<0.001	<0.001	<0.001	0.241	0.238	0.233	0.232	0.22	0.235
Beryllium	mg/L	0.001	-	0.04	0.045	0.041							0.238	0.238	0.234						
Boron	mg/L	0.05	**5.0**	0.12	0.13	0.12	0.12	0.12	0.13	0.11	0.13	0.13	0.12	0.13	0.13	0.11	0.12	0.13	0.11	0.12	0.12
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.013	<0.001	0.002	0.005	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002
Cobalt	mg/L	0.001	**1.0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.5 - 5^**	0.012	0.007	0.011	0.026	0.01	0.005	0.017	0.018	0.008	0.068	0.02	0.02	0.024	0.024	0.015	0.022	0.024	0.026
Iron	mg/L	0.05	-	2.78	3.9	2.58	3.28	1.26	1.18	2.49	8.76	1.28	1.06	0.55	0.54	0.92	0.3	0.11	0.07	0.15	0.45
Lead	mg/L	0.001	**0.1**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/L	0.001	-	0.214	0.221	0.233	0.22	0.215	0.237	0.233	0.39	0.216	0.041	0.07	0.052	0.071	0.047	0.036	0.033	0.033	0.046
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	<0.001	<0.001	<0.001							0.008	<0.001	0.001						
Nickel	mg/L	0.001	**1**	<0.001	0.002	0.001	0.001	0.001	0.002	0.005	0.013	0.001	0.009	0.006	0.007	0.007	0.004	0.004	0.002	0.004	0.006
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	8.01	7.98	7.96	8.11	7.77	8.26	8.18	7.81	8.19	6.55	6.63	6.67	6.72	6.63	6.92	6.79	6.59	6.87
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.028	0.015	0.007	0.008	0.011	0.006	0.03	0.024	<0.005	0.018	0.017	0.011	0.015	0.013	0.006	0.006	0.007	0.021
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Stock Water**	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN1014	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)	MN0011 (REG1)
Date Sampled				26/9/2017	)9/10/201	27/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	6/1/2018	18/1/2018	26/9/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	6/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	-	11.4	11.3	11.6	11.6	11.4	11.5	11.3	11.4	11.4	11.8	11.7	11.8	11.9	11.7	11.8	11.6	11.7	11.7
Electrical conductivity	µS/cm	1	-	7330	7050	7870	7690	7810	7790	8070	7910	7890	6040	5640	6680	6360	6210	6300	6460	6130	5990
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	3950	3900	4000	3970	4190	4100	4000	4010	4120	3330	2800	3310	3260	3130	2790	2580	2670	3040
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	247	174	354	311	278	284	292	242	240	460	384	466	559	455	479	467	391	354
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	360	466	304	343	304	294	284	264	371	145	138	83	79	84	98	104	126	199
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	607	640	658	654	582	578	576	506	610	605	522	549	638	540	577	571	517	552
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	86	101	107	95	117	110	108	109	116	315	361	397	403	437	376	399	439	380
Chloride	mg/L	1	-	1870	1770	1710	1670	1800	1720	1840	1840	1860	912	1010	960	948	1000	1000	1030	1010	980
Calcium	mg/L	1	**1000**	7	8	8	8	9	12	9	9	10	65	104	96	88	2	77	50	41	39
Magnesium	mg/L	1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sodium	mg/L	1	-	1260	1410	1410	1410	1420	1520	1510	1330	1400	939	968	953	973	1020	1060	1010	900	955
Potassium	mg/L	1	-	84	93	87	90	87	101	91	86	85	75	76	76	77	81	87	78	72	75
Total Anions	meq/L	0.01	-	66.7	64.8	63.6	62.2	64.8	62.4	65.7	64.3	67.1	44.4	46.4	46.3	47.9	48.1	47.6	48.8	48	46.6
Total Cations	meq/L	0.01	-	57.3	64.1	64	64	64.4	69.3	68.4	60.5	63.6	46	49.2	48.2	48.7	46.5	52.2	48.4	43	45.4
