BHP Mitsubishi Alliance

Appendix F

Groundwater Impact Assessment Report

CAVAL RIDGE MINE

Horse Pit Extension Project
Groundwater Assessment

Prepared for:

BMA
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Brisbane QLD 4000 Australia

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with BMA (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
620.13593.00005-R01-v8.0	6 December 2021	Derwin Lyons	Peter Smith	Peter Smith
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APPENDICES

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by BM Alliance Coal Operations Pty Ltd (BMA) to undertake a Groundwater Assessment for the Caval Ridge Mine (CVM) Horse Pit Extension (HPE) Project (the Project), for incorporation into an application for an Environmental Authority (EA) Amendment and Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Approval.

BMA proposes to develop the Project, an extension of the CVM metallurgical open cut coal mine primarily on Mining Lease (ML) 1775 within the Bowen Basin, located approximately 5 kilometres (km) south of Moranbah within the Isaac Regional Council Local Government Area (LGA) (**Figure 1-1**). Associated infrastructure for the CVM is located on ML 70403 and ML 70462. Open cut mining operations at CVM (using dragline and truck/shovel equipment) produce hard coking coal product for the export market. Existing operations at CVM are undertaken under the conditions of EA EPML00562013 (in effect as of 17 August 2020), EPBC Act approval 2008/4417 and the Coordinator-General's imposed conditions.

This Groundwater Assessment forms part of an EA Amendment Application and an EPBC Act Referral, which has been prepared in accordance with the Queensland Department of Environment and Science (DES) Guideline *Requirements for site-specific and amendment applications—underground water rights* and the Independent Expert Scientific Committee (IESC) *Information guidelines for proponents preparing coal seam gas and large coal mining development proposals*.

1.1 Horse Pit Extension Project

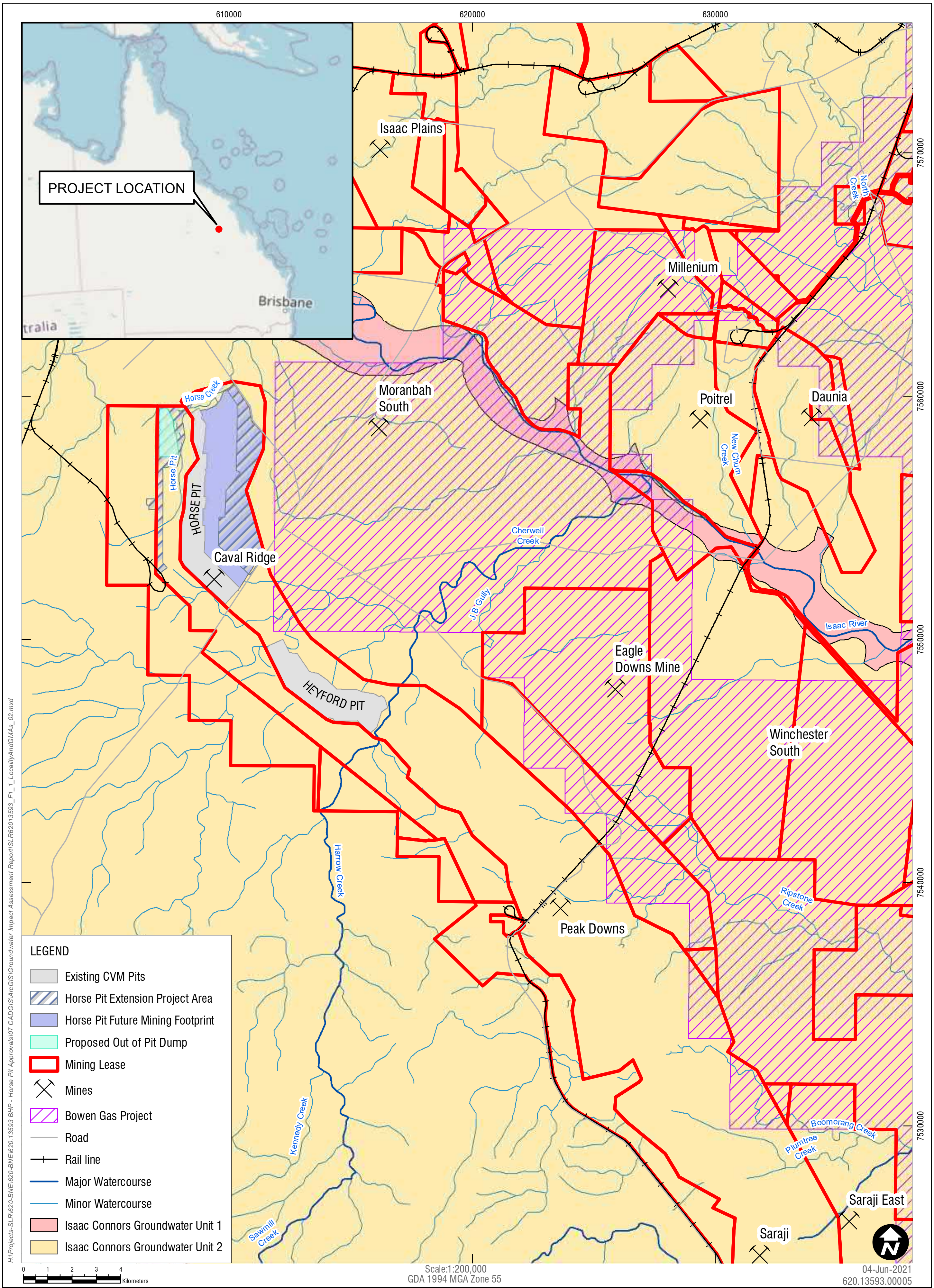
The Project involves the eastwards extension of the existing Horse Pit in the northern part of CVM, as well as associated infrastructure and the addition of an out of pit waste rock dump (OOPD) in the northwest of CVM (**Figure 1-1**).

The Project will target the Permian-aged Moranbah Coal Measures of the Bowen Basin. The Project is planned to produce up to 15 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal for approximately 30 years. The coal resource will be mined by open cut mining methods, with product coal to be processed using existing infrastructure on site before being transported by rail to port for export, including the Goonyella rail system to the Hay Point Coal Terminal coal port.

Located immediate south of CVM are existing mine operations Peak Downs and Saraji. Located to the immediate east is the proposed Moranbah South Project, and further east are the existing Eagle Downs Underground Mine, and the proposed Winchester South and Olive Downs projects. Located to the northeast of the Project is Daunia Mine, Poitrel Mine, and the proposed Moorvale South Project (**Figure 1-1**).

Throughout this report, the terms "the Project Area" and "Study Area" are used as defined by:

- The Project Area is defined as areas within Mining Lease (ML) 1775, ML 70462 and ML 70403, located to the west, north and east of Horse Pit (**Figure 1-1**).
- The Study Area is the regional area surrounding the Project considered in detail within this assessment, and is synonymous with the numerical groundwater model boundary as shown in **Figure 1-2**. The selection of this boundary is discussed in **Section 6**.



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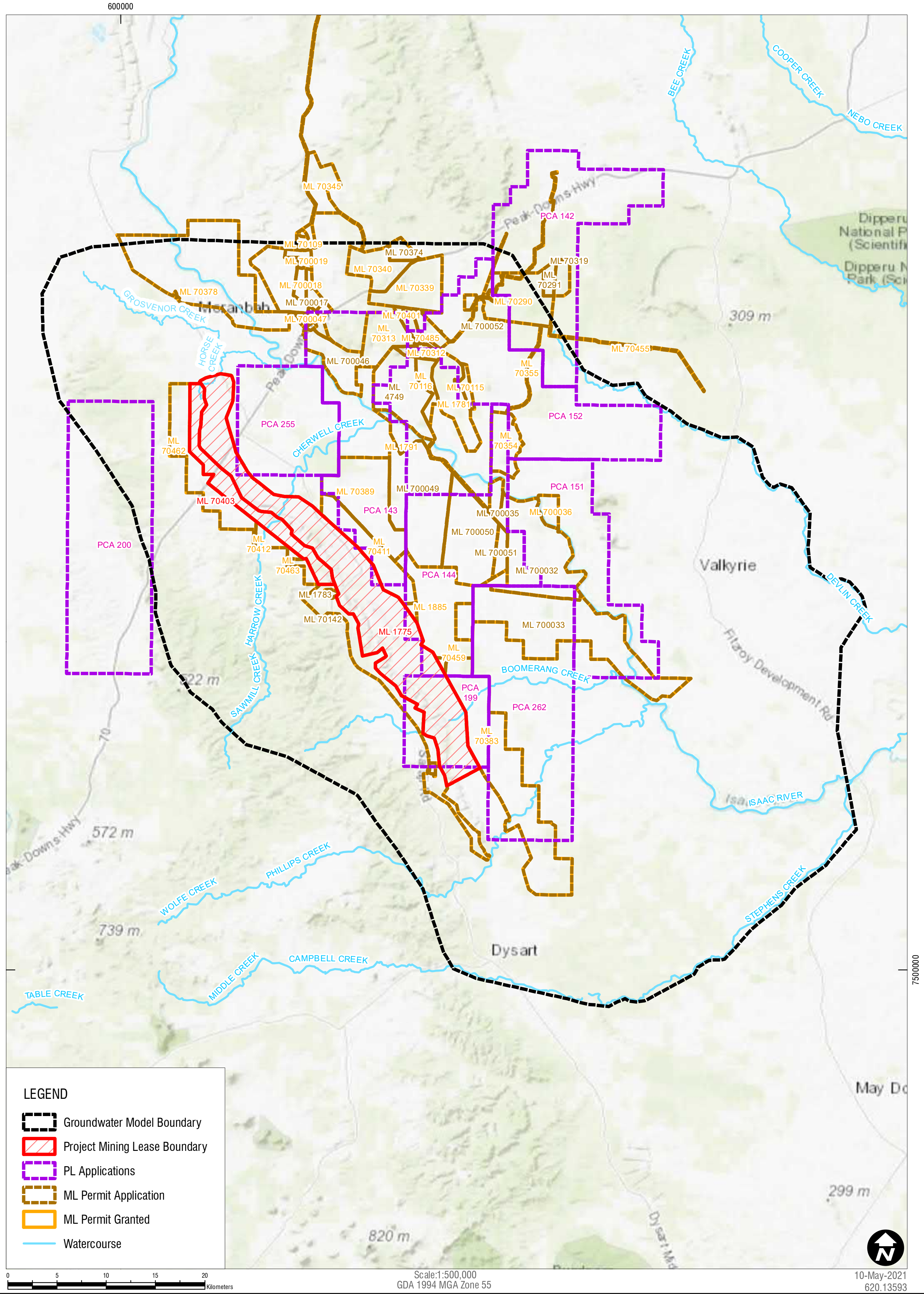
Project Location

FIGURE 1-1



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Project Study Area and Surrounding Mine Tenements

FIGURE 1-2

1.2 Project Design

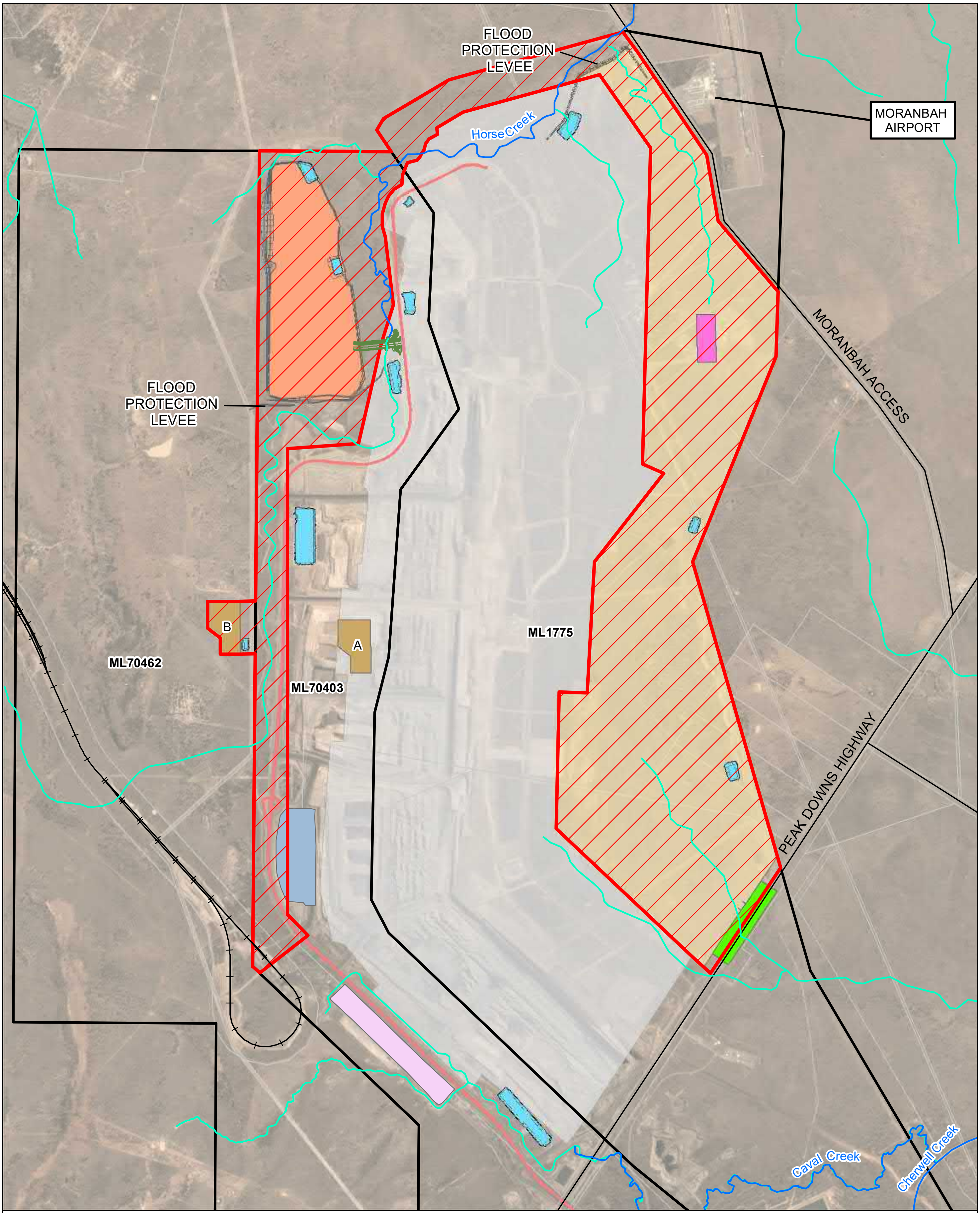
The Project involves the extension of Horse Pit at the CVM an existing mining precinct (**Figure 1-2**) for export of metallurgical coal products to the steel production industry. Where possible the Project will utilise existing infrastructure including the coal handling and preparation plant (CHPP), train load-out facility and rail spur, which will be used for the handling, processing and transport of coal. As required by the progress of mining the Project will include relocation and redevelopment of enabling infrastructure, mine water dams, extension of haul road access and expansion of sediment dams. An infrastructure corridor will also form part of the Project, including a raw water supply pipeline connecting to the Eungella pipeline network, an electricity transmission line and a mine access road.

The Project involves activities and infrastructure relevant to this groundwater assessment (**Figure 1-3**), including:

- Extension of the existing open cut Horse Pit targeting the Moranbah Coal Measures beyond the approved extent;
- Development of an Out of Pit Dump (OOPD) in the north-west of ML 70403;
- Extension of the haul road to access to the proposed OOPD in the north-west of ML 70403 including the construction of a bridge over Horse Creek
- Co-disposal of coal rejects on-site within the footprint of the open cut void and/or out-of-pit emplacement areas;
- Construction of two flood levees: the northern levee bounds a portion of Horse Pit and the western levee is located at the south-west extent of the proposed OOPD;
- Expansion of sediment dam capacities and construction of new sediment dams, clean water diversion drains and mine affected water (MAW) drains to manage runoff associated with the proposed OOPD.
- Progressive development of sediment dams and storage dams, pumps, pipelines and other water management equipment and structures (including levees);
- Relocation of enabling infrastructure, including: an EME Build Pad, blasting compound (two potential relocation options), go-lines, substations, back-access roads and powerlines as required by the progress of mining;
- Relocation of the Peak Downs Highway dragline crossing; and
- Post–closure rehabilitated final landform with a single final void.

The Project does not include any proposed alteration to main water demands such as those for the CHPP and dust suppression. The raw water for operations will continue to be sourced from the BMA owned Eungella-Bingegang pipeline.

The Project final void is outside the Isaac River Floodplain as defined by the Queensland Floodplain Assessment Overlay (DNRME, 2017).



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Project No.: 620.13593
Date: 01-Feb-2021
Drawn by: PM

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- — Existing Road
- ┼ Existing Rail
- 🟩 Zone for Dragline Crossing
- ▨ Existing Horse ROM Stockpile
- ▨ Existing Train Load Out Stockpile
- ▨ Caval Ridge EIS Boundary (2010)
- ☐ BHP Tenements
- ☐ Cadastre
- — Bridge over Horse Creek
- — Haul Roads
- — Watercourses (Water Act 2000)
- — Drainage features
- — Proposed Water Management Infrastructure
- ▨ Dams
- ▨ Proposed EME Build Pad
- ▨ Proposed Blast Compound Options
- ▨ Proposed Out of Pit Dump
- ▨ Horse Pit Extension
- 🟥 Horse Pit Extension Project Area

Conceptual Project Layout

FIGURE 1-3

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1.3 Objectives

The groundwater assessment was undertaken in accordance with the Queensland Government requirements and the EPBC Act 1999 (Water Trigger). The groundwater assessment comprises two parts; (i) a description of the existing hydrogeological environment; and (ii) an assessment of the impacts of mining on that environment. To this end, the stated scope of work was to:

- Review relevant groundwater, geotechnical and environmental reports to characterise the geological and hydrogeological setting of the Project.
- Review publicly available hydrogeological data such as The Queensland Government's spatial data system (Queensland Globe) and The Bureau of Meteorology's (BoM) National Groundwater Information System (NGIS) (BoM, 2019).
- Undertake a census of groundwater supply bores near to the Project to confirm locations, usage and groundwater quality.
- Characterise the existing groundwater resources, including properties and quality.
- Conceptualise the groundwater regime of the Project Area and Study Area.
- Assess the potential interaction between the alluvium of proximal watercourses (Cherwell Creek, Horse Creek and the Isaac River) and the Project;
- Identify the potential for groundwater dependent ecosystems (GDEs) to occur in proximity to the Project;
- Construction and calibration of a numerical groundwater flow model suitable for assessment of potential impacts of the Project, in accordance with the Australian Groundwater Modelling Guidelines (Barnett *et al*., 2012) and Murray Darling Basin Commission guidelines (Middlemis *et al*., 2001).
- Perform predictive modelling for the scale and extent of mining impacts upon groundwater levels, groundwater quality and groundwater users at various stages during mine operations and post closure.
- Model the cumulative impacts of the Project and surrounding existing and proposed mines.
- Assess the extent of groundwater impacts as a result of the operation of the Project; including long-term impacts on regional groundwater levels, water quality impacts on environmental flows and baseflows.
- Assess potential impacts on GDEs resulting from short and/or long-term changes in the quantity and quality of groundwater.
- Assess potential third party impacts (i.e. private bores) as a result of changes to the regional groundwater system.
- Develop feasible mitigation and management strategies where potential adverse impacts are identified.
- Develop a groundwater monitoring program and management measures.

1.4 Information Sources

In addition to publicly available data and Project specific information and data, this groundwater assessment has been prepared utilising private project based information and data collected and collated as part of recent groundwater assessments for the nearby Winchester South Project (SLR, 2020), Moorvale South Project (SLR, 2019a), Eagle Downs Mine (SLR, 2019c) and Olive Downs Project (HydroSimulations, 2018a). BMA has established groundwater data sharing agreements with the owners of each of these projects/mines, which allows for the sharing of groundwater data, models and documentation. Under these agreements, data utilised as part of each project/mine's groundwater assessment has been incorporated into this groundwater assessment where relevant.

2 Legislative Requirements and Relevant Guidelines

Legislation and guidelines relevant to the Project as they pertain to groundwater are outlined below.

2.1 Legislation

Relevant legislation in relation to taking or interfering with groundwater resources in the Project Area are the:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Queensland *Water Act 2000* (Water Act).
    - *Water Resource (Fitzroy Basin) Plan 2011.*
    - *Environmental Protection (Underground Water Management) and Other Legislation Amendment Act 2016.*
- Queensland *Environmental Protection Act 1994* (EP Act).
    - *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water and Wetland Biodiversity).

The following sections summarise Commonwealth and Queensland groundwater legislation and policy relevant to the Project.

2.1.1 Commonwealth Environment Protection and Biodiversity Act 1999

The EPBC Act is administered by the Department of Agriculture, Water and the Environment (DAWE). The EPBC Act is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES). Under the 2013 amendment to the EPBC Act, potentially significant impacts on groundwater resources were included where they pertain to a coal seam gas (CSG) or large coal mine development, known as the ‘water trigger’.

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) is a statutory committee established under the EPBC Act that provides scientific advice to the Commonwealth Environment Minister and relevant state ministers. Guidelines have been developed in order to assist the IESC in reviewing CSG or large coal mining development proposals that are likely to have significant impacts on water resources. This includes completion of an independent peer review of numerical groundwater modelling in accordance with the Australian Groundwater Modelling Guidelines (Barnett *et al*., 2012). The IESC information requirements checklist is presented in **Table 2-1**, with details on where aspects have been addressed and documented within the report.

Table 2-1 IESC Information Requirements Checklist

Assessment Item - Description of Proposal	
Context and Conceptualisation	**Section in Report**
Provide a regional overview of the proposed project area including a description of the geological basin; coal resource; surface water catchments; groundwater systems; water-dependent assets; and past, present and reasonably foreseeable coal mining and CSG developments.	Section 3, Section 4 and Section 5
Describe the proposal's location, purpose, scale, duration, disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	Section 1 and Section 7
Describe the statutory context, including information on the proposal's status within the regulatory assessment process and any applicable water management policies or regulations	Section 2
Describe how impacted water resources are currently being regulated under state or Commonwealth law, including whether there are any applicable standard conditions.	Section 2
Assessment Item – Risk Assessment	**Section in Report**
Identify and assess all potential environmental risks to water resources and water-related assets, and their possible impacts. In selecting a risk assessment approach consideration should be given to the complexity of the project, and the probability and potential consequences of risks.	Section 7
Incorporate causal mechanisms and pathways identified in the risk assessment in conceptual and numerical modelling. Use the results of these models to update the risk assessment.	Section 5.7 and Section 6
Assess risks following the implementation of any proposed mitigation and management options to determine if these will reduce risks to an acceptable level based on the identified environmental objectives.	Section 8
The risk assessment should include an assessment of: - all potential cumulative impacts which could affect water resources and water-related assets, and mitigation and - management options which the proponent could implement to reduce these impacts.	Section 7 and Section 8
Assessment Item – Groundwater	
Context and Conceptualisation	**Section in Report**
Describe and map geology at an appropriate level of horizontal and vertical resolution including: Definition of the geological sequence(s) in the area, with names and descriptions of the formations and accompanying surface geology, cross-sections and any relevant field data. Geological maps appropriately annotated with symbols that denote fault type, throw and the parts of sequences the faults intersect or displace.	Section 4
Provide data to demonstrate the varying depths to the hydrogeological units and associated standing water levels or potentiometric heads, including direction of groundwater flow, contour maps, and hydrographs. All boreholes used to provide this data should have been surveyed.	Section 4 and Section 5.3

Define and describe or characterise significant geological structures (e.g. faults, folds, intrusives) and associated fracturing in the area and their influence on groundwater – particularly groundwater flow, discharge or recharge. Site-specific studies (e.g. geophysical, coring/ wireline logging etc.) should give consideration to characterising and detailing the local stress regime and fault structure (e.g. damage zone size, open/closed along fault plane, presence of clay/shale smear, fault jogs or splays). Discussion on how this fits into the fault's potential influence on regional-scale groundwater conditions should also be included.	Section 5.2
Provide hydrochemical (e.g. acidity/alkalinity, electrical conductivity, metals, and major ions) and environmental tracer (e.g. stable isotopes of water, tritium, helium, strontium isotopes, etc.) characterisation to identify sources of water, recharge rates, transit times in aquifers, connectivity between geological units and groundwater discharge locations.	Section 5.4
Provide site-specific values for hydraulic parameters (e.g. vertical and horizontal hydraulic conductivity and specific yield or specific storage characteristics including the data from which these parameters were derived) for each relevant hydrogeological unit. In situ observations of these parameters should be sufficient to characterise the heterogeneity of these properties for modelling.	Section 5.2
Describe the likely recharge, discharge and flow pathways for all hydrogeological units likely to be impacted by the proposed development.	Section 5.3
Provide time series level and water quality data representative of seasonal and climatic cycles.	Section 5.3 and Section 5.4
Assess the frequency (and time lags if any), location, volume and direction of interactions between water resources, including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.	Section 5.3.7 and Section 5.6
Analytical and Numerical Modelling	**Section in Report**
Provide a detailed description of all analytical and/or numerical models used, and any methods and evidence (e.g. expert opinion, analogue sites) employed in addition to modelling.	Appendix B
Provide an explanation of the model conceptualisation of the hydrogeological system or systems, including multiple conceptual models if appropriate. Key assumptions and model limitations and any consequences should also be described.	Section 5.7
Undertaken groundwater modelling in accordance with the *Australian Groundwater Modelling Guidelines* (Barnett et al. 2012), including independent peer review.	Appendix B and Section 6
Consider a variety of boundary conditions across the model domain, including constant head or general head boundaries, river cells and drains, to enable a comparison of groundwater model outputs to seasonal field observations.	Appendix B
Calibrate models with adequate monitoring data, ideally with calibration targets related to model prediction (e.g. use baseflow calibration targets where predicting changes to baseflow).	Appendix B
Undertake sensitivity analysis and uncertainty analysis of boundary conditions and hydraulic and storage parameters, and justify the conditions applied in the final groundwater model (see Middlemis and Peeters 2018).	Appendix B
Describe each hydrogeological unit as incorporated in the groundwater model, including the thickness, storage and hydraulic characteristics, and linkages between units, if any.	Appendix B
Provide an assessment of the quality of, and risks and uncertainty inherent in, the data used to establish baseline conditions and in modelling, particularly with respect to predicted potential impact scenarios.	Appendix B

Describe the existing recharge/discharge pathways of the units and the changes that are predicted to occur upon commencement, throughout, and after completion of the proposed project.	Section 5.3 and Section 6.6
Undertake an uncertainty analysis of model construction, data, conceptualisation and predictions (see Middlemis and Peeters 2018).	Appendix B
Describe the various stages of the proposed project (construction, operation and rehabilitation) and their incorporation into the groundwater model. Provide predictions of water level and/or pressure declines and recovery in each hydrogeological unit for the life of the project and beyond, including surface contour maps for all hydrogeological units.	Section 6 and Appendix B
Provide a program for review and update of models as more data and information become available, including reporting requirements.	Appendix B
Identify the volumes of water predicted to be taken annually with an indication of the proportion supplied from each hydrogeological unit.	Section 6.2 and Appendix B
Provide information on the magnitude and time for maximum drawdown and post-development drawdown equilibrium to be reached.	Section 6 and Appendix B
Undertake model verification with past and/or existing site monitoring data.	Appendix B
Impacts to Water Resources and Water-Dependent Assets	**Section in Report**
Provide an assessment of the potential impacts of the proposal, including how impacts are predicted to change over time and any residual long-term impacts. Consider and describe: - any hydrogeological units that will be directly or indirectly dewatered or depressurised, including the extent of impact on hydrological interactions between water resources, surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water. - the effects of dewatering and depressurisation (including lateral effects) on water resources, water-dependent assets, groundwater, flow direction and surface topography, including resultant impacts on the groundwater balance. - the potential impacts on hydraulic and storage properties of hydrogeological units, including changes in storage, potential for physical transmission of water within and between units, and estimates of likelihood of leakage of contaminants through hydrogeological units. - the possible fracturing of and other damage to confining layers. - For each relevant hydrogeological unit, the proportional increase in groundwater use and impacts as a consequence of the proposed project, including an assessment of any consequential increase in demand for groundwater from towns or other industries resulting from associated population or economic growth due to the proposal.	Section 7
Describe the water resources and water-dependent assets that will be directly impacted by mining or CSG operations, including hydrogeological units that will be exposed/partially removed by open cut mining and/or underground mining.	Section 7
For each potentially impacted water resource, provide a clear description of the impact to the resource, the resultant impact to any water-dependent assets dependent on the resource, and the consequence or significance of the impact.	Section 7
Describe existing water quality guidelines, environmental flow objectives and other requirements (e.g. water planning rules) for the groundwater basin(s) within which the development proposal is based.	Section 2 and Section 5.4
Provide an assessment of the cumulative impact of the proposal on groundwater when all developments (past, present and/or reasonably foreseeable) are considered in combination.	Section 6.5

Describe proposed mitigation and management actions for each significant impact identified, including any proposed mitigation or offset measures for long-term impacts post mining.	Section 8
Provide a description and assessment of the adequacy of proposed measures to prevent/minimise impacts on water resources and water-dependent assets.	Section 8
Data and Monitoring	**Section in Report**
Provide sufficient data on physical aquifer parameters and hydrogeochemistry to establish pre-development conditions, including fluctuations in groundwater levels at time intervals relevant to aquifer processes.	Section 5.2 and Section 5.3
Provide long-term groundwater monitoring data, including a comprehensive assessment of all relevant chemical parameters to inform changes in groundwater quality and detect potential contamination events.	Section 5.4
Develop and describe a robust groundwater monitoring program using dedicated groundwater monitoring wells – including nested arrays where there may be connectivity between hydrogeological units – and targeting specific aquifers, providing an understanding of the groundwater regime, recharge and discharge processes and identifying changes over time.	Section 5.1
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy (NWQMS) guidelines (ANZG 2018) and relevant legislated state protocols (e.g. QLD Government 2013).	Section 8.2.1
Develop and describe proposed targeted field programs to address key areas of uncertainty, such as the hydraulic connectivity between geological formations, the sources of groundwater sustaining GDEs, the hydraulic properties of significant faults, fracture networks and aquitards in the impacted system, etc., where appropriate.	Section 5.1.1, Section 5.2, Section 5.5.1, Section 5.6.1 and Appendix A3
Assessment Item – Water-dependent assets	
Context and conceptualisation	**Section in Report**
Identify water-dependent assets, including: water-dependent fauna and flora and provide surveys of habitat, flora and fauna (including stygofauna) (see Doody et al. 2019). public health, recreation, amenity, Indigenous, tourism or agricultural values for each water resource.	Section 5.5 and Section 5.6
Estimate the ecological water requirements of identified GDEs and other water-dependent assets (see Doody et al. 2019).	Section 5.6
Identify the hydrogeological units on which any identified GDEs are dependent (see Doody et al. 2019).	Section 5.6.1
Identify GDEs in accordance with the method outlined by Eamus et al. (2006). Information from the GDE Toolbox (Richardson et al. 2011) and GDE Atlas (CoA 2017a) may assist in identification of GDEs (see Doody et al. 2019).	Section 5.6
Provide an outline of the water-dependent assets and associated environmental objectives and the modelling approach to assess impacts to the assets.	Section 6 and Section 7
Describe the conceptualisation and rationale for likely water-dependence, impact pathways, tolerance and resilience of water-dependent assets. Examples of ecological conceptual models can be found in Commonwealth of Australia (2015).	Section 5.6
Describe the process employed to determine water quality and quantity triggers and impact thresholds for water-dependent assets (e.g. threshold at which a significant impact on an asset may occur).	Section 7

Impacts, risk assessment and management of risks	**Section in Report**
Provide an assessment of direct and indirect impacts on water-dependent assets, including ecological assets such as flora and fauna dependent on surface water and groundwater, springs and other GDEs (see Doody et al. 2019).	Section 5.6
Provide estimates of the volume, beneficial uses and impact of operational discharges of water (particularly saline water), including potential emergency discharges due to unusual events, on water-dependent assets and ecological processes.	Section 7.3
Describe the potential range of drawdown at each affected bore, and clearly articulate of the scale of impacts to other water users.	Section 7.2
Assess the overall level of risk to water-dependent assets through combining probability of occurrence with severity of impact.	Section 7
Indicate the vulnerability to contamination (e.g. from salt production and salinity) and the likely impacts of contamination on the identified water-dependent assets and ecological processes.	Section 7.4
Identify the proposed acceptable level of impact for each water-dependent asset based on leading-practice science and site-specific data, and ideally developed in conjunction with stakeholders.	Section 7.2
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion and habitat fragmentation of water-dependent species and communities.	Section 8
Propose mitigation actions for each identified impact, including a description of the adequacy of the proposed measures and how these will be assessed.	Section 8
Data and Monitoring	**Section in Report**
Identify an appropriate sampling frequency and spatial coverage of monitoring sites to establish pre-development (baseline) conditions, and test potential responses to impacts of the proposal (see Doody et al. 2019).	Section 8.2
Develop and describe a monitoring program that identifies impacts, evaluates the effectiveness of impact prevention or mitigation strategies, measures trends in ecological responses and detects whether ecological responses are within identified thresholds of acceptable change (see Doody et al. 2019).	Section 8.2.1
Consider concurrent baseline monitoring from unimpacted control and reference sites to distinguish impacts from background variation in the region (e.g. BACI design, see Doody et al. 2019).	Section 8.2
Describe the proposed process for regular reporting, review and revisions to the monitoring program.	Section 8.2.3
Ensure ecological monitoring complies with relevant state or national monitoring guidelines (e.g. the DSITI guideline for sampling stygofauna (QLD Government 2015)).	Terrestrial Ecology Assessment
Assessment Item – Water and salt balance, and water quality	**Section in Report**
Provide a quantitative site water balance model describing the total water supply and demand under a range of rainfall conditions and allocation of water for mining activities (e.g. dust suppression, coal washing etc.), including all sources and uses.	Surface Water and Flooding Assessment
Provide estimates of the quality and quantity of operational discharges under dry, median and wet conditions, potential emergency discharges due to unusual events and the likely impacts on water-dependent assets.	Surface Water and Flooding Assessment

Describe the water requirements and on-site water management infrastructure, including modelling to demonstrate adequacy under a range of potential climatic conditions.	Surface Water and Flooding Assessment
Provide salt balance modelling that includes stores and the movement of salt between stores, and takes into account seasonal and long-term variation.	N/A
Assessment Item – Cumulative Impacts	
Context and conceptualisation	**Section in Report**
Provide cumulative impact analysis with sufficient geographic and temporal boundaries to include all potentially significant water-related impacts.	Section 6
Consider all past, present and reasonably foreseeable actions, including development proposals, programs and policies that are likely to impact on the water resources of concern in the cumulative impact analysis. Where a proposed project is located within the area of a bioregional assessment consider the results of the bioregional assessment.	Appendix B
Impacts	**Section in Report**
Provide an assessment of the condition of affected water resources which includes: - identification of all water resources likely to be cumulatively impacted by the proposed development - a description of the current condition and quality of water resources and information on condition trends - identification of ecological characteristics, processes, conditions, trends and values of water resources - adequate water and salt balances, and - identification of potential thresholds for each water resource and its likely response to change and capacity to withstand adverse impacts (e.g. altered water quality, drawdown).	Section 5.3 and Section 7
Assess the cumulative impacts to water resources considering: - the full extent of potential impacts from the proposed project, (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts), and encompassing all linkages, including both direct and indirect links, operating upstream, downstream, vertically and laterally - all stages of the development, including exploration, operations and post closure/decommissioning - appropriately robust, repeatable and transparent methods - the likely spatial magnitude and timeframe over which impacts will occur, and significance of cumulative impacts, and - opportunities to work with other water users to avoid, minimise or mitigate potential cumulative impacts.	Section 7
Mitigation, monitoring and management	**Section in Report**
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts. Evidence of the likely success of these measures (e.g. case studies) should be provided.	Section 8
Identify cumulative impact environmental objectives.	Section 8
Identify measures to detect and monitor cumulative impacts, pre and post development, and assess the success of mitigation strategies.	Section 8
Describe appropriate reporting mechanisms.	Section 8
Propose adaptive management measures and management responses.	Section 8

Assessment Item – Final landform and voids – coal mines	Section in Report
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.	Surface Water and Flooding Assessment
Assess the adequacy of modelling, including surface water and groundwater quantity and quality, lake behaviour, timeframes and calibration.	Appendix B
Provide an evaluation of stability of void slopes where failure during extreme events or over the long term (for example due to aquifer recovery causing geological heave and landform failure) may have implications for water quality.	Land Resources Assessment
Provide an assessment of the long-term impacts to water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider: - groundwater behaviour – sink or lateral flow from void. - water level recovery – rate, depth, and stabilisation point (e.g. timeframe and level in relation to existing groundwater level, surface elevation). - seepage – geochemistry and potential impacts. - long-term water quality, including salinity, pH, metals and toxicity. - measures to prevent migration of void water off-site. For other final landform options considered sufficient detail of potential impacts should be provided to clearly justify the proposed option.	Section 6.6 and Section 7.4
Evaluate mitigating inflows of saline groundwater by planning for partial backfilling of final voids.	Section 4.3
Assess the probability of overtopping of final voids with variable climate extremes, and management mitigations.	Section 6.6
Assessment Item – Acid-forming materials and other contaminants of concern	**Section in Report**
Identify the presence and potential exposure of acid-sulphate soils (including oxidation from groundwater drawdown).	Geochemistry Assessment
Describe handling and storage plans for acid-forming material (co-disposal, tailings dam, and encapsulation).	Geochemistry Assessment
Identify the presence and volume of potentially acid-forming waste rock, fine-grained amorphous sulphide minerals and coal reject/tailings material and exposure pathways.	Section 5.4.4
Assess the potential impact to water-dependent assets, taking into account dilution factors, and including solute transport modelling where relevant, representative and statistically valid sampling, and appropriate analytical techniques.	Section 5.4.4
Identify other sources of contaminants, such as high metal concentrations in groundwater, leachate generation potential and seepage paths.	Section 7.4
Describe proposed measures to prevent/minimise impacts on water resources, water users and water-dependent ecosystems and species.	Section 8

2.1.2 Queensland Water Act 2000

The Water Act, supported by the subordinate Water Regulation 2016, is the primary legislation regulating groundwater resources in Queensland. The purpose of the Water Act is to advance sustainable management and efficient use of water resources by establishing a system for planning, allocation and use of water.

The Water Act was amended in 2014 with introduction of the *Water Reform and Other Legislation Amendment Act 2014* (WROLA Act). Changes to this legislation included giving new mines a limited statutory right to take groundwater they intercept through routine mining activities (‘associated water’); for example, the groundwater contained within coal seams that is removed with extraction of the coal. The WROLA Act was later amended in 2016 with the introduction of the *Water Legislation Amendment Act 2015* and the *Environmental Protection (Underground Water Management) and Other Legislation Amendment Act 2016* (EPOLA Act), which came into effect on 6th December 2016. The EPOLA Act amends the EP Act and Water Act (Chapter 3), and removes the statutory right to water, requiring applicants to quantify and be licenced for the take of ‘associated water’. That is, project proponents may be required to apply for and obtain an Associated Water License (AWL) under the Water Act. A component of the AWL application process includes greater emphasis on baseline data collection for environmental assessments. In addition, mine applications that are granted an AWL can be required to verify and update groundwater impact predictions through an underground water impact report (UWIR) three years following project approval, or at a frequency prescribed by the chief executive.

Management framework relevant to the Project

The Water Act is enacted under a framework of catchment specific Water Resource Plans (WRPs). A WRP provides a management framework for water resources in a plan area, and includes outcomes, objectives and strategies for maintaining balanced and sustainable water use in that area. Resource Operations Plans (ROPs) implement the outcomes and strategies of WRPs. Groundwater Management Areas (GMAs) and their component groundwater units are defined under WRPs. Authorisation is required to take non-associated groundwater from a regulated GMA or groundwater unit for specified purposes. The specified purposes are defined under a WRP, the Water Regulation 2016 or a local water management policy.

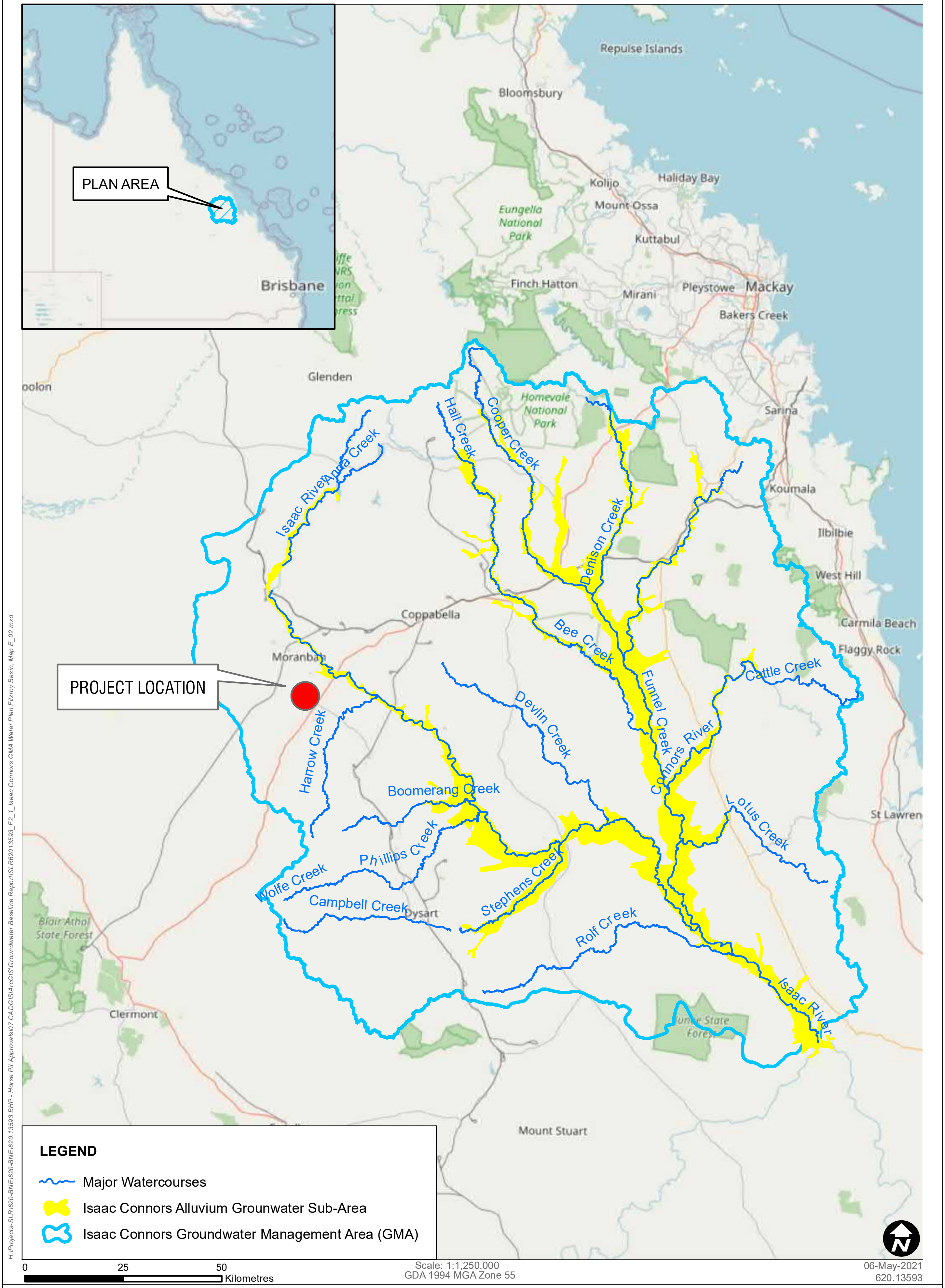
Water resources within the Project Area are captured under the Water Plan (Fitzroy Basin) 2011. The plan covers surface water (zone WQ1301) associated with Isaac River, and groundwaters (zone WQ1310 – Fitzroy Basin groundwaters).