Ionic Balance	%	0.01	-	7.55	0.55	0.27	1.49	0.31	5.27	2.08	3.03	2.68	1.81	2.93	1.98	0.83	1.65	4.62	0.36	5.41	1.28
Nutrients																					
Ammonia as N	mg/L	0.01	-	7.8	9.6	7.86							1	0.97	1.04						
Nitrite as N	mg/L	0.01	**30**	<0.01	<0.01	<0.01							0.02	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-	0.04	0.04	0.05							0.01	0.02	0.01						
Nitrite + Nitrate as N	mg/L	0.01	**400**	0.04	0.04	0.05							0.03	0.02	0.01						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	14.2	11.9	9.9							3.5	2.3	3.2						
Total Nitrogen as N	mg/L	0.1	-	14.2	11.9	10							3.5	2.3	3.2						
Total Phosphorus as P	mg/L	0.01	-	0.56	0.56	0.26							0.74	0.58	0.83						
Reactive Phosphorus as P	mg/L	0.01	-	0.6	0.29	0.2							<0.01	<0.01	<0.01						
Total Metals																					
Aluminium	mg/L	0.01	**5**	2.62	2.41	2.82	2.6	2.43	2.37	2.47	2.27	2.48	0.16	0.09	0.07	0.76	0.21	0.16	0.19	0.41	0.54
Antimony	mg/L	0.001	-	0.002	0.003	0.004	0.002	0.002	0.002	0.002	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	0.006	0.007	0.006	0.007	0.007	0.007	0.007	0.007	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.038	0.033	0.032	0.032	0.03	0.036	<0.001	<0.001	<0.001	0.185	0.12	0.116	0.115	0.104	0.126
Beryllium	mg/L	0.001	-	0.037	0.034	0.035							0.15	0.132	0.133						
Boron	mg/L	0.05	**5.0**	0.12	0.12	0.12	0.11	0.12	0.13	0.12	0.12	0.13	0.06	0.06	<0.05	0.06	0.06	0.08	0.07	0.07	0.08
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							0.0002	<0.0001	0.0001						
Chromium	mg/L	0.001	**1.0**	<0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.003	0.002	0.001	0.004	0.002	0.002	0.002	0.002	0.004
Cobalt	mg/L	0.001	**1.0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.5 - 5^**	0.038	0.01	0.026	0.016	0.022	0.009	0.006	0.042	0.063	0.002	<0.001	<0.001	0.007	<0.001	<0.001	0.001	<0.001	0.002
Iron	mg/L	0.05	-	0.25	0.36	0.57	0.36	0.37	0.11	0.1	0.39	0.35	0.32	<0.001	0.06	1.86	0.37	0.12	0.24	0.61	0.71
Lead	mg/L	0.001	**0.1**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	-	0.01	0.01	0.017	0.012	0.008	0.008	0.004	0.007	0.012	0.007	<0.001	<0.001	0.039	0.008	0.005	0.011	0.014	0.024
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	0.12	0.11	0.116							0.499	0.479	0.524						
Nickel	mg/L	0.001	**1**	0.025	0.024	0.02	0.025	0.023	0.026	0.022	0.023	0.023	0.009	0.009	0.008	0.012	0.01	0.009	0.008	0.01	0.01
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	0.321	0.364	0.338	0.36	0.363	0.372	0.365	0.36	0.357	2.06	1.97	2.06	2.1	1.75	1.79	1.7	1.49	1.6
Vanadium	mg/L	0.01	-	0.01	0.01	0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.026	0.026	0.023	0.016	0.008	0.017	0.007	0.009	0.016	0.021	<0.005	<0.005	0.047	0.011	0.006	0.011	0.015	0.021
BTEX																					
Benzene	µg/L	1		<1	<1	<1							----	<1	<1						
Toluene	µg/L	2		<2	<2	<2							----	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							----	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							----	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							----	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							----	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							----	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							----	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							----	<100	<100						

Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																				
Sample Location																							
Lab Number			**Stock Water**	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18A	MP18B	MP18B	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A	MP19A
Date Sampled				27/9/2017	10/10/2017	27/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	27/9/2017	27/10/2017	27/9/2017	10/10/2017	26/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018
Lithology																							
Field Parameters																							
Field pH	pH units		-																				
Field Electrical Conductivity (EC)	µS/cm		-																				
Depth to Groundwater	m TOC		-																				
Physical Parameters																							
pH	pH Units	0.1	-	7.6	7.24	7.6	7.36	7.35	7.4	7.23	7.42	7.36	7.7	7.4	7.7	7.83	7.33	7.53	7.49	7.65	7.3	7.48	7.54
Electrical conductivity	µS/cm	1	-	12500	12500	12200	12200	12300	12200	12400	12200	12500	22800	23000	15200	14900	15200	14900	15000	14900	14600	14200	14000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	5900	7990	7670	8000	7810	8030	7400	6630	7650	14300	17200	7490	9330	9480	9300	8550	9620	8810	6710	8120
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	851	924	934	926	839	790	829	726	904	1080	1170	1100	1170	1110	1060	974	1120	1120	1000	1210
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	851	924	934	926	839	790	829	726	904	1080	1170	1100	1170	1110	1060	974	1120	1120	1000	1210
Major Ions																							
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	258	318	257	305	314	284	291	299	286	810	894	152	248	314	309	319	267	254	255	215
Chloride	mg/L	1	-	3620	3740	3770	3830	4000	3860	4030	3830	3770	6570	7690	1700	4700	4960	4690	4870	4800	4780	4430	3850
Calcium	mg/L	1	**1000**	203	194	199	198	198	244	203	181	204	140	140	119	147	149	146	145	171	147	137	137
Magnesium	mg/L	1	-	441	453	448	459	451	480	466	408	422	817	937	489	505	531	473	507	514	555	416	417
Sodium	mg/L	1	-	1670	1740	1740	1750	1760	1930	1750	1570	1690	3460	3960	915	2360	2480	2360	2450	2480	2610	2070	2190
Potassium	mg/L	1	-	29	30	30	30	31	32	30	28	30	76	84	56	40	42	41	42	40	42	35	40
Total Anions	meq/L	0.01	-	124	130	130	133	136	130	136	129	130	224	259	73.1	161	169	160	163	163	162	150	137
Total Cations	meq/L	0.01	-	120	123	123	124	124	136	125	112	119	227	258	87.4	152	160	150	157	160	168	132	137
Ionic Balance	%	0.01	-	1.92	2.82	2.8	3.24	4.52	2.2	4.18	7.13	4.48	0.64	0.08	8.92	2.72	2.6	3.22	2.15	1.12	1.55	6.46	0.07
Nutrients																							
Ammonia as N	mg/L	0.01	-	0.32	0.32	0.29							0.21	0.14	0.07	0.36	0.43						
Nitrite as N	mg/L	0.01	**30**	<0.01	0.02	0.02							<0.01	<0.01	<0.01	0.02	0.01						
Nitrate as N	mg/L	0.01	-	0.06	0.07	0.02							0.16	0.03	0.43	0.18	0.1						
Nitrite + Nitrate as N	mg/L	0.01	**400**	0.06	0.09	0.04							0.16	0.03	0.43	0.2	0.11						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	0.5	0.4	0.8							4.5	9.9	0.4	<0.5	0.7						
Total Nitrogen as N	mg/L	0.1	-	0.6	0.5	0.8							4.7	9.9	0.8	<0.5	0.8						
Total Phosphorus as P	mg/L	0.01	-	0.15	0.08	0.09							2.3	6.56	1.18	1.05	0.09						
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							0.07	0.03	0.02	<0.01	0.02						
Total Metals																							
Aluminium	mg/L	0.01	**5**	0.22	0.3	0.12	0.24	0.08	0.02	<0.01	<0.01	0.27	108	261	0.42	0.14	2.93	0.31	0.15	0.06	0.05	0.17	1.01
Antimony	mg/L	0.001	-	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	0.004	0.004	0.003	0.003	0.002	0.003	0.002	0.001	0.003	0.026	0.078	0.015	0.021	0.008	0.008	0.001	0.004	0.003	0.006	0.004
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.315	0.223	0.184	0.249	0.16	0.286	0.008	0.02	<0.001	<0.001	<0.001	0.422	0.388	0.244	0.33	0.377	0.772
Beryllium	mg/L	0.001	-	0.375	0.449	0.308							5.24	2.64	0.333	0.282	2.8						
Boron	mg/L	0.05	**5.0**	0.08	0.08	0.08	0.07	0.07	0.08	0.07	0.06	0.08	0.08	0.1	0.11	0.12	0.12	0.1	0.12	0.13	0.12	0.16	0.12