As part of the Project, BMA is proposing to exercise underground water rights during the period in which resource activities will be carried out at ML 1775. The Project will affect groundwater within the Isaac Connors Groundwater Management Area (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. This relates to both Groundwater Unit 1 (containing aquifers of the Quaternary alluvium) and Groundwater Unit 2 (sub-artesian aquifers) as shown in **Figure 2-1**. The extent of Groundwater Unit 1 (Isaac Connors Alluvium Groundwater Sub-area) is based on the mapped extent of Quaternary alluvium, which, whilst not mapped within the Project footprint, may be connected and interact with aquifers within the Project Area. As discussed further in **Section 4.2**, the extent of alluvium has been refined based on information specific to the Study Area.

Water Act declared watercourses and drainage

The Water Act includes criteria for determining watercourses that require authorisation under the Water Act to take water, interfere with the flow of water, take quarry material or excavate and place fill in a watercourse. The Water Act also includes criteria for drainage features that may require authorisation to take or interfere with overland flow. In the Study Area, the Isaac River, Horse Creek and Cherwell Creek are defined as a watercourse under the Water Act criteria, and several small tributaries of these watercourses that traverse the Project Area are defined as drainage features.

These declared watercourses and drainage features may be relevant to the groundwater assessment for the Project if there is a component of surface water-groundwater interaction associated with them.



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H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Baseline Report\SLR62013593_F2_1_Isaac Connors GMA Water Plan Fitzroy Basin, Map E_02.mxd

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Isaac Connors Alluvium GMA (Water Plan (Fitzroy Basin, Map E))

FIGURE 2-1

2.1.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The EPP Water and Wetland Biodiversity aims to achieve objectives set out by the EP Act and applies to all waters of Queensland. EPP Water provides a framework to protect and/or enhance the suitability of Queensland waters for various beneficial uses by:

- Identifying environmental values and management goals for Queensland waters;
- Providing state water quality guidelines and water quality objectives (WQO) to enhance or protect the environmental values;
- Providing a framework for making consistent, equitable and informed decisions;
- Monitoring and reporting on the condition of Queensland waters.

Groundwater resources within the vicinity of the Project are scheduled under the EPP Water and Wetland Biodiversity as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). The legislated EVs for these groundwaters are:

- Biological integrity of aquatic ecosystems;
- Human use EVs:
  - Suitability of water supply for irrigation;
  - Farm water supply/use;
  - Stock watering;
  - Primary recreation;
  - Drinking water supply;
  - Cultural and spiritual values.

The EPP Water and Wetland Biodiversity also provides limited water quality objectives for underground aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs provided in the EPP Water and Wetland Biodiversity are classified by groundwater depth and regional chemistry zone.

Surface water resources within the vicinity of the Project are scheduled under the EPP Water and Wetland Biodiversity as:

- Waters of the Isaac northern tributaries of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1301);
- Waters of the Isaac and lower Connors River main channel of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1301).

The legislated EVs for these surface waters are:

- Biological integrity of aquatic ecosystems;
- Human use EVs:
  - Suitability of water supply for irrigation;
  - Farm water supply/use;
  - Stock watering;

- Human consumption;
- Primary recreation;
- Secondary recreation;
- Visual recreation;
- Drinking water supply;
- Industrial water supply;
- Cultural and spiritual values.

The surface water WQOs for both the Isaac northern tributaries of the Isaac River Sub-basin of the Fitzroy Basin water plan and the Isaac and lower Connors River main channel of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1301) may be relevant to the groundwater assessment for the Project if there is a component of surface water-groundwater interaction associated with them.

2.1.4 Environmental Authority

Under the EP Act, an environmental assessment is required as part of the application for an Environmental Authority (EA), or the application for an amendment to an existing EA, to undertake an environmentally relevant activity. The process assesses the potential environmental impact of the Project, and how impacts should be avoided, minimised and managed. The DES is responsible for the administration and delivery of applications for an EA, and amendment applications.

Minimum reporting requirements for groundwater impact assessments are outlined within the EP Act Guideline *Requirements for site-specific and amendment applications – underground water rights*. A summary of the guideline requirements and where they have been addressed within this report is provided in **Table 2-2**.

Table 2-2 Requirement for Site Specific and Amendment Applications – Underground Water Rights

	Detail	Section in Report
Part A	A statement that the applicant proposes to exercise underground water rights.	Section 2
Part B	A description of the area/s in which underground water rights are proposed to be exercised.	Section 1
Part C	A description of the aquifer/s affected or likely to be affected.	
	• Aquifer type (confined, unconfined, fractured etc)	Section 5.3
	• Geology/ stratigraphy for each aquifer	Section 4
	• Depth to and thickness of the aquifers	Section 4
	• Physical integrity of the aquifer, fluvial processes and morphology	Section 5
	• Depth to water level and seasonal changes in levels	Section 5
	• Hydrogeological cross sections	Section 4.2 and Section 5.7

	Detail	Section in Report
	• Maps (spatial extent)	Section 4 and Section 5.3
Part D	An analysis of the movement of underground water to and from the aquifer.	
	• Inputs (i.e. recharge) and outputs (i.e. baseflow and abstraction);	Section 5.3
	• Underground water elevations (i.e. mapped groundwater flow directions);	Section 5.3
	• Connectivity between aquifers and hydraulic properties;	Section 5.2
	• Preferential flow pathways (i.e. faults);	Section 5.3
	• Springs.	Section 5.6
Part E	A description of the area of the aquifer where the water level is predicted to decline because of the exercise of underground water rights.	Section 6
	Predictions should: • Be made for the life of the resource project and for post resource tenure closure; • Be made about the timing, spatial extent and magnitude of maximum water level declines in affected aquifers; • Be made about the timing and magnitude of groundwater level equilibrium in affected aquifers.	Section 6.3
	Produce potentiometric contour maps showing maximum predicted water level decline for each affected aquifer.	Section 6.3
	Modelling methodology, including: • Model type (e.g. numerical or analytical); • Modelling platform; • Model inputs; • Model boundary conditions; • Model assumptions and limitations; • Sensitivity analysis and calibration results.	Appendix B
Part F	The predicted quantities of water to be taken or interfered with because of the exercise of underground water rights.	Section 6.2
	Details on the methodology used for measuring extraction volumes and developing the extraction schedule.	Appendix B
Part G	Information on predicted impacts to the quality of groundwater that will, or may, happen because of the exercise of underground water rights.	Section 7.4
	Identify the quality of the groundwater prior to the resource activity commencing.	Section 5.4
	Explain the variation of chemical concentrations as a result of chemical reactions over the life of the project due to the exercise of underground water rights (i.e. changes in salinity and concentration of dissolved gas).	Section 5.4.4 and Section 7.4

	Detail	Section in Report
	Estimate extent and likelihood of groundwater quality impacts, with justification based on potential sources of contamination.	Section 7.4
Part H	Identifying and describing environmental values: • Information on the environmental values that will, or may, be affected by the exercise of underground water rights; • Describe and define environmental value of aquifers, presenting available raw data used. • Document groundwater use, including details on operating bores within the areas predicted to be affected by the exercise of underground water rights.	Section 5 and Appendix A3
	Nature and extent of the impacts on the environmental values (risk assessment): • The magnitude, relative size or actual extent of any impact in relation to the environmental value being affected; • The vulnerability or resilience of the environmental value (severity and duration) Uncertainty of impacts and any assumptions.	Section 7
	Surface subsidence impacts.	Not applicable
Part I	Information on strategies for avoiding, mitigating or managing the predicted impacts on the environmental values or predicted impacts on the quality of groundwater. Strategies for avoiding, mitigating and managing the predicted impacts on both environmental values and predicted changes in groundwater quality should include: • Objectives which define the outcomes that are intended to be achieved (i.e. avoiding, mitigating and managing the predicted impacts) and a description of unavoidable impacts to environmental values; • Measures (specific methods/procedures/tools) to be implemented to demonstrate how the objectives will be achieved; • Indicators relevant to protection of the environmental values (i.e. indicators are the values that are to be measured to gauge whether the objectives are being achieved and are used to are to be used in auditing the performance of measures); • A program for monitoring the indicators (see EP Act Guideline for requirements); • A reporting program which includes triggers for the review of the strategies, and identifies additional data, assessment, analysis and reporting requirements.	Section 8

2.1.5 Relevant Guidelines

There are several available guidelines designed to assist project proponents to meet the relevant legislative requirements to complete a groundwater assessment for coal mining proposals such as this Project. These guidelines are:

- Queensland Department of Environment and Science *Guideline - Requirements for site-specific and amendment applications—underground water rights* - EP Act;
- Queensland Department of Environment and Science *Guideline - Underground water impact reports and final reports* - Water Act;

- *Information guidelines for proponents preparing coal seam gas and large coal mining development proposals* – EPBC Act;
- *Information Guidelines explanatory note. Uncertainty analysis—Guidance for groundwater modelling within a risk management framework* – EPBC Act;
- *Information Guidelines Explanatory Note. Assessing groundwater-dependent ecosystems* – EPBC Act;
- *Australian groundwater modelling guidelines*. Waterlines report. National Water Commission, Canberra, 2012.

3 Existing Conditions

3.1 Climate

The climate at the Study Area is sub-tropical with higher temperatures, higher rainfall and higher evaporation occurring over the summer months (December to February). The closest Bureau of Meteorology (BoM) weather station is located at Moranbah Airport (station 34035), 1.5 km to the north-east of the project. This Moranbah weather station has been in operation since 2012. The nearest weather station with a longer data record is Wentworth (034015) located approximately 35km to the west of the Project. The Wentworth weather station has been in operation since 1963 and has a continuous record with only a few occasional months of missing data. **Table 3-1** provides the details of the nearby operational weather stations.

Table 3-1 Operational BoM weather stations near the Project

Name	Site Number	Date Commenced	Easting	Northing	Elevation (mAHD)	Operational Status	Distance from Project
Moranbah Airport	34035	2012	610999	7559653	232	Open	1.5 km NE
Wentworth	34015	1963	574284	7559250	225	Open	34 km W
Iffley	34100	1998	647356	7539801	173	Open	40 km SE
Carfax	34016	1962	673063	7515595	128	Open	75 km SE

mAHD = metres Australian Height Datum.

SILO Grid point data (Latitude: -22.10, Longitude: 148.05) was used to assess long-term rainfall trends in the vicinity of the Project. This dataset is interpolated from quality checked observational timeseries data collected at nearby stations by the BoM. Data from January 1900 until February 2021 was used to assess the long-term rainfall trends in the vicinity of the Project. From this data, the average annual site rainfall is 542.4 millimetres (mm). The two highest annual rainfalls were recorded for the years 1910 and 2010, with annual rainfalls of 961.5 mm and 1,059 mm, respectively. The minimum annual rainfall occurred in 1948 with 206.9 mm. Monthly averages for the two stations discussed as well as the SILO grid point are listed in **Table 3-2**.

Table 3-2 Average Monthly Rainfall

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Moranbah Airport	92.0	100.6	92.7	23.8	30.2	16.7	28.0	9.0	8.3	24.0	38.3	63.0	523.7
Wentworth	87.8	75.6	52.7	26.5	29.9	18.1	15.7	19.3	8.3	28.4	51.5	82.0	493.2
SILO Grid Point Data	99.0	92.0	61.5	29.3	25.5	26.5	19.9	17.2	13.2	28.5	49.8	80.2	542.4

Source: http://www.bom.gov.au/climate/data/index.shtml

Note: SILO Grid point data coordinates are Latitude: -22.10 and Longitude: 148.05.

Rainfall trends for Wentworth over the past century are indicated by analysis of the residual mass curve (RMC) (**Figure 3-1**). Positive gradients on this curve (rising limbs) confirm wetter conditions than normal, while negative gradients (falling limbs) indicate dry conditions. Average rainfall conditions are inferred during periods of stable residual mass. **Figure 3-1** shows that, over the past 50 years, the wettest periods occurred during 1973-1979, and in 2010. The driest periods were 1963-1970, 1991-1998 and 2001-2006. As shown by the declining trend in the RMC, the Site is currently experiencing drier than average conditions.

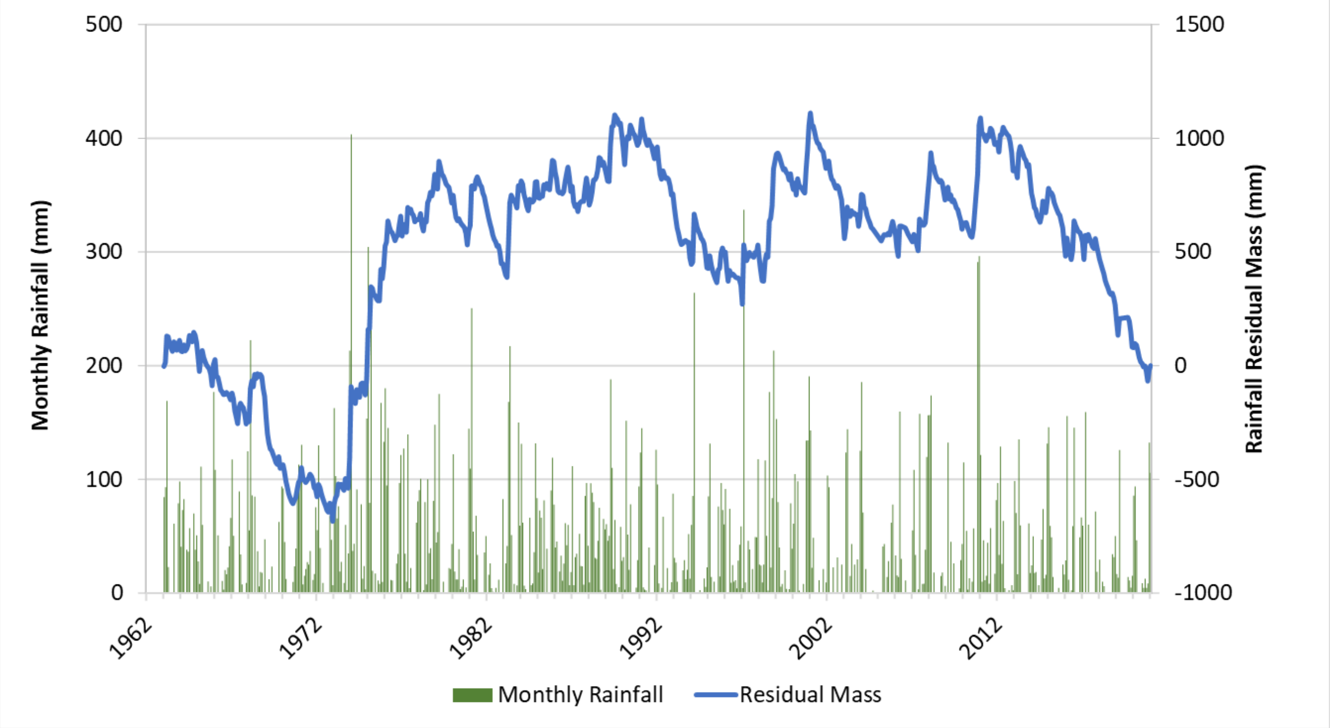


Figure 3-1 Long-term Monthly Rainfall and Rainfall Residual Mass Curve at Wentworth (Station 34016)

The RMC performs an additional service: if rainfall recharge is a significant source of groundwater, the temporal variability in recorded groundwater levels can be expected to mimic the pattern of this curve. That is, natural fluctuations in the groundwater table result from temporal changes in rainfall recharge to groundwater systems. Typically, changes in groundwater elevation reflect the deviation between the long-term monthly (or yearly) average rainfall, and the actual rainfall, illustrated by the rainfall RMC. Groundwater hydrographs showing the relationship between rainfall and groundwater levels are assessed in **Section 5**.

Actual and potential evapotranspiration (ET) have been taken from BoM's Australia wide interpolation dataset at the locations of the weather stations (BoM, 2018). The potential ET in the district is about 2,100 mm/yr according to BoM (2012) (**Table 3-3**). The definition of potential ET is: "*… the ET that would take place, under the condition of unlimited water supply, from an area so large that the effects of any upwind boundary transitions are negligible and local variations are integrated to an areal average*". For example, this represents the ET which would occur over a very large wetland or large irrigated area, with a never-ending water inflow. Further to this, where the water table approaches the ground surface, ET can also approach the potential ET value.

Table 3-3 Average Monthly Potential Evapotranspiration

PE (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Moranbah Airport	244	201	205	173	143	119	134	165	205	248	256	263	2,355
Wentworth	247	205	209	176	145	120	134	168	208	253	261	268	2,395

PE = Potential Evapotranspiration.

The actual ET in the district is about 1,105 mm/year according to BoM (2012) (**Table 3-4**). The definition for actual ET is: "*... the ET that actually takes place, under the condition of existing water supply, from an area so large that the effects of any upwind boundary transitions are negligible and local variations are integrated to an areal average*". For example, this represents the predicted ET that is occurring over a large area of land under the existing (mean) rainfall conditions.

Table 3-4 Average Monthly Actual Evapotranspiration

AE (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Moranbah Airport	132	121	118	87	57	40	45	66	85	106	119	129	1,105
Wentworth	123	115	112	81	53	37	42	59	77	96	107	119	1,021

AE = Actual Evapotranspiration.

Figure 3-2 shows that the average potential monthly ET exceeds the average monthly rainfall over the entire year, often by more than double. Average actual ET is slightly greater than average rainfall for all months.

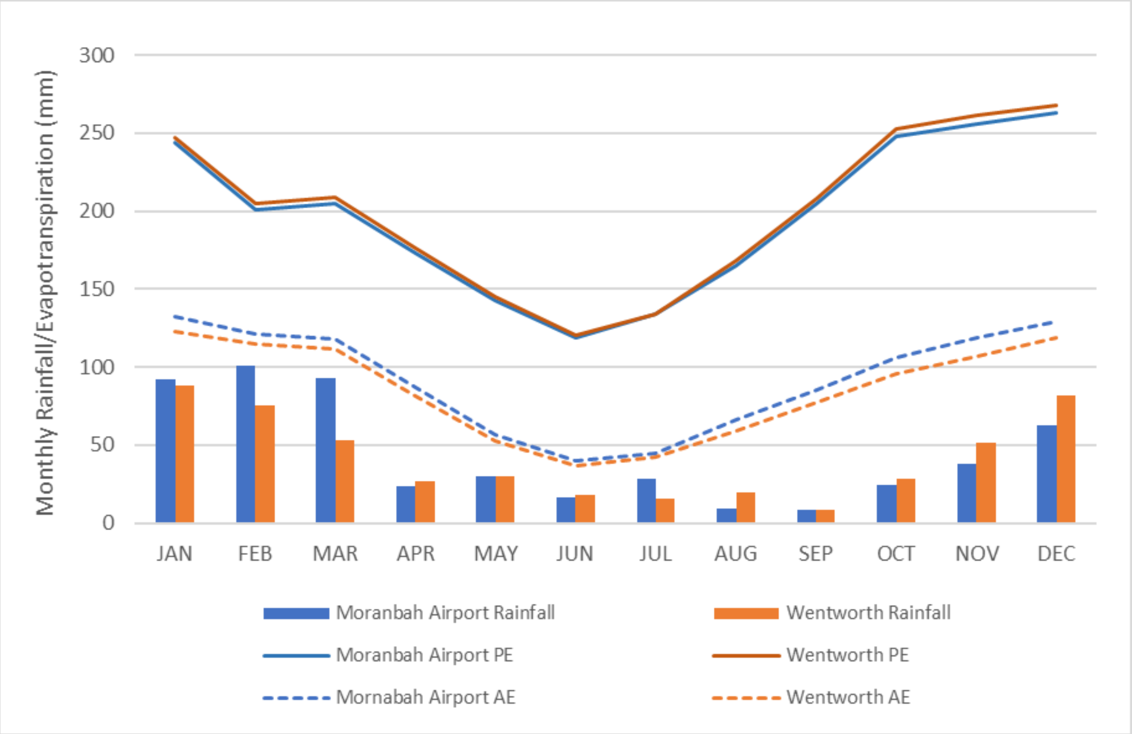


Figure 3-2 Average Monthly Rainfall and Evapotranspiration at Nearby Weather Stations

3.2 Topography and Drainage

The Project is located in the Isaac Connors surface water catchment, a sub-catchment of the upper Fitzroy Basin. The topography of the Project Area is relatively flat with gentle undulation and average elevations of approximately 200 mAHD (**Figure 3-3**). Elevations across the Project Area in general range between approximately 274 mAHD in the east to 220 mAHD in the west. The topography gently grades (<1% slope) east-north east towards the Isaac River, where elevations are approximately 200 mAHD.

The Isaac River, located approximately 13k m directly northeast of the Project Area, is the major drainage feature of the region and flows from northwest to southeast (**Figure 3-3**). Drainage across the Project Area is divided by a relatively indistinct ridgeline dividing a northern and southern watershed (URS, 2009). The northern watershed includes Horse Creek and tributaries and the southern watershed includes Nine Mile Creek, Caval Creek, Harrow Creek, Cherwell Creek and tributaries. Nine Mile Creek and Caval Creek join Cherwell Creek within the Project Area, with Harrow Creek joining Cherwell Creek downstream of the Project Area.

Cherwell Creek, located approximately 4 km directly southeast of the Project Area, is a secondary drainage feature in the region and flows from northeast to southwest (**Figure 3-3**). The confluence of Cherwell Creek to the Isaac River is approximately 18 km east of the Project at an elevation of 200 mAHD. Cherwell Creek is used as a controlled release point by Caval Ridge Mine (authorised under Environmental Authority (EA) number EPML00562013). Horse Creek, adjacent to the Project northern boundary, joins Grosvenor Creek downstream of the Project Area, before joining the Isaac River to the east.

All watercourses and tributaries within and in the vicinity of the Project Area are ephemeral and only flow briefly after rainfall. After significant rainfall, water remains in ponds that are used as livestock water sources.

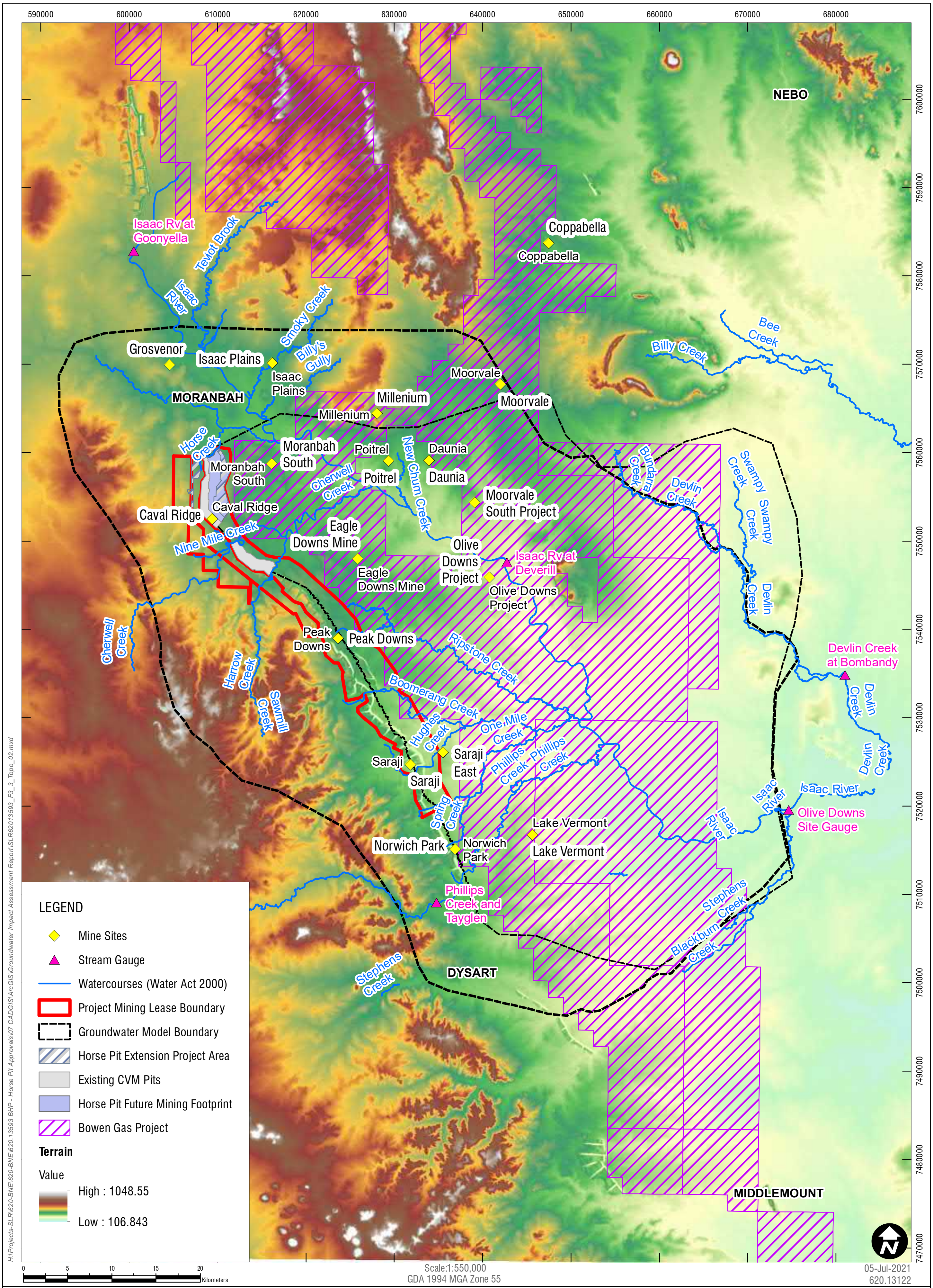
There is a DoR gauging station located at Isaac River at Deverill (station 130410A), located approximately 1.8 km downstream of the Isaac River and Cherwell Creek confluence. A gauging station referred to as both ‘ISDS' and ‘Olive Downs Site Gauge’ has also been installed downstream of the Study Area in the Isaac River at the bridge on Fitzroy Developmental Road, just downstream of the confluence with Stephens Creek. Data records are taken at 10 minute intervals, with logging commencing on 22 December 2016. As at 22 April 2018, five flow events (peak flow greater than 1 m^3/s) have been recorded at this gauge. The greatest discharge as recorded in March 2018 at 804 m^3/s.

Table 3-5 presents a summary of stream gauge stations along the Isaac River near the Project, derived from the DoR Water Monitoring Information Portal (WMIP) (DoR, 2019). **Figure 3-3** shows the relative locations of the stream gauging stations except for Isaac River at Yatton which is located south east beyond the figure extents.

Table 3-5 DoR Stream Gauging Stations

Station Location	Number	Distance from Project	Zero-gauge Elevation (mAHD)	Mean Flow (ML/day)	Max Flow (GL/day)	Max Flow Date
Isaac River at Deverill	130410A	34km downstream (along river channel, located south east of the Project)	169.30	439	228	Mar 1988
ISDS / Olive Downs Site Gauge	-	80 km downstream (along river channel, located south east of the Project)	136.93	-	-	-
Isaac River at Goonyella	130414A	28 km upstream (along river channel, located north of the Project)	230.06	146	150	Jan 1991
Isaac River at Yatton	130401A	145 km downstream (along river channel, located south east of the Project)	89.15	5393	2060	Mar 2017

ML/day = megalitres per day, GL/day = gigalitres per day.



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Topography and Drainage

FIGURE 3-3

Figure 3-4 presents daily mean stream discharge at the Isaac River at Deverill station (130410A) from 1968 to January 2021, compared against daily rainfall at Wentworth station (34015). The graphs show that flows within the Isaac River are typically ephemeral, with short-duration flows generally occurring over the summer months.

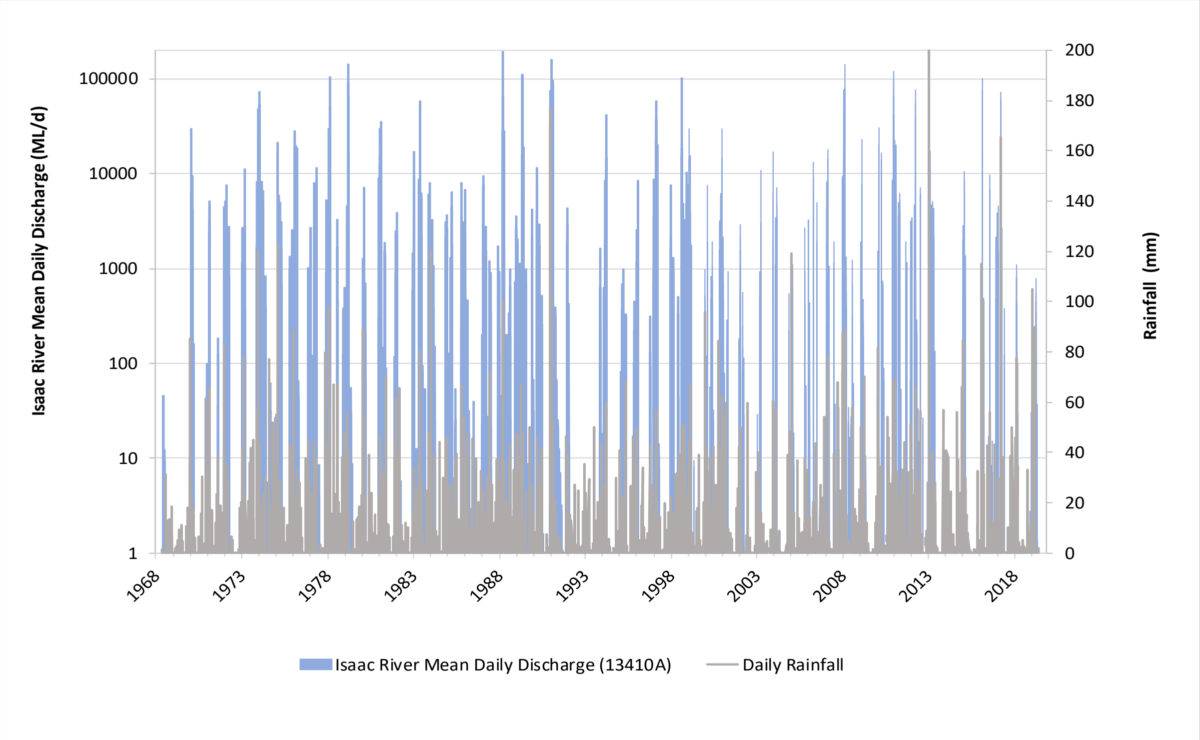


Figure 3-4 Isaac River (Station 130410A) Stream Flow and Rainfall at Wentworth (Station 34015)

Based on daily flow data since 1968, **Figure 3-5** shows that the Isaac River flows only 27 percent of the time, with less than 11 % probability of flows exceeding 100 ML/day. Less than 1 % of readings exceed 10,000 ML/day, which includes high flow/flood events in 2008 (January and February), 2010 (December), 2012 (March), 2016 (February), 2017 (March) and 2021 (January).

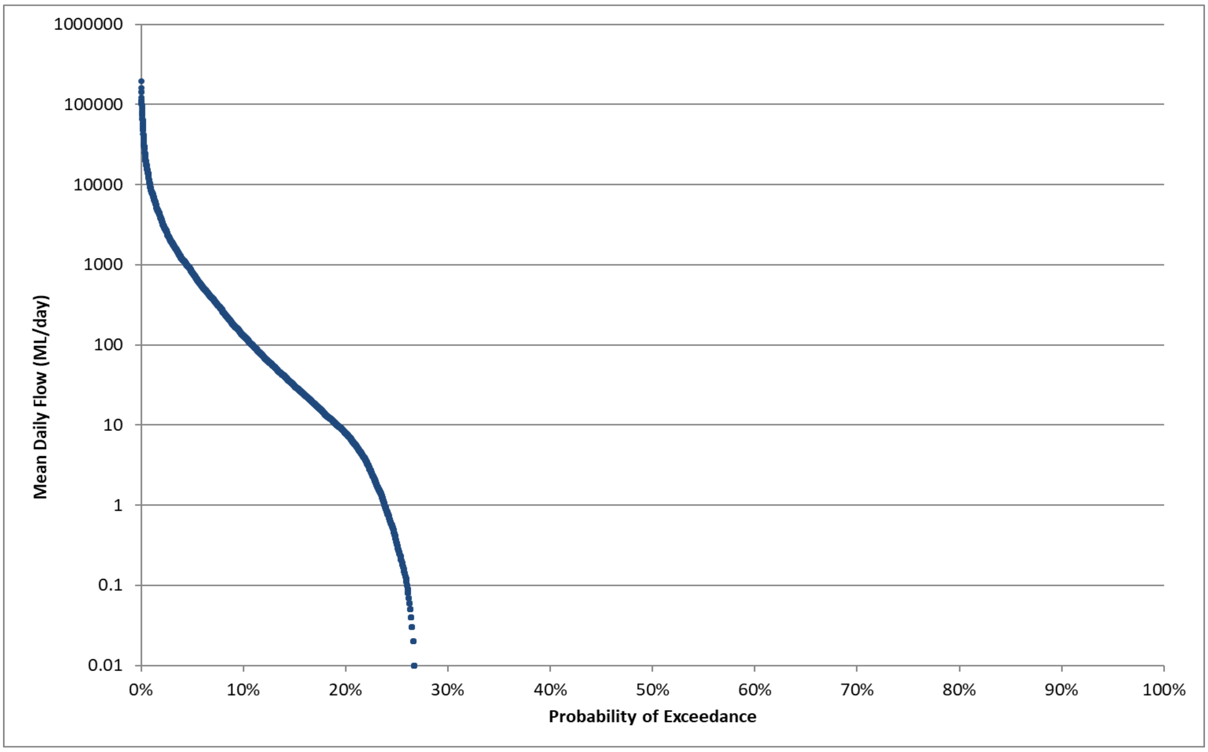


Figure 3-5 Isaac River (Station 130410A) Mean Daily Flow Duration Curve (1968 – 2021 data)

3.3 Land Use and Mining

The Project covers approximately 1,214 ha of land on ML 1775, ML 70403 and ML70462. The land is largely covered with infrastructure associated with the existing Horse Pit mining area surrounded by native pasture used for grazing with remnant and regrowth woodland vegetation present in some small patches. There are no nature conservation areas, including National or State Parks within or nearby the Project Area. Strategic Cropping Land is mapped 3km to the east of the Project Area.

The predominant surrounding land uses within the Study Area are mining and agriculture (grazing). There are several proposed and active coal mining operations near to the Project. There are also several proposed wellfields for extraction of CSG associated with the Bowen Gas Project. **Table 3-6** summarises the nearby resource extraction operations.

Table 3-6 Proposed and current operations near to the Project

Operation	Status	Type	Planned Start	Planned End	Distance from Project	Target Coal Resource
Bowen Gas Project[1]	Proposed	Coal Seam Gas	~2017[2] (On Hold)	2055	2km east	Rangal Coal Measures, Moranbah Coal Measures
Olive Downs Project[1]	Proposed	Open-cut	2020 (Delayed)	2099	32 km south-east	Rangal Coal Measures
Lake Vermont[1]	Operating	Open-cut	2014	2045	54 km south-east	Rangal Coal Measures

Operation	Status	Type	Planned Start	Planned End	Distance from Project	Target Coal Resource
Saraji[1]	Operating	Open-cut	1974	2040	42 km south-east	Moranbah Coal Measures
Saraji East[1]	Proposed	Underground - Longwall	2023	2042	46 km south-east	Moranbah Coal Measures
Peak Downs[1]	Operating	Open-cut	1972	2075	20 km south-east	Moranbah Coal Measures
Eagle Downs Mine[1]	Care and Maintenance	Underground - Longwall	~2017[2] (On Hold)	2064	17 km south-east	Moranbah Coal Measures
Poitrel[1]	Operating	Open-cut	2006	2026	21 km east	Rangal Coal Measures
Daunia[1]	Operating	Open-cut	2011	2034	26 km north-east	Rangal Coal Measures
Millennium	Operating	Open-cut	2005	2027	21 km north-east	Rangal Coal Measures
Moorvale	Operating	Open-cut	2003	2017+	35 km north east	Rangal Coal Measures
Moorvale South Project[1]	Proposed	Open-cut	2021	2031	32 km to the north-east	Rangal Coal Measures, Fort Cooper Coal Measures
Coppabella	Operating	Open-cut	1998	2035	45 km north-east	Rangal Coal Measures, Fort Cooper Coal Measures
Isaac Plains	Operating	Open-cut	2006	2070	17 km north-east	Rangal Coal Measures
Norwich Park	Care and Maintenance	Open-cut	1979	2012	82 km south east	German Creek Formation
Moranbah South	Proposed	Underground – Longwall and Bord and Pillar	2017[2] (On Hold)	2060	5 km north-east	Moranbah Coal Measures
Winchester South	Proposed	Open-cut	2021 (Delayed)	2051	23 km south-east	Rangal Coal Measures, Fort Cooper Coal Measures

Note:

1. Cumulative impacts assessed as part of this groundwater assessment

2. On Hold – Projects approved and proposed to commence, but have not yet commenced

A brief summary of each of the surrounding mines included in the cumulative assessment is provided below. These mines are included largely based on their proximity to the Project. **Figure 1-1** and **Figure 1-2** show the locations of the developments.

The potential for cumulative groundwater impacts due to the neighbouring mining and gas developments is discussed in **Section 6**.

3.3.1 Bowen Gas Project

The Bowen Gas Project is a CSG development by Arrow Energy Pty Ltd (Arrow), targeting gas within coal seams of the Rangal Coal Measures and Moranbah Coal Measures. The Bowen Gas Project proposes to extract approximately 270 GL of associated water with the gas over a period of 55 years from 6,000+ extraction wells covering and area of 9,500 km^2. Arrow has identified an extraction wellfield targeting the Rangal Coal Measures and Moranbah Coal Measures in the vicinity of the Project.

3.3.2 Peak Downs

The Peak Downs Mine is an open cut metallurgical coal mine operated by BMA and follows the strike of the Moranbah Coal Measures, immediately south of CVM. Coal extraction commenced in 1972 and is expected to continue until approximately 2075. The mine will continue to develop from its current extents in an easterly direction.

3.3.3 Moranbah South Project

The Moranbah South Project is a proposed underground coal mine 3 km south-east of Moranbah. The project is an unincorporated venture between Anglo Coal (Grosvenor) Pty Ltd and Exxaro Australia Pty Ltd. The project will target the Moranbah Coal Measures using longwall extraction. The project proposes a production rate of up to 18 Mtpa with a mine life of more than 30 years. The project was approved in 2014 however no activities have been conducted at the site. It is currently unknown when operations will commence.

3.3.4 Eagle Downs Mine

Eagle Downs Mine is a multi-seam underground mine operated by Eagle Downs Coal Management Pty Ltd (a joint venture between South 32 and Aquila Resources) east of the Moranbah South Project. The project targets the Moranbah Coal Measures using longwall extraction. The project was approved in 2011 and development of a small boxcut and drift commenced in 2013. However, no activities have been conducted at the site since 2015. The project proposes a production rate of up to 11 Mtpa with a mine life of 50 years, however, it is currently unknown when operations will recommence.

3.3.5 Winchester South Project

Whitehaven WS Pty Ltd proposes to develop the Winchester South Project located to the south-east of Project Area. The mine will consist of a series of open cut pits targeting the Rangal Coal Measures and Fort Cooper Coal Measures. The mine will extract up to 15 Mtpa over a mine life of approximately 30 years, commencing approximately in 2023. Based on the planned maximum production rate, approximately 130 Mt of product coal would be produced during the life of the mine.

3.3.6 Olive Downs Project

The Pembroke Olive Downs Pty Ltd Olive Downs Project is located to the south-east of the Project Area. The mine will consist of a series of open cut pits targeting the Leichhardt and Vermont Seams of the Rangal Coal Measures. The mine will extract up to 20 Mtpa over a mine life of approximately 79 years, commencing approximately in 2021. Based on the planned maximum production rate, approximately 400 Mt of product coal would be produced during the life of the mine.

3.3.7 Lake Vermont

The Lake Vermont Coal Mine is a medium size open cut coal mine producing coking and pulverised coal injection (PCI) coal for the export market to be used in steel production, with a majority ownership held by Jellinbah Group. Mining operations at the site commenced in September 2008, with first coal production in January 2009. The planned production rate is 12 Mtpa, targeting the Rangal Coal Measures. The project has gained recent approval to extend the existing mining operation into new mining areas to the north of the current operation.

3.3.8 Saraji

The Saraji Mine is an open cut metallurgical coal mine operated by BMA. The mine targets the Moranbah Coal Measures where they shallow at the western limb of the Bowen Basin further south along strike from Peak Downs. Coal extraction commenced in 1974 and is expected to continue until approximately 2040. For the purposes of this study it is assumed the mine will continue to develop primarily in an easterly direction following the coal seam down-dip.

3.3.9 Saraji East

BMA's proposed Saraji East project includes an underground single-seam mine operation and associated project infrastructure. The Saraji East project has planned extraction of up to 8 Mtpa of metallurgical product coal for the export market over a life of 20 years and is located east and adjacent to the existing Saraji Mine. The project is currently undergoing the EIS process and is anticipated to commence in coal extraction in 2024, subject to approval (BMA, 2017).

3.3.10 Poitrel

The Poitrel Coal Mine owned by BHP Mitsui Coal Pty Ltd (BMC) is located 25 km east-southeast of Moranbah. The project is an open cut mine targeting the Leichhardt and Vermont Seams within the Rangal Coal Measures, which consists of 79 Mt of resources.

3.3.11 Daunia

BMA's Daunia Mine is located approximated 30 km southeast of Moranbah. As with Poitrel, Daunia is an open cut mine targeting the Leichhardt and Vermont Seams within the Rangal Coal Measures. The mine is located on the eastern limb of an anticline that separates it from the adjacent Poitrel Mine.