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							0.0002	0.0003	<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	<0.001	0.003	0.008	0.003	<0.001	<0.001	<0.001	<0.001	0.001	0.215	0.538	0.002	0.004	0.004	0.004	<0.001	0.004	0.002	<0.001	0.003
Cobalt	mg/L	0.001	**1.0**	<0.001	0.002	<0.001	0.002	0.002	0.002	<0.001	<0.001	0.001	0.061	0.163	<0.001	0.001	0.002	0.001	<0.001	<0.001	<0.001	0.184	<0.001
Copper	mg/L	0.001	**0.5 - 5^**	0.006	0.006	0.01	0.014	0.072	0.055	0.172	0.046	0.132	0.374	0.58	0.002	0.007	0.006	0.007	0.002	0.03	0.003	0.028	0.007
Iron	mg/L	0.05	-	8.58	6.08	5.16	7.54	3.59	3.54	4.62	1.74	4.05	137	351	20	20.5	10.6	11.8	1.95	4.71	3.84	2.33	5.39
Lead	mg/L	0.001	**0.1**	<0.001	<0.001	0.004	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.064	0.186	<0.001	0.002	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Manganese	mg/L	0.001	-	0.194	0.213	0.196	0.234	0.21	0.213	0.209	0.202	0.257	0.358	0.857	0.162	0.259	0.217	0.23	0.179	0.192	0.182	0.166	0.187
Mercury	mg/L	0.0001	**0.002**	<0.0001	0.0004	<0.0001						<0.0001	0.0002	0.0005	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	0.002	0.007	0.001							<0.001	<0.001	0.003	0.004	0.005						
Nickel	mg/L	0.001	**1**	0.001	0.17	0.007	0.258	0.227	0.209	0.185	0.161	0.146	0.121	0.413	<0.001	0.003	0.013	0.025	0.005	0.005	0.002	1.55	0.006
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	0.26	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.002
Strontium	mg/L	0.001	-	5.9	6.06	6.17	6	5.96	6.15	6.14	5.82	6.16	7.75	8.14	6.51	6.74	6.8	6.08	6.51	6.94	6.7	6.38	5.61
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							0.34	0.86	<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.024	0.032	0.035	0.029	0.011	0.013	0.008	0.012	0.031	0.204	0.546	0.007	0.037	0.062	0.024	0.006	0.018	0.016	0.016	0.05
BTEX																							
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																							
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50	<50	<50						
Total Recoverable Hydrocarbons																							
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																	
Sample Location																				
Lab Number			**Stock Water**	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	MP20A	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2	GW10-A2
Date Sampled				27/9/2017	10/10/2017	26/10/2017	8/11/2017	22/11/2017	4/12/2017	21/12/2017	4/1/2018	19/1/2018	25/9/2017	09/10/2017	26/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018
Lithology																				
Field Parameters																				
Field pH	pH units		-																	
Field Electrical Conductivity (EC)	µS/cm		-																	
Depth to Groundwater	m TOC		-																	
Physical Parameters																				
pH	pH Units	0.1	-	7.84	8.08	7.41	7.56	7.59	7.68	7.43	7.57	7.6	7.31	6.86	6.97	6.94	6.92	7.01	6.85	7
Electrical conductivity	µS/cm	1	-	11800	12100	13300	14000	14400	15100	15800	15900	16400	450	533	638	605	664	752	890	839
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	6030	6520	7730	8220	7950	8990	8610	9140	9470	472	722	1230	1650	1980	2060	1440	1370
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	1760	1920	1820	1790	1610	1390	1530	1350	1600	40	43	50	49	45	45	47	45
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	1760	1920	1820	1790	1610	1390	1530	1350	1600	40	43	50	49	45	45	47	45
Major Ions																				
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	85	123	178	199	244	263	298	315	298	39	34	40	54	44	39	36	36
Chloride	mg/L	1	-	2910	3260	3880	4000	4380	4570	4850	4800	5040	43	65	124	119	132	176	222	194
Calcium	mg/L	1	**1000**	81	79	100	96	119	148	128	133	131	1	2	2	6	2	1	7	2
Magnesium	mg/L	1	-	116	150	222	233	314	302	349	308	299	4	4	6	19	8	4	19	9
Sodium	mg/L	1	-	2340	2530	2740	2690	2990	3070	3120	2770	2770	77	93	109	114	120	137	147	148
Potassium	mg/L	1	-	24	27	29	29	31	31	33	30	32	4	4	5	8	6	4	9	7
Total Anions	meq/L	0.01	-	119	133	150	153	161	162	174	169	180	2.82	4.23	5.33	5.46	5.54	6.68	7.95	7.12
Total Cations	meq/L	0.01	-	116	127	143	142	163	166	172	153	152	3.83	4.58	5.46	7.03	6.13	6.44	8.54	7.46
Ionic Balance	%	0.01	-	1.29	2.25	2.16	3.74	0.56	1.34	0.56	4.87	8.38	15.1	3.99	1.23	12.5	5.08	1.79	3.56	2.3
Nutrients																				
Ammonia as N	mg/L	0.01	-	2.51	3.3	2.25							<0.01	0.02	0.02					
Nitrite as N	mg/L	0.01	**30**	0.06	<0.01	<0.01							0.02	<0.01	<0.01					
Nitrate as N	mg/L	0.01	-	0.45	0.03	0.02							12.4	11.6	11.5					
Nitrite + Nitrate as N	mg/L	0.01	**400**	0.51	0.03	0.02							12.4	11.6	11.5					
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	3.5	4	2.8							5	2.6	2.7					
Total Nitrogen as N	mg/L	0.1	-	4	4	2.8							17.4	14.2	14.2					
Total Phosphorus as P	mg/L	0.01	-	0.23	0.17	0.11							0.93	0.24	0.89					
Reactive Phosphorus as P	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	0.01	0.01					
Total Metals																				
Aluminium	mg/L	0.01	**5**	0.45	0.13	0.52	0.81	0.24	0.07	0.09	0.71	0.68	69.1	2.78	120	15.1	59.7	117	8.09	89.6
Antimony	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	0.002	0.002	0.002	0.002	0.001	0.002	<0.001	0.001	0.002	0.004	<0.001	0.009	0.002	0.005	0.011	0.002	0.005
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.799	0.807	0.336	0.309	0.961	0.734	0.003	<0.001	0.006	0.071	0.099	0.25	0.069	0.149
Beryllium	mg/L	0.001	-	1.26	0.518	1.94							0.098	0.028	0.17					
Boron	mg/L	0.05	**5.0**	0.48	0.44	0.35	0.38	0.3	0.34	0.3	0.28	0.29	0.09	0.11	0.12	0.1	0.09	0.14	0.08	0.1
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001					
Chromium	mg/L	0.001	**1.0**	0.001	0.001	0.005	0.007	0.002	0.002	0.001	0.005	0.007	0.131	0.005	0.238	0.025	0.122	0.357	0.017	0.172
Cobalt	mg/L	0.001	**1.0**	0.001	0.002	0.002	0.004	<0.001	0.003	<0.001	0.003	0.002	0.035	0.012	0.054	0.031	0.029	0.08	0.024	0.043
Copper	mg/L	0.001	**0.5 - 5^**	0.012	0.014	0.006	0.009	0.01	0.008	0.017	0.028	0.018	0.08	0.021	0.125	0.045	0.071	0.185	0.047	0.105
Iron	mg/L	0.05	-	3.46	2.67	6.66	13.3	4.08	5.06	2.32	5.04	3.79	59.1	2.79	101	12.3	46.9	112	8.35	68
Lead	mg/L	0.001	**0.1**	0.002	0.001	<0.001	0.04	<0.001	<0.001	<0.001	0.002	0.003	0.027	0.008	0.05	0.017	0.024	0.066	0.016	0.035
Manganese	mg/L	0.001	-	0.092	0.139	0.116	0.216	0.109	0.178	0.12	0.145	0.184	0.316	0.146	0.511	0.346	0.298	0.73	0.302	0.442
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	0.0001					
Molybdenum	mg/L	0.001	**0.15**	<0.001	0.001	0.011							<0.001	<0.001	<0.001					
Nickel	mg/L	0.001	**1**	0.005	0.01	0.03	0.065	0.129	0.118	0.128	0.166	0.14	0.071	0.008	0.112	0.024	0.058	0.174	0.022	0.086
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	0.01	0.02	<0.01	0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	6.78	6.71	7.54	7.02	7.57	7.71	7.65	7.29	7.88	0.147	0.131	0.255	0.208	0.136	0.321	0.26	0.232
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							0.08	0.02	0.16					
Zinc	mg/L	0.005	**20**	0.025	0.039	0.03	0.044	0.006	0.012	0.016	0.038	0.078	0.154	0.026	0.258	0.06	0.127	0.361	0.103	0.24
BTEX																				
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1					
Toluene	µg/L	2		<2	<2	40							<2	<2	<2					
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2					
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2					
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2					
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2					
Sum of BTEX	µg/L	1		<1	<1	40							<1	<1	<1					
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5					
Total Petroleum Hydrocarbons (Silica gel cleanup)																				
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50					
Total Recoverable Hydrocarbons																				
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100					
>C10 - C16 Fraction minus Naphthalene	µg/L	100		<100	<100	<100							<100	<100	<100					