3.3.12 Moorvale South Project

Moorvale South Project, located 23 km south of Coppabella, is operated by Peabody Energy Australia PCI (C&M Management) Pty Ltd and is owned by the Coppabella and Moorvale Joint Venture. The project initially targets the Leichhardt and Vermont Seams, and where economically viable also the Fort Cooper Coal Measures using conventional open cut mining and strip-mining methods. The mine is projected to extract between 1.5 and 2 Mt per year with a mine life of 10 years.

4 Geology

4.1 Regional Geology

The Project coal deposit is located in the northern part of the Bowen Basin, a foreland sedimentary basin of approximately 200,000 km^2 (**Figure 4-1**). The Bowen Basin is a north-northwest to south-southeast oriented basin and contains the largest coal reserves in Australia. The southern half of the Bowen Basin is covered by the Surat Basin, and the Galilee Basin exists to the west (Geoscience Australia, 2017).

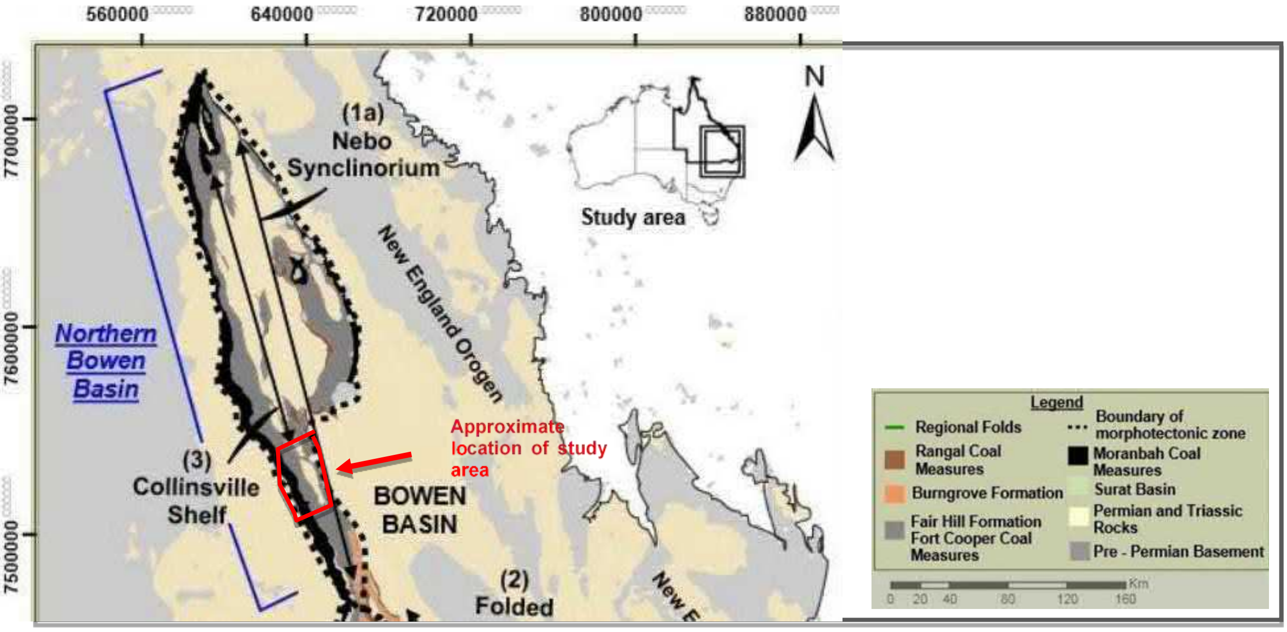


Figure 4-1 Structural Setting of the Bowen Basin (after Dickins and Malone, 1973)

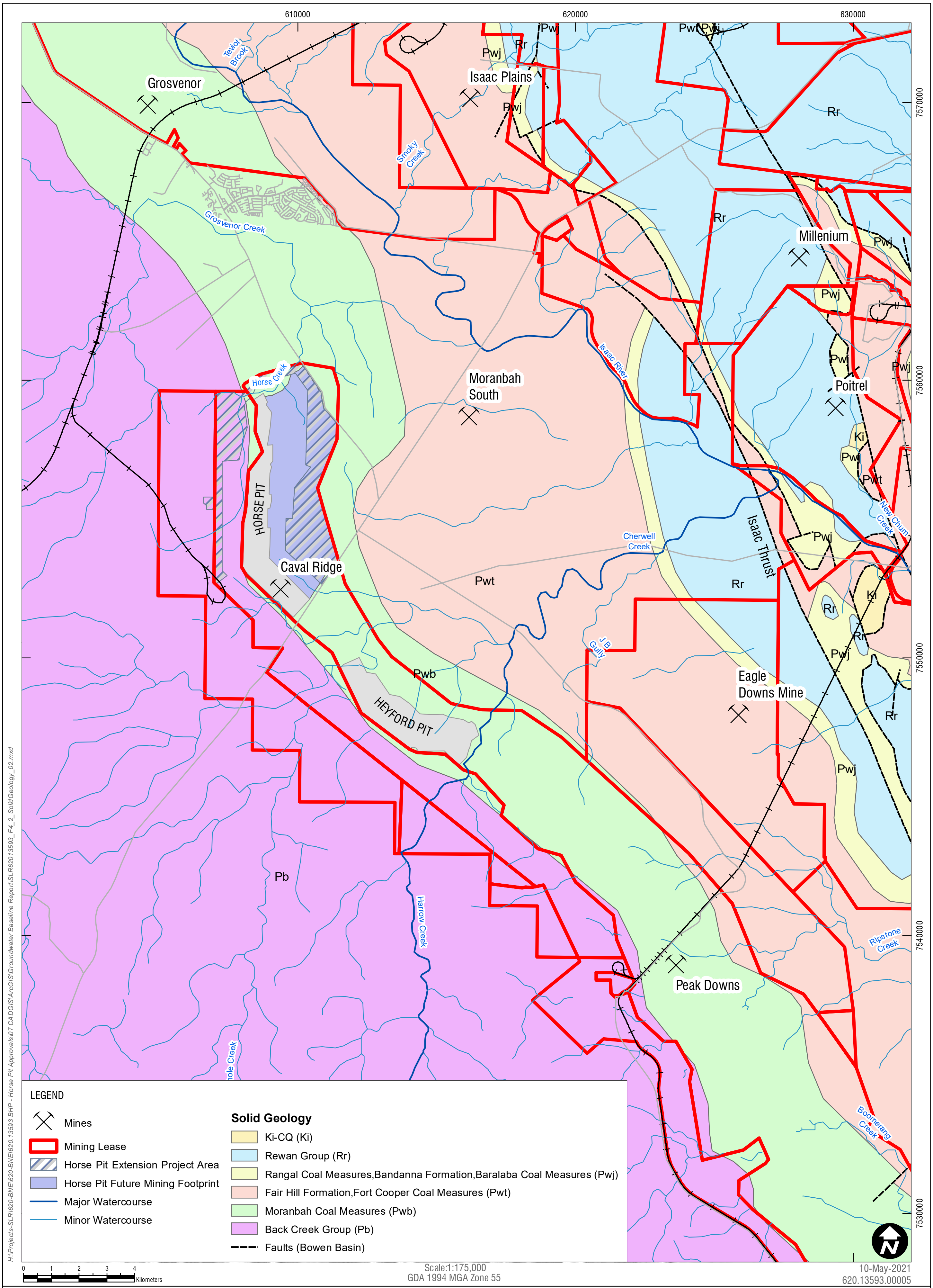
Basin geology within the Collinsville Shelf includes the basal Permian aged Back Creek Group, which generally comprises of generally fine-grained clastic sedimentary rocks deposited in a fluvial to shallow marine environment. The Back Creek Group is conformably overlain by the Blackwater Group, which includes the Moranbah Coal Measures, Fort Cooper Coal Measures and Rangal Coal Measures. The economic seams of the Project are contained in the Moranbah Coal Measures. The Permian strata occur at outcrop on the eastern and western edges of the Basin and are unconformably overlain by the Triassic aged consolidated sedimentary rocks of the Rewan Group. While not present in the vicinity of the Project, isolated pockets of remnant quartzose sandstones of the Middle Triassic Clematis Group are also mapped within the Study Area, on the eastern side of the Isaac River.

The Permian and Triassic units are covered by a thin veneer of unconsolidated to semi-consolidated Cainozoic sediments (Tertiary to Quaternary alluvium and colluvium). The alluvial sediments are localised along rivers and creeks (i.e. Isaac River, Cherwell Creek, Horse Creek and Harrow Creek). Volcanic extrusions (i.e. basalt) are also present within the region including within the Project Area.

The generalised regional stratigraphy is summarised in **Table 4-1**. The solid geology is presented in **Figure 4-2**, based on the 1:500k solid geology outcrop mapping of the Bowen Basin. The surficial geology is shown in **Figure 4-3**, and is based on the Clermont (SF5511) and St Lawrence (SF5512) 1:250k geological maps, as compiled within the Queensland Geology Detailed Surface Mapping (DNRME, 2017).

Table 4-1 Regional Stratigraphy

Period		Stratigraphic Unit		Description	Distribution	Max Thickness (m)
Cainozoic		Isaac River Quaternary alluvium (Qa)		Flood plain alluvium comprising clay, silt, sand and gravel.	Surficial cover localised along Isaac River, Grosvenor Creek and the confluence of Isaac River and Cherwell Creek	~ 50 m
		Regolith - alluvium, colluvium and other sediments in floodplains, alluvial fans, and high terraces (Qr, Qr\b and TQa)		Colluvial and residual deposits comprising poorly sorted clay, silt, sand, gravel and black soils, silts and muds derived from weathered basalts.	Surficial cover throughout the Project Area. Localised TQa coverage along Horse Creek to the north, Cherwell Creek and Harrow Creek to the south east.	~ 20 m
		Tertiary Basalt (Tb)		Olivine basalt lava flows and some plugs; some areas pf nephelinitie and basanite	Surficial cover localised in the east and north-east of the Project Area. Subcrop in the centre and south of Project Area.	~30 m
		Duaringa Formation (Tu)		Mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt.	Present to north-west, north and north east of the Study Area.	~100 m
Triassic		Mimosa Group	Clematis Group (Re)	Cross-bedded quartz sandstone, some quartz conglomerate and minor red-brown mudstone.	Isolated outcrop 40 km south-east of the Study Area.	~100 m
			Rewan Group (Rr) (Rewan Formation and Sagittarius Sandstone)	Rewan Formation: green lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanolithic pebble conglomerate (at base). Sagittarius Sandstone: lithic sandstone interbedded with mudstones and siltstones with scattered carbonaceous plant material.	Outcrops located 18 km to the east, north east and south east of the Project Area. Subcrops located 15 km east of the Project Area / underlies eastern zones of Study Area.	~840
Permian	Late	Blackwater Group	Rangal Coal Measures (Pwj)	Coal seams, carbonaceous shale and mudstone, tuff, siltstone and mudstone.	Isolated outcrops located 14 km east of the Project Area. Underlies eastern zones of Study Area.	~200
			Fort Cooper Coal Measures (Pwt) (Fair Hill Formation)	Coal, brown and green sandstone, conglomerate, carbonaceous shale, tuff.	Subcrops along total extent of Project Area to directly the east.	~350
			Moranbah Coal Measures (Pwb)	Quartzose to sublabile locally argillaceous sandstone, siltstone, mudstone, carbonaceous mudstone and coal.	Within/underlies the whole Project; Outcrops approximately 2 km south east of the Project Area	~ 400
	Early to Middle	Back Creek Group (Pb)		Quartzose to lithic sandstone, siltstone, carbonaceous shale, minor coal and sandy coquinite.	Within/underlies western areas of Project Area; Outcrops in south-western section of Project Area.	~400



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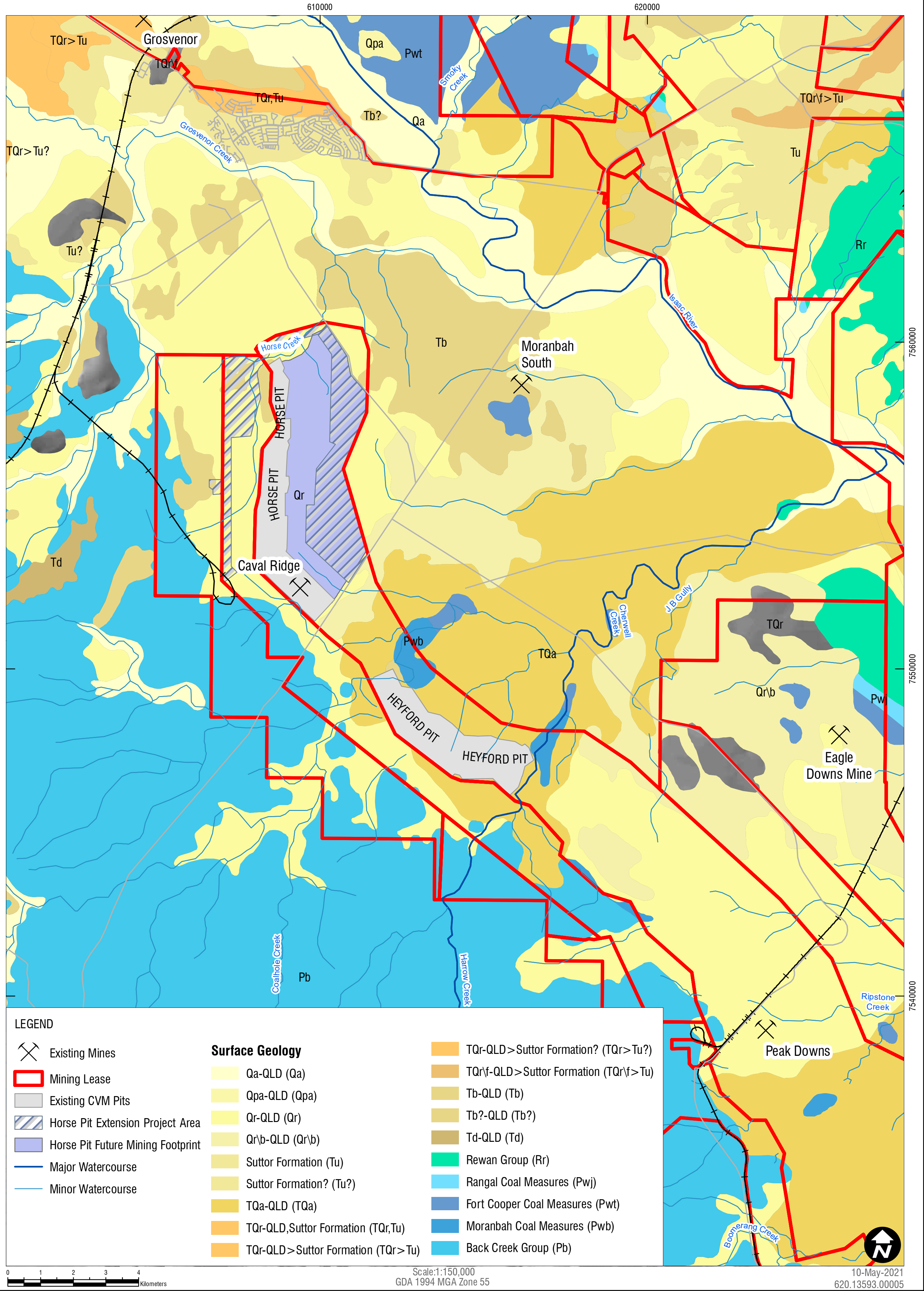
Solid Geology

FIGURE 4-2



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Surface Geology

FIGURE 4-3

4.2 Local Geology

The stratigraphic profile within the Project Area comprises three distinct units:

- Cainozoic sediments (alluvium and regolith);
- Cainozoic (Tertiary) basalt; and
- Permian coal measures.

Each of the main stratigraphic units is discussed in further detail below. The structural geology of the Study Area is also discussed in **Section 4.2.3.3**. Geological cross sections of the Project Area are presented in **Figure 4-6** and **Figure 4-7**, with the transect location for each cross section is presented in **Figure 4-8**.

4.2.1 Cainozoic Sediments

4.2.1.1 Isaac River Alluvium

State (Queensland Government) Detailed Surface Geology (SDSG) mapping (**Figure 4-3**) shows that alluvium is localised along the Isaac River, to the north and east of the Project. The extent and thickness of the unconsolidated sediments along the Isaac River east of the Project Area was assessed as part of the Winchester South Project in March 2019, where geophysical surveys were undertaken (AgTEM and DC-ERT transects) adjacent to the Isaac River to improve understanding of the extent, permeability, and depth of alluvium. Detailed subcrop geology information was also identified as part of the survey. The results from the survey are summarised as follows:

- The rock weathering horizon is high in groundwater salinity, resulting in high electrical conductivity. This weathering horizon is absent within the alluvium, as it has been eroded and replaced with recent alluvium. The absence of the highly conductive weathering horizon allows for clear identification of alluvial extents within the geophysical data.
- A shallow 8 to 10 m embayment of flat layered alluvium covers coal measures to the east of the survey extent. This alluvium has been mapped in previous reports (Douglas Partners, 2012) as a Cainozoic Sand Plain with somewhat different extents.
- The Isaac River alluvium is limited in extent away from the modern river channel.

AgTEM surveys have also been conducted for the Moorvale South Project and Olive Downs Project groundwater assessments to further understand the nature and extent of alluvium in the vicinity of those projects, east of the Project Area. Survey results from the Moorvale South Project and Olive Downs Project investigations have contributed to defining alluvial extents and thicknesses in the vicinity of their respective sites.

Additionally, slope break analysis was performed for the Winchester South project groundwater assessment using 1 m DEM topography data. This analysis has been used to define alluvial extents in the area west of that project's AgTEM survey. Alluvial extents identified from the slope break analysis do not differ dramatically from the extents previously identified by the SDSG mapping, giving credibility to the accuracy of the alluvium extents in areas within the Study Area where only SDSG mapping information is available. The mapped extents of the Isaac River alluvium as identified from the Moorvale South Project and Olive Downs Project AgTEM surveys, slope break analysis and SDSG mapping is presented in **Figure 4-4**.

Given that the minimum distance between the Project open cut pit and the Isaac River alluvium is approximately 5 km, **Figure 4-4** indicates that there would be no direct interception of alluvium by the proposed Project pit (mining activity).

4.2.1.2 Regolith

The surficial regolith material covering much of the Study Area comprises Cainozoic (Quaternary to Tertiary) aged sediments, including alluvium and colluvium. Older alluvial (TQa) sediments are distributed extensively across the region and colluvium and residual deposits (Qr and Qr\b) are abundant in the north west of the Study Area and at site. The Cainozoic (Tertiary) aged Duaringa Formation (Tu) is also mapped at surface at the southern end of the Study Area. Drill logs in the Project Area indicate the sequences exhibit similar geological characteristics and have therefore been grouped as ‘regolith’ within this report.

Based on geological logs, the regolith in the Project Area comprises a heterogeneous distribution of fine to coarse grained sand, clay, sandstone and claystone. The regolith material is generally 15 m to 45 m thick. The units are highly weathered, with the depth of weathering extending to a maximum of 50 metres below ground level (mbgl), into the underlying coal measures. The extent and thickness of the regolith material is presented in **Figure 4-5**, interpolated based on geological data and the CSIRO Soil and Landscape Grid of Australia (CSIRO 2015) data.

Regolith deposits over the Project Area comprise older alluvial sediments, colluvium, residual deposits and weathered Permian units. Project drill logs indicate unconsolidated sediments in the area comprise clay, silt, sand, gravel and soil. Within the Project Area, Permian units are, on average, weathered to a depth of 25 mbgl and Tertiary to Quaternary aged deposits are on average weathered to 25 mbgl. The extent and thickness of the surficial material is presented in **Figure 4-5**.

4.2.1.2.1 Tertiary-Quaternary Alluvium

SDSG mapping shows Tertiary-Quaternary alluvium (TQa) deposits distributed in the areas south of Horse Pit and across the south east of the Study Area. TQa is defined as a *poorly consolidated or unconsolidated alluvial deposit in an ancestral valley, which has been dissected by more recent channel activity*. SDSG mapping shows that the TQa deposits are located 1.7km to the south of Horse Pit, extending to the south and south east across the Study Area along the courses of Cherwell Creek and Harrow Creek. Review of lithological logs and aerial imagery shows that deposits are also distributed along Horse Creek to the north of the Project Area. The inferred extent of the surficial material is presented in **Figure 4-4**.

Cherwell Creek is a tributary to the Isaac River that traverses the CVM ML’s from west to east, immediately south of the Project pit. Quaternary alluvium associated with Cherwell Creek is only mapped in SDSG mapping in the area of confluence with the Isaac River, approximately 15 km east of the Project Area. Older alluvial sediments (TQa) are mapped along the course of Cherwell Creek from west to east and along the Cherwell Creek tributaries.

Groundwater drilling investigations undertaken by BMA at CVM in 2009, 2019 and 2020 have confirmed the presence of a localised alluvial deposit associated with Cherwell Creek. Drilling logs correlate with the SDSG mapping showing that the alluvium extends along Cherwell Creek onto the CVM site. These drilling investigations show that within the Project Area the Cherwell Creek alluvium extends from the creek approximately 1.7 km north towards Horse Pit, with the unit extent constrained by Tertiary basalt deposits. Review of the drilling log for monitoring bore MB19CVM09A (located adjacent to Cherwell Creek; refer **Figure 5-1**), shows a total thickness of approximately 17m, with the alluvium comprising between 6 to 9m of clay and silt, which is underlain by up to 10m of fine to coarse sand and gravel. Review of available drilling logs shows that the thickness of the alluvium decreases towards Horse Pit and is thickest in immediate proximity to the modern creek channel.

Based on channel features noted on aerial imagery and the SDSG mapping, the Cherwell Creek alluvium west of monitoring bore MB19CVM01A (located southwest of Horse Pit, refer **Figure 5-1**) potentially appears to be constrained by the eroded extents of the Back Creek Group. To the south of Cherwell Creek slightly sandy clay is logged in monitoring bore MB19CVM10P to 10m and sandy/silty clay with some gravel is logged to 9m at PZ11-S (located adjacent to Harrow Creek, refer **Figure 5-1**). In Pz09, located at an equal distance between both creeks (refer **Figure 5-1**), siltstone is logged from surface potentially indicating that the Cherwell Creek alluvium does not extend this far south. In summary, available drill hole logs indicate the Cherwell Creek alluvium is largely constrained to the immediate proximity of the modern creek channel, and the presence of coarser grained alluvial material has only been identified in a few drillholes adjacent the modern channel. The lateral extents of the Cherwell Creek alluvium have been inferred based on the information presented above and are presented on **Figure 4-4**.

Horse Creek extends along the western and northern site boundaries (refer **Figure 5-1**). Quaternary colluvium and residual deposits are mapped in SDSG mapping in association with Horse Creek along its course. Quaternary alluvium is only mapped in SDSG mapping 3.75 km to the north east of the Project Area in association with Grosvenor Creek. Drill hole logs for monitoring bores located in the north of the Project Area show the colluvium in the area to comprise 2 to 3m of silt and sandy clay, overlying weathered claystone/siltstone/ sandstone. Based on channel features noted on aerial imagery and SDSG mapping, the inferred extent of alluvial deposits associated with Horse Creek is believed to be constrained to the creek channel, with no evidence of deposition beyond these extents (refer **Figure 4-4**).

Harrow Creek is a tributary to Cherwell Creek that traverses the CVM ML directly to the south of Heyford Pit (refer **Figure 5-1**). SDSG mapping shows that alluvial deposits are located adjacent to Harrow Creek, extending approximately 3km south and 1km south east. Drill hole logs show the alluvium in the area to comprise 2m of silt and clay, overlying 6m of sands and gravels with bands of silt and clay.

4.2.1.3 Tertiary Basalt

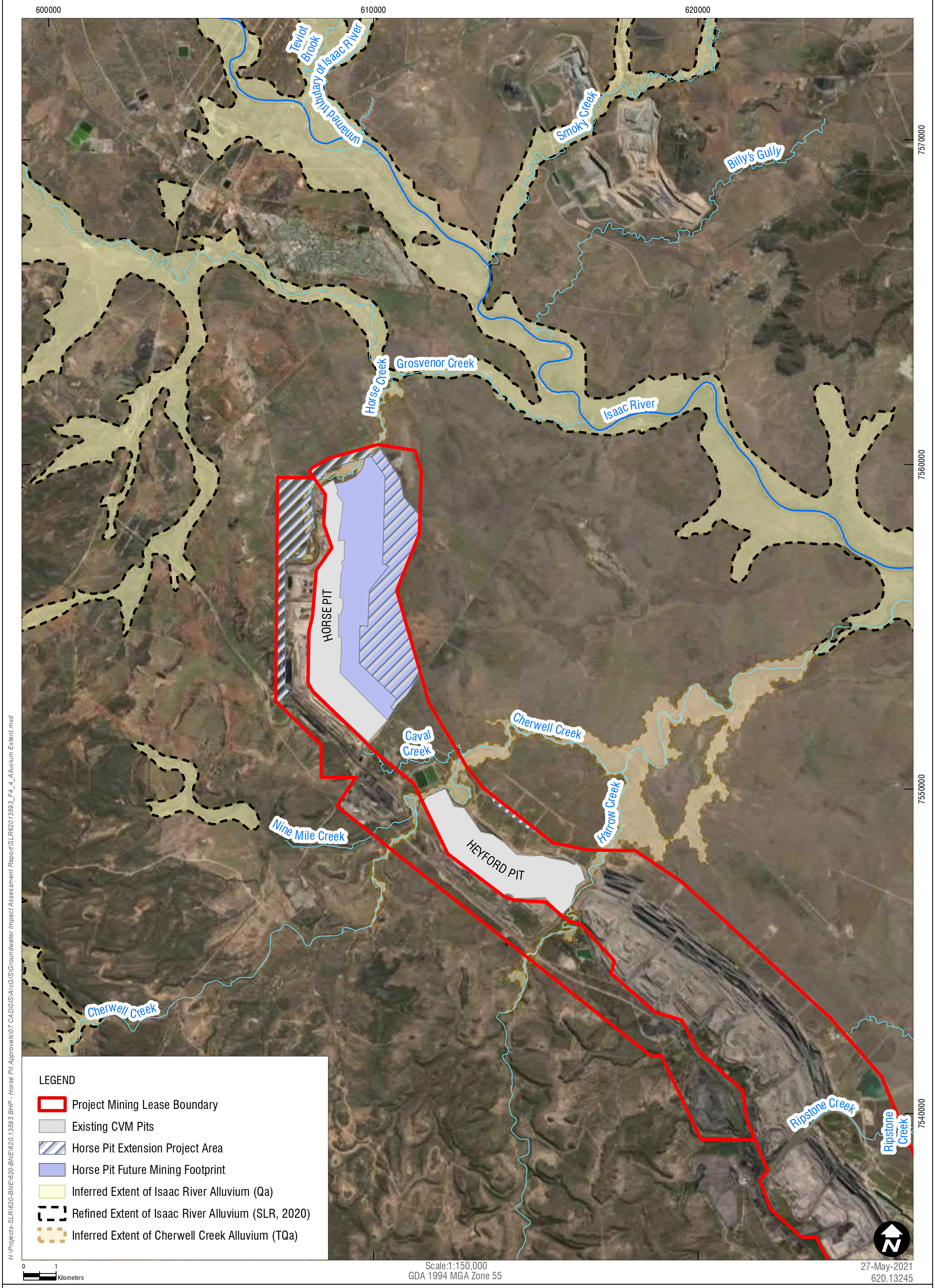
SDSG mapping shows isolated patches of surficial Tertiary aged basalt present within the north western areas of the Project Area, and in the eastern and north-eastern areas of the Study Area. An aeromagnetic geophysical survey was undertaken over the CVM site as part of the original EIS (URS, 2008). The survey showed Tertiary basalts to underlie the Tertiary sediments within the Project Area, extending from the north of the site to the south, along the ridge adjacent to Horse Creek. It is likely that the basalt may have formed along an existing creek associated with a single flow.

Project drill logs align with the survey results, with basalt found to be present in the west of the Project Area extending from monitoring bores MB20CVM04T and MB20CVM05P in the north to MB19CVM04P and MB19CVM03T in the south of Horse Pit (**Figure 4-8**). At this point the basalt extends north east across the Project Area as identified in monitoring bores MB19CVM06P, PZ06, MB19CVM08P and CVMVWP07.

Review of the monitoring well drill logs across the Project Area show the basalt to consistently be up to 30 m thick. Within the Project Area, the basalt is on average weathered to a depth of 25m bgl. Exploration boreholes and monitoring wells across the Project Area found the basalt to range from fresh to highly weathered with variable clay, and to be up to 35 m thick. The distribution of the less weathered, water bearing fracture and vesicular basalt has been to be found quite variable (URS, 2009).

There are no exploration drill hole logs available within this unit outside of the Project Area. A review of monitoring bores associated with the Moranbah South Project located to the east of the Project Area revealed that 3 groundwater bores (MB12, MB07 and MB03) have been logged as intersecting basalt. From these logs an average depth to base of basalt of 67 mbgl is observed, with the depth to base of weathering recorded between 35 and 45m bgl.

The ground truthing of the original TEM survey results gives confidence on the inferred extents generated. The extent and thickness of the surficial material are presented in **Figure 4-5**.



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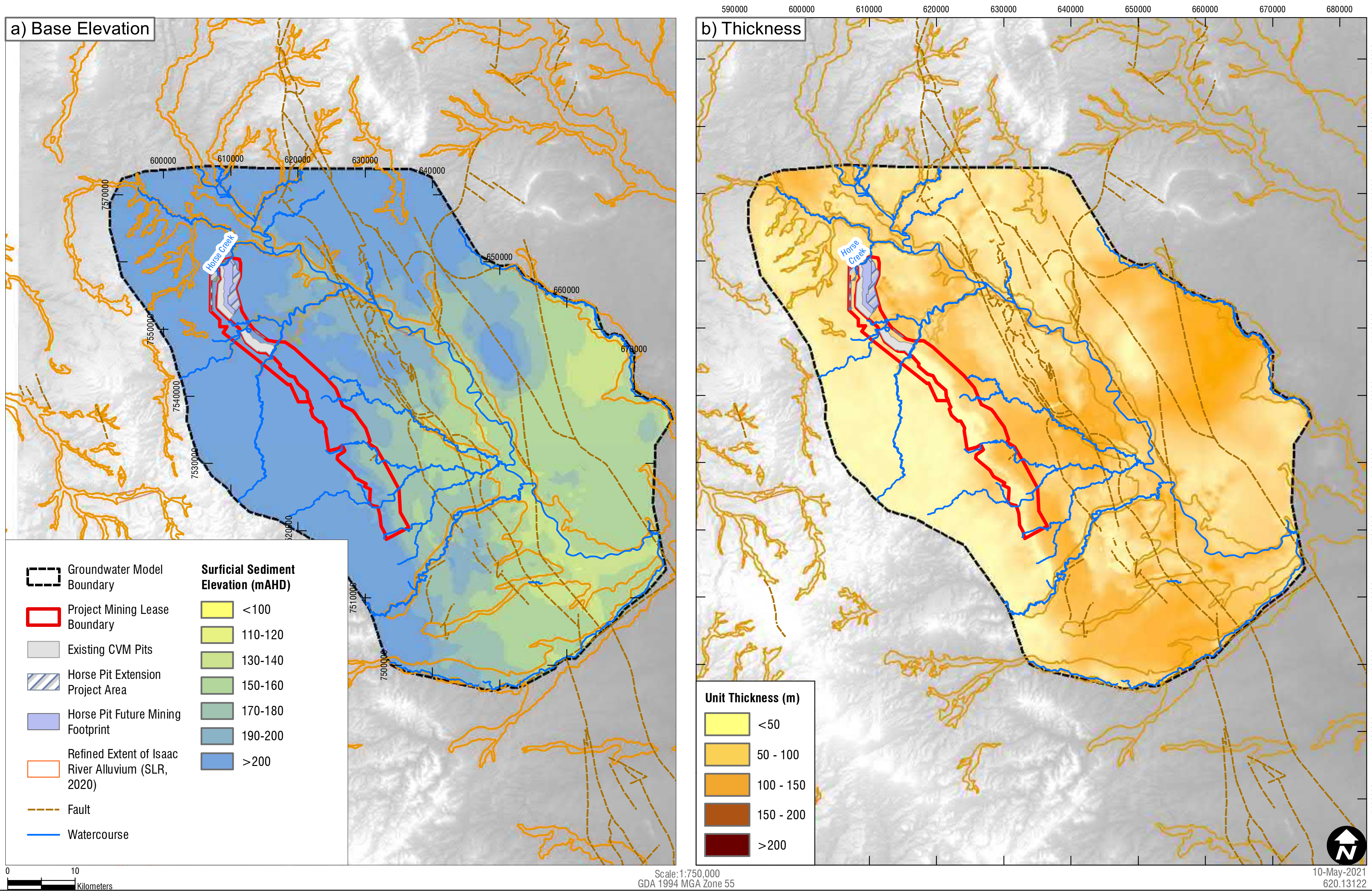
Alluvium Extent

FIGURE 4-4



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Base Elevation and Thickness of Surficial Units

FIGURE 4-5

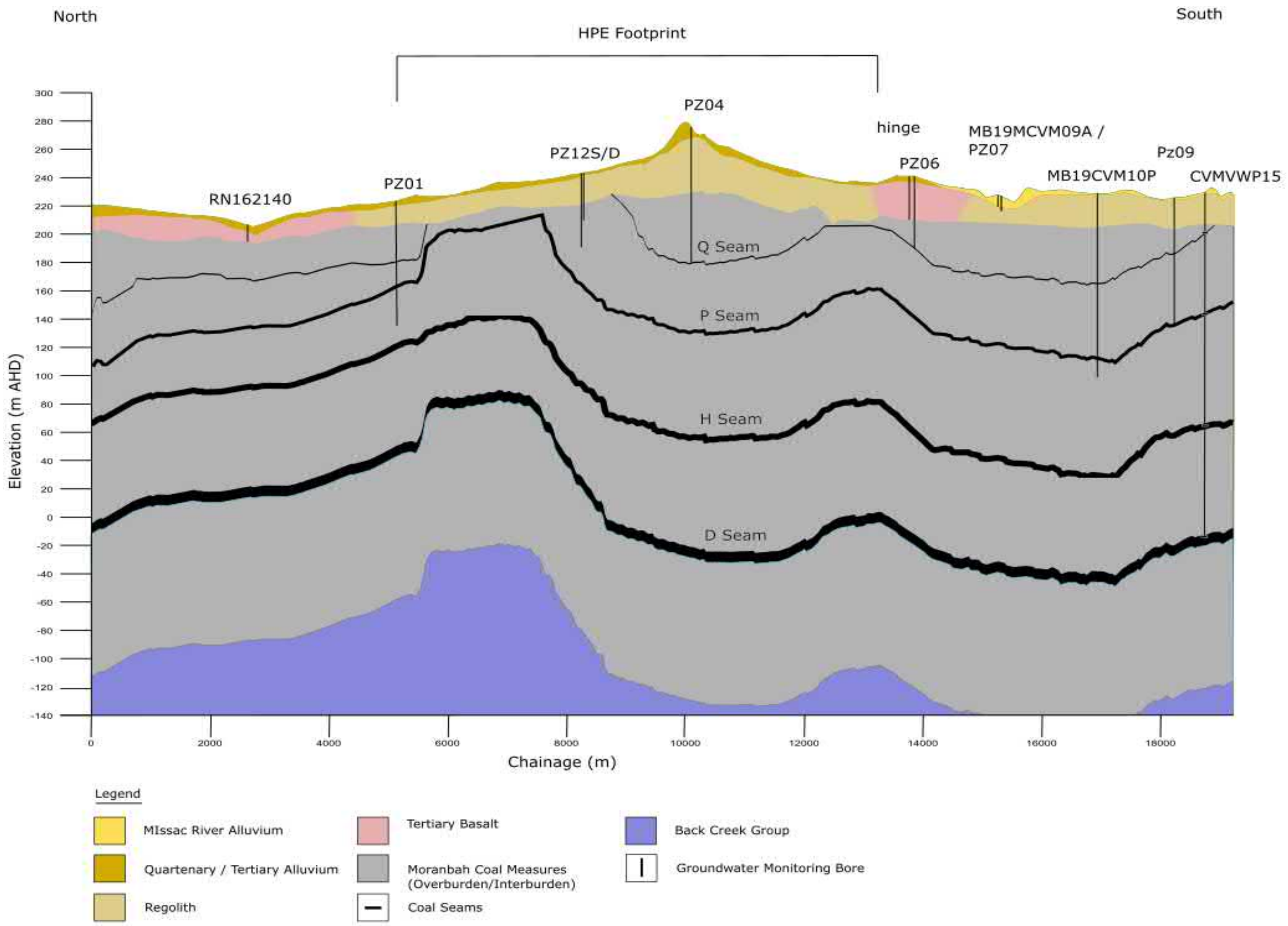


Figure 4-6 Geological Cross Section: North – South

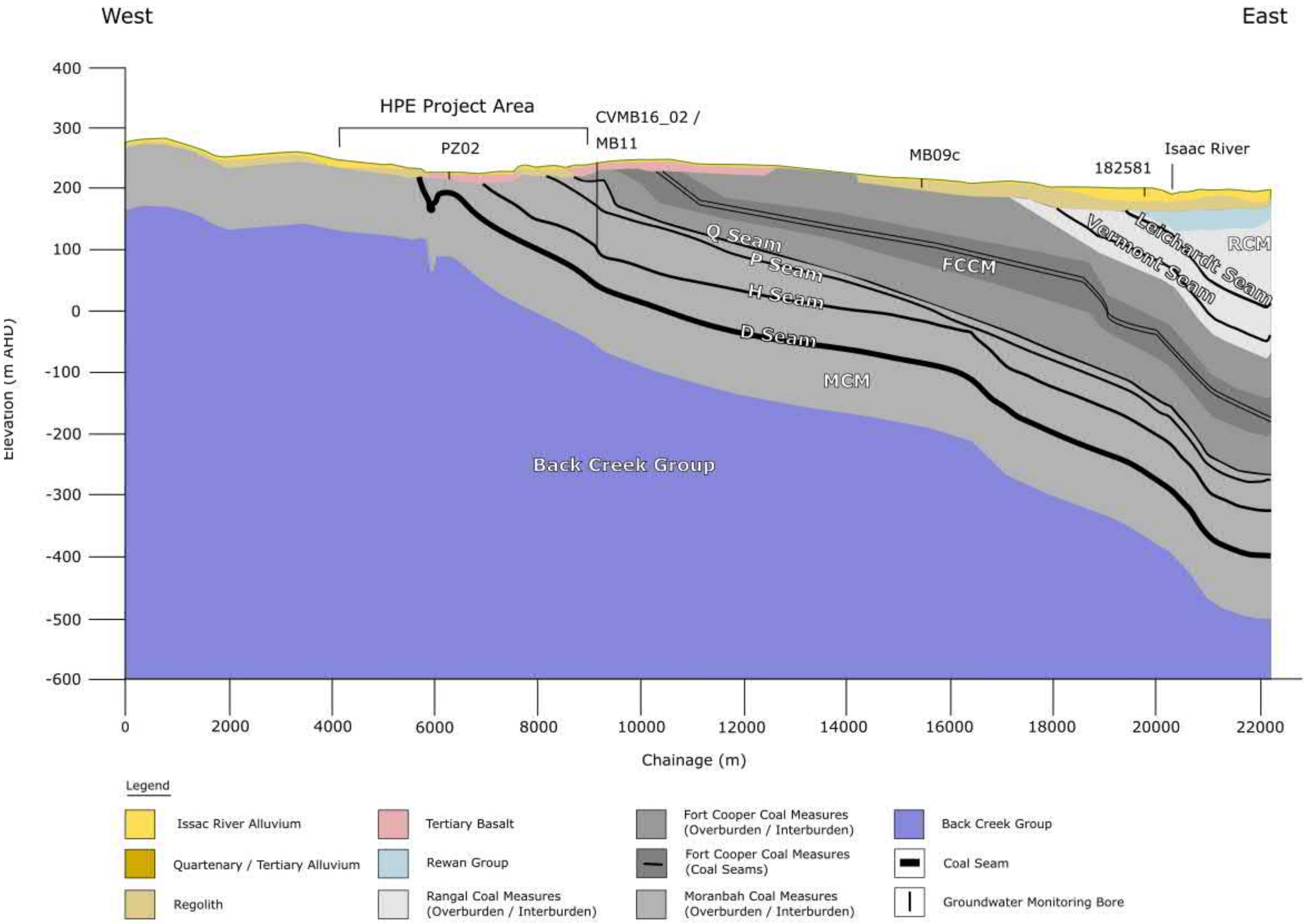
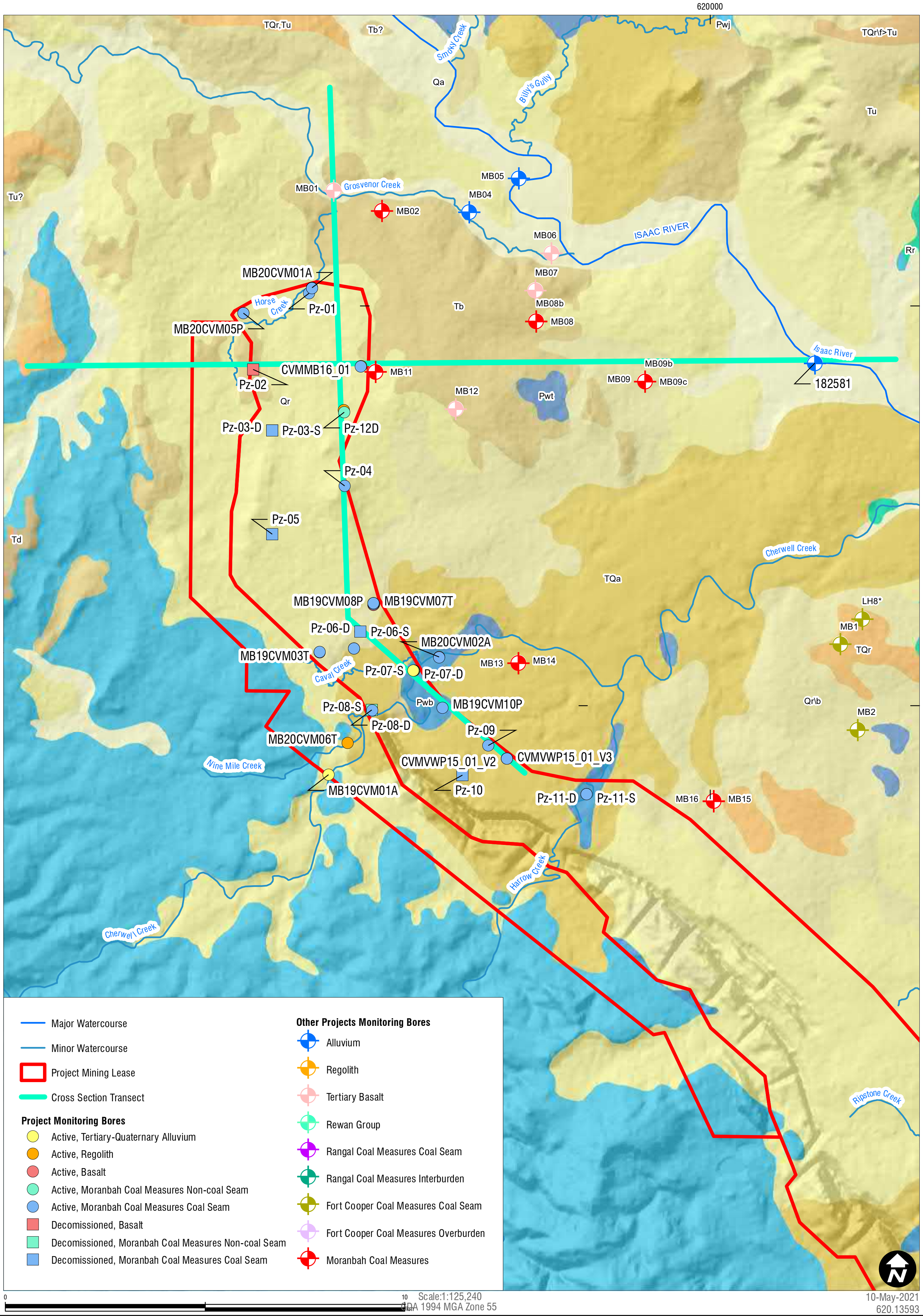


Figure 4-7 Geological Cross Section: West – East



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Transect Location Plan

FIGURE 4-8

4.2.2 Triassic Strata

The Triassic sedimentary rocks include the regionally extensive Rewan Group and an isolated pocket of Clematis Group approximately 10 km east of the Project Area. The subcrop of Clematis Group is less than 100 m thick. The Clematis Group typically comprises cross-bedded quartzose sandstone with minor conglomerate and mudstone.