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

AGE

G1839Z

Parameter	Units	LOR#	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Stock Water**	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P1	GW10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2	GW 10-P2
Date Sampled				25/9/2017	09/10/2017	26/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018	19/1/2018	25/9/2017	09/10/2017	30/10/2017	9/11/2017	23/11/2017	4/12/2017	20/12/2017	5/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	-	7.48	7.63	7.38	7.49	7.47	7.55	7.38	7.58	7.52	7.92	8.12	7.61	7.76	7.68	7.7	7.59	7.77	7.7
Electrical conductivity	µS/cm	1	-	795	892	13500	12400	12400	13100	14000	14000	14400	8310	8000	9020	9060	9230	9430	9970	9820	10000
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	420	566	8680	8060	6540	8960	9600	8960	8550	3660	4620	5110	5150	4780	5310	5940	5460	5650
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	96	116	706	659	606	613	666	629	736	1160	1280	1210	1210	1070	1050	1100	1100	1200
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	96	116	706	659	606	613	666	629	736	1160	1280	1210	1210	1070	1050	1100	1100	1200
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	36	42	193	170	182	172	190	192	194	26	30	54	52	66	69	75	74	68
Chloride	mg/L	1	-	142	243	4600	4060	4200	4330	4760	4670	4240	1830	2160	2260	2560	2680	2730	2970	2800	2570
Calcium	mg/L	1	**1000**	5	6	112	103	103	129	124	130	124	71	68	84	74	84	112	99	114	106
Magnesium	mg/L	1	-	15	16	542	507	480	512	622	585	520	106	110	129	128	142	142	169	156	147
Sodium	mg/L	1	-	125	141	1880	1730	1700	1790	2120	2030	1830	1500	1500	1730	1590	1720	1690	1920	1740	1710
Potassium	mg/L	1	-	6	6	56	53	52	53	63	66	60	24	25	26	26	28	26	31	29	29
Total Anions	meq/L	0.01	-	6.67	10	148	131	134	138	152	148	138	75.3	87.1	89	97.5	98.4	99.4	107	102	97.9
Total Cations	meq/L	0.01	-	7.07	7.9	133	123	120	128	151	145	130	78.1	78.3	90.7	84	91.4	91.4	103	95	92.5
Ionic Balance	%	0.01	-	2.92	11.9	5.15	3.05	5.68	3.83	0.11	1.26	3.06	1.82	5.32	0.93	7.39	3.66	4.18	1.98	3.82	2.82
Nutrients																					
Ammonia as N	mg/L	0.01	-	0.34	0.18	0.14							2.13	2.35	1.94						
Nitrite as N	mg/L	0.01	**30**	0.12	0.15	0.02							0.33	0.1	0.13						
Nitrate as N	mg/L	0.01	-	<0.10	0.51	0.05							<0.01	0.08	<0.01						
Nitrite + Nitrate as N	mg/L	0.01	**400**	0.11	0.66	0.07							0.04	0.18	0.05						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	1.6	0.6	0.2							2.9	3	2.4						
Total Nitrogen as N	mg/L	0.1	-	1.7	1.3	0.3							2.9	3.2	2.4						
Total Phosphorus as P	mg/L	0.01	-	0.14	0.16	0.08							0.37	0.2	0.16						
Reactive Phosphorus as P	mg/L	0.01	-	0.08	<0.01	<0.01							0.16	0.17	0.13						
Total Metals																					
Aluminium	mg/L	0.01	**5**	1.14	0.16	0.84	0.66	0.74	1.04	0.58	1.12	0.65	1.39	0.25	0.73	0.24	0.22	0.44	0.97	0.26	1.58
Antimony	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.144	0.163	0.165	0.172	0.139	0.184	<0.001	<0.001	<0.001	0.614	0.601	0.603	0.659	0.603	0.693
Beryllium	mg/L	0.001	-	0.054	0.061	0.141							0.583	0.565	0.608						
Boron	mg/L	0.05	**5.0**	0.08	0.08	0.05	<0.05	0.05	0.06	0.05	<0.05	0.07	0.26	0.26	0.26	0.24	0.24	0.24	0.24	0.24	0.24
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							<0.0001	<0.0001	<0.0001						
Chromium	mg/L	0.001	**1.0**	0.003	0.002	0.002	0.002	0.002	0.003	0.002	0.003	0.004	0.005	0.002	0.002	<0.001	0.002	0.002	0.003	0.001	0.006
Cobalt	mg/L	0.001	**1.0**	0.004	0.002	0.004	0.004	0.004	0.004	0.003	0.002	0.004	0.002	<0.001	0.002	<0.001	<0.001	<0.001	0.003	0.001	0.002
Copper	mg/L	0.001	**0.5 - 5^**	0.009	0.007	0.005	0.005	0.006	0.007	0.008	0.007	0.014	0.012	0.003	0.007	0.002	0.002	0.002	0.013	0.001	0.019
Iron	mg/L	0.05	-	2.47	1.4	2.51	2.39	2.56	2.79	1.69	1.67	1.83	2.38	0.72	1.78	1.08	1.16	1.23	1.92	0.71	1.94
Lead	mg/L	0.001	**0.1**	0.004	0.003	0.001	0.002	0.003	0.002	0.003	0.002	0.002	0.006	0.002	0.003	0.002	0.003	<0.001	0.008	<0.001	0.003
Manganese	mg/L	0.001	-	0.064	0.051	0.163	0.175	0.197	0.188	0.138	0.103	0.223	0.284	0.319	0.248	0.267	0.272	0.281	0.368	0.265	0.34
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	<0.0001						0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	<0.001	<0.001	<0.001							0.001	<0.001	0.002						
Nickel	mg/L	0.001	**1**	0.009	0.008	0.006	0.009	0.01	0.012	0.012	0.014	0.014	0.006	0.006	0.006	0.003	0.004	0.005	0.009	0.004	0.015
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	0.188	0.235	4.33	4.2	4.12	4.75	4.5	4.57	4.96	5.52	5.48	6.45	6.63	6.66	7.08	7.46	7.03	7.56
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.096	0.07	0.042	0.06	0.077	0.062	0.08	0.122	0.115	0.173	0.066	0.083	0.067	0.067	0.033	0.197	0.022	0.149
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