Regionally the Rewan Group unconformably overlies the Permian coal measures as in-fill material. The unit is absent at the Project Area but and is only present 10km east of the Project across much of the Study Area, and thickens towards the Isaac River. The Triassic aged Rewan Group includes two formations, the Rewan Formation that comprises green lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanolithic pebble conglomerate, and the underlying Sagittarius Sandstone unit that comprises lithic sandstone interbedded with mudstones and siltstones with scattered carbonaceous plant material. Interpolated structure and thickness contours of the Rewan Group within the Study Area are presented in **Figure 4-9** based on previous geological models and drill hole logs.

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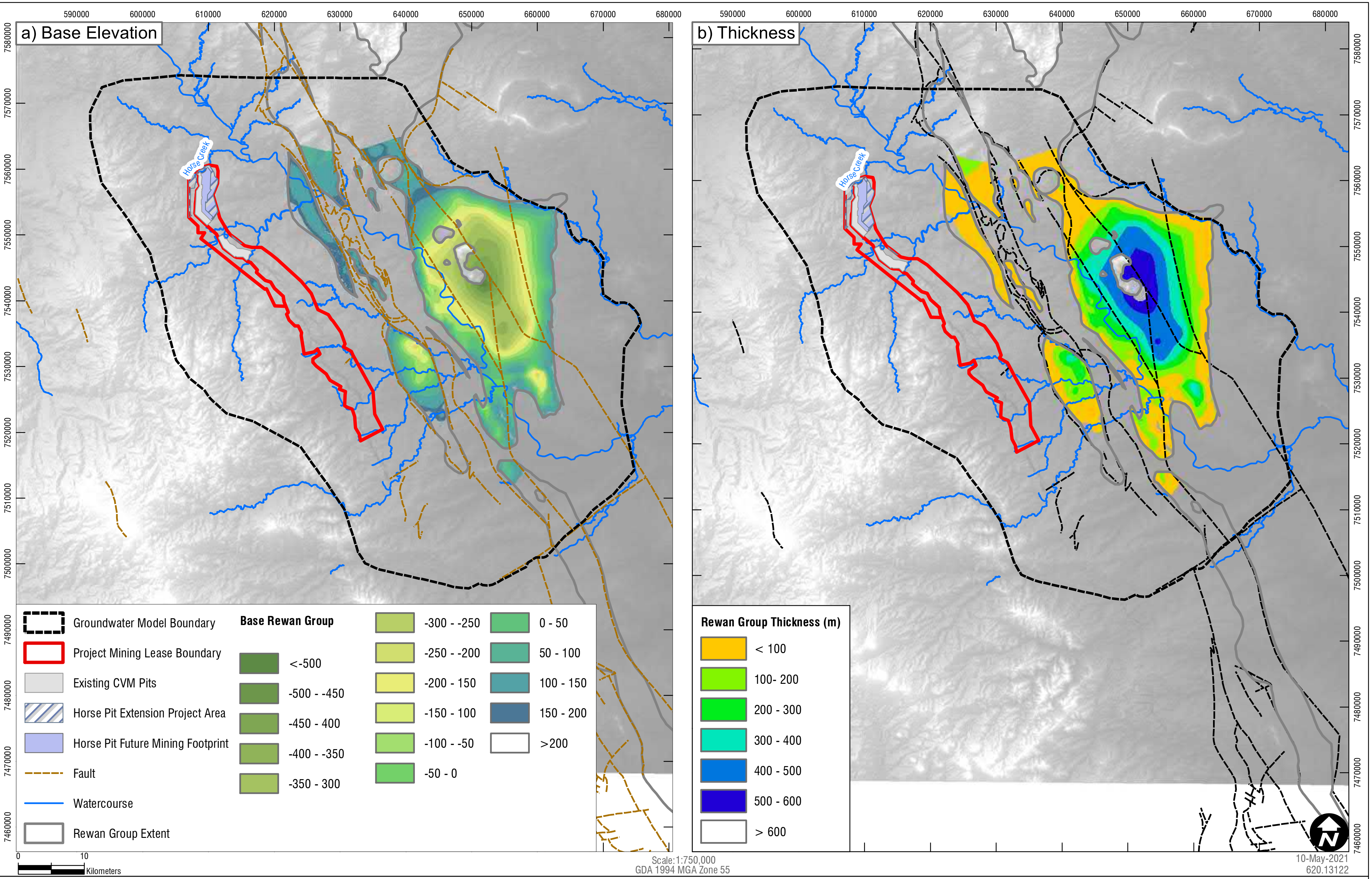

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Structure and Thickness of Triassic Units

FIGURE 4-9

4.2.3 Permian Coal Measures (Blackwater Group)

Permian coal-bearing sedimentary rocks of the Blackwater Group form the main economic resource of the numerous mines in the Study Area. In decreasing depth (age) order, the major coal measures in the Study Area include the:

- Moranbah Coal Measures;
- Fort Cooper Coal Measures; and
- Rangal Coal Measures.

Each of these units is discussed further below.

4.2.3.1 Moranbah Coal Measures

The Moranbah Coal Measures are the lowermost coal-bearing sequence of the Blackwater Group and form the coal resource targeted by mining at CVM and at the Project. These coal measures subcrop at CVM on the western limb of the Bowen Basin, and are also mined at the Peak Downs and Saraji mines immediately south of CVM. The Moranbah Coal Measures comprise volcanic lithic sandstones, with lesser siltstone, mudstone, conglomerate and coal.

There are four main coal seams (each comprised of multiple plies) within the Moranbah Coal Measures at the Project, in order of increasing depth these are known as the Q seams, P seams, the Harrow Creek (H) seams and the Dysart (D) seams. These main coal seams subcrop on the western part of the CVM.

The Q seam comprises several coal intervals modelled as Q01, Q02 and Q03 with a cumulative thickness of 2 to 3.5 m. Throughout the Project Area the Q seam is unsplit (Q01), splitting in central areas of the project into Q02 and Q03.

The P seam is together as one seam in the south and splits to the north. One stringer splits low to attach near the H162 seam. The three major P seam units have been modelled as P02, P07 and P08. P07 and P08 are present across most of the Project Area, with the unsplit P02 occurring in the southern and central areas. The combined average thickness of the P seam is 2 m.

The Harrow Creek group of seams is up to 12 m thick when fully merged in the Harrow Pit in the centre of Peak Downs Mine (south of the Project Area). From there it splits to the north (within Horse Pit) into a major separation as the Harrow Creek Upper, H16, and Lower, H15. Through most of the Project Area the Harrow Creek Upper sequence splits into the H161 and H162 seams. Six separate units, modelled as H15, split from the Harrow Creek Lower as it develops to the north. H15 is split apart by H08 and H00, with H08 splitting into H06 and H01. H00 occurs consistently through the Project Area, with an average thickness of 1.2 m. At the northern extent of the Project Area the H03 and H02 splits, merge back into the H01 with an approximate thickness of 2.5 to 3 m.

The Dysart Upper seam attains a maximum thickness of 3.5 m where fully coalesced and is modelled as D47, but splits into multiple units at both ends of the lease. In the Project Area D47 splits to D43, D40 and D45. D43 and D40 shale out to the north D45 is identified through most of the Project Area, however it is often less than 0.3 m thick. None of these seams provide economic thicknesses except where their proximity to D04 enables it.

The primary Dysart can be a single seam that reaches 5 m in thickness, and is then modelled as D05. North of Heyford Pit, it is divided quickly into two major splits over most of the Project Area. The D05 splits into D02 and D04 with further splitting off the bottom of the D04 forming the minor D03 seam. The D02 is generally constant but banding develops in some areas. The DL seam is a consistent 60 cm band that correlates under the D02 through most of the area. Two additional coaly bands sitting below the DL have been identified and modelled. These have been named the DLL (approx. 20 cm thick) and DLLL (10-20 cm thick).

Two seams identified below the D02 have been named the D00 and C01 seams and a focus on their correlation from recent exploration programs has helped determine their extent. The D00 sits around 20 m below the D02 through much of the Project Area. It averages 1 m thick, but does thicken to 2.0 m in places. At this time, initial quality results indicate a high ash coal and poor yielding seam. C01 occurs 50-55 m below the D02 and is about 1 m thick. It has only been identified in a handful of drillholes. No quality data is currently available for the C01.

The average combined thicknesses of the constituent plies comprising each seam is given:

- Q Seam combined thickness = 2 to 3.5 m;
- P Seams combined average thickness = 2 m;
- H Seam combined thickness = up to 12 m
- D Seam combined average thickness = up to 5 m

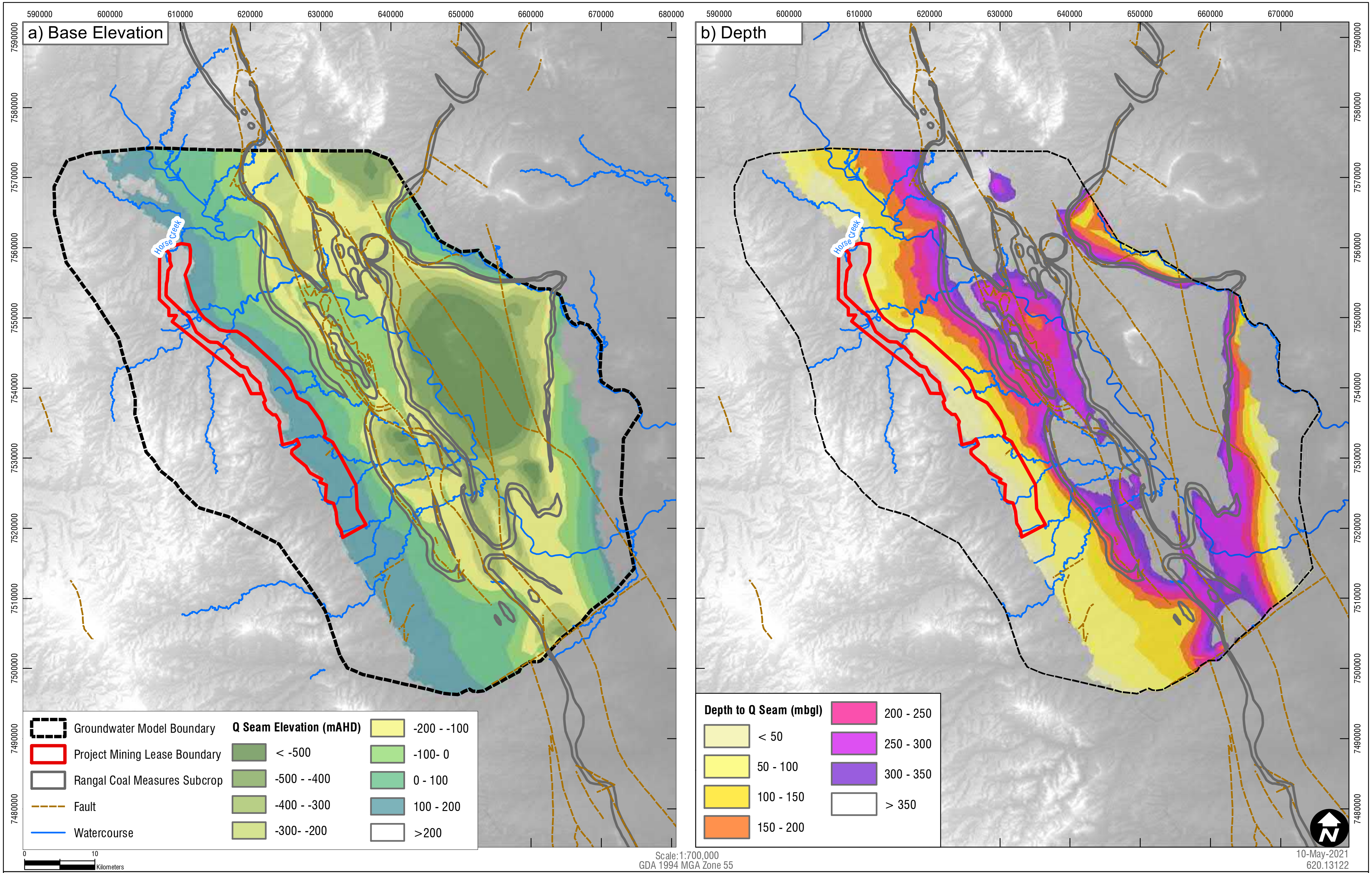
From drillhole logs of monitoring bores within the Project Area the Moranbah Coal Measures were identified at the following depths. In generally depths were shallowest in the west of the Project Area and deepest in the east:

- Q Seam was encountered between 41m bgl (192m AHD) to 87 m bgl (185m AHD);
- P Seams was encountered between 55m bgl (169m AHD) to 112 m bgl (122m AHD);
- H Seam was encountered between 49.5m bgl (168m AHD) to 179 m bgl (55m AHD); and
- D Seam was encountered between 30m bgl (212m AHD) to 256.5 m bgl (-22.4m AHD).

Interpolated structure and thickness contours of the Q Seam, P Seam, H Seam and D Seam at the Project are presented in **Figure 4-10** to **Figure 4-13** respectively. These contours have been based on the Project geological model and drill hole data.

4.2.3.2 Fort Cooper Coal Measures

The Fort Cooper Coal Measures conformably overlie the Moranbah Coal Measures immediately east of CVM. Limited information local to the Project is available for the Fort Cooper Coal Measures. Regionally, however, the formation has a maximum thickness of approximately 350 m (HydroSimulations, 2018a) and drill logs indicate the Fort Cooper Coal Measures comprise lithic sandstone, conglomerate, mudstone, carbonaceous shale, coal, tuff and tuffaceous (cherty) mudstone. Coal seams above 30 m thickness within the Fort Cooper Coal Measures are the S seam (3 to 4 m thick) and the R seam (1 to 2 m thick) (BMA, 2020). The two seams are rarely found in the lease and only at the eastern margins.



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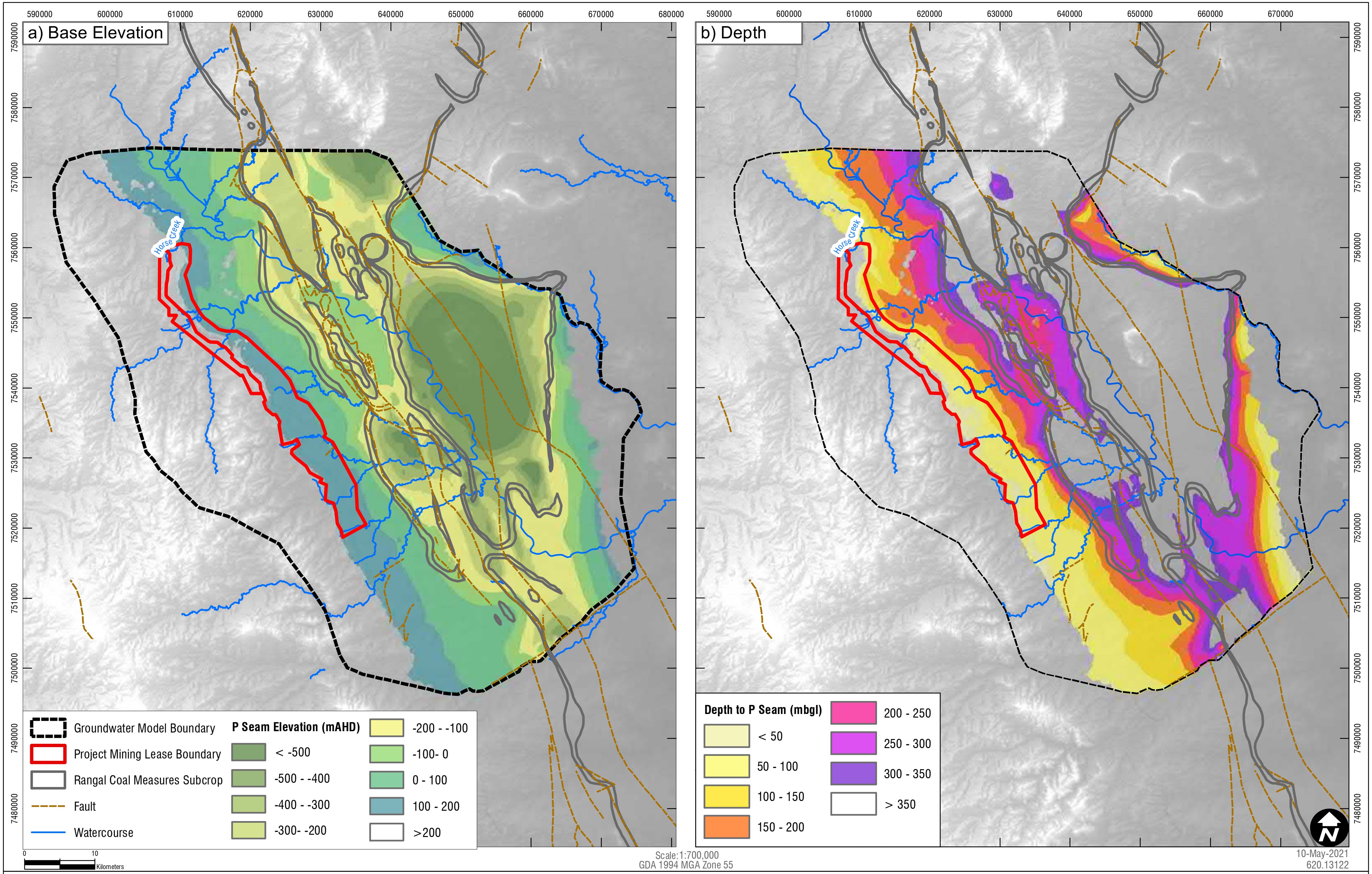
Base Elevation and Depth to Q Seam

FIGURE 4-10



Base Elevation and Depth to P Seam

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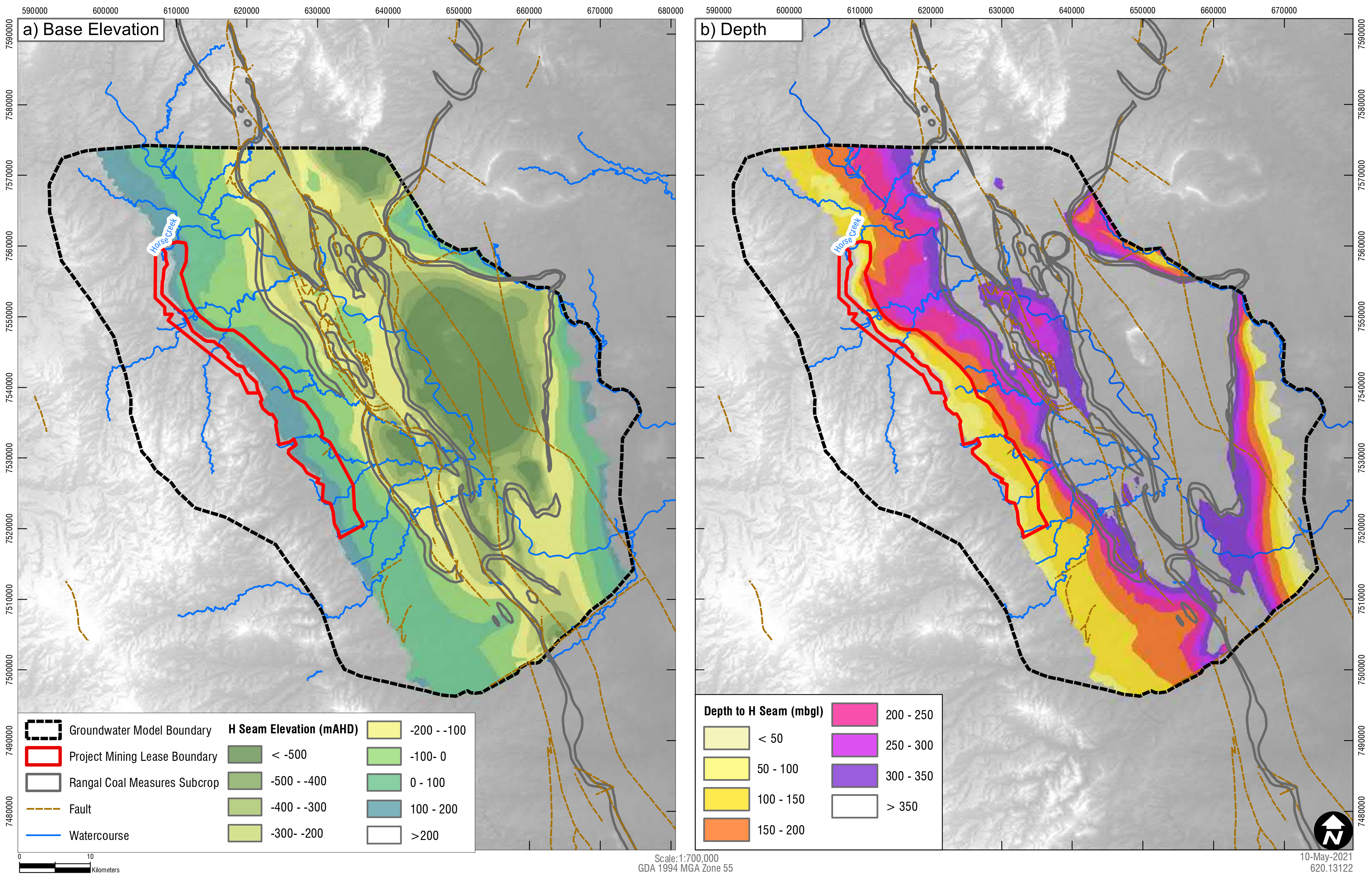
FIGURE 4-11



Base Elevation and Depth to H Seam

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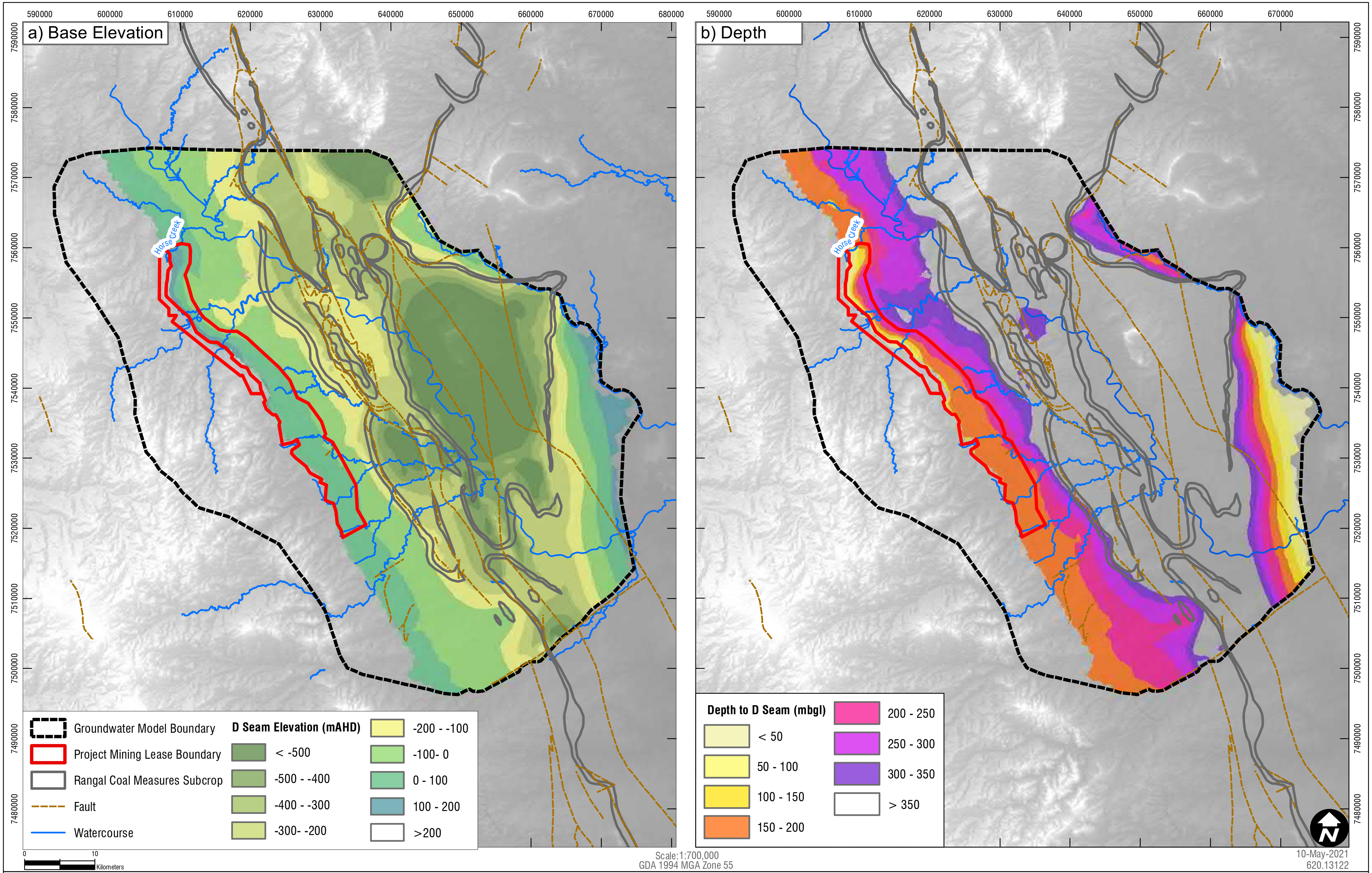
FIGURE 4-12



Base Elevation and Depth to D Seam

Sheet Size : A4

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FIGURE 4-13

4.2.3.3 Rangal Coal Measures

Where they occur, the youngest coal measures, the Rangal Coal Measures, overlie the Fort Cooper Coal Measures. The transition between the Rangal Coal Measures and the Fort Cooper Coal Measures is marked by the Yarrabee Tuff which immediately overlies the Vermont Lower Seam. The Yarrabee Tuff is a basin-wide marker bed comprised of weak, brown tuffaceous claystone, and drillhole logs indicate the volcanic tuff has an average thickness of 0.7 m within the Project Area. The Rangal Coal Measures comprise light grey, cross-bedded, fine to medium grained labile and well cemented sandstones, grey siltstones, mudstones, shale and coal seams. The non-coal portions of the sequence being predominantly sandstones, siltstones, mudstone and shales are referred to as interburden in the mining context.

The Leichhardt Seam is highly weathered where it occurs at subcrop near the surface. Winchester South Project drill logs indicate that the Vermont Upper Seam is separated from the overlying Leichhardt Seam by interburden material ranging in thickness up to 90 m. The interburden between the Leichhardt and Vermont Seams consist primarily of sandstone, with some mudstone and siltstone. The interburden thickens to the south, where massive sandstone bands characterise the sequence (Golder, 1981).

4.2.4 Structural Geology

The Bowen Basin was subject to significant tectonic compression from the eastern side at the end of coal deposition in the late Triassic. The compression from the eastern side caused major thrust faulting which resulted in the commercial viability of mining the coal deposits across the region.

CVM is located within the regional Western Foreland structural domain of the Bowen Basin, located approximately 20km west of the Jellinbah Fault Zone.

All units of the Permian sequence generally dip from west to east at between 3 and 6 degrees in the vicinity of CVM, towards the axis of a local syncline that is truncated by the north-south trending Isaac Thrust Fault. Further along strike to the south at the Peak Downs Mine, the strata show considerable deformation with strata dipping to 30 degrees and along strike flexures in excess of 10 degrees.

Geophysical surveys across the Project Area have identified minor faulting in the CVM area. Faulting is typically confined to the coal seams of the Moranbah Coal Measures, with the majority of faults (40%) identified within the Dysart Seam group.

Thrust faults are the dominant structural feature in the Project Area, comprising 73% of the faults identified. Thrust fault throws range between 3 and 15 m and average 6.6 m. Thrust faults commonly strike north west to south east and north to south, except to the north of the Project where they strike north north east to south south west.

Normal faults account for 25% of faults identified. Normal fault throws range between 3 and 20 m and average 7 m. Normal faults typically trend north north east to south south west and north east to south west. In the north of Horse pit, these normal faults are parallel to the axial fold plane of the north east to south west trending anticline.

Two gentle synclines and one anticline with north east to southwest fold axes are observed across CVM. These folds are observed in the hinge of a large gentle syncline plunging to the east within the Project Area. There are also two sets of faults observed parallel and perpendicular to the fold axes.

Exploration drilling in the CVM Project Area suggest that the likelihood of a regional scale fault is unlikely.

5 Hydrogeology

Based on the understanding of the geological setting presented in **Section 4**, the hydrogeological regime relevant to the Project comprises the following key hydrogeological units:

- Cainozoic sediments:
  - Quaternary alluvium – unconfined aquifer (water-bearing strata of permeable rock, sand, or gravel) localised along Cherwell Creek and the Isaac River;
  - Quaternary to Tertiary colluvium and weathered units (regolith) – unconfined and largely unsaturated unit bordering alluvium;
- Tertiary Basalt:
  - Unconfined, heterogenous and discontinuous; and
  - Highly variable permeability - dependent on degree of weathering and nature of fracturing / vesicularity
- Permian coal measures with:
  - Low permeability interburden units with aquitard properties; and
  - Coal sequences that exhibit water bearing properties associated with secondary porosity through cracks and fissures.

The sandstones of the Clematis Group are generally considered to form an aquifer and are included within the Great Artesian Basin (GAB) aquifers. However, at the Project this unit is not present, but does occur as a small isolated outcrop within the Study Area to the far south-east of the Project. This outcrop is not regionally extensive or hydraulically connected to the GAB. Consequently, the Clematis Group is not considered in detail as part of this assessment.

The Tertiary basalt is not regionally extensive, occurring only as subcrop along the western edge of the Project Area. Its isolated occurrence and discontinuous nature within the Study Area makes it of little hydrogeologic importance to the region, however its location within the Project means it has been considered in further detail as part of this assessment.

The coal seams within the Moranbah Coal Measures are the primary aquifer units within the Project Area. The coal seams can be characterised as confined fractured rock aquifers, with the Q Seam, P Seam, H Seam and D Seam forming the main aquifer units locally. The Moranbah Coal Measures overburden and interburden act as aquitards and are typically dry, or very low yielding.

As discussed further in **Section 4.2.4** the Project Area is not heavily faulted however significant structural faulting occurs 23 km south east of the Project. Field investigations into the hydraulic parameters of the major faults east of the Project were undertaken in 2019 as part of the Winchester South Project EIS (SLR, 2020). The findings of these investigations are further discussed in **Section 5.2.3**.

This section discusses each of the hydrogeological units relevant to the Project, covering hydraulic properties, groundwater occurrence, hydraulic gradients, recharge, discharge, groundwater quality, and water use.

5.1 Groundwater Monitoring

5.1.1 CVM (including Project Area)

BMA installed a CVM groundwater monitoring network that comprises a total of 47 monitoring sites consisting of 36 monitoring bores (29 active and seven decommissioned), two pumping bores and three Vibrating Wire Piezometer (VWP) arrays (**Table 5-1** and **Table 5-2**). The monitoring network was established in 2008 as part of the CVM EIS (URS, 2009), and expanded further in 2019 (AGE 2019) and 2020 (GHD, 2020 and Hydrogeologist Field Services (HFS), 2021) in the context of supporting further environmental approvals, including for the Project. All associated drilling reports post-EIS are presented in **Appendix A4**. The network's monitoring bores intersect a range of hydrostratigraphic units, including:

- the Isaac River Alluvium (three private landholder bores);
- Tertiary Quaternary Alluvium (six monitoring bores);
- Regolith (two monitoring bores, one pumping bore and one VWP sensor);
- Tertiary Basalt (eight monitoring bores and one pumping bore);
- the Q seam of the Moranbah Coal Measures (two monitoring bores);
- the P Seam of the Moranbah Coal Measures (four monitoring bores, one pumping bore and two VWP sensor);
- the H Seam of the Moranbah Coal Measures (five monitoring bores and three VWP sensors);
- the D seam of the Moranbah Coal Measures (six monitoring bores and three VWP sensors); and
- interburden of the Moranbah Coal Measures (two monitoring bores)

Groundwater monitoring from the groundwater monitoring network has been undertaken since 2008. The locations of the current monitoring network are shown in **Figure 5-1** and details provided in **Table 5-1**. Further details about the groundwater monitoring network are included within **Appendix A1**.

Table 5-1 CVM Groundwater Monitoring Network – Standpipe Bores

Bore ID	Easting	Northing	Surface Elevation (m AHD)	Screen Top Elevation (m AHD)	Screen Base Elevation (m AHD)	Monitored Unit	Install Date
PZ01	609841	7560145	220.33	137.83	134.83	D coal seam group	May-08
PZ02	608440	7558242	240	216	205	Basalt	May-08
PZ03-S	608915	7556716	246	228.5	219.5	Basalt	May-08
PZ03-D	608916	7556712	246.11	206.31	203.31	D coal seam group	May-08
PZ04	610731	7555326	279.27	192.17	186.17	Q coal seam group	May-08
PZ05	608917	7554118	255	140	137	D coal seam group	May-08
PZ-06-S	611124	7551676	242	220	211	Basalt	May-08
PZ-06-D	611128	7551678	242	161	158	P coal seam group	May-08

Bore ID	Easting	Northing	Surface Elevation (m AHD)	Screen Top Elevation (m AHD)	Screen Base Elevation (m AHD)	Monitored Unit	Install Date
PZ-07-S	612471	7550703	226.16	217.16	211.16	Tertiary Quaternary alluvium	May-08
PZ-07-D	612465	7550704	226.17	185.17	182.17	Q coal seam group	May-08
PZ-08-S	611411	7549709	230.58	221.58	215.58	Tertiary Quaternary alluvium	May-08
PZ-08-D	611413	7549713	231	171	168	Non-coal Permian	May-08
PZ09	614326	7548822	224.82	153.82	147.82	P coal seam group	May-08
PZ10	613679	7548084	234	157	151	H coal seam group	May-08
PZ11-S	616791	7547600	219	213	210	Tertiary Quaternary alluvium	May-08
PZ11-D	616791	7547600	218.77	163.77	160.77	P coal seam group	May-08
PZ12s	610712	7557219	242.24	215.44	212.44	Regolith	Oct-13
PZ12D	610721	7557164	241.79	189.79	192.79	Non-coal Permian	Oct-13
MB19CVM01A	610330	7548084	238.06	231.06	225.06	Tertiary Quaternary alluvium	Mar-19
MB19CVM02P	611424	7549705	242.00	212.00	206.00	D coal seam group	Mar-19
MB19CVM03T	610087	7551152	245.81	216.81	210.81	Basalt	Mar-19
MB19CVM04P	610101	7551163	245.94	204.94	198.94	D coal seam group	Mar-19
MB19CVM05T	610967	7551247	240.82	201.32	195.32	Basalt	Mar-19
MB19CVM06P	610961	7551247	240.87	173.87	167.87	H coal seam group	Mar-19
MB19CVM07T	611464	7552357	233.87	212.87	206.87	Basalt	Mar-19
MB19CVM08P	611465	7552347	233.78	76.28	70.28	H coal seam group	Mar-19
MB19CVM09A	612448	7550698	226.94	211.44	208.44	Tertiary Quaternary alluvium	Feb-19
MB19CVM10P	613181	7549769	230.61	107.11	101.11	H coal seam group	Feb-19
MB20CVM01A	610028	7560466	217.88	212.88	209.88	Tertiary Quaternary alluvium	Apr-20
MB20CVM04T	608307	7559829	230.82	208.82	202.82	Basalt	Apr-20

Bore ID	Easting	Northing	Surface Elevation (m AHD)	Screen Top Elevation (m AHD)	Screen Base Elevation (m AHD)	Monitored Unit	Install Date
MB20CVM05P	608312	7559824	230.68	191.68	185.68	D seam group	Apr-20
MB20CVM06T	610921	7549067	231.89	220.14	214.14	Regolith	Apr-20
MB20CVM02A	613209	7551216	224.86	208.36	205.36	Basalt	Nov-20
MB20CVM03P	613211	7551207	255.15	155.15	152.15	P seam group	Nov-20
CVMMB16_01	611257	7558498	237.30	226.40	223.40	Regolith	Nov-20
CVMMB16_02	611248	7558493	237.41	173.61	167.61	H Seam Group	Nov-20
CVMPB07_01[$]	611565	7552523	235.72	213.72	207.72	Basalt	Dec 20
CVMPB07_02[$]	611565	7552540	236.68	125.68	119.68	P Seam Group	Dec 20

Note: Coordinates in GDA 94 MGA Zone 55 mbgl – meters below ground level
* – estimated from DEM mAHD – meters above Australian Height Datum $ - Pumping Bore

Table 5-2 CVM Groundwater Monitoring Network - VWPs

Bore ID	Easting	Northing	Surface Elevation (m AHD)	Total Depth (m bgl)	Sensor Depth (m bgl)	Sensor Elevation (m AHD)	Monitored Unit	Install Date
CVMVWP 01_01	610028	7560450	217.84	119.7	49.5	168.3	H Seam Group	Nov-20
					82	135.8	D Seam Group	Nov-20
CVMVWP 07_01	611566	7552559	234.06	234.06	112	122.1	P Seam Group	Nov-20
					179	55.1	H Seam Group	Nov-20
					256.5	-22.4	D Seam Group	Nov-20
CVMVWP 15_01	614909	7548676	227.52	229.2	14.5	213.0	Regolith	Nov-20
					68	159.5	P Seam Group	Nov-20
					145	82.5	H Seam Group	Nov-20
					210	17.5	D Seam Group	Nov-20

5.1.2 Other Projects

Groundwater monitoring data from bores installed at the nearby Moranbah South Project, Winchester South Project, Olive Downs Project, Moorvale South Project, and Eagle Downs Mine sites have been incorporated into this groundwater assessment. The bores are shown on **Figure 5-2** and a summary provided in **Table 5-3**.

Table 5-3 Groundwater Monitoring Networks for Surrounding Operations

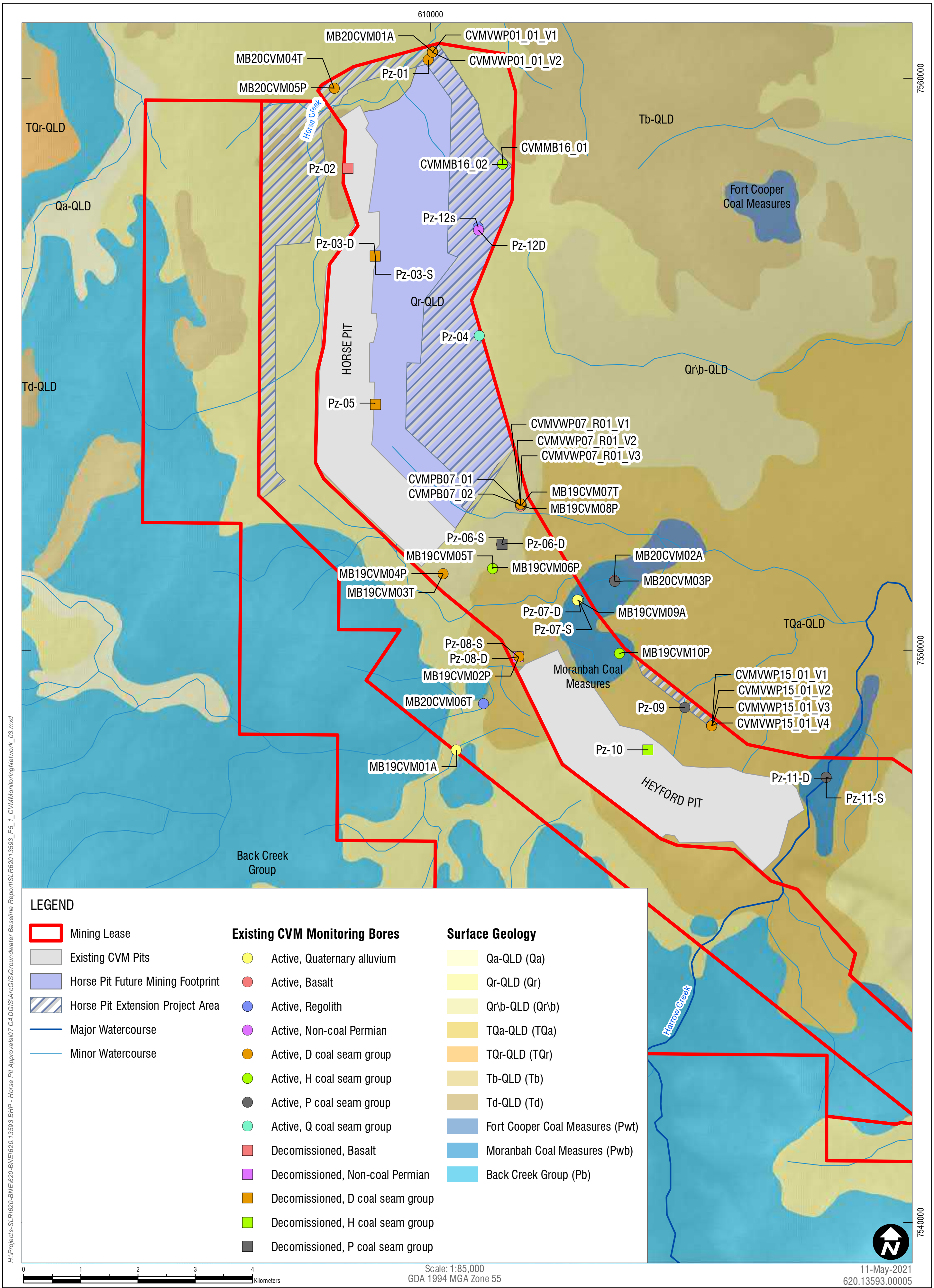
Bore ID	Site ID	Easting	Northing	Total Depth (mbgl)	Monitored Unit
Moorvale South Project					
MS0234	ODN18MB1	640275	7547943	43	Leichhardt Seam
MS0235	ODN18MB2	640263	7547944	20	Alluvium
MS0128	ODN18MB3	639750	7551426	45	Leichhardt Seam
-	ODN18MB4	640684	7549869	24.5	Alluvium
MS0135	ODN18MB5	640000	7551811	27	Alluvium
MS0163	ODN18MB6	639944	7551802	129	Leichhardt Seam
MS0117	ODN18MB7	640310	7554734	36	Alluvium
MS0129	ODN18MB8	638921	7550183	26	Alluvium
MS0113	ODN18MB9	640089	7557236	27	Rangal Overburden
MS0125	ODN18MB10	639451	7554580	135	Fort Cooper Coal Measures - Coal
MS0162	ODN18MB11	638599	7553465	122.8	Fort Cooper Coal Measures - Coal
MS0236	ODN18MB12	640277	7547944	124	Leichhardt Seam
MS0231	ODN18VWP1	640295	7547985	128	Alluvium Rangal Overburden Leichhardt Seam Vermont Lower Seam
MS0233	ODN18TB1	640318	7547935	57	Leichhardt Seam
MS0232	ODN18TB2	640303	7547935	21	Alluvium
Olive Downs Project					
IF3839P	GW01s	642481	7547491	20	Alluvium
IF3837P	GW02s	641152	7546517	19	Alluvium
IF3838P	GW02d	641141	7546507	137	Vermont Upper Seam
IF3841P	GW04	643388	7544973	41	Alluvium
IF3835P	GW06s	639329	7542005	10	Regolith
VP3833P	GW08s	645312	7539839	13	Alluvium
VP3831P	GW12s	641504	7532788	42	Regolith
VE3827P	GW16s	660836	7525291	27	Regolith
VE3829P	GW18s	656889	7522809	15	Alluvium
VE3830P	GW18d	656868	7522804	183	Vermont Upper Seam
VE3825P	GW21s	661590	7521656	9	Regolith
VE3826P	GW21d	661585	7521655	157	Rangal Interburden
IF3856P	S7	641443	7545828	21	Alluvium
IF3857P	S9	641767	7545426	22	Alluvium
IF3858P	S11	642455	7545332	14	Alluvium
IF3859P	S10	642552	7546035	24	Alluvium

IF3860P	S8		642340	7546343	15	Alluvium
IF3861P	S6		642054	7546721	21	Alluvium
IF3862P	S4		641567	7546845	18	Alluvium
IF3863P	S5		642239	7547332	24	Alluvium
IF3864P	S2		641386	7547617	18	Alluvium
IF3840P	GW01d	VWP1	642479	7547491	413	Vermont Upper Seam
		VWP2				Leichhardt Seam
		VWP3				Rewan Group
		VWP4				Rewan Group
IF3836P	GW06d	VWP1	639334	7542008	203	Fort Cooper Coal Measures - siltstone
		VWP2				Fort Cooper Coal Measures - Coal
		VWP3				Fort Cooper Coal Measures - sandstone
		VWP4				Fort Cooper Coal Measures - sandstone
VP3834P	GW08d	VWP1	645312	7539846	585	Leichhardt Seam
		VWP2				Rangal Overburden
		VWP3				Rewan Group
		VWP4				Rewan Group
VP3832P	GW12d	VWP1	641495	7532795	519	Leichhardt Seam
		VWP2				Leichhardt Seam
		VWP3				Rangal Overburden
		VWP4				Rewan Group
VE3828P	GW16d	VWP1	660835	7525287	339	Vermont Upper Seam
		VWP2				Leichhardt Seam
		VWP3				Rewan Group
		VWP4				Rewan Group
Eagle Downs Mine						
MB1	n/a		623254	7551541	50.5	Fort Cooper Coal Measures - siltstone
MB2	n/a		623684	7549391	50.5	Fort Cooper Coal Measures – sandstone and siltstone
MB3	n/a		627240	7549946	51.4	Rewan Group
MB4	n/a		626507	7544152	51.0	Fort Cooper Coal Measures – coal, sandstone and siltstone
MB5	n/a		628491	7542693	51.5	Fort Cooper Coal Measures – coal, sandstone and siltstone
LH8*	n/a		623797	7552173	>85.0	Fort Cooper Coal Measures
LH11*	n/a		627205	7546949	~30.0	Fort Cooper Coal Measures

LH13*		n/a	627200	7546952	~30.0	Fort Cooper Coal Measures
Winchester South Project						
C2105R		n/a	634650	7541857	60.00	Leichhardt Seam
C2136		n/a	631742	7547243	65.60	Leichhardt Seam
G2304R		n/a	633245	7543171	56.00	Vermont Seam
G2307		n/a	630881	7547844	81.00	Vermont Seam
R2008		n/a	630879	7542573	-#	Leichhardt Seam
R2009R		n/a	631332	7542812	83.00	Interburden
R2010R		n/a	631730	7543070	66.00	Leichhardt Seam
R2032		n/a	630495	7545853	81.10	Leichhardt Seam
R2034R		n/a	629598	7545346	39.50	Interburden
R2035		n/a	629190	7545103	37.40	Vermont Seam
R2054		n/a	629240	7548107	82.50	Interburden
R2055		n/a	628798	7547863	67.90	Vermont Seam
Knob Hill 1		n/a	631005	7553874	Not accessible	Isaac River Alluvium
Knob Hill 2		n/a	630431	7554061	24.30	Isaac River Alluvium
Winnet Bore		n/a	634791	7550023	18.12	Isaac River Alluvium
VWP1	Sensor 1902630	n/a	632312	7549767	50$^{\$}$	Fort Cooper Coal Measures Overburden
	Sensor 1902544	n/a			90$^{\$}$	Fort Cooper Coal Measures (Coal Seams Combined)
	Sensor 1902541	n/a			150$^{\$}$	Fort Cooper Coal Measures Underburden
VWP2	Sensor 1902631	n/a	635711	7546357	50$^{\$}$	Fort Cooper Coal Measures Overburden
	Sensor 1902543	n/a			90$^{\$}$	
	Sensor 1902542	n/a			150$^{\$}$	Fort Cooper Coal Measures (Coal Seams Combined)
Moranbah South Project						
MB01		n/a	610570	7562897	13	Tertiary Basalt & Sediments
MB02		n/a	611777	7562388	139	Moranbah Coal Measures
MB03		n/a	613610	7650388	74	Tertiary Basalt & Sediments
MB04		n/a	613961	7562355	15	Alluvium
MB05		n/a	615206	7563212	16.5	Alluvium
MB06		n/a	616017	7561336	22	Tertiary Basalt & Sediments
MB07		n/a	615613	7560398	81	Tertiary Basalt & Sediments
MB08b		n/a	615638	7559628	91	Fort Cooper Coal Measures
MB09b		n/a	618366	7558118	43	Fort Cooper Coal Measures
MB09c		n/a	618366	7558118	15	Tertiary Basalt & Sediments
MB11		n/a	611617	7558367	139	Moranbah Coal Measures

MB12		n/a	613627	7557429	74.5	Tertiary Basalt & Sediments
MB14		n/a	615195	7551070	23	Fort Cooper Coal Measures
MB16		n/a	620083	7547608	31	Moranbah Coal Measures
MB08	VWP Sensor 1	n/a	615638	7559628	309.45$	Goonyella Middle Seam 1
	VWP Sensor 2				310.20$	Goonyella Middle Seam 2
	VWP Sensor 3				311.70$	Goonyella Middle Seam 3
	VWP Sensor 4				313.20	Goonyella Middle Seam 4
MB09	VWP Sensor 1	n/a	618366	7558118	431.20$	Goonyella Middle Seam 1
	VWP Sensor 2				431.60$	Goonyella Middle Seam 2
	VWP Sensor 3				433.40$	Goonyella Middle Seam 3
	VWP Sensor 4				435.40$	Goonyella Middle Seam 4
MB13	VWP Sensor 1	n/a	615195	7551070	285.70$	Goonyella Middle Seam 1
	VWP Sensor 2				286.40$	Goonyella Middle Seam 2
	VWP Sensor 3				287.70$	Goonyella Middle Seam 3
	VWP Sensor 4				289.00$	Goonyella Middle Seam 4
MB15	VWP Sensor 1	n/a	620083	7547608	156.60$	Goonyella Middle Seam 1
	VWP Sensor 2				156.80$	Goonyella Middle Seam 2
	VWP Sensor 3				158.40$	Goonyella Middle Seam 3
	VWP Sensor 4				160.00$	Goonyella Middle Seam 4

Note: * construction details not available # - Depth unknown $ Sensor Depth



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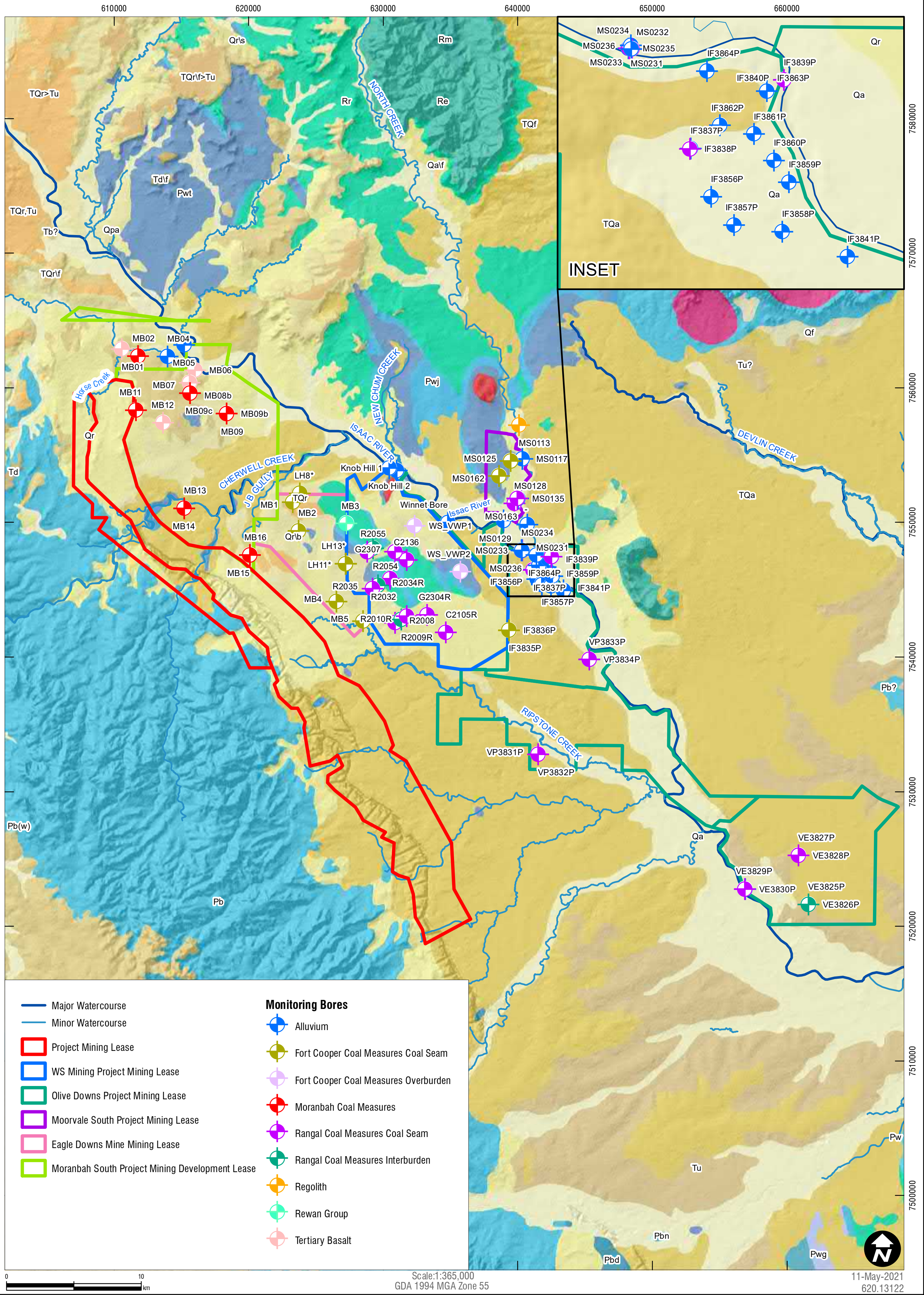
CVM Groundwater Monitoring Network

FIGURE 5-1



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Surrounding Groundwater Monitoring Bores

FIGURE 5-2

5.2 Hydraulic Properties

As part of this groundwater assessment, hydraulic testing was conducted on major geological units within the Project Area. Relevant nearby hydraulic testing was also conducted in 2017 for the Olive Downs Project groundwater assessment, in 2019 for the Moorvale South Project groundwater assessment, and in 2019 for the Winchester South Project groundwater assessment.

Project site hydraulic testing includes slug (rising and falling head) tests performed on monitoring network bores completed in 2009 (URS, 2009), 2019 (AGE, 2019) and 2020 (HFS, 2020). Additionally, two test production bores were drilled in 2020 (one into the Rangal Coal Measures, one into the Tertiary Basalt) with the intent of completing additional hydraulic testing (pumping tests) in support of the Project's groundwater assessment. Following installation however, the yields from these two production bores were found to be insufficient for the completion of the intended hydraulic testing program.

The Winchester South Project hydraulic testing included slug tests on the monitoring network, core sample from the interburden of the coal seams, as well as downhole packer tests targeting major faults in the Project Area. The Olive Downs Project and Moorvale South Project assessments included laboratory geotechnical testing of core samples for vertical (Kv) and horizontal (Kh) hydraulic conductivity, and field testing using methods such as monitoring bore slug testing, packer testing for horizontal hydraulic conductivity, pumping tests, as well as documenting airlift yields. Across July 2019 step and constant rate pumping tests were conducted at two bores as part of the Moorvale South Project assessment.

Two pumping test have been carried out near the Moorvale South Project site, 5 km north east of the Project. The purpose of these tests was to establish characteristics of the Isaac River alluvial aquifers and the coal seam aquifers of the Rangal Coal Measures (Golder Associates, 2019). This information contributes to the understanding of the connectivity between the deep and shallow aquifers, the interaction between the shallow aquifer and the Isaac River and the flow dynamics within the aquifers.

This section presents a summary of the available field hydraulic data and comparison to reported hydraulic properties within external sources.

5.2.1 Hydraulic Data

The database of available field results for horizontal (Kh) and vertical (Kv) hydraulic conductivity is presented graphically as **Figure 5-3**. Tests from the Project Area are provided as a separate classification on the plot. The data are also presented separately for each test method as results can vary based on the type of testing and analysis undertaken.

Figure 5-3 shows that the hydraulic conductivity of the alluvium is variable, ranging from 10^{-2} to almost 10^{1} metres per day (m/day), which reflects the heterogeneous nature of the alluvial sediments. Hydraulic testing of the alluvium within the Project Area itself also showed found hydraulic conductivity to be at the lower end of this scale, with values ranging from 0.09 m/d to 1.25 m/d. Pumping tests conducted in 2019 as part of the Moorvale South Project assessment reported hydraulic conductivity values in the range of 2.1 – 2.7 m/day, which is in the range of values provided by slug testing conducted across the Study Area.

Hydraulic conductivity testing of the Tertiary basalt within the Study Area is limited to slug testing of Project monitoring bores. Hydraulic conductivity of the Tertiary Basalt is highly variable, ranging from 5.18×10^{-3} to 3.19 m/d, which reflects the heterogenous nature of the basalt as controlled by the degree of weathering and/or nature of fractures / vesicules.

The Rewan Group sediments exhibit a low hydraulic conductivity, typically less than 10^{-4} m/day, similar to the interburden/overburden material of the Rangal Coal Measures. Interburden/overburden testing shows a hydraulic conductivity of at least an order of magnitude less than that of coal seams at similar depths.

The coal seams of the Permian coal measures generally record higher hydraulic conductivity than the majority of the interburden/overburden for tests. This is due to the dual porosity of the coal seams, with a primary matrix porosity and a second (dominant) porosity provided by fractures (joints and cleats), which supports the concept of the coal seams themselves forming the dominant groundwater zones of the Permian units.

Slug tests were performed in 2009, 2019 and 2020 on Project monitoring bores targeting the coal seams of the Moranbah Coal Measures. The testing reported the following horizontal hydraulic conductivities (Kh) ranges (**Figure 5-3**).:

- 0.26– 0.33 m/d for the Q Seam;
- 0.024 – 0.16 m/d for the P Seam;
- 0.007 – 0.33 m/d for the H Seam; and
- 0.025 – 0.59 m/d for the D Seams

The hydraulic conductivity of non-coal Permian units tested (interburden) was generally found to be lower than the coal seam permeabilities with hydraulic conductivity values of 0.026 m/d and 0.034 m/d reported. No Project vertical hydraulic conductivity (Kv) data exists for the Moranbah Coal Measures and as such anisotropy has not been calculated.

Permeability testing of Permian units has also been undertaken across the Study Area. Moorvale South Project site pumping tests in 2019, performed on the Leichhardt and Vermont Seams of the Rangal Coal Measures, reported hydraulic conductivity ranges between 0.5 – 1.5 m/day, and 0.5 – 1.2 m/day, respectively. These values are generally higher than within the Project Area but align with previous testing of the Permian coal measures across the Study Area.

Figure 5-3 shows that the hydraulic conductivity of the Permian coal measures as well as the Rewan Group generally declines with depth, due to increasing overburden pressure reducing the aperture of secondary porosity features. Anisotropy for the Rangal Coal Measures interburden material was more variable, with Kv ranging between 11% and 76% of Kh. During the Olive Downs Project groundwater assessment, core samples were collected within the coal seam roof/ floor material and proximal to fault zones, where practicable (i.e. for competent samples). Results for these samples indicated a Kv of between 50% to 160% of Kh. Comparison of Kh and Kv indicates that within the Rewan Group the Kv is around 10% to 40% of Kh.

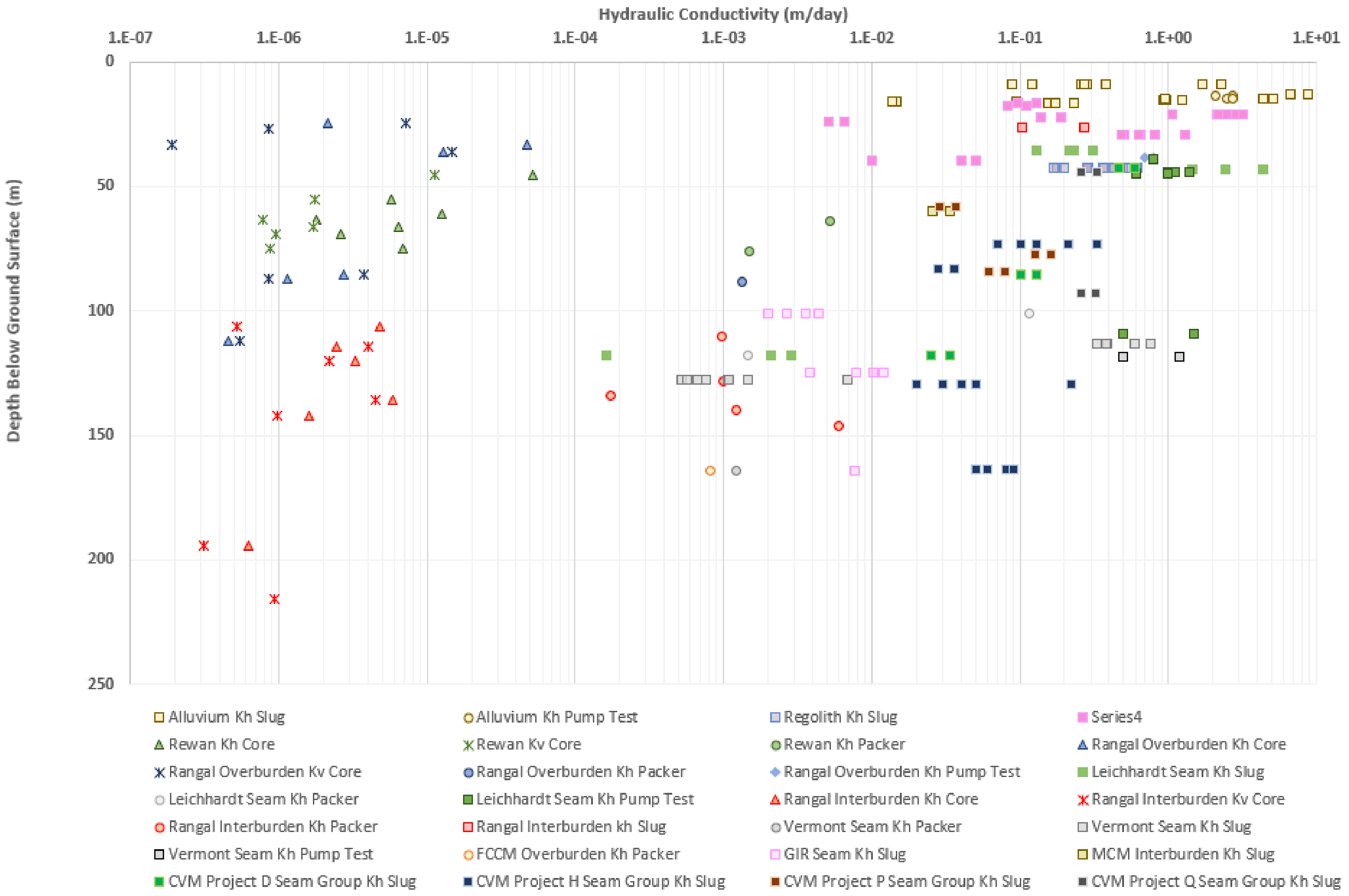
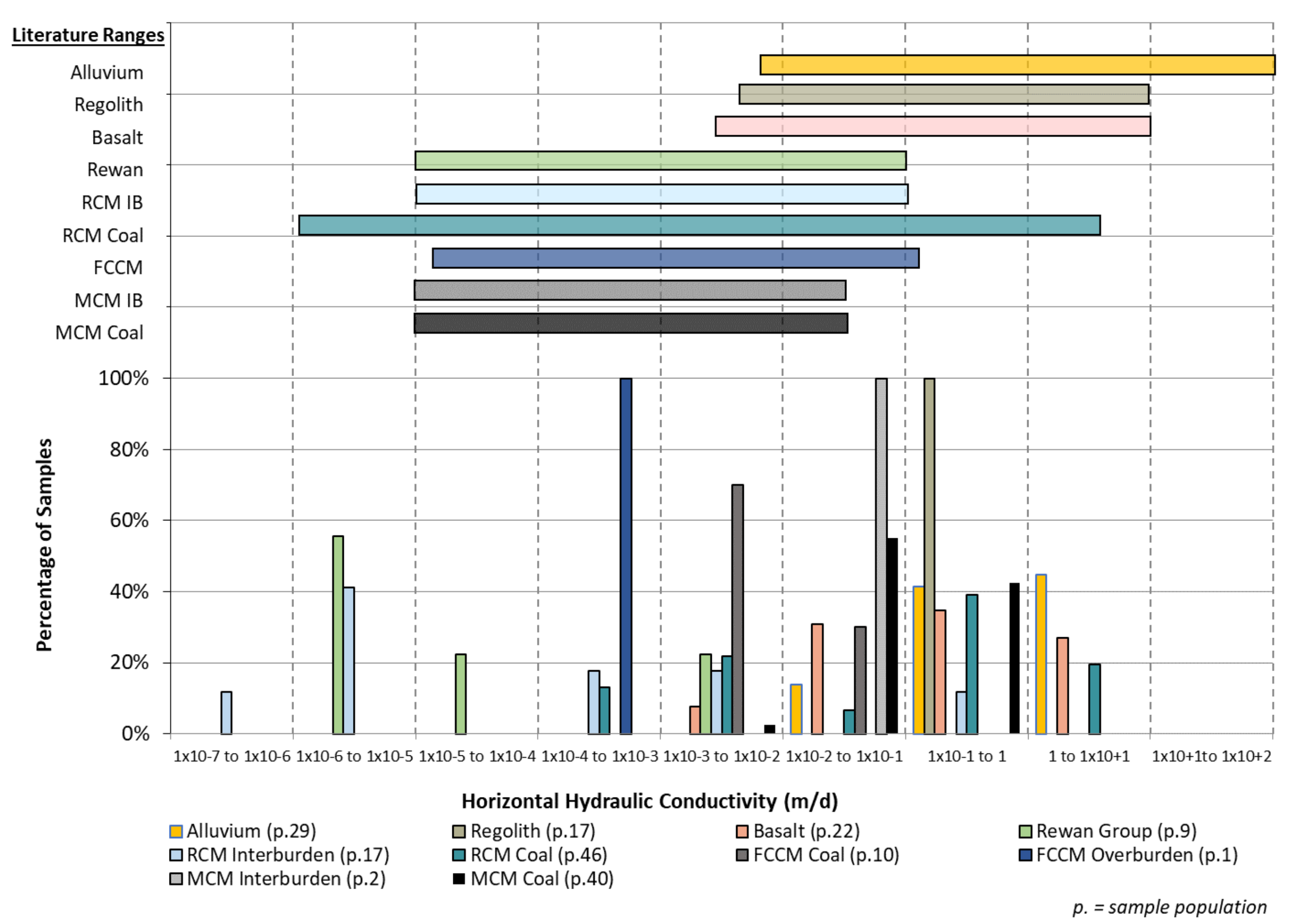


Figure 5-3 Summary of Results for All Hydraulic Testing

5.2.2 Hydraulic Conductivity Ranges

A histogram of the spread of horizontal hydraulic conductivity (Kh) from the field testing at CVM, as well as at the Winchester South Project, Olive Downs Project and Moorvale South Project, is presented in **Figure 5-4**. The results are compared to the range of documented values for each relevant units as presented within a literature review previously completed by HydroSimulations (2018) based on a number of other studies within the Bowen Basin.



RCM = Rangal Coal Measures, FCCM = Fort Cooper Coal Measures, RCM IB = Rangal Coal Measures Interburden, MCM = Moranbah Coal Measures

Figure 5-4 Histogram of Horizontal Hydraulic Conductivity Distribution

The comparison shows that the field results for alluvium, regolith, basalt, Rangal Coal Measures and Fort Cooper Coal Measures within the Study Area and immediate surrounds fall within the range of field data collected through other studies across the Bowen Basin. Results from the Moorvale South Project site recorded some lower readings for the Rewan Group than previously identified in literature. Results for the Moranbah Coal Measures from the CVM Project site recorded higher readings than previously identified in literature. Review of **Figure 5-3** shows that within the Moranbah Coal Measures the higher readings are attributed to the H seam where hydraulic conductivities are generally an order of magnitude greater than measured within the Q, P and D coal seams. As discussed in **Section 4.2.3.1** the H seam is generally thicker than the other seams, which may result in wider cleats and fissures within the unit.

5.2.3 Faulting

As discussed in **Section 4.2.3.3**, significant faulting is not present at CVM or in the Project Area, however extensive faulting has been mapped within the Permian coal measures east of the Project (see **Figure 4-2**). As identified by Jourde *et al*. (2002), faulting can result in higher permeabilities within strata parallel with the fault plane, and lower permeabilities within strata perpendicular to the fault plane. However, this can also be dependent on whether faults are currently active (Paul *et al.*, 2009). Faulting has been inactive within the Bowen Basin for over 140 million years (Clark *et al.*, 2011), indicating that the fault zones are less likely to act as conduits to flow; this relates to filling of the fractured pore spaces over time through hydrothermal alteration and mineralisation (Uysal *et al.*, 2000). Drill core logs from within the Study Area and the Project Area show that where fractures and faults have been geologically logged, many fractures are “healed” with calcite and siderite. This indicates that although the system contains a fracture network, many of the existing fractures are cemented, which reduces the effective permeability of the fracture when compared to any open fracture network.

Downhole hydraulic testing undertaken, was conducted in the Permian coal measures for the Winchester South Project. Fault zones were confirmed to be intersected at these drill holes due to the presence of fracturing, calcite infills, and slickensides in core obtained from the drill holes, all of which are considered an indicative marker of faulting. Testing results showed relatively low hydraulic conductivity values ranging from 6.93 x 10^{-5} to 2.07 x 10^{-3} m/day, and in line with those presented in **Figure 5-5**. These properties indicate that the faulting zones intercepted and tested are ‘healed’ and not pathways for preferential groundwater flow.

As discussed in **Section 5.2.1**, laboratory geotechnical analysis of core samples of interburden immediately above and below coal seams proximal to a fault zone has previously been undertaken in support of groundwater assessments in the Study Area. The samples recorded vertical hydraulic conductivity of 50% to 160% of horizontal hydraulic conductivity; i.e. although some samples show a typical Kv of somewhat less than Kh, some samples also suggest greater Kv than Kh which may be indicative of preferential vertical flow pathways associated with faulting. However, it was also noted that these areas of increased Kv are limited vertically, with samples collected from the same drill hole at horizons further above and below the fault zone (interburden and Rewan Group) returning a lower Kv of between 11% and 76% of Kh.

The impact of faults on groundwater flow within the Study Area was also assessed as part of the Bowen Gas Project. Kinnon (2010) assessed the movement of water and gas across a series of faults in the Bowen Basin using stable isotope and water quality analysis to assess zones of potential recharge, water mixing and flow pathways. Higher gas production rates were also observed on either side of a major fault, with differences in isotopic compositions of produced water for wells north and south of the major fault line at similar depths, implying little communication across the fault boundary, and suggesting that the fault acts as a horizontal permeability barrier to water and gas flow. The results of the study showed that compartmentalisation was evident and that this was due to the structural geology (faulting) in the basin.

Based on a detailed literature review of the effect of faulting on groundwater flow, Coffey (2014) has developed a conceptual model for fault zone hydraulic characterisation in the Bowen Basin (**Figure 5-5**), largely based on Jourde *et al.* (2002) and Flodin *et al.* (2001). This conceptualisation provides a means of inferring hydraulic conductivities of the fault core and the fault damage zone from regional hydraulic conductivity, with the fault core typically one to three orders of magnitude lower conductivity than the regional host rock, and the damage zone approximately an order of magnitude higher.

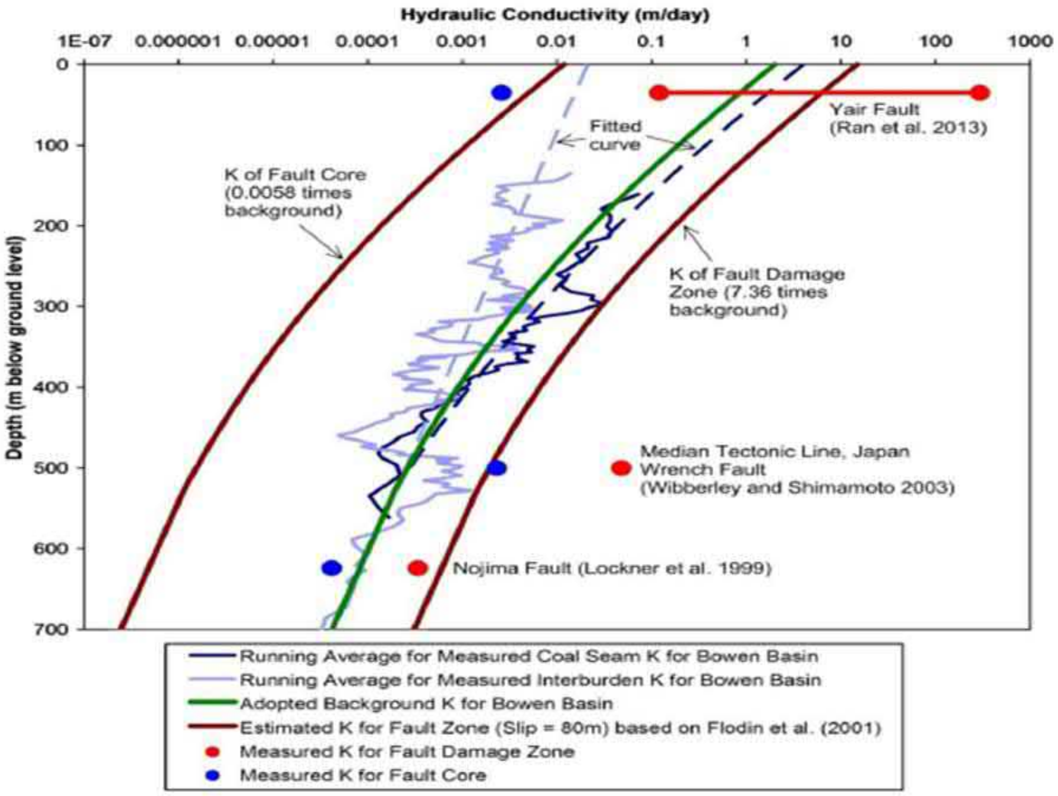


Figure 5-5 Faulting Conceptual Model Developed by Coffey (2014)

5.3 Groundwater Distribution, Flow, Recharge and Discharge

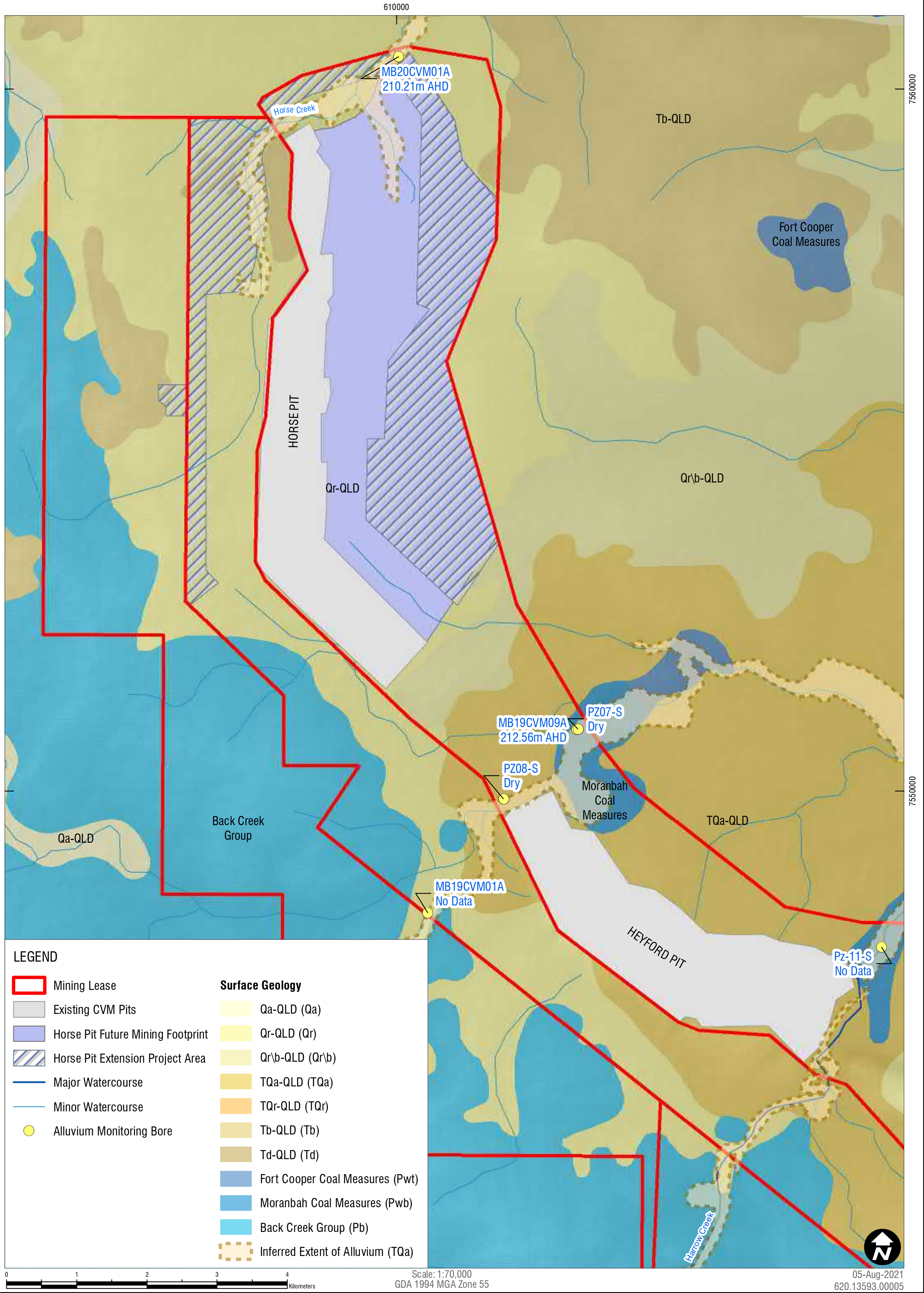
5.3.1 Alluvium

5.3.1.1 Distribution and Flow

Due to the apparent heterogeneity and discontinuity of the Quaternary alluvium or Tertiary sediments pre-mining groundwater flow directions were not calculated as part of the original EIS project (URS, 2009). The groundwater flow direction was determined as likely to be topographically controlled, flowing from higher to lower elevations (URS, 2009).

Alluvial groundwater levels are currently monitored at six bores (refer to **Table 5-1** and **Figure 5-1**) as part of the Project. Water levels have been periodically monitored at these sites since 2008. Routine monitoring of these bores commenced in July 2019 to support the Project and establish baseline levels over time.

The majority of available groundwater monitoring data for the alluvium relates to the area of this aquifer along the upstream parts of Cherwell Creek on the CVM ML immediately south of the Project Area. Monitoring data from one monitoring bore is also available for the alluvium associated with Horse Creek in the north of the Project (MB20CVM01A). Available monitoring data shows groundwater elevations in the alluvium are approximately 225 to 224.25 mAHD in the upstream (west) parts of the Cherwell Creek alluvium, and 213.3 to 212 mAHD in the downstream (east) parts of the alluvium, where it extends across CVM south of the Project. Groundwater elevations for bores within alluvium near to the Project Area are displayed in **Figure 5-6**.



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Alluvium Groundwater Elevations December 2020

FIGURE 5-6

Quarterly alluvium aquifer monitoring records date back to June 2008 for bore PZ08-S located south of the Project Area near Cherwell Creek, and generally show groundwater levels between 216 and 220 mAHD (11 to 14.5 m below top of casing (mbTOC)). Some fluctuation is evident in the data, possibly related to climatic trends.

Monthly data from alluvial monitoring bores is presented in **Figure 5-7** and shows a declining trend of approximately 0.25 to 0.3 m over the second half of 2019 at two bores, again likely related to dry recent climate trends. Since June 2020 monitoring bores Pz07s, PZ08s and MB19CVM01A have been reported as dry, which is likely to be related to the drier than average climate conditions. MB20CVM01A (located in the north of the Project Area) and MB19CVM09A (located to the south of the Project Area) show generally declining groundwater elevations in correspondence to drier than average condition. A slight recovery in groundwater elevations was observed in both bores in early 2021, in response to wetter than average climatic conditions reported.