G1839Z

Parameter	Units	LOR[#]	ANZECC GUIDELINES																		
Sample Location																					
Lab Number			**Stock Water**	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW047877	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249	GW202249
Date Sampled				26/9/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	4/12/2017	21/12/2017	5/1/2018	18/1/2018	26/9/2017	09/10/2017	24/10/2017	8/11/2017	23/11/2017	5/12/2017	21/12/2017	5/1/2018	18/1/2018
Lithology																					
Field Parameters																					
Field pH	pH units		-																		
Field Electrical Conductivity (EC)	µS/cm		-																		
Depth to Groundwater	m TOC		-																		
Physical Parameters																					
pH	pH Units	0.1	-	7.81	7.92	7.74	7.63	7.55	7.65	7.44	7.64	7.66	7.81	8.13	8.06	8.11	7.99	8.06	7.92	8.1	8.17
Electrical conductivity	µS/cm	1	-	5380	5230	5630	5020	5140	5000	5260	5050	5080	5380	2320	2450	2340	2450	2450	2550	2530	2580
Total Dissolved Solids (grav) @180°C	mg/L	1.00	**3000 - 13000***	3320	2590	3090	2960	2910	3060	3020	2840	2680	3320	1150	1380	1270	1240	1420	1360	1330	1320
Hydroxide Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1.00	-	544	576	458	412	415	348	412	366	380	544	373	340	377	347	355	356	315	382
Total Alkalinity as $CaCO_3$	mg/L	1.00	-	544	576	458	412	415	348	412	366	380	544	373	340	377	347	355	356	315	382
Major Ions																					
Sulfate as SO_4 - Turbidimetric	mg/L	1	**1000 - 2000**	146	134	139	166	168	162	154	157	164	146	15	12	16	19	17	16	15	15
Chloride	mg/L	1	-	1560	1390	1300	1240	1340	1290	1350	1340	1310	1560	571	560	574	606	608	634	620	600
Calcium	mg/L	1	**1000**	22	19	22	14	16	27	17	35	20	22	37	39	36	37	54	38	40	41
Magnesium	mg/L	1	-	181	176	163	176	180	197	186	155	170	181	25	23	24	25	30	25	25	26
Sodium	mg/L	1	-	857	819	775	720	743	816	703	662	688	857	432	405	430	438	513	440	417	439
Potassium	mg/L	1	-	39	36	34	33	33	34	32	28	32	39	10	10	11	11	12	11	11	11
Total Anions	meq/L	0.01	-	57.9	53.5	48.7	46.7	49.6	46.7	49.5	48.4	48	57.9	23.9	22.8	24	24.4	24.6	25.3	24.1	24.9
Total Cations	meq/L	0.01	-	54.3	52	49.1	47.3	48.8	53.9	47.6	44	45.7	54.3	23	21.7	22.8	23.2	27.8	23.4	22.5	23.6
Ionic Balance	%	0.01	-	3.25	1.45	0.38	0.72	0.83	7.16	2.02	4.72	2.38	3.25	1.97	2.53	2.78	2.49	6.08	4.02	3.48	2.7
Nutrients																					
Ammonia as N	mg/L	0.01	-	0.08	0.08	0.13							0.08	0.02	0.08						
Nitrite as N	mg/L	0.01	**30**	<0.10	<0.01	<0.01							<0.10	<0.01	<0.01						
Nitrate as N	mg/L	0.01	-	<0.10	0.04	0.07							<0.10	1.62	1.89						
Nitrite + Nitrate as N	mg/L	0.01	**400**	<0.10	0.04	0.07							<0.10	1.62	1.89						
Total Kjeldahl Nitrogen as N	mg/L	0.1	-	0.2	<0.1	0.4							0.2	0.2	0.4						
Total Nitrogen as N	mg/L	0.1	-	0.2	<0.1	0.5							0.2	1.8	2.3						
Total Phosphorus as P	mg/L	0.01	-	0.02	0.01	0.02							0.02	0.17	0.24						
Reactive Phosphorus as P	mg/L	0.01	-	0.07	0.01	0.01							0.07	0.19	0.18						
Total Metals																					
Aluminium	mg/L	0.01	**5**	0.1	0.01	0.03	<0.01	<0.01	0.02	0.01	0.02	0.03	0.69	0.06	0.19	0.18	0.14	0.04	0.06	0.07	0.09
Antimony	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	**0.5**	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	0.002	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001
Barium	mg/L	0.001	-	<0.001	<0.001	<0.001	0.05	0.051	0.064	0.092	0.081	0.064	<0.001	<0.001	<0.001	0.206	0.202	0.21	0.205	0.187	0.216