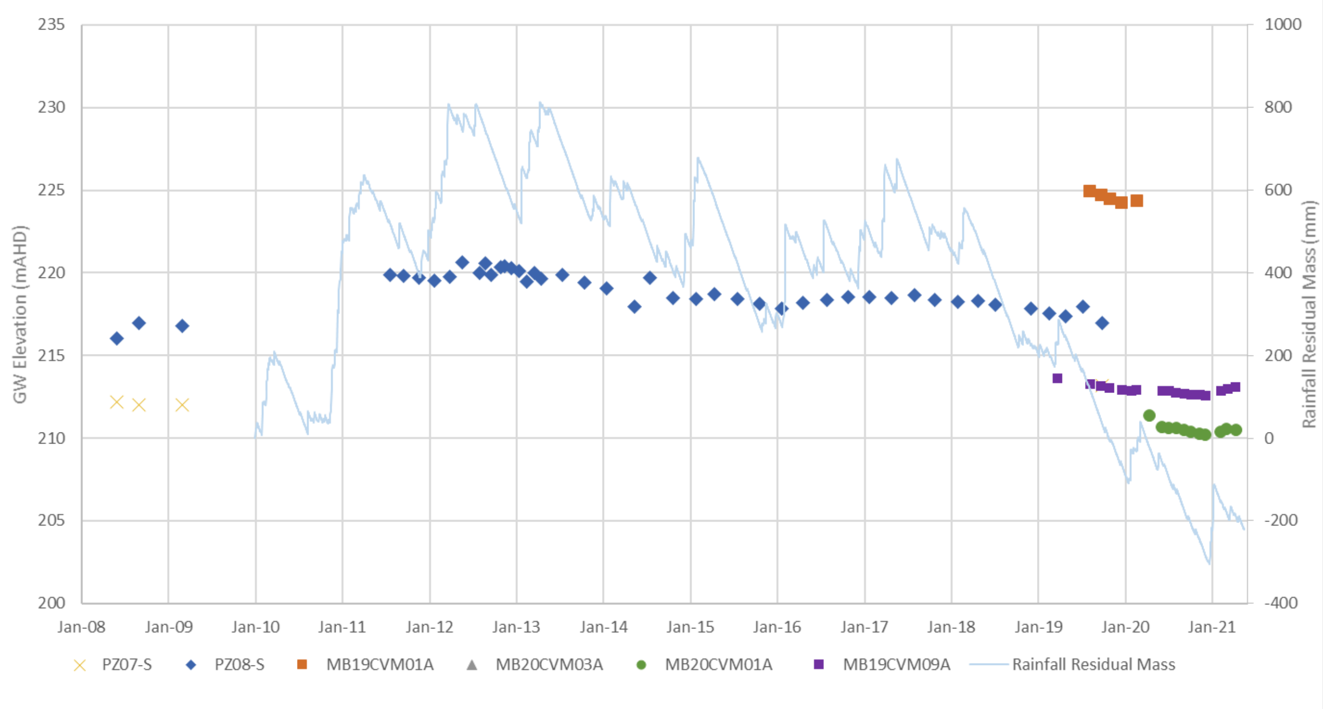
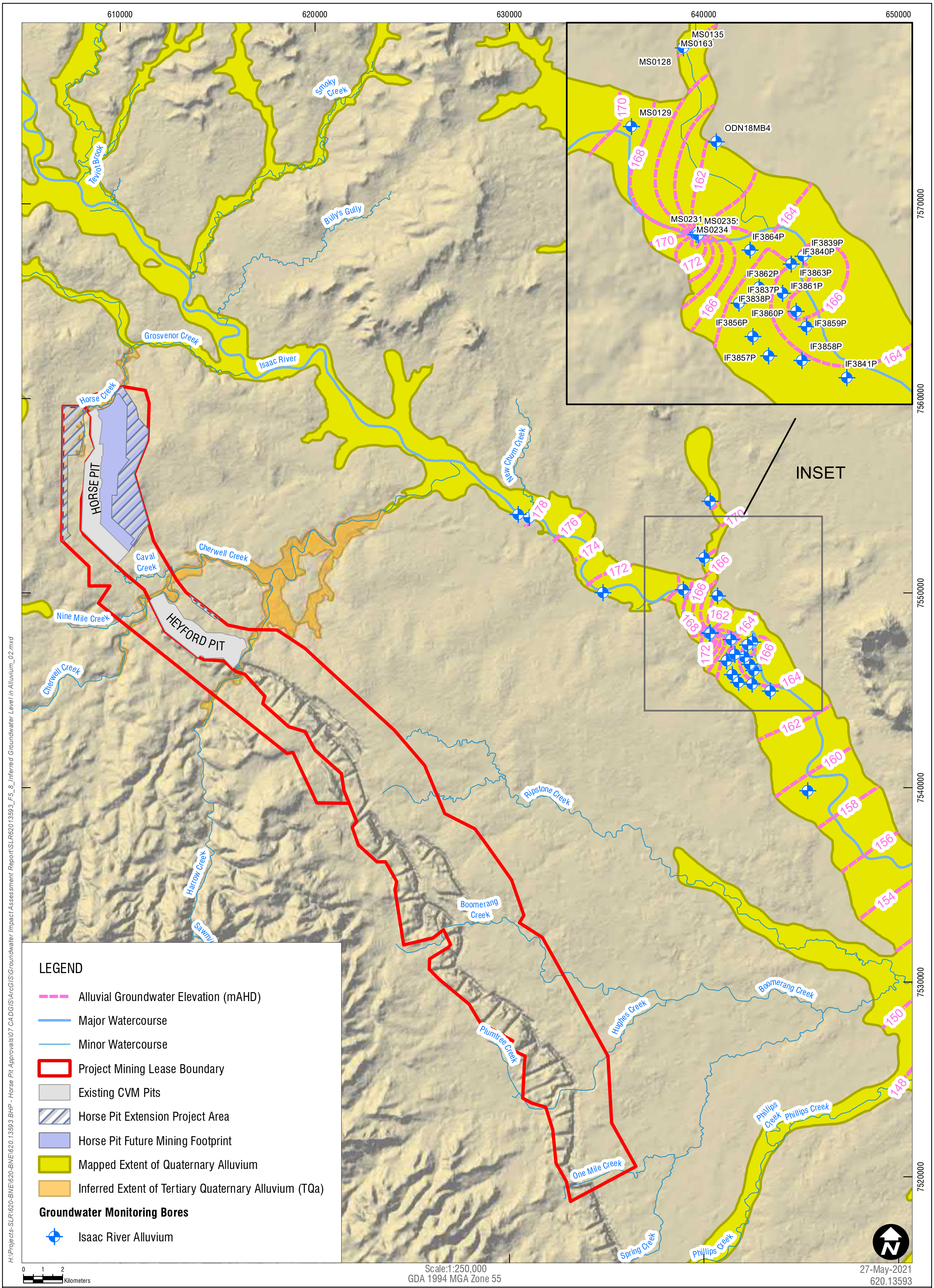


Figure 5-7 Hydrograph of Alluvial Groundwater Trends

Groundwater elevation data for the Isaac River Alluvium has been collected as part of the Winchester South Project, Moorvale South Project and Olive Downs Project groundwater assessments, which are located to the east / southeast of the Project Area. A potentiometric surface for the Isaac River alluvium from water level observations collected during these groundwater assessments is displayed in **Figure 5-8**. Groundwater elevations were found to range from around 179 mAHD in the northern end of the Winchester South Project Area, and between approximately 162 mAHD to 166 mAHD to the south-east, increasing with proximity to the Isaac River. This suggests losing stream conditions as discussed in **Section 5.3.7**. The water levels in the Isaac River alluvium clearly follow the flow direction of the Isaac River, with south-easterly flow gradients.



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Inferred Groundwater Level and Flow Direction in Isaac River Alluvium

FIGURE 5-8

5.3.1.2 Recharge and Discharge

Recharge to the alluvium is considered to be mostly from stream flow or flooding (losing streams), with direct infiltration of rainfall also occurring where there are no substantial clay barriers in the shallow subsurface. Short term monitoring data available for monitoring bores MB19CVM09A and MB20CVM01A show a response in groundwater elevations with climate. As shown in **Figure 5-7** groundwater levels generally decline during drier than average conditions before showing slight recovery in response to wetter than average conditions experienced at the start of 2021.

Long term monitoring data available for monitoring bore Pz08-S does not show any correlation between groundwater elevations and climatic conditions at this location. Groundwater levels at Winchester South Project bore Knob Hill 2 were found to generally show trends similar to rainfall, whereas groundwater levels at Winnet Bore were observed as unresponsive to climate, remaining relatively stable to slightly increasing from April 2012 to July 2019. The lack of response to rainfall trends may relate to the presence of surficial clays restricting groundwater recharge, as discussed in **Section 4.2**, or that rainfall was not sufficient to wet the unsaturated zone within the alluvium above the water table as well as providing vertical groundwater flow towards the water table. Similar variable trends have been observed in alluvial bores located at Winchester South Project located to the south east of the Project Area.

Recharge rates have been estimated using chloride mass balance (CMB) calculations. The CMB calculations were based on available water quality results (chloride concentrations) collected from the monitoring bores at CVM and other monitoring bores within the Study Area. The CMB calculation assumed average annual rainfall of 564 mm based on SILO Grid point data (Latitude: -22.10, Longitude: 148.05) as discussed in Section **3.1**. The calculations also assumed a mean annual rainfall chloride flux of 3 milligrams per litre (mg/L), which is consistent with the values used as part of the Winchester South (SLR, 2020) and Olive Downs (Hydrosimulations. 2018b) numerical groundwater models. Outliers were excluded from the calculations and were identified as readings more than four standard deviations above the mean (USEPA, 2009). Using the CMB method recharge rates for the various alluvium unit have been calculated:

- Isaac River Channel Alluvium – 3 mm/yr
- Isaac River Flood Plain Alluvium – 1.3 mm/yr
- Other alluvium – 1.3 mm/yr
- Tertiary sediments – 0.1 mm/yr

Groundwater within the alluvium is discharged as evapotranspiration from riparian vegetation growing along the Isaac River, as well as potential baseflow contributions after significant rainfall and flood events. Groundwater within the alluvium is also discharged through the landholder use of bores in the region.

Geological logs in the Study Area indicate that the alluvium is underlain by low hydraulic conductivity stratigraphy (i.e. claystone, siltstone and sandstone), which restricts the rate of downward leakage to underlying formations. Localised perched water tables within the alluvium are evident where waterbodies continue to hold water throughout the dry period (e.g. pools in the Isaac River and floodplain wetlands) and occur where clay layers slow the percolation of surface water.

5.3.2 Tertiary Basalt

5.3.2.1 Distribution and Flow

Due to the apparent heterogeneity and discontinuity of the Tertiary basalt pre-mining groundwater flow directions were not calculated as part of the original EIS project (URS, 2009). The groundwater flow direction was determined as likely to be topographically controlled, with local flow from higher to lower elevations (URS, 2009).

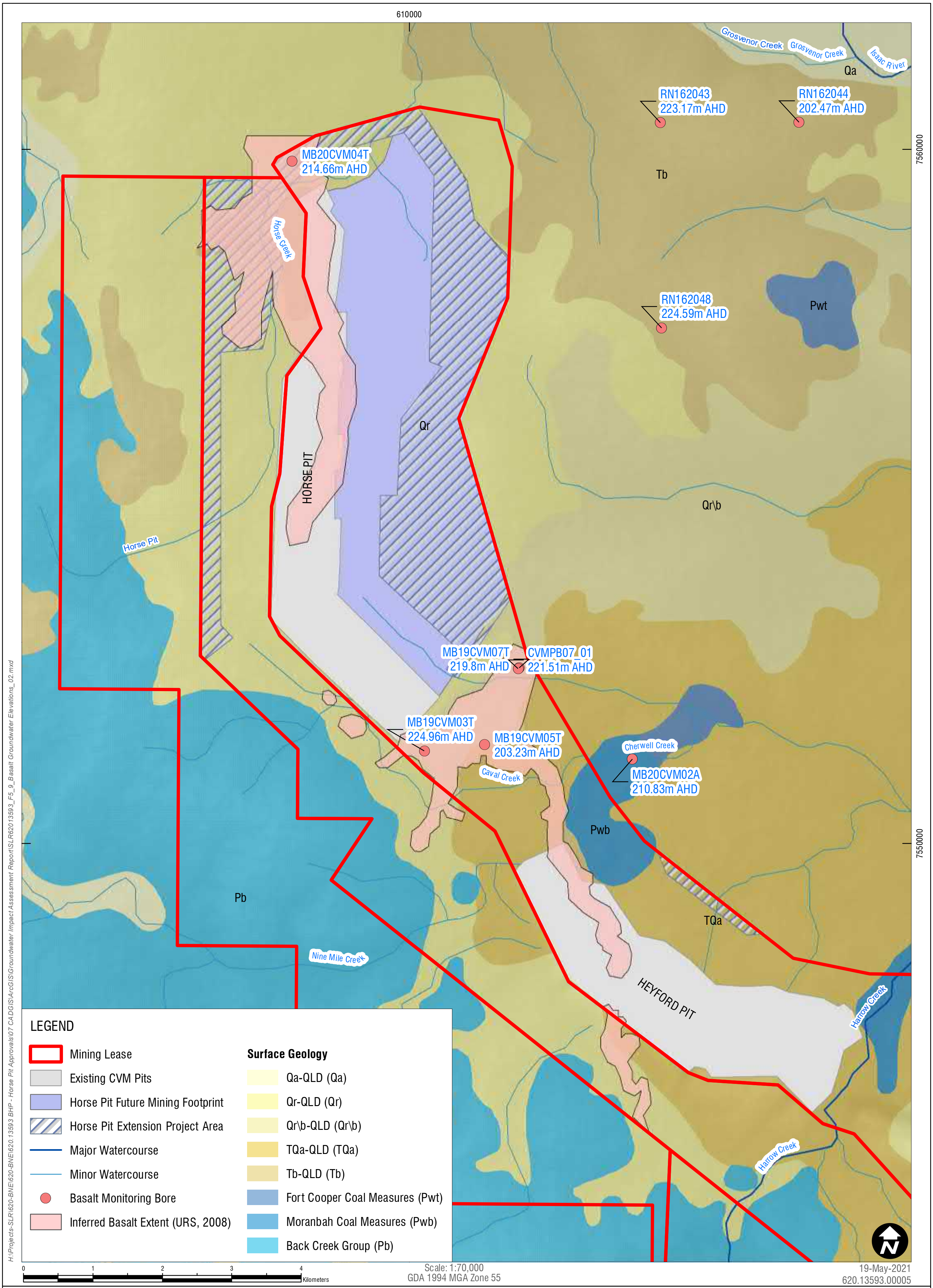
Tertiary basalt groundwater levels are currently monitored at six bores (refer to **Table 5-1** and **Figure 5-1**) as part of the Project. Monitoring records date from mid-2008 to mid-2017 for bore PZ03-S located west of the Project Area where the Horse Pit has been mined through, and shows relatively stable groundwater levels of 223.5 mAHD (22.5 mbTOC) between late 2013 and mid-2016 after which mining in Horse Pit eventually approached the bore (**Figure 5-10**). Groundwater levels declined to 221 mAHD prior to the bore being absorbed by mining activities in mid-2017.

Monitoring records date from mid-2008 to mid-2013 for bore PZ06-S located south of the Project Area, and show relatively stable groundwater levels of 215.8 mAHD (26.2 mbTOC) until monitoring ceased.

No groundwater level data is available for the basalt aquifer between mid-2017 and early 2019, however monitoring of this aquifer recommenced following the establishment of three new monitoring bores south of the Project in early 2019. Monthly monitoring of these bores since late 2019 shows slightly declining trends at bores MB19CVM03T (225.4 to 224.6 mAHD) and MB19CVM05T (207.4 to 203.6 mAHD), although bore MB19CVM07T is comparatively steady at 220.2 to 219.9 mAHD over this time. A slight recovery of groundwater levels is noted between December 2020 and February 2021 corresponding with wetter than average conditions over this period. The declining trends and slight recovery may be indicative of several influences including settling of the bores following drilling, recent climatic trends or impacts from mining activities.

Two additional bores, monitoring bore MB20CVM02A and pumping bore CVMPB07_01 were established in late 2020. Routine monitoring of these bores commenced in April 2021 to support the Project and establish baseline levels over time. Groundwater elevations recorded are consistent with the other Project monitoring bores, ranging from 221.5 m AHD (CVMPB07_01) and 210.8 mAHD (MB20CVM02A).

Groundwater elevations for the Tertiary basalt are displayed in **Figure 5-9**. The elevations are based on measurements from the Project’s basalt monitoring bores. Basalt groundwater elevations range from around 224.6 mAHD to the south west of the Project Area to 202.5 mAHD to the east. **Figure 5-9** includes the inferred extent of the basalt as interpreted from the aeromagnetic geophysical surveys (URS, 2008; **Section 4.2.1.3).** Flow within the basalt is therefore believed to be localised to these extents.



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Basalt Groundwater Elevations April 2021

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FIGURE 5-9

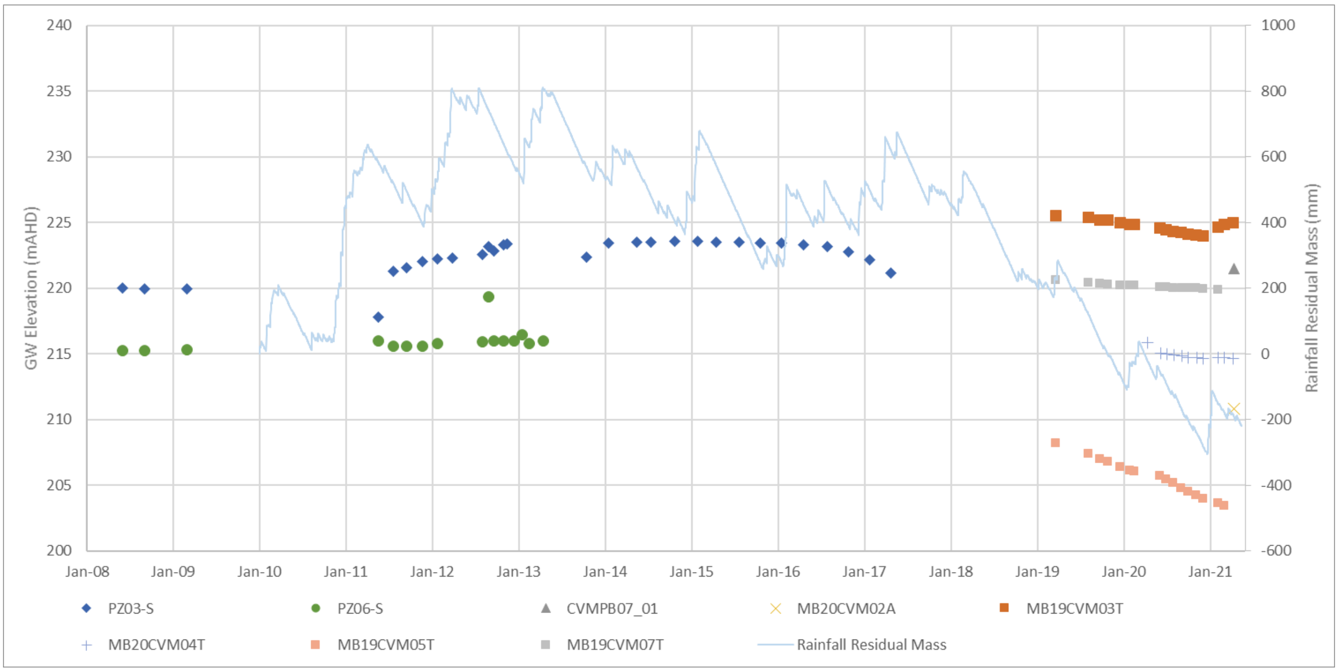


Figure 5-10 Hydrograph of Basalt Groundwater Trends

5.3.2.2 Recharge and Discharge

Recharge to the basalt aquifers is likely to be via surface infiltration and overland flow in areas where the basalt is exposed and/or no substantial clay barriers occur in the shallow subsurface. Recharge may also occur via vertical seepage from overlying alluvium aquifers in areas where underlying low hydraulic conductivity stratigraphy (i.e. claystone, siltstone and sandstone) is absent.

Using the CMB method (refer **Section 5.3.1.2**) a recharge rate for the Tertiary basalt has been calculated as 1.7 mm/yr.

Groundwater discharge occurs primarily via evapotranspiration. Discharge via baseflow to minor tributaries of Cherwell Creek (in areas intersected by the basalt) may also occur after significant rainfall and flood events. Vertical seepage through the basalt is limited by the underlying low hydraulic conductivity overburden of the Blackwater Group and other aquitards.

5.3.3 Regolith

5.3.3.1 Distribution and Flow

The regolith is not expected to form a significant aquifer at CVM in relation to the Project. Bore PZ12-S, located in the east of the Project area, has quarterly water level records available from early 2014 to early 2021 (**Figure 5-11**). The records show falling groundwater levels from 24.5 mbTOC (217.7 mAHD) at the commencement of monitoring down to 26.5 mbTOC (215.7 mAHD) in mid-2016; however, levels have been generally stable since that time and even show a slight recovery to approximately 25.9m bTOC (216.3 mAHD) in the most recent data.

Additional monitoring bores were installed within the regolith in mid to late 2020. **Figure 5-11** presents monthly water levels recorded at bore MB20CVM06T located to the south of the Project Area and CVMB16_02 located on the north eastern boundary of the Project Area. **Figure 5-11** shows generally stable groundwater levels ranging between 13.82m bTOC (218.1 mAHD) and 11.94m bTOC (220.1 mAHD). Water level measurements of additional monitoring bore CVMB16_01 commenced in April 2021, at which time the bore was recorded to be dry. The depth to the base of the screen at CVMB16_01 is 13.9m bTOC (224.08m AHD).

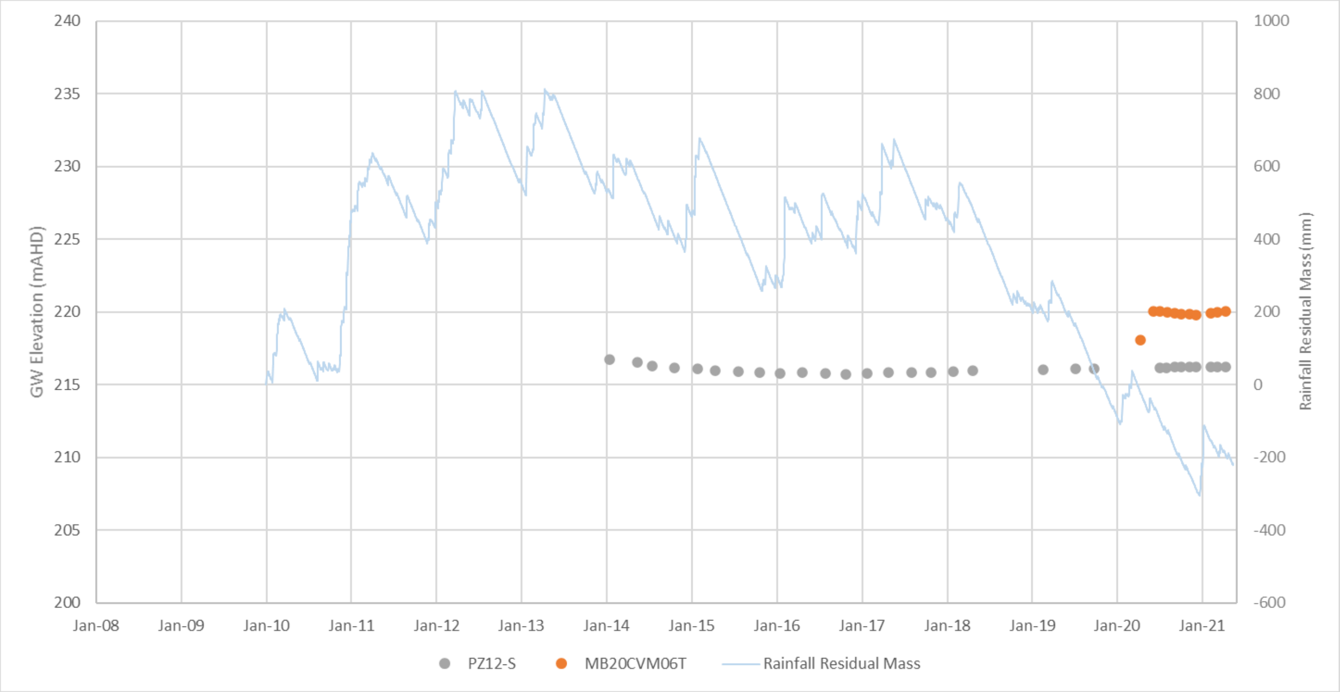


Figure 5-11 **Hydrograph of Regolith Groundwater Trends**

Exploration drilling across the Winchester South Project Area suggested that the regolith is not commonly saturated. Groundwater monitoring conducted within the Study Area includes four monitoring bores intersecting the regolith (GW06s, GW12s, GW16s and GW21s at the Olive Downs Project). The location of these bores is shown in **Figure 5-2**. Of these bores, two (GW06s and GW16s) have remained dry (unsaturated) between June 2017 and February 2019. However, bore GW12s which is located along Ripstone Creek, records a saturated thickness of around 23 m in the regolith, while bore GW21s has a saturated thickness of less than 1 m.

Overall, the regolith within the Project Area and Study Area is considered to be largely unsaturated, with the presence of water restricted to lower elevation areas along the Isaac River and the lower reaches of its tributaries (i.e. Cherwell Creek and Cherwell Creek). Flow within the regolith where it is saturated is a reflection of topography, flowing towards nearby drainage lines.

5.3.3.2 Recharge and Discharge

Water within the regolith, where it is saturated, occurs at depths of approximately 12 mbgl to 26 mbgl. As discussed in **Section 4.2**, the regolith material comprises low hydraulic conductivity strata (i.e. clay and claystone), which restricts rainfall recharge. This is shown by the general lack of response to climatic conditions in both Project monitoring bores. This is consistent with observations within regolith monitoring bores (GW12s and GW21s) in the Winchester South Project Area, where groundwater levels have remained relatively stable between June 2017 and February 2019, despite above average rainfall, although not substantial, from October to December 2017 and over February 2018. This lack of response in monitoring bores within the Study Area may also be due to rainfall being insufficient to wet the unsaturated zone above the water table as well as providing vertical groundwater flow towards the water table.

Using the CMB method (refer **Section 5.3.1.2**) a recharge rate for the regolith has been calculated as 0.1 mm/yr.

Groundwater discharge occurs primarily via evapotranspiration, with some baseflow to streams from the regolith under wet climatic conditions. Vertical seepage through the regolith is limited by the underlying low hydraulic conductivity of the Blackwater Group overburden and other aquitards.

5.3.4 Rewan Group

5.3.4.1 Distribution and Flow

The closest bores to the Project Area screened within the Rewan Group is bore RN141383 (MB3), which is part of the Eagle Downs Mine monitoring network and is located 17km south east of the Project. VWP GW01d (at the Olive Downs Project) is approximately 5 km to the east of the Winchester South Project boundary, on the western side of the Isaac River. The location of both bores is shown in **Figure 5-2**. The unit thickens towards the Isaac River, and can be up to 300 m thick within the Study Area. In general, the occurrence of the unit can vary regionally based on the structural setting. The Rewan Group comprises low hydraulic conductivity lithologies and is typically considered an aquitard.

5.3.4.2 Recharge and Discharge

Groundwater elevations for Olive Downs Project monitoring VWP's GW01d (logger P3 and P4) are shown in **Figure 5-12**. Excluding recovery/stabilisation trends following construction and data considered to be erroneous, the graph shows that groundwater elevations within the Rewan Group have remained stable to slightly declining from 2017 to 2019. Groundwater elevations within the Rewan Group are above those recorded within the deeper Permian coal measures, indicating a downward hydraulic gradient. **Figure 5-12** also presents trends for nested alluvial bore GW01s (at the Olive Downs Project), which show alluvial groundwater levels above the Rewan Group groundwater elevation. This indicates a downward gradient from the overlying alluvium. However, as outlined above, due to the low hydraulic conductivity of the Rewan Group stratigraphy (**Section 5.2**), the unit is considered an aquitard, restricting groundwater flow. No site data is available for the low permeability Rewan Group and therefore recharge estimates have not been calculated.

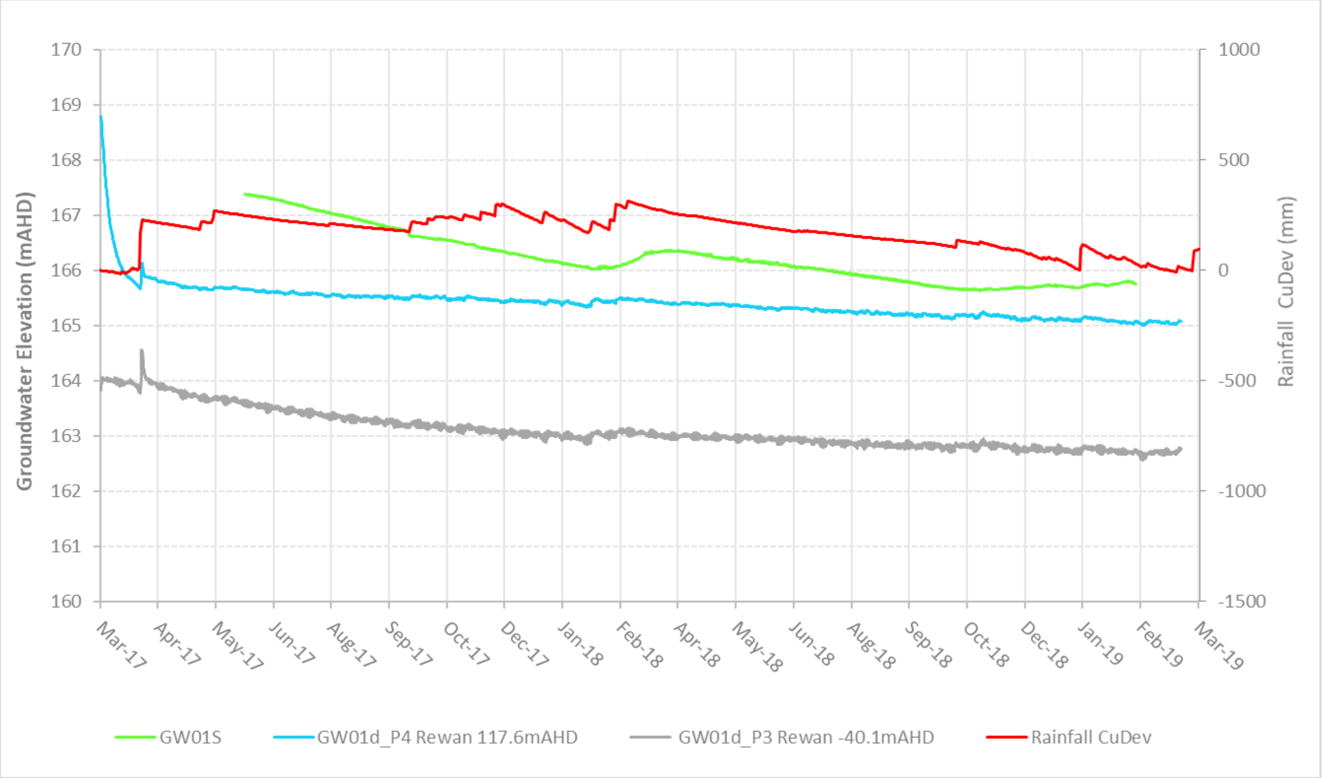


Figure 5-12 Hydrograph for VWP GW01d (P3 and P4) and Bore GW01s

5.3.5 Permian Coal Measures Interburden

5.3.5.1 Distribution and Flow

Within the Project Area, two monitoring bores are established within the overburden/interburden (PZ08-D and PZ12-D), the location of these monitoring bores is shown on **Figure 5-1.** Groundwater occurrence within the Permian coal measures interburden is largely restricted to weathered horizons or to secondary porosity through fractures (**Section 5.2**).

Groundwater monitoring of the Permian Coal measure interburden has been undertaken in the east of the Project Area (PZ12-D) since early 2014. Groundwater monitoring of the Permian Coal measure interburden was also undertaken to the southwest of the Project Area (PZ08-D), immediately northwest of Heyford Pit, between mid 2008 and late 2019.

Figure 5-13 shows that groundwater elevations gradually declined within PZ12-D until early mid 2020 after which they have slightly recovered. The data potentially indicates a subdued response to mining activities from Horse Pit located directly to the west. Although limited, the data for PZ08-D shows a gradual increase in groundwater elevations from 203.5 mAHD in June 2008 to 214.8 mAHD. This may be indicative of increase recharge from rehabilitated areas associated with the nearby Heyford Pit. Water levels remained relatively stable since the start of monitoring indicating no influence from climate conditions or proximal mining activities

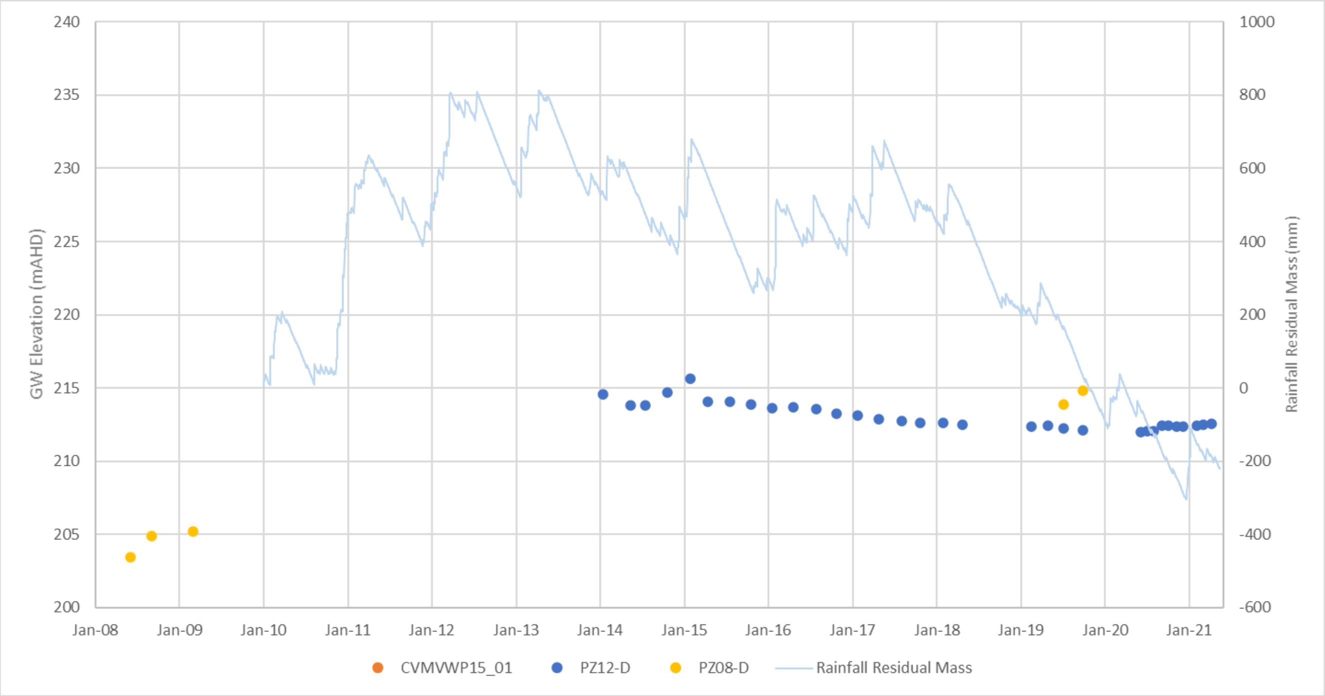


Figure 5-13 Hydrograph of Non Coal Permian Measures Groundwater Trends

5.3.5.2 Recharge and Discharge

Recharge to the Permian coal measures occurs at subcrop. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows horizontally within the coal measures, along the bedding plane of the coal seams in the direction of the hydraulic gradient to the east. Groundwater discharge occurs via evaporation and abstraction from active mine areas.

5.3.6 Permian Coal Measures Coal Seams

5.3.6.1 Distribution and Flow

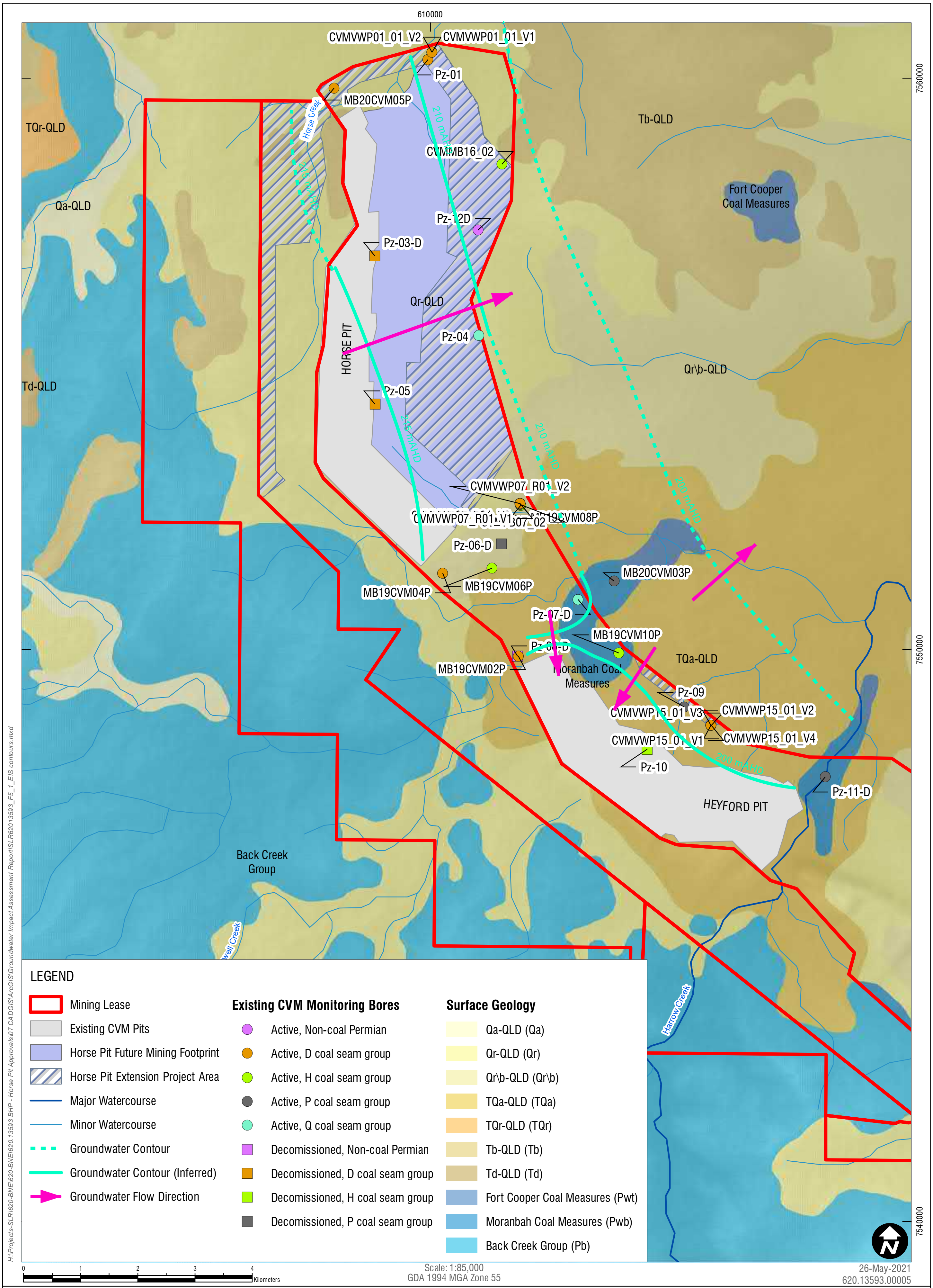
Within the Study Area the coal seams of the Permian coal measures underlie the Rewan Group and surficial cover, and outcrop along the ridgelines to the east and west. The coal seams of the Moranbah Coal Measures subcrop throughout the west and portions of the northern section of the Project Area. Throughout the remainder of the Project Area the coal seams underlie the surficial cover. Groundwater occurrence within the Permian coal measures is largely restricted to the more permeable coal seams that exhibit secondary porosity through fractures and cleats (**Section 5.2**). Regionally groundwater flow is to the east, consistent with local topography (GHD, 2017). Differences in piezometric heads within the confined coal seam aquifers of the Moranbah Coal Measures drive groundwater flow eastwards across the Bowen Basin, from the slightly more elevated subcrop areas on the western flank of the Basin to the less elevated subcrop areas on the eastern flank (GHD, 2017). However, mining activities throughout the region have created locally modified groundwater flow systems within the Permian coal measures that are superimposed on these regional flow gradients.

Monitoring bores within the Project Area comprise two bores within the Q Seam (Pz04 and Pz07-D), seven within the P Seam (monitoring bores PZ06-D, PZ09, PZ11-D, MB20CVM03P, pumping bore CVMPB07_02 and VWP sensors CVMVWP07_R01_V1 and CVMVWP15_01_V2), eight within the H Seam (monitoring bores PZ10, MB19CVM06P, MB19CVM08P, MB19CVM10P and VWP sensors CVMVWP_01_V1, CVMVWP07_R01_V2, CVMVWP15_01_V3 and CVMB16_02), and nine within the D Seam (monitoring bores PZ01, PZ03-D, PZ05, MB19CVM02P, MB19CVM04P, MB20CVM05P and VWP sensors CVMP01_01_V2, CVMVWP07_R01_V3 and CVMVWP15_01_V4).

Using combined water level monitoring data from the target coal seams a potentiometric surface map was generated for the Moranbah Coal Measures as part of the original CVM EIS project (URS, 2009; recreated in **Figure 5-14**). The contours show pre-mining groundwater flow within the Permian coal measures to be west to east across the Project Area north of Cherwell Creek, consistent with recharge of the coal seams where they subcrop to the west of the Project (URS, 2009).

Groundwater monitoring of the Q Seam has been undertaken in the east of the Project Area (PZ04) and to the south of the Project Area in the vicinity of Heyford Pit (PZ07-D), since mid 2008. Groundwater elevations for current Q Seam monitoring bores are displayed in **Figure 5-15.** Groundwater elevations within the Q Seam bores are similar, ranging from 210.2 mAHD to 209.6 mAHD.

An insufficient number of data points are available to generate potentiometric contours for the Q Seam given it is not widespread across the CVM and Project areas, existing only towards the east of the CVM mining leases. An inferred groundwater flow to the south east has been estimated (**Figure 5-15)** based on the saturated heads generated as part of the calibration of the Project numerical model (**Appendix B**). It is understood that the Q Seam has yet to be intercepted by existing mining activities at Horse Pit. The inferred groundwater flow direction is therefore indicative of the influence of mining activities associated with Peak Downs Mine located further to the south east of the Project Area.



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Permian Coal Measures
Pre-mining Potentiometric Surface Map
(URS, 2009)

FIGURE 5-14

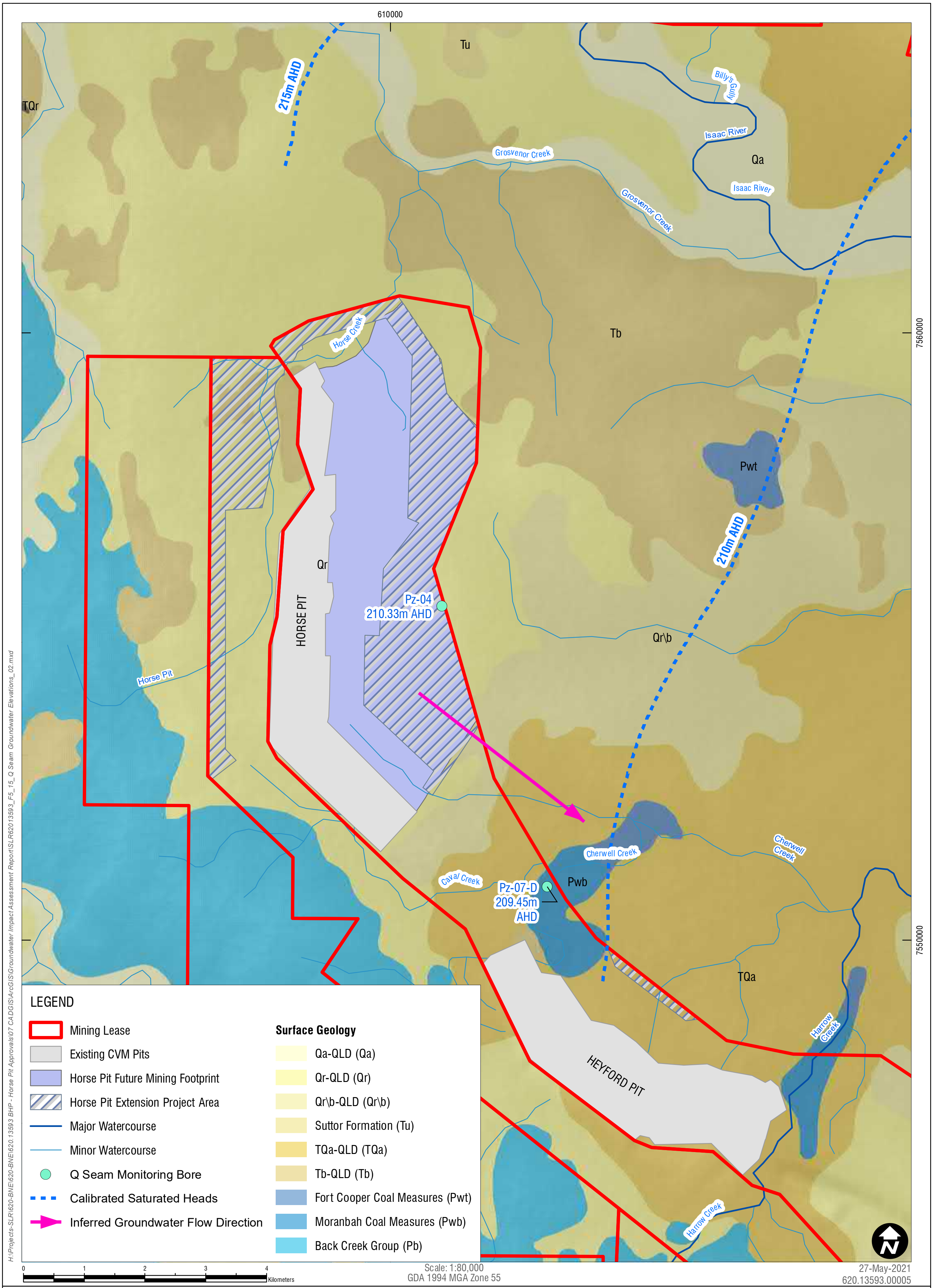
Groundwater monitoring of the P Seam has been undertaken to the south of the Project Area, in the vicinity of Heyford Pit, since 2008. Groundwater elevations for current P Seam monitoring bores are displayed in **Figure 5-16.** Groundwater elevations within the P Seam range from 209.99 mAHD (MB20CVM03P) to 175.2 mAHD (PZ11- D). An insufficient number of data points are available to generate potentiometric contours for the P Seam. End of calibration (December 2020) saturated heads, calculated as part of the numerical model (**Appendix B)**, have been generated to provide an indication of localised groundwater flow in the Project Area. It is understood that the P Seam has yet to be intercepted by mining at the existing Horse Pit. It is therefore believed that the local groundwater flow direction in the areas north of Cherwell Creek will be easterly in line with regional flow. This is supported by the calibration saturated heads which show an inferred groundwater flow direction to the south east across the Project Area (**Figure 5-16)**. The lower groundwater elevations in the P Seam at monitoring bore PZ09, potentially indicate a localised south / south westerly flow direction in the area south of Cherwell Creek, towards the existing Heyford Pit, where the P Seam has been intercepted. This is also supported by the calibration saturated heads for the P Seam in these areas (**Figure 5-16)**.

Groundwater monitoring of the H Seam has been undertaken immediately south of the Project Area since 2019. Groundwater elevations within the H Seam monitoring bores range from around 209.63 mAHD to the east of Horse Pit in the north of the Project Area to 191.84 mAHD to the south east. Groundwater elevations for H Seam monitoring bores are displayed in **Figure 5-17.** Groundwater levels in the H Seam potentially indicate flow in a south westerly /westerly direction towards the southern extents of Horse Pit and towards Heyford Pit where the seam has been intercepted during mining activities. End of calibration (December 2020) saturated heads calculated as part of the numerical model (**Appendix B)** have been generated to provide an indication of localised groundwater flow in the Project Area. As shown in **Figure 5-17,** the calibrated saturated heads indicate localised groundwater flow to the south west, towards the southern area of Horse Pit and towards Heyford Pit. Based on the calibration data, the influence of mining activities on groundwater elevations in the north of the Project Area appears to be limited, with local flow direction inferred to be west to east in line with regional flow.

Groundwater monitoring of the D Seam has been undertaken immediately south of the Project Area since 2008. Groundwater elevations within the D seam currently range from 199.34 mAHD (PZ01) to 191.5 mAHD (MB20CVM05P). Groundwater elevations for D Seam monitoring bores are displayed in **Figure 5-18**. End of calibration (December 2020) saturated heads have been generated as part of the numerical model (**Appendix B)** to provide an indication of localised groundwater flow in the Project Area. Given that the D Seam is currently mined at both Horse Pit and Heyford Pit it is believed that the local groundwater flow direction will be east to west towards the active mining areas. This is supported by the calibration saturated heads which show an inferred groundwater flow direction to the west across the Project Area (**Figure 5-18)**.

Within the Project Area no monitoring bores target the regionally shallower Rangal Coal Measures or Fort Cooper Coal Measures as these units are not present within or in the vicinity of the CVM leases or the Project.

Within the Study Area the Rangal Coal Measures are targeted by the Winchester South Project, with 12 Project groundwater monitoring bores that intersect the Permian coal measures within the Project Area. Five of the bores are established within the Leichhardt Seam (C2105R, C2136, R2008, R2010R, R2032), four within the Vermont Seam (G2304R, G2307, R2035, R2055), and three within the interburden (R2009R, R2034R, R2054). Groundwater levels within the Rangal Coal Measures coal were found to range from 189.65 mAHD to 165.95 mAHD.



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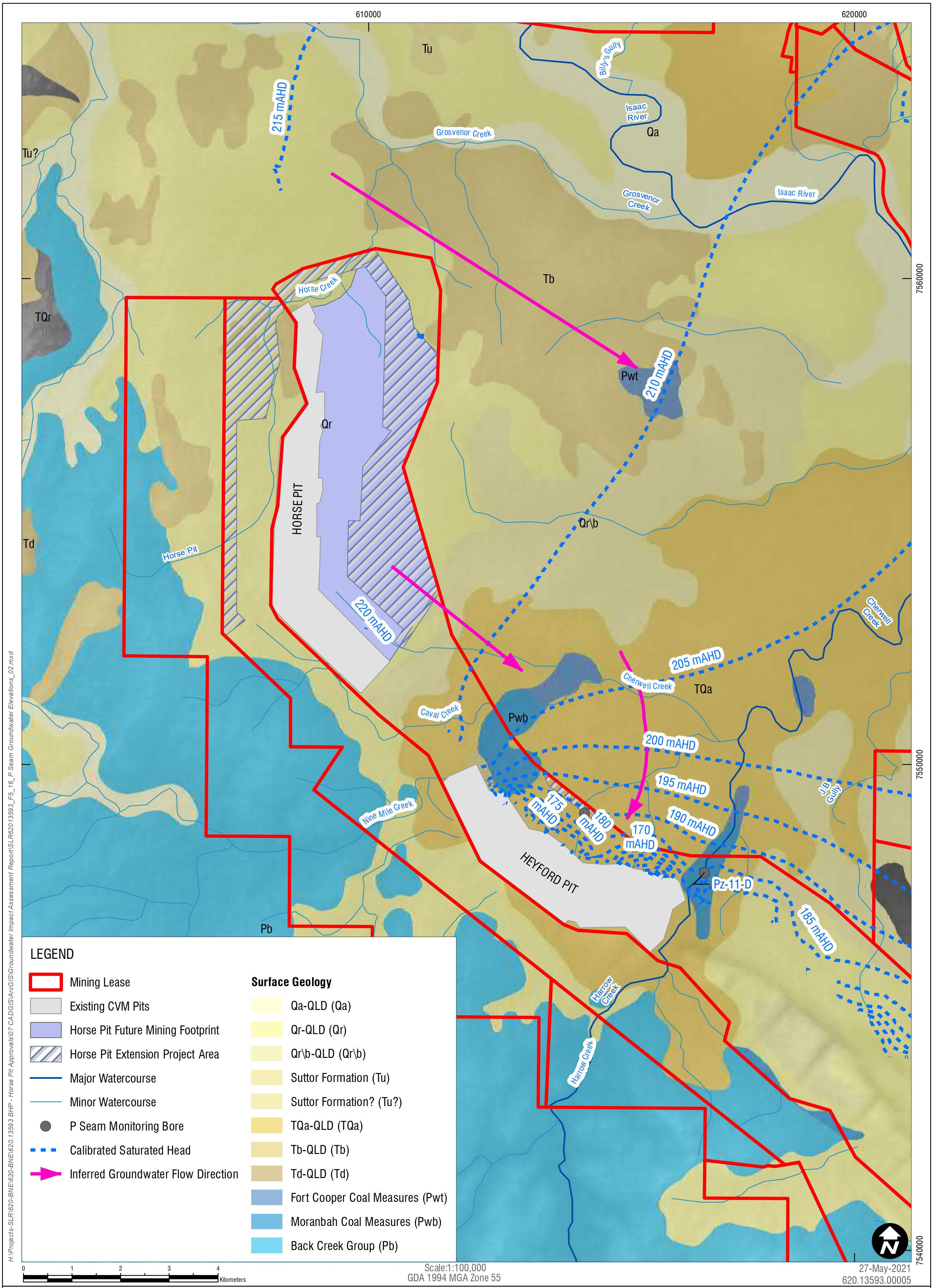
Q Seam Elevations December 2020

FIGURE 5-15



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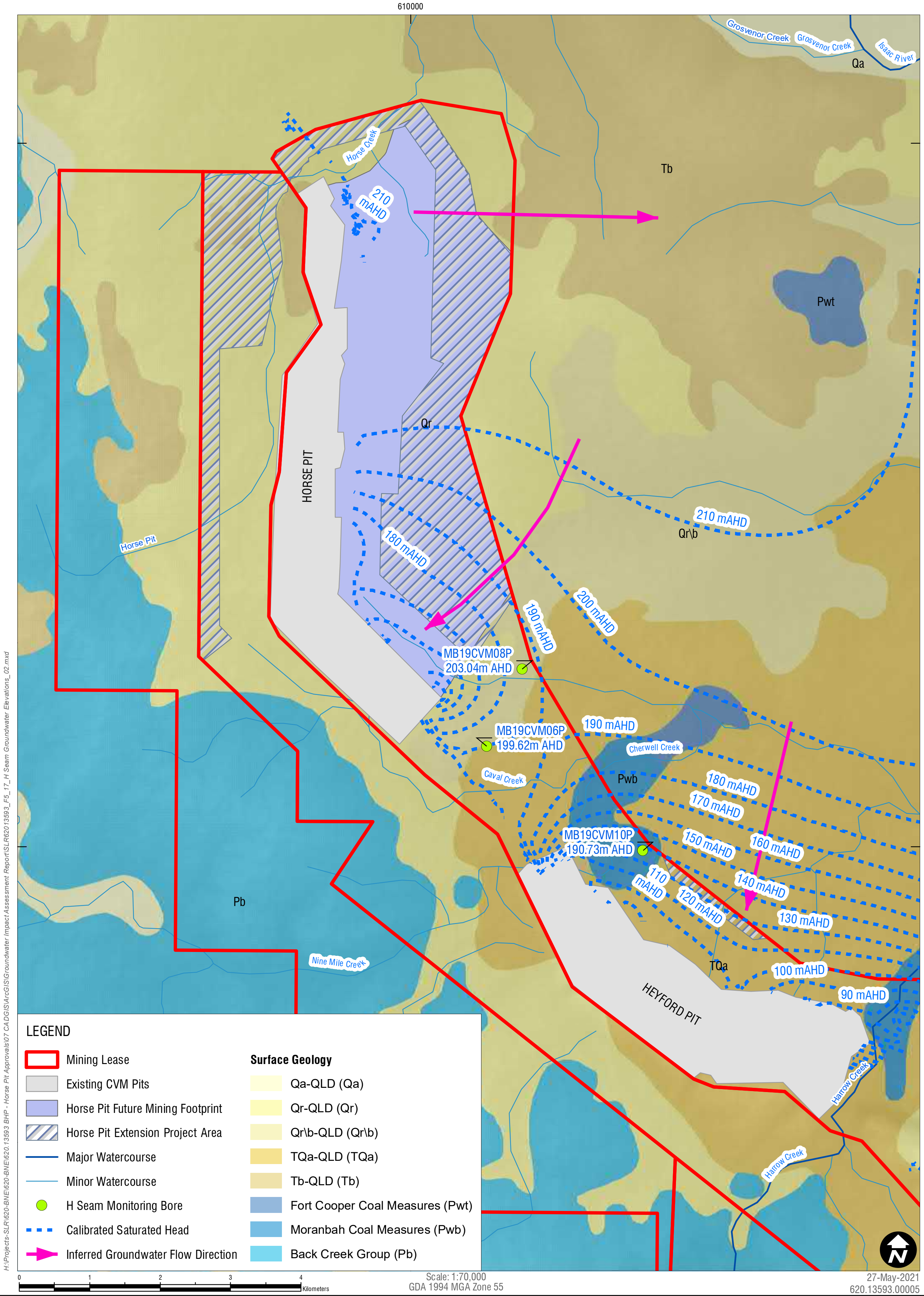
P Seam Elevations December 2020

FIGURE 5-16



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H Seam Elevations Decemberl 2020

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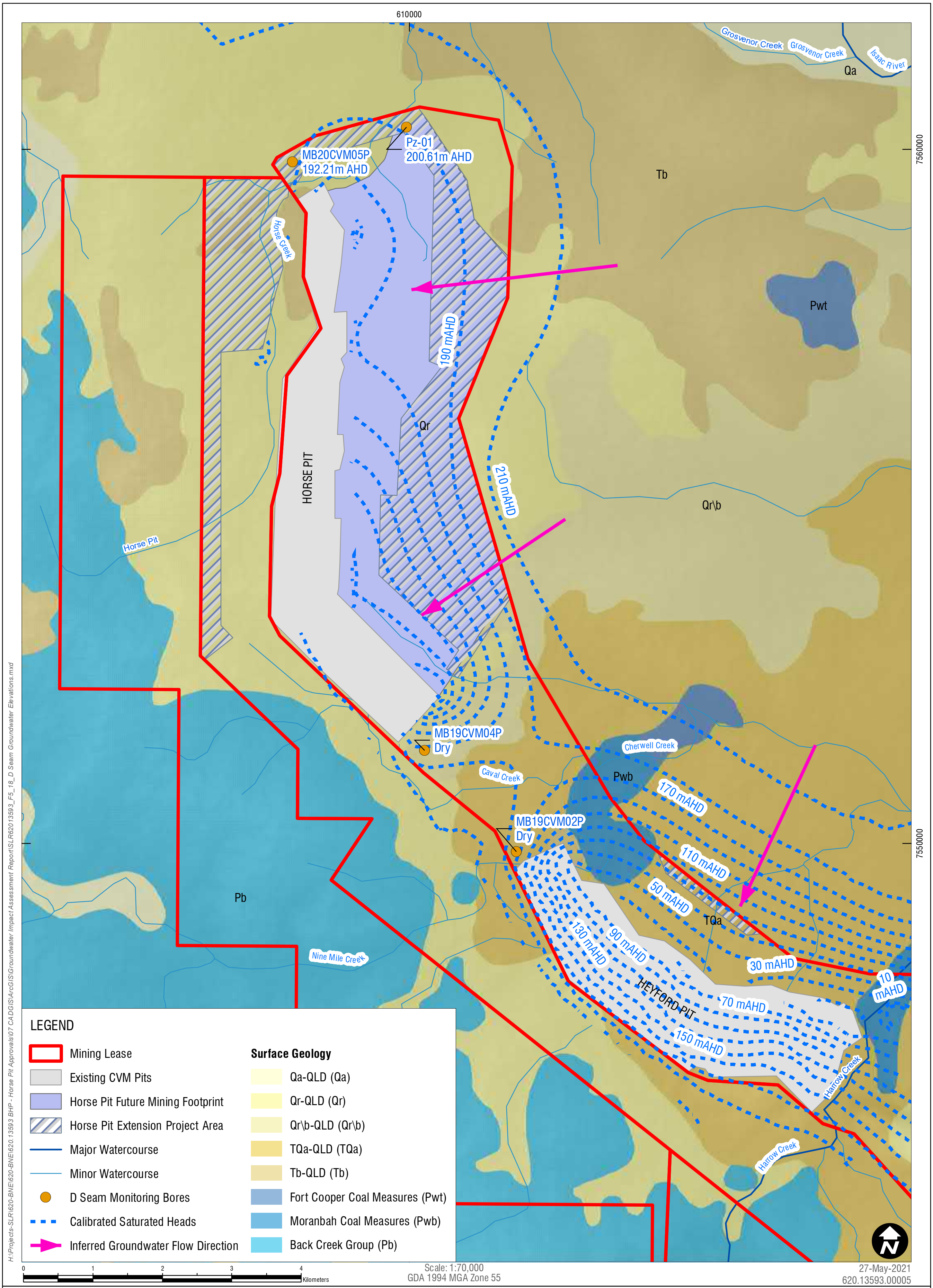
FIGURE 5-17



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D Seam Elevations December 2020

FIGURE 5-18

Groundwater levels in the Fort Cooper Coal Measures of range from 31.9 mbgl to 32.7 mbgl (165.5 mAHD to 168 mAHD) within the Study Area. Seven monitoring bores, as part of the Eagle Downs Mine monitoring network located directly to the east of the Project Area, are screened within the Fort Cooper Coal Measures. Groundwater levels within this unit to the east of the Project Area range from approximately 187 mAHD (MB1) to 196.74 mAHD (MB4).

5.3.6.2 Recharge and Discharge

Groundwater level trends for monitoring bores intersecting the Moranbah Coal Measures coal seams within the Project Area are presented in **Figure 5-19** to **Figure 5-22**.

Figure 5-19 shows that groundwater elevations have remained relatively stable at approximately 213m AHD since the start of monitoring indicating no influence from climate conditions or proximal mining activities.

Figure 5-20 shows generally stable elevations from 2008 to mid 2013, after which they steadily decline in response to the progression of the Heyford Pit. The relatively stable elevations observed prior to mining indicate that groundwater response at this location is independent from climate, potentially indicating more confined conditions. Groundwater elevations at 2020 monitoring bore MB20CVM03P and test production bore CVMPB07_02 were recorded at 210 mAHD and 208.4 mAHD respectively. This is approximately 35m higher than observed at bores PZ09 and PZ11-D located to the south of the Project Area, indicating a general hydraulic gradient towards Heyford Pit.

Figure 5-21 shows that groundwater elevations appear to correlate with climate conditions. Groundwater elevations within monitoring bores MB19CVM06P and MB19CVM08P have remained relatively similar since the start of monitoring, with elevations consistently around 10m lower within MB19CVM10P. This difference may be due to the influence of mining operations on MB19CVM10P at the nearby Heyford Pit or could be indicative of the level of connectivity with the overlying material at both locations.

Figure 5-22 shows that groundwater elevations with D Seam monitoring bores were relatively stable in monitoring bores PZ03-D and PZ01 prior to and during the early phases of mining of Horse Pit. PZ03-D was mined through as Horse Pit progressed in early 2019. Drawdown within PZ01 related to Horse Pit activities was first observed in late 2017, with groundwater elevations having steadily declined since. Declining groundwater levels have been observed in MB20CVM05P since installation in 2019. MB19CVM04P located directly to the south west of Horse Pit has been recorded as dry since installation in early 2019. Similarly, MB19CVM02P, located directly to the northwest of Heyford Pit, is recorded as dry since installation in early 2019. The declining groundwater elevations and 'dry' observations in Project monitoring bores confirm the dewatering of the D Seam from current mining activities within the Project Area.

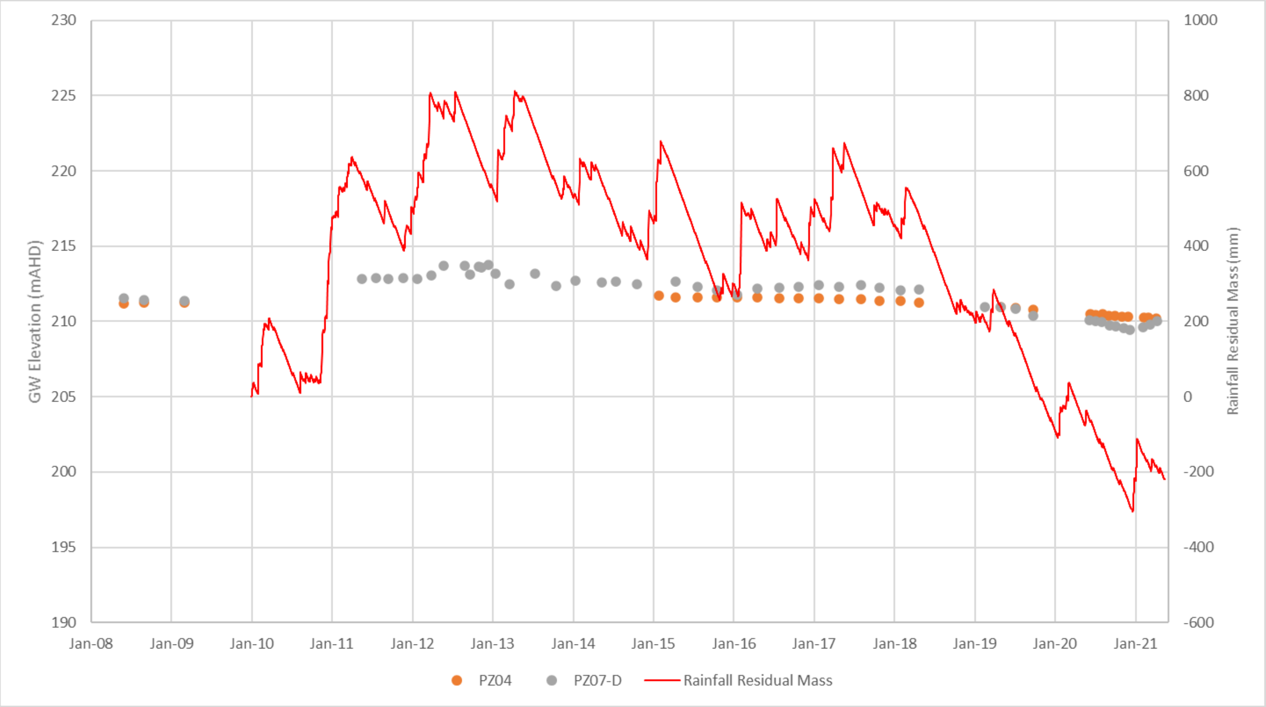


Figure 5-19 Hydrograph for Q Seam Bores

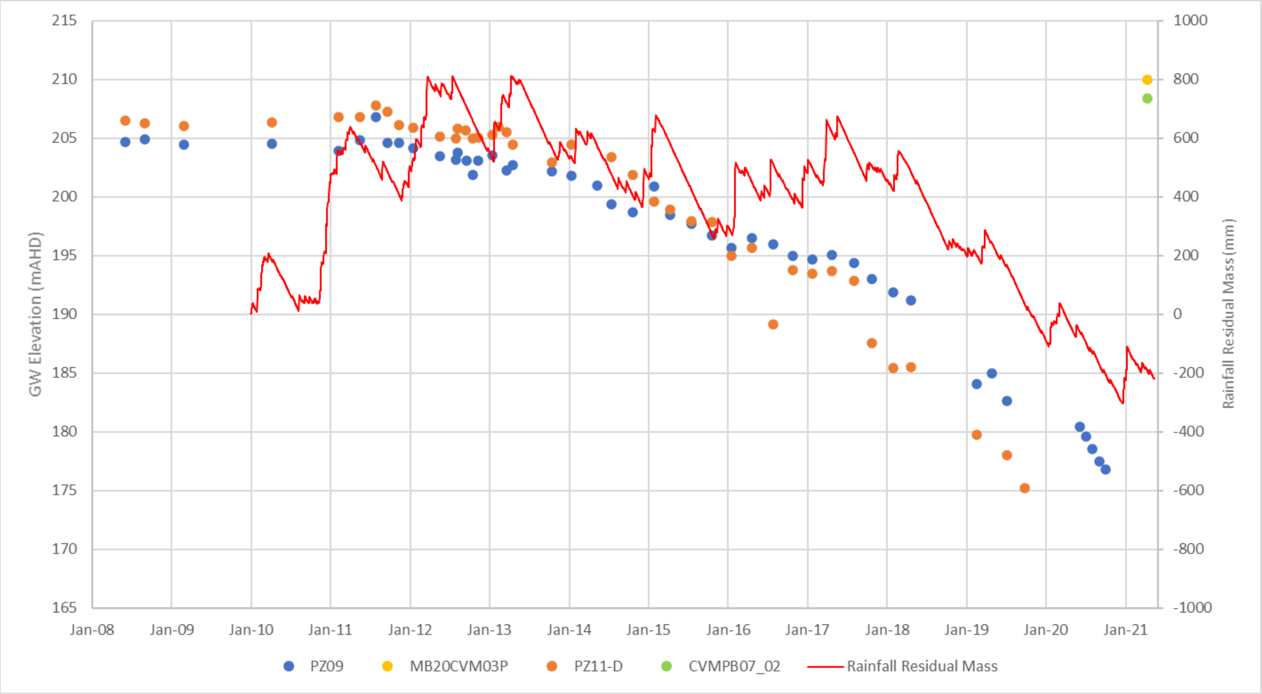


Figure 5-20 Hydrograph for P Seam Bores

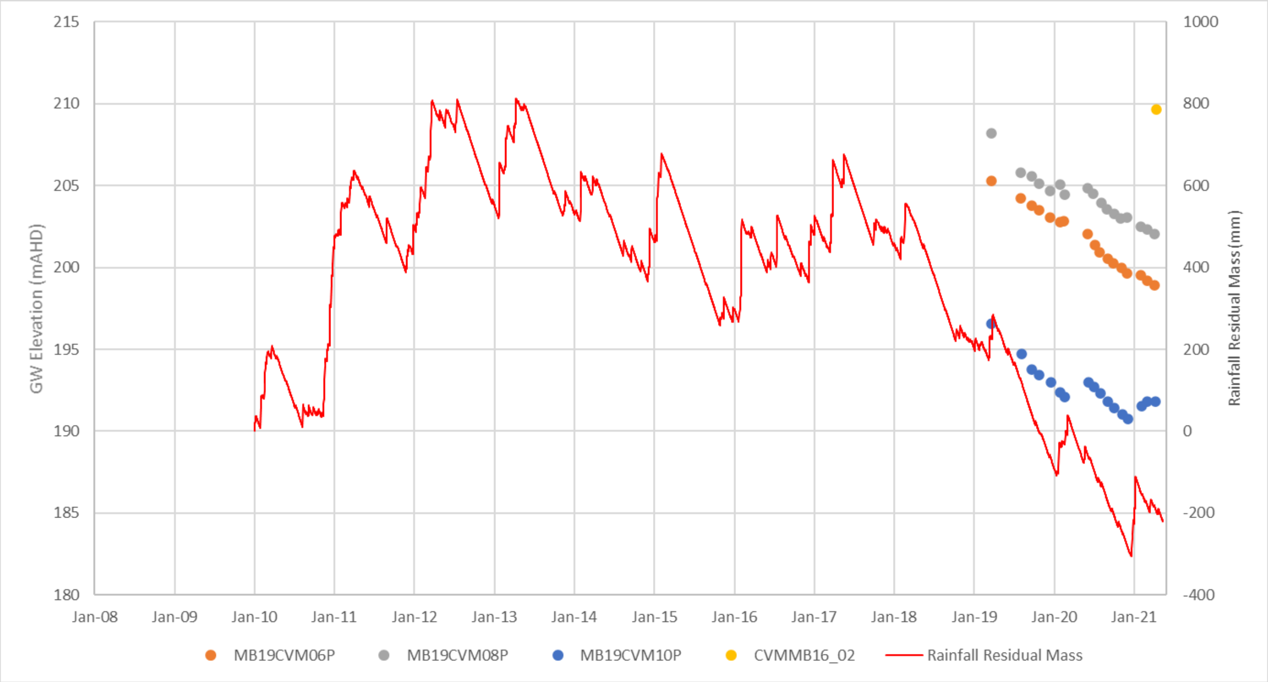


Figure 5-21 Hydrograph for H Seam Bores

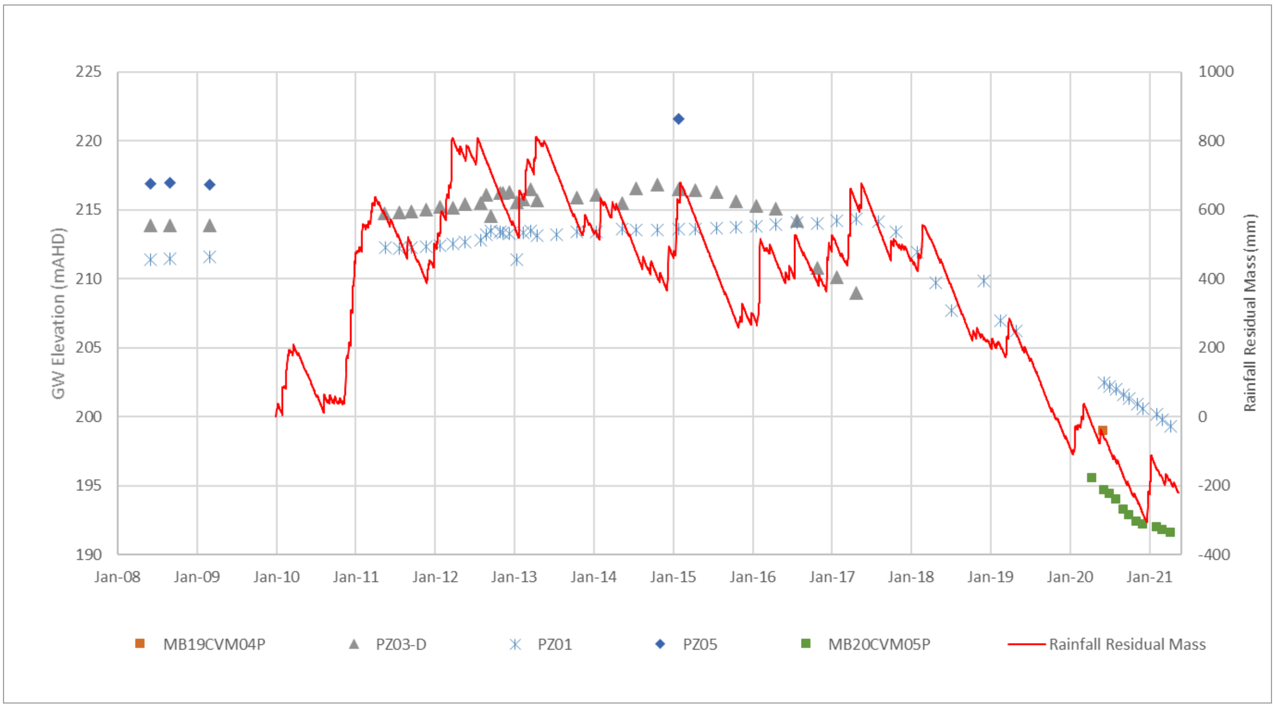


Figure 5-22 Hydrograph for D Seam Bores

Groundwater level trends for monitoring bores intersecting the Rangal Coal Measures coal seams within the Winchester South Project area are presented in **Figure 5-23**. Trends for the underlying Fort Cooper Coal Measures unit in landholder bores close to this Project are presented in **Figure 5-24**. Groundwater level trends for monitoring bores included in the Eagle Downs Mine monitoring network intersecting the Fort Cooper Coal Measures are presented in **Figure 5-25**. Groundwater levels at these bores can be seen to be relatively stable since 2015. Bore R2032 recorded a 3 m water level drop from approximately 188.5 mAHD to 185.2 mAHD in March 2019. This change coincides with the routine monitoring event in March 2019, and is likely a result of the logger being set at a different level. Groundwater levels have been relatively stable since, with a slight increase observed towards the end of 2019.

Groundwater within the Permian coal measures is confined and sub-artesian. For the shallower coal measures, groundwater elevations are generally at or below groundwater elevations within the overlying unconfined sediments, indicating a downward hydraulic gradient. However, with increased depth of cover and pressure the hydraulic gradient within the Permian coal measures reverses. This coincides with a decrease in hydraulic conductivity with depth as discussed in **Section 5.2**.

Recharge to the Permian coal measures occurs where the unit occurs at subcrop. Using the CMB method (refer **Section 5.3.1.2**) a recharge rate for the weathered Permian units has been calculated as 0.1 mm/yr. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows horizontally within the coal measures, along the bedding plane of the coal seams. Groundwater discharge occurs via evaporation and inflow from active mine areas.

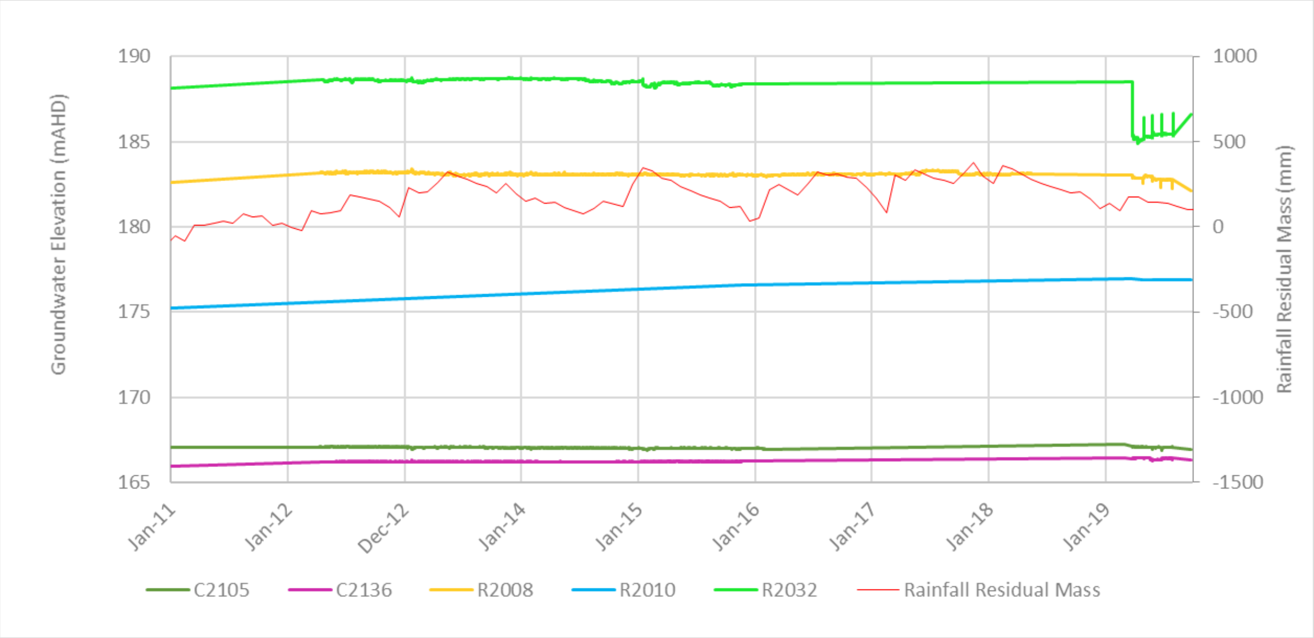


Figure 5-23 Hydrograph of Rangal Coal Measures Coal Groundwater Trends

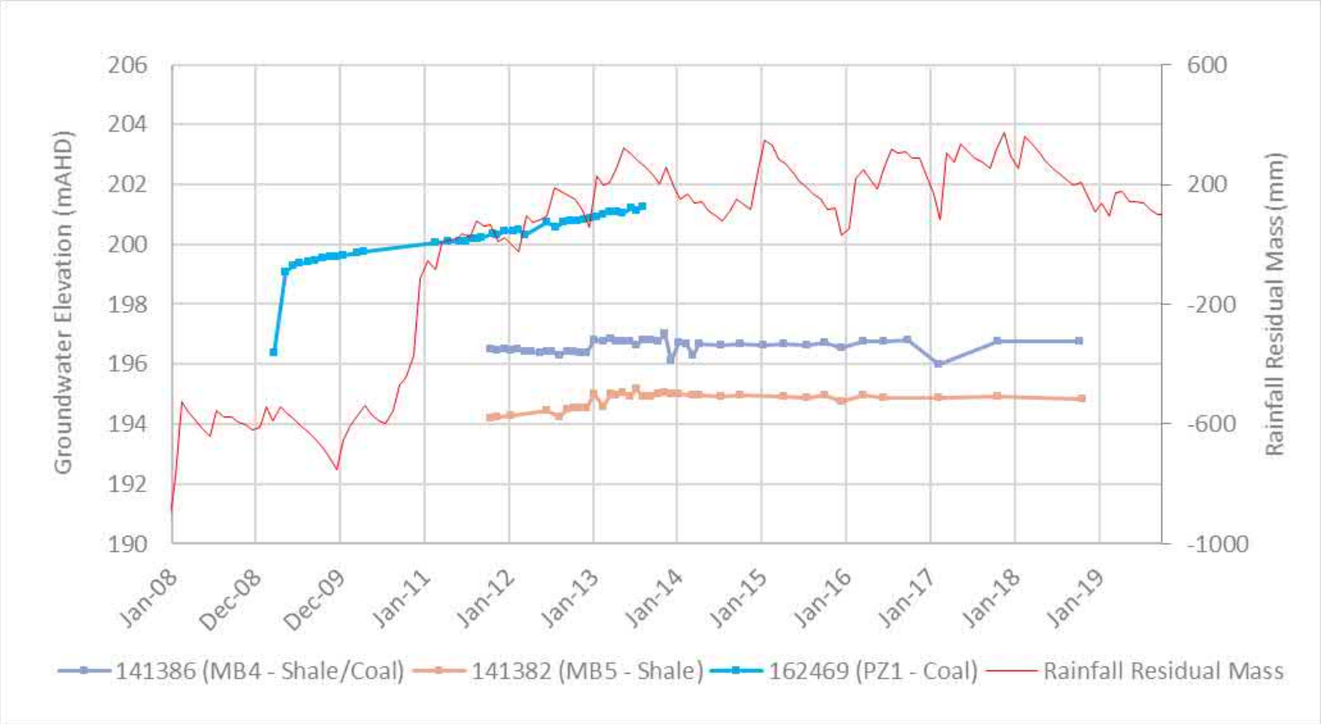


Figure 5-24 Hydrograph for Bores within the Fort Cooper Coal Measures

Figure 5-25 Hydrograph for Eagle Downs Mine Monitoring Bores within the Fort Cooper Coal Measures

5.3.7 Groundwater Interaction with Watercourses

In central Queensland, highly seasonal rainfall results in intermittent stream flow, limited groundwater recharge and deep water tables. In this environment, the most appropriate way to assess surface water and groundwater interaction is by comparing stream stage elevation data to the underlying groundwater elevation in a nearby monitoring bore. The Isaac River at Deverill (130410A) stream gauge provides a long-term record of stream stage for the Isaac River near to the Project. The location of the stream gauges is shown in **Figure 3-3**. The Water Monitoring Information Portal (WMIP) data indicate that at Station 130410A surface water (flowing and ponded) elevations generally remain around 170 mAHD. The gauge has recorded a maximum stream elevation of 180 mAHD, which has been recorded five times since 1968, in March 1979, March 1988, April 1989, January 1991 and February 2008.

The closest bore to the Project with long-term groundwater level monitoring in the Isaac River alluvium is registered bore RN13040180, which is approximately 40 km downstream of the stream gauge. The bore is located approximately 80 m from the Isaac River, along Carfax Road. Water levels in this bore follow the rainfall residual mass curve, indicating that rainfall derived recharge (including from stream flow) is a key source of water to this aquifer (**Figure 5-26**). From 1970 to present, water levels within the alluvium at RN13040180 were recorded between 12 mbgl to 18 mbgl.

Sharp peaks have been recorded occasionally in the dataset and appear to correlate with times of high flow in the Isaac River, however, there does not appear to be a definitive relationship between river level/magnitude of discharge and magnitude of fluctuation in groundwater level. This is in part a reflection of the intermittent water level data (where data at times corresponds to high river levels is often not recorded due to flooding).

Figure 5-26 Groundwater Level in RN13040180 against Isaac River Levels

The Isaac River is largely a losing system with stream-stage above that of the local groundwater levels, resulting in the water draining through the alluvial sediments to the local groundwater system. Occasional periods of baseflow to the river from the underlying alluvium may occur after prolonged rainfall events or following flood events. Under these conditions, recharged alluvial sediments will drain to the river as the hydraulic gradient reverses and sustains stream-flow for a short period after the rainfall event.

5.4 Baseline Water Quality

This section reports on the chemical characteristics and resulting possible beneficial uses of groundwater within the various geological units across the wider Study Area. Water quality results for surface water (Isaac River) and leachate analysis of potential spoil and reject materials at the Project are also discussed below. **Appendix A2** presents the groundwater quality data collected at site, as well as other publicly available data.

5.4.1 Water Type

The proportions of the major anions and cations were used to determine the hydrochemical facies of groundwaters sampled. The anion-cation balance from the CVM monitoring bores is shown on the Durov plot in **Figure 5-27**.

The results for these monitoring bores generally indicate that Na and Cl are the dominant major ions in groundwater across the Project Area. Surficial alluvial and basalt generally display a more mixed water type, with higher proportions of magnesium and bicarbonate ions. The dominant water types in the basalt and unconsolidated alluvium therefore generally Na-Mg-Cl and Na-Mg-Cl-HCO_3. Regolith strata showed a similar water type but a greater proportion of the Cl ion.

Non coal Permian bores also showed mixed water types of Na-Cl-HCO_3 (PZ012-D) and Na-Mg-Cl (PZ08-D).

Within the Moranbah Coal Measures only P seam monitoring bores consistently recorded a Na-Cl water type. Water types of the Q seam, H seam, D seam were more variable with the distribution of the major ions appearing to be associated with the depth of the bore. In general, deeper bores, typically in the east of the Project Area, displayed Na-Cl water types, with shallower bores showing water types with higher proportions of calcium or magnesium ions. This is likely to be due to greater recharge from overlying surficial deposits in the shallower areas, the greater thickness of the unweathered material preventing the mobilisation of salts into the coal seams in the deeper locations. As the shallower bores are closer to the base of weathering, seepage of mobilised salts during recharge is more likely to occur. Within the deeper deposits, recharge from overlying units is likely to be less, with major ions distribution more influenced by secondary salinity mechanisms.

From Durov plot it is also clear that the H seam bores are strongly alkaline, which also accounts for a greater proportion of carbonate to bicarbonate ions. This contrasts to all other aquifers in the Project Area which are neutral to slightly acidic and therefore have a greater proportion of bicarbonate to carbonate ions.

Studies undertaken in the Winchester South Project showed similar results with alluvial bore Knob Hill 2 displaying a mixed water type which differs from the two nearby alluvial monitoring bores that are both Na-Cl type; this suggests some degree of compartmentalisation in the alluvial aquifer. Bore R2010, R2032, R2035, and R2054, screened in the Rangal Coal Measures (Leichhardt Seam, Vermont Seam, & interburden) all reported three consecutive readings of Sodium at or close to LOR resulting in the water type plotting as HCO_3-Cl type. Sodium levels have since returned to average with the cause of the low concentrations unknown, but should be considered anomalous, with the Rangal Coal Measures being classified as a Na-Cl water type, which is consistent with other samples in the Study Area.

Major ion data collected from the Eagle Downs Mine, Winchester South Project, Moorvale South Project, and Olive Downs Project sites, and publicly available sources is presented in **Figure 5-28**, along with data for the Isaac River at Deverill (station 130410A).