Beryllium	mg/L	0.001	-	0.066	0.064	0.069							0.216	0.203	0.211						
Boron	mg/L	0.05	**5.0**	0.08	0.09	0.06	0.08	0.1	0.1	0.09	0.08	0.1	0.09	0.1	0.08	0.09	0.1	0.11	0.11	0.09	0.11
Cadmium	mg/L	0.0001	**0.01**	<0.0001	<0.0001	<0.0001							0.0002	0.0001	0.0002						
Chromium	mg/L	0.001	**1.0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	**1.0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	**0.5 - 5^**	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.003	0.001	0.003	0.002	<0.001	0.001	0.002	0.002	0.002
Iron	mg/L	0.05	-	0.15	<0.05	0.06	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	0.36	0.07	0.22	0.28	0.16	<0.05	0.08	0.09	0.13
Lead	mg/L	0.001	**0.1**	0.006	0.003	0.006	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.019	0.01	0.018	0.013	0.005	0.004	0.005	0.004	0.006
Manganese	mg/L	0.001	-	0.032	0.025	0.026	0.01	0.006	0.013	0.03	0.021	0.008	0.021	0.017	0.021	0.016	0.012	0.009	0.007	0.005	0.008
Mercury	mg/L	0.0001	**0.002**	<0.0001	<0.0001	<0.0001						<0.0001	<0.0001	<0.0001	<0.0001						<0.0001
Molybdenum	mg/L	0.001	**0.15**	0.002	0.002	0.008							0.003	0.003	0.004						
Nickel	mg/L	0.001	**1**	0.001	<0.001	<0.001	0.002	0.002	0.002	0.001	<0.001	0.001	0.024	0.016	0.017	0.016	0.016	0.017	0.016	0.013	0.014
Selenium	mg/L	0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	mg/L	0.001	-	0.942	0.926	1.02	0.666	0.653	0.798	1.17	1.06	0.757	1.79	1.94	2.07	1.9	1.94	2.1	2.05	1.91	2.12
Vanadium	mg/L	0.01	-	<0.01	<0.01	<0.01							<0.01	<0.01	<0.01						
Zinc	mg/L	0.005	**20**	0.008	0.006	0.008	<0.005	<0.005	0.006	<0.005	0.006	0.009	0.108	0.089	0.103	0.091	0.078	0.08	0.074	0.068	0.072
BTEX																					
Benzene	µg/L	1		<1	<1	<1							<1	<1	<1						
Toluene	µg/L	2		<2	<2	<2							<2	<2	<2						
Ethylbenzene	µg/L	2		<2	<2	<2							<2	<2	<2						
meta- & para-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
ortho-Xylene	µg/L	2		<2	<2	<2							<2	<2	<2						
Total Xylenes	µg/L	2		<2	<2	<2							<2	<2	<2						
Sum of BTEX	µg/L	1		<1	<1	<1							<1	<1	<1						
Naphthalene	µg/L	5		<5	<5	<5							<5	<5	<5						
Total Petroleum Hydrocarbons (Silica gel cleanup)																					
C10 - C14 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C15 - C28 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
C29 - C36 Fraction (EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
C10 - C36 Fraction (sum - EP071 SG)	µg/L	50		<50	<50	<50							<50	<50	<50						
Total Recoverable Hydrocarbons																					
>C10 - C16 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C16 - C34 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C34 - C40 Fraction (EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C40 Fraction (sum - EP071 SG)	µg/L	100		<100	<100	<100							<100	<100	<100						
>C10 - C16 Fraction minus Naphthalen	µg/L	100		<100	<100	<100							<100	<100	<100						

\# Limit of Reporting

a NHMRC Health Guidelines for Drinking Water (2015)

b NHMRC Aesthetic Guidelines for Drinking Water (2015)

m TOC metres below top of casing

* Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.

^ Maximum concentrations of copper for sheep is 0.5 mg/L, 1 mg/L for cattle and 5 mg/L for pigs & poultry.

\+ NHMRC acid-soluable aluminium concentrations (2015)

\- No value.

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