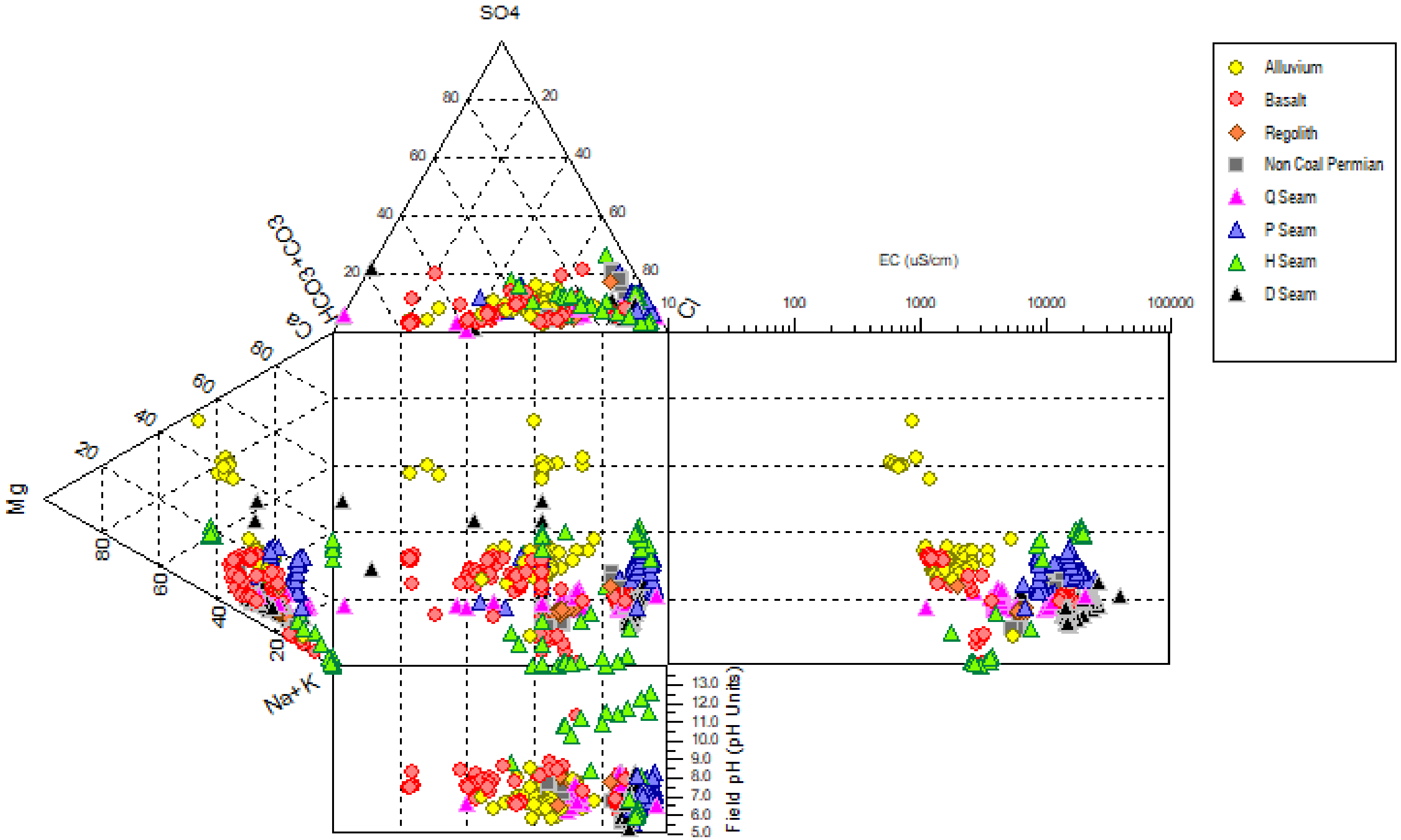


Figure 5-27 Durov Plot of CVM Bores

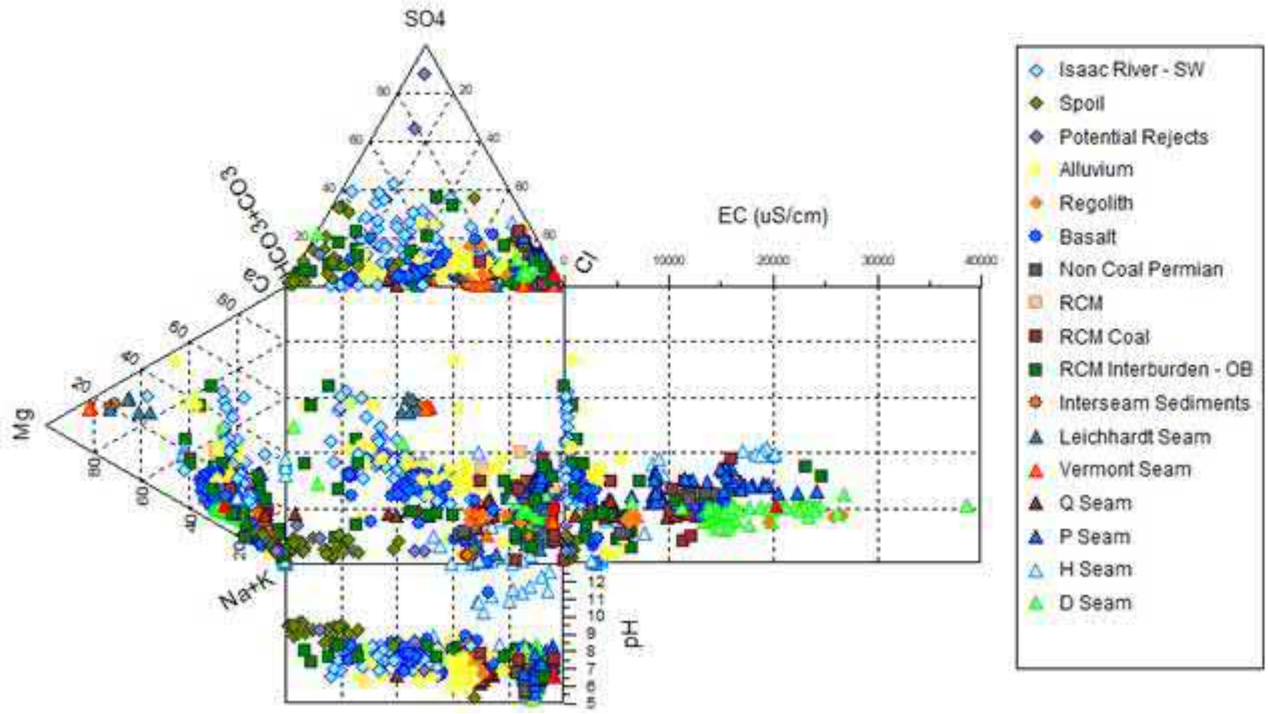


Figure 5-28 Durov Plot of All Data

5.4.2 Salinity

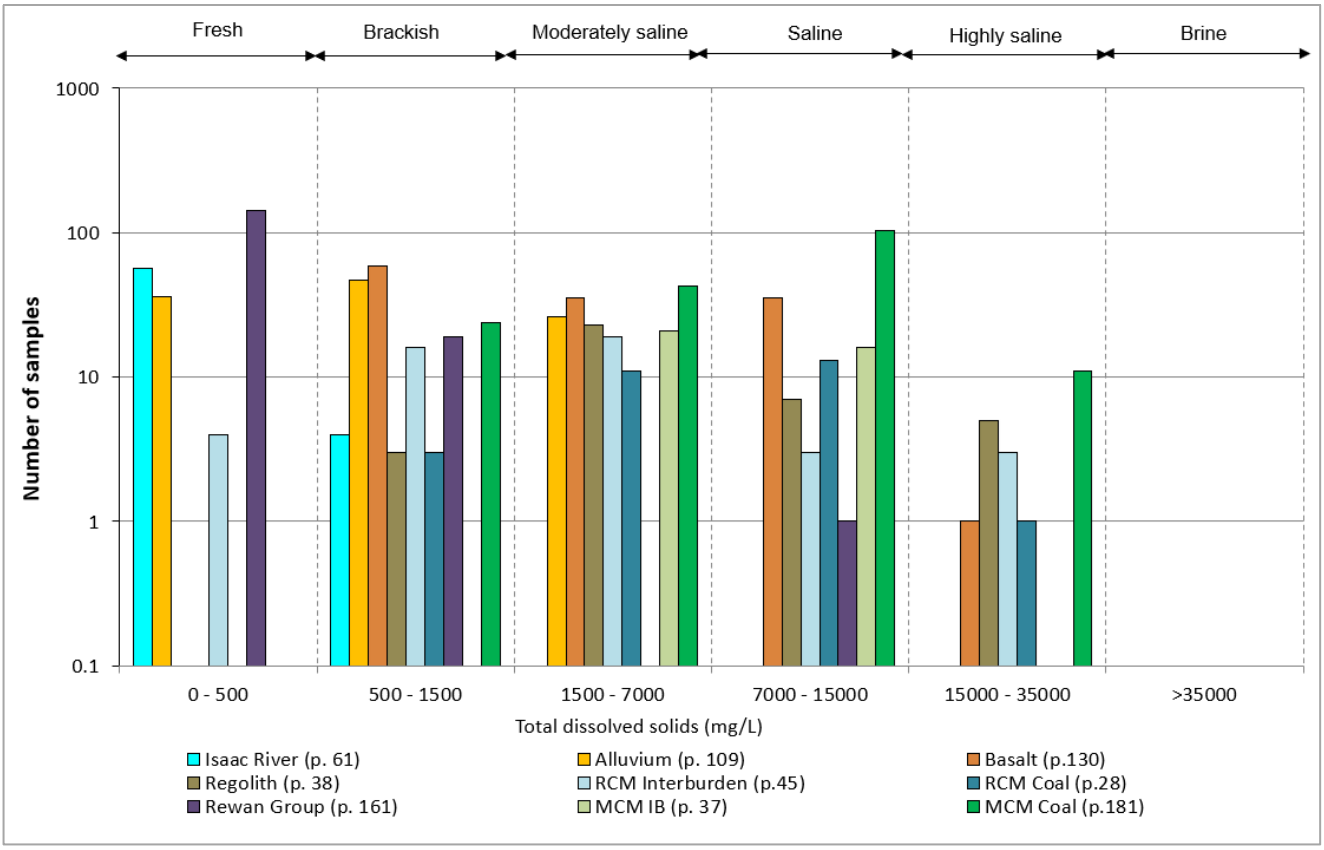
Salinity is a key constraint to water management and groundwater use and can be described by total dissolved solid (TDS) concentrations.

Figure 5-29 presents the TDS data associated with waters screened in the various geological horizons for CVM monitoring bores, registered bores and publicly available data. Salinity ranges represented on **Figure 5-29** are defined by the Food and Agriculture Organization of the United Nations (FAO).

The graph shows that surface water within the Isaac River is largely fresh, while water within the alluvium is fresh to saline with an average TDS of 556 milligrams per litre (mg/L) (marginal) and ranging between 10 mg/L and 5,620 mg/L. Where water is present within the regolith material, it is generally highly saline, but can be brackish to moderately saline with an average TDS of 7,101 mg/L and ranging between 1,110 mg/L and 18,600 mg/L. Water present in the Tertiary basalt is generally moderately saline with an average TDS of 3,538 mg/L, but can be fresh to highly saline ranging between 656 mg/L and 16,526 mg/L.

Water within the Permian Moranbah Coal Measures is generally saline within the coal seams and moderately saline to saline interburden units, but can range between fresh and highly saline. Coal seam units of the Moranbah Coal Measures record an average TDS of 7,598 mg/L, ranging between 720 mg/L and 24,704 mg/L. The interburden units of the Permian coal measures record an average TDS of 5,349 mg/L, ranging between 1,520 mg/L and 9,126 mg/L.

Water within the Permian Rangal Coal Measures is generally saline within the coal seams and saline interburden units but can range between fresh and highly saline. Coal seam units of the Rangal Coal Measures record an average TDS of 6,212 mg/L, ranging between 923 mg/L and 16,400 mg/L. The interburden units of the Permian coal measures record an average TDS of 3,436 mg/L, ranging between 421 mg/L and 18,400 mg/L.



Note: RCM = Rangal Coal Measures, MCM = Moranbah Coal Measures

Figure 5-29 FAO (2013) Salinity Ranking by Unit – CVM

Available long-term trends in salinity within the alluvium and Isaac River within the Study Area are presented in **Figure 5-30**. The salinity in the alluvium and Isaac River has been described by electrical conductivity rather than TDS. As discussed above, salinity within the alluvium can be highly variable spatially. As demonstrated by **Figure 5-30**, salinity can also vary at one location temporally. Results for government alluvial bore RN13040180 indicates electrical conductivity (EC) can range between 199 µS/cm and 7,400 µS/cm (fresh to saline). **Figure 5-30** also presents EC as recorded at Isaac River station 130410A since 2011, which ranges between 7 µS/cm and 1,773 µS/cm (fresh to brackish).

The water quality data for the alluvium occasionally shows an inverse correlation in EC to rainfall residual mass curve, with rising EC recorded during periods of declining/below average rainfall and vice versa. However, due to the lack of temporal readings, there is no clear correlation between groundwater salinity in the alluvium at RN13040180 and stream flow and salinity of the Isaac River.

Spatial distribution of TDS is shown in **Figure 5-31** for the Study Area, which is based on measured TDS and calculated TDS from available EC data in the CVM monitoring network, and from the Eagle Downs Mine monitoring network, Winchester South Project, Moorvale South Project and Olive Downs Project groundwater assessments. The figure depicts mostly fresh water quality localised along the Isaac River, with brackish to moderately saline water along the river and tributaries. Alluvial monitoring bores for the Project support this showing generally brackish to saline water along Cherwell Creek upstream of the Isaac River. The salinity within the coal measures appears to increase with depth. Bores within the coal measures near the subcrop areas in the west generally record moderately saline water quality, which increases to saline quality where the coal measures are deepest near the Isaac River. This information supports the coal measures being largely recharged by rainfall where they occur at subcrop.

Due to limitations of the routine monitoring of ephemeral water bodies, surface water quality sampling is not currently conducted as part of the Project. Sampling of surface water features (Cherwell Creek) is therefore limited to discharge events and during periods of flow.

Surface water quality sampling was conducted as part of the Winchester South Project at nine locations within the Study Area throughout 2019. The surface monitoring network monitors the Isaac River, Ripstone Creek, and several un-named drainage features associated with the Winchester South Project. Over the monitoring period, the data indicate that both EC is higher at the upstream site compared to the downstream sites for both the Isaac River and the un-named drainage feature that traverses centre of the Winchester South Project Area. Similar results were observed during aquatic ecology surveys completed for the Project in December 2019 and April 2019 (ESP, 2020). Sites upstream of the Project were generally found to be more saline than sites downstream of the Project.

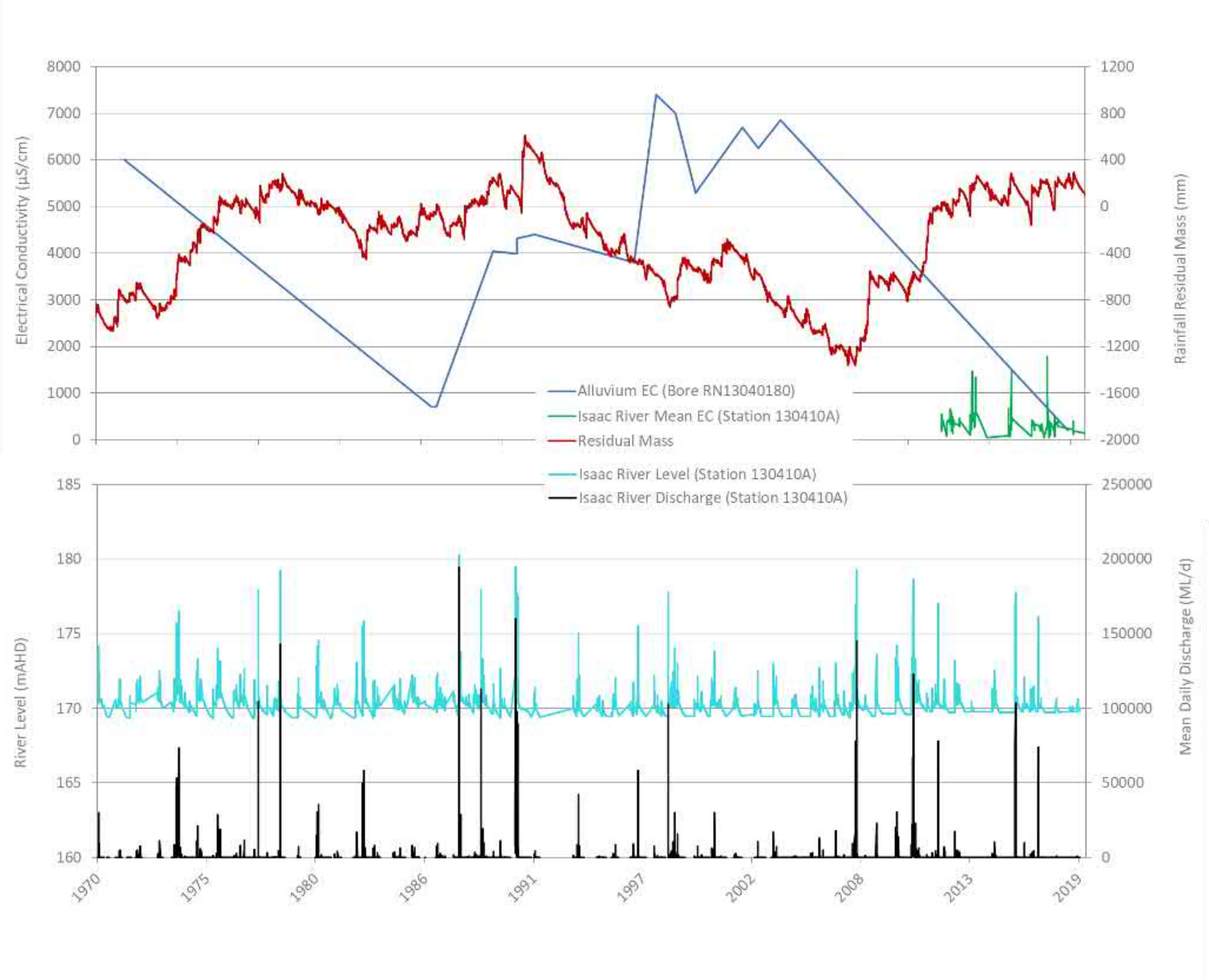
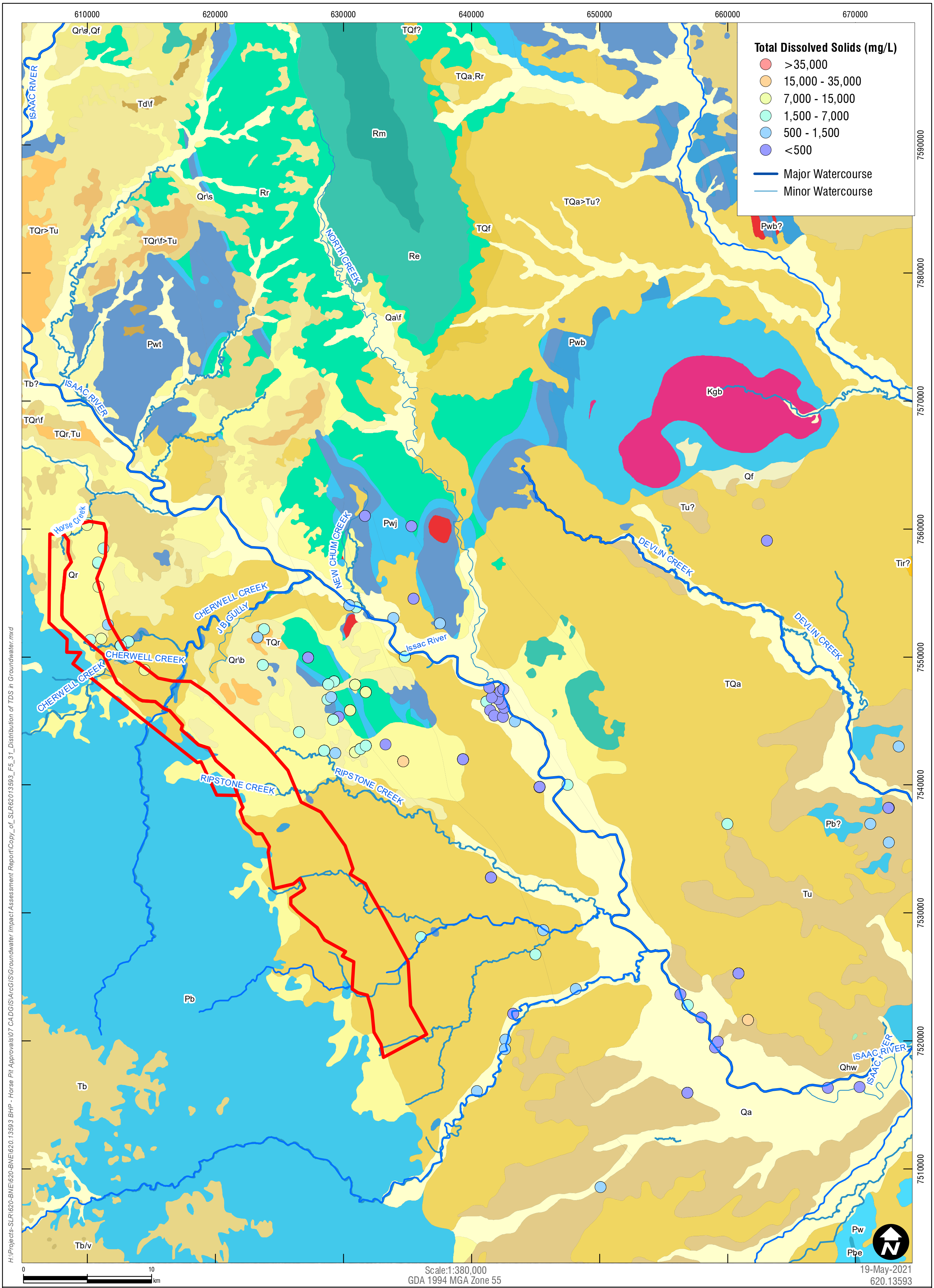


Figure 5-30 Isaac River Salinity Versus Alluvium Salinity



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Distribution of Total Dissolved Solids in Groundwater

FIGURE 5-31

5.4.3 Beneficial Groundwater Use

The Project lies within the Isaac Connors Groundwater Management Area (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. Groundwater at the Project includes alluvial groundwater under GMA Groundwater Unit 1 and water within the hard rock aquifers in GMA Groundwater Unit 2 (sub-artesian aquifers). The management objective of the Water Plan (Fitzroy Basin) 2011 is to maintain the 20th, 50th and 80th percentiles water quality results in order to preserve or enhance groundwater quality for its recognised uses. In the case of Isaac groundwaters, these values include aquatic ecosystems, irrigation, farm supply/use, stock watering, primary recreation, drinking water as well as being of cultural and spiritual value.

In order to understand the groundwater resources within the Project and Study Area, available water quality data have been compared to the:

- Fitzroy Basin Zone 34 groundwater quality objectives for deep and shallow water;
- Australian Drinking Water Guidelines (ADWG) (NHMRC, 2011);
- ANZECC (2000) guidelines for aquatic ecosystems, irrigation (long-term and short-term) and stock water supply.

Comparing the data to relevant guideline levels, the summary results indicate that, where present, water within the alluvium at the Project is generally suitable for stock water supply and short-term irrigation (**Appendix A2**). However, the alluvial groundwater generally exceeds guideline levels for drinking water (i.e. TDS, chloride and sodium), freshwater aquatic systems, and long-term irrigation (boron and iron). The alluvial groundwater also records concentrations of fluoride above the Fitzroy Plan Water Quality Objectives (WQO) for Zone 34 (shallow).

Results for the Winchester South Project indicate that water within the Quaternary alluvium (not present in the Project Area) is generally suitable for stock water supply, long-term irrigation and short-term irrigation. However, the Quaternary alluvial groundwater generally exceed guidelines levels for drinking water (i.e. TDS, chloride and sodium), freshwater aquatic systems, and long-term irrigation (chromium, iron, and manganese). The alluvial groundwater also records concentrations of total and dissolved iron and manganese above the Fitzroy Plan Water Quality Objectives (WQO) for Zone 34 (shallow).

Results from the Project, Moorvale South Project and Olive Downs Project groundwater assessments show that, where water is present within the regolith material, it exhibits poorer quality compared to the alluvium and is not considered a suitable groundwater resource for livestock, irrigation, drinking water or aquatic ecosystems. The water within regolith material was found to exceed the Fitzroy Plan WQO (Zone 34 –shallow) for EC, chloride, calcium, sodium, hardness, magnesium, sulfate, copper and manganese.

Water within Tertiary basalt within the Project Area is generally suitable for stock water supply and short-term irrigation (**Appendix A2**). However, the basalt groundwater generally exceed guidelines levels for drinking water (i.e. TDS, chloride, sodium, total iron, total and dissolved manganese and dissolved arsenic), freshwater aquatic systems, and long-term irrigation (total boron, total iron and total and dissolved manganese). The basalt groundwater also records concentrations of bicarbonate, total and dissolved manganese and dissolved iron manganese above the Fitzroy Plan Water Quality Objectives (WQO) for Zone 34 (shallow).

Water within the interburden of the Permian coal measures is generally suitable for stock water supply. Groundwater quality within the Project coal seams is variable, with TDS values generally increasing with seam depth. Comparison of results to the guideline levels indicates the Moranbah Coal Measures (interburden and coal) are not considered a suitable groundwater resource for irrigation, drinking water or aquatic ecosystems. Groundwater within the coal measures (coal) recorded concentrations of:

- Bicarbonate (D Seam) and sodium (D Seam) above the Fitzroy Plan WQO (Zone 34 – deep);
- EC levels (P Seams), concentrations of sulfate (D Seam), total manganese (D Seam), sodium (P Seam), chloride (P and D Seam) and magnesium (D Seam) above the Fitzroy Plan WQO (Zone 34 – shallow); and
- Concentrations of sodium (D Seam) sulphate (P, H and D seams), fluoride (Q and D seams), dissolved iron (Q, P, H and D seams), calcium (P and H seams), EC levels (D Seam) and pH units above the Fitzroy Plan WQO (Zone 34 –shallow and deep).

Similar results were reported for the Winchester South Project, with the interburden of the Permian coal measures being generally suitable for stock water supply. In contrast, groundwater within the coal seams generally exhibit a higher TDS, which is on average higher than the guideline level for beef cattle but below the guideline level for sheep. Comparison of results to the guideline levels indicates the Rangal Coal Measures (interburden and coal) are not considered a suitable groundwater resource for irrigation, drinking water or aquatic ecosystems. Groundwater within the coal measures (coal and interburden) record concentrations of bicarbonate above the Fitzroy Plan WQO (Zone 34 – deep), and fluoride above the Fitzroy Plan WQO (Zone 34 – shallow and deep).

Groundwater chemistry results from the Eagle Downs Mine monitoring network suggest that water within the Fort Cooper Coal Measures could be suitable for stock water supply and short term irrigation. It is noted however that not all analytes are available for a complete assessment of the suitability for this unit.

5.4.4 Leachate Analysis

Leachate analysis was undertaken for the Project by Terrenus Earth Sciences (2021). The analysis was conducted on weathered overburden (clay), overburden (sandstone and siltstone), and interburden (claystone, sandstone, coal with some claystone, mudstone, and siltstone) material representative of future spoil material. Some of the overburden and interburden samples were also noted to be carbonaceous. Analysis was also conducted on material representative of future spoil material, and carbonaceous claystone and siltstone (coal seam roof and floor) representative of potential rejects material, as well as composite samples representing coarse rejects. It is important to note that the results from the geochemistry assessment represent an ‘assumed worst case’ scenario as the samples are pulverised prior to testing, and therefore have a very high surface area compared to materials in the field and do not account for mixing during emplacement.

Within the Study Area leachate analysis was also conducted by Terrenus Earth Sciences (2017) for the Olive Downs Project EIS, and the Winchester South Project Area by EGi (2012) and Terrenus Earth Sciences (2019), and is considered relevant to the Project given the similar geological setting.

Terrenus Earth Sciences (2021 undertook a desktop review of geochemical data sourced from samples collected and analysed from the CVM EIS (URS 2007; Terrenus 2009); from samples collected in 2013 at the commencement of mining (PW Baker 2013); and from samples collected since 2013 by BMA and BHP Minerals Closure Planning. In 2020 a sampling program was completed to supplement the existing data set.

A total of 474 samples were reviewed by Terrenus Earth Sciences (2021) as part of the desktop assessment. Analysis of these samples found the following:

- 453 samples (96% of all samples) were identified as non-acid forming (NAF)
- 5 samples (1% of all samples) were identified as ‘uncertain classification’ with 4 likely to be NAF, and one likely to be potentially acid forming
- 9 samples (<2% of all samples) were identified as potentially acid forming (PAF)
- 2 samples (<1% of all samples) were identified as low capacity PAF

Analysis by Terrenus Earth Sciences (2021) of 81 samples collected as part of the 2020 sampling program found the following:

- pH ranged from 5.9 to 8.9 with a median value of 9.5
- EC ranged from 163 µS/cm to 1730 µS/cm with a median value of 391 µS/cm
- Sulfur concentration ranged from 9 mg/L to 512 mg/L with a median value of is 46 mg/L
- Al concentration ranged from 0.01 mg/L to 1.8 mg/L with a median value of 0.09 mg/L
- As concentrations ranged from 0.001 mg/L to 0.875 mg/L with a median value of 0.042 mg/L.
- Analytes for where all samples tested were below LOR include Be, Bi, P, Sn, Th and Zr; and analytes for which concentrations were generally below LOR (i.e. 80% or more were below LOR) include Cd, Co, Cr, Cu, Fe, Hg, Ni, Pb, Ti, U and Zn
- Other analytes tested include:
- B ranged from 0.05 mg/L to 0.30 mg/L with a median concentration of 0.12 mg/L
- Ba ranged from 0.001 mg/L to 0.0172 mg/L with a median concentration of 0.009 mg/L
- Mn ranged from 0.001 mg/L to 0.092 mg/L with a median concentration of 0.004 mg/L
- Mo ranged from 0.004 mg/L to 0.282 mg/L with a median concentration of 0.039 mg/L
- Sb ranged from 0.001 mg/L to 0.032 with a median concentration of 0.004 mg/L
- Se ranged from 0.010 mg/L to 0.100 mg/L with a median concentration of 0.030 mg/L
- V ranged from 0.001 mg/L to 0.090 mg/L with a median concentration of 0.020 mg/L
- W ranged from 0.001 mg/L to 0.002 mg/L with a median concentration of 0.001 mg/L

Analysis by Terrenus Earth Sciences (2019) tested 38 samples and found the following:

- 29 samples were identified as NAF with very low Sulfur (<0.1 %)
- 7 samples were identified as NAF
- 2 samples were identified as ‘uncertain classification’ with one likely to be NAF, and one likely to be potentially acid forming
- pH is generally 8.7 and ranges between 6.3 and 10.1.
- EC is generally 601 µS/cm and ranges between 110 µS/cm and 2,410 µS/cm.
- Sulfur content is generally 37 mg/L and ranges between 2 mg/L and 319 mg/L.
- Aluminium concentrations are all below the limit of reporting (LOR) of <0.2 mg/L in the 2019 sampling, with values between <0.01 mg/L and 0.15 mg/L observed in 2012.

- Arsenic concentrations between <0.001 mg/L and 0.4 mg/L.
- Metals concentrations were all below the laboratory limit of reporting for Be, Cd, Co, Hg, Ni, Pb, and V.
- Metals concentrations above the LOR were identified for the following:
    - Ba with all 2019 values below LOR of <0.2, and 2012 values between 0.06 mg/L and 0.94 mg/L.
    - B with a majority of samples below LOR ranging between <0.05 mg/L and 0.4 mg/L.
    - Cr with all values below with the exception of one 2012 sample with a concentration of 0.08 mg/L.
    - Cu with all 2019 values below LOR of <0.02, and 2012 values between
    - Fe with all 2019 values below LOR of <0.2, and 2012 values between0.001 mg/L and 0.1 mg/L.
    - Mn with values between <0.001 mg/L and 0.07 mg/L.
    - Se with a majority below LOR, and 10 samples between 0.01 mg/L and 0.02 mg/L.

Analysis by Terrenus Earth Sciences (2018) found the analysis of the 27 samples tested as being representative of spoil material (as a bulk material) had the following outcomes:

- All samples were identified as NAF with most showing very low Sulfur content (<0.1%).
- One sample returned ‘uncertain’ results, due to conflicting results.
- pH is generally 9.0 and ranges between 5.4 and 9.7, with only one reading below pH 7.
- EC is generally 400 µS/cm and ranges between 158 µS/cm and 1,050 µS/cm.
- Sulfur content is generally 27 mg/L and ranges between 4 mg/L and 92 mg/L.
- Aluminium concentrations are around 0.3 mg/L and range between <0.2 mg/L and 0.5 mg/L.
- Arsenic concentrations are around 0.12 mg/L and range between <0.02 mg/L and 0.5 mg/L.
- Metals concentrations were all below the laboratory LOR for Ba, Be, B, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb and Zn.

Analysis of the eight samples tested by Terrenus Earth Sciences (2018) as being representative of potential reject material found:

- Six of the eight samples were identified as NAF, with five classified as having very low sulfur content (<0.1%).
- One sample returned ‘uncertain’ results, due to conflicting results.
- One sample was classified as potentially acid forming (PAF) – derived from carbonaceous claystone of the Lower Leichhardt Seam roof at a depth of 104 m below surface.
- pH is generally 8.9 and ranges between 6.9 and 9.6.
- EC is generally 293 µS/cm and ranges between 120 µS/cm and 554 µS/cm.
- Sulfur content is generally 49 mg/L and ranges between 6 mg/L and 206 mg/L.
- Aluminium concentrations are around 0.4 mg/L and range between <0.2 mg/L and 1.0 mg/L.
- Arsenic concentrations are around 0.07 mg/L and range between <0.02 mg/L and 0.22 mg/L.

- Metals concentrations were all below the laboratory LOR for Ba, Be, B, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb and Zn.

Overall, the geochemical assessments found that:

- potential spoil material is expected to be overwhelmingly NAF, with excess acid neutralising capacity (ANC) and has a negligible risk of developing acid conditions;
- spoil is predicted to generate low to moderate salinity surface run-off and seepage with low soluble metal/metalloid concentrations;
- approximately 30% of potential reject material has a relatively low degree of risk associated with potential acid generation. However, the magnitude of any localised acid, saline or metalliferous drainage would be buffered by the presence of the alkaline NAF spoil. As a bulk material (of relatively small total quantity), coal reject is regarded as posing a generally low risk of environmental harm and health-risk.

5.5 Groundwater Usage - Anthropogenic

A search of the Queensland Government's Groundwater Bore Database (GWBD) and the Bureau of Meteorology's National Groundwater Information System (NGIS) was carried out for registered bores within the Study Area. The search indicated that there are 310 registered bores, of which 177 bores (57%) are used for groundwater monitoring and investigations, and 83 bores (27%) are used for water supply. The remainder of bores have an unknown use or resulted from exploration activities (**Table 5-4**).

Table 5-4 Registered use of groundwater bores within the Study Area

Use	Count	Percent of Total
Groundwater monitoring (mine monitoring, water resource investigation etc)	177	57
Water Supply	83	27
Unknown	33	11
Exploration (petroleum, gas, coal, stratigraphic etc)	17	5
Total	310	100

5.5.1 Field Bore Censuses

Three field bore censuses have been carried out within the Study Area:

- A field bore census was conducted for the Project in 2020, targeting properties in the immediate vicinity of CVM. Results are provided in **Appendix A3.**
- A field bore census was conducted for the Moorvale South Project in 2019 (Golder Associates, 2019).
- A field bore census was conducted as part of the Olive Downs Project groundwater assessment in 2017 (HydroSimulations, 2018a).

Across the three bore census, a total of 157 bore locations were assessed. Of the 157 bores:

- 64 bores were found to be existing and in use;
- 44 bores are existing but not in use;
- 8 bores were of unknown status (could not access); and
- 41 bores were abandoned and destroyed.

Of the existing and unknown bores with water use information available, 56 are used for stock water supply, 31 are used of groundwater monitoring and 6 are used for domestic water supply. For the existing and unknown bores with geological information available, 24 intersect alluvium, 12 are within regolith material, four intersect Tertiary basalt material and 37 intersect Permian coal measures (Rangal Coal Measures, Blackwater Group and Back Creek Group).

For the 26 bores surveyed as part of the Project's 2020 bore census (i.e. a subset of those discussed above):

- 17 bores were found to be existing and in use;
- seven bores are existing but not in use (abandoned);
- one bore was decommissioned; and

- one bore was destroyed.

Of the existing and unknown bores with water use information available surveyed in the Project's bore census, one is used for Quarry water supply (gravel washing and dust suppression), four are used for stock water supply, 12 are used of groundwater monitoring and one is used for domestic water supply.

For the existing and unknown bores with geological information available, two intersect alluvium, one is within regolith material, four intersect Tertiary basalt and seven intersect Permian coal measures (Rangal Coal Measures, Blackwater Group and Back Creek Group).

Results of the 2020 Project bore census conducted at CVM (**Appendix A3**) found groundwater use in the area to be limited due to low yields, with many bores abandoned in favour of utilisation of connection to the water supply from the Eungella-Bingegang pipeline. Based on the bore census results, it has been determined that groundwater is not privately extracted from the Moranbah Coal Measures within 5km of the Project. Given the increasing depth to the Moranbah Coal Measures further from the Project, it is considered unlikely groundwater extraction is undertaken from the unit further east. Correlation of the total depths for the surveyed bores against the model layer elevations (**Section 6**) show that water extraction in the surveyed bores is primarily from the shallower Fort Cooper Coal Measures where it overlies the Moranbah Coal Measures. The census results show groundwater take from private extraction is relatively insignificant with estimated yields for assessed stock water bores ranging from 1.6 to 4.7ML/yr and yields from the one quarry water supply bore estimated at 6.57 ML/yr.

Figure 5-32 shows the locations and uses of bores detailed in the combined bore censuses. Full results of the Olive Downs Project and Moorvale South Project bore census surveys are provided in the full groundwater assessment reports (Hydrosimulations, 2018a; and Golder Associates, 2019 respectively)**.**

5.5.2 Mine Pit Inflows

Groundwater inflows from the Permian coal measures to the Mine's active pits are generally small in volume and do not typically need to be actively managed via advance dewatering or other groundwater management methods, with evaporation from the pit walls and floors accounting for most of the groundwater. Small volumes of groundwater inflow requiring management, when they occur, which are generally managed via the use of in-pit sumps to capture water that is then used for dust suppression purposes or circulated via the Mine water management system for use in coal washing.

Groundwater Inflow estimates for Horse Pit and Heyford Pit at CVM are provided in **Table 5-5** below based on BMA's annual Associated Water Take reporting to DoR. Estimates are based on BMA's site water balance calculations using site climate data, pit inflow, pit storage and outflow data.

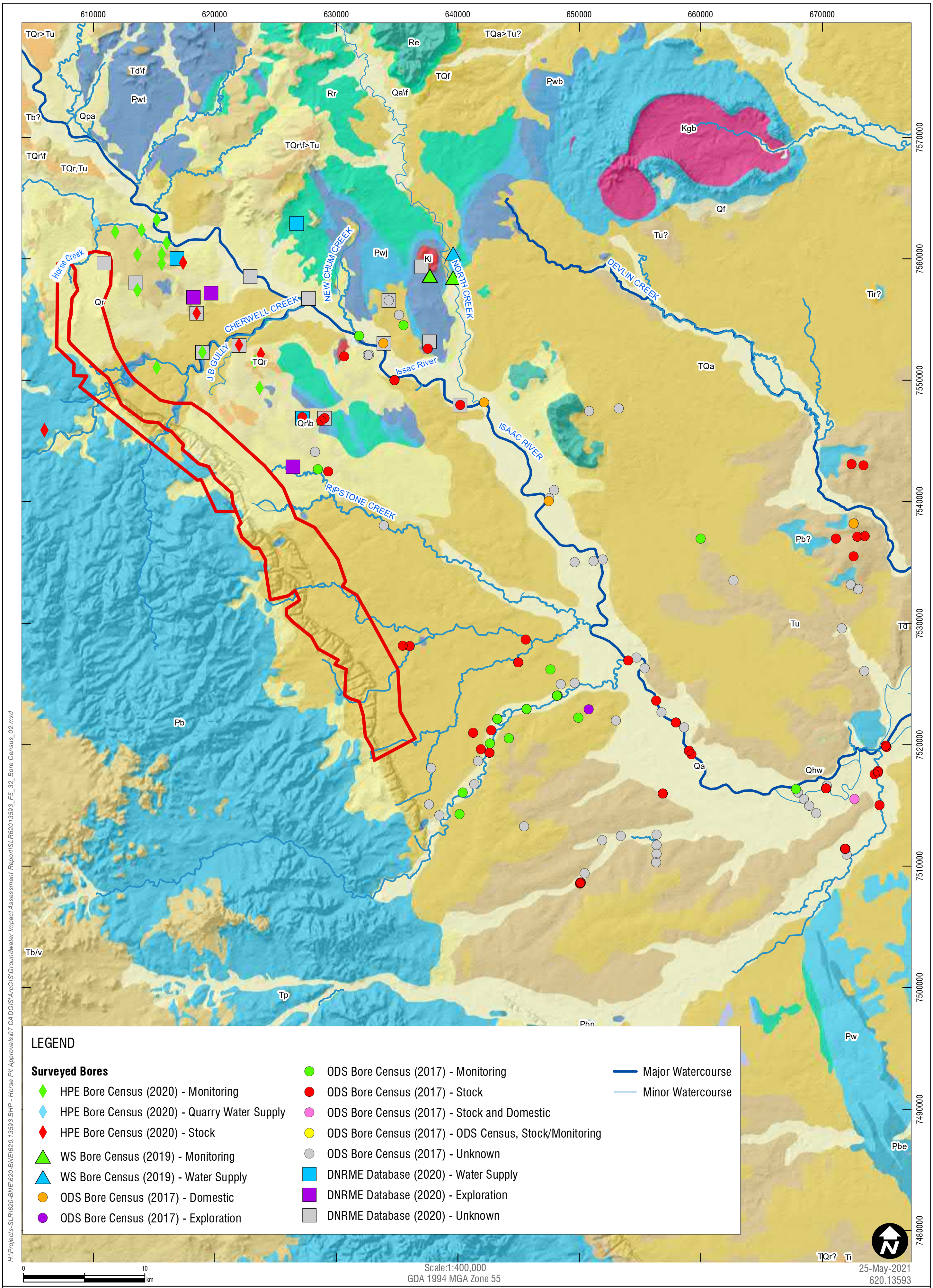
Table 5-5 Estimated Groundwater Inflow at CVM 2018/2019 (BMA, 2019)

CVM Pit	Ramps	Monthly Estimate (ML/mth)	Annual Estimate (ML/yr)
Horse Pit	R20, R30, R40, R50, R60	72	865
Heyford Pit	R10N, R11N, R12N	20.1	241
	Total	90.1	1,106

Associated mine water data for CVM, Peak Downs mine and Saraji mine are presented in **Table 5-6**.

Table 5-6 Estimated Cumulative Groundwater Inflow at CVM, Peak Downs and Saraji 2017 to 2020 (BMA, 2020)

Tenure	Name of section of mine	Date From	Date To	Volume (ML)
ML1775	CVM, Peak Downs and Saraji	July 2017	July 2018	6,199
		July 2018	July 2019	3,474
		July 2019	July 2020	9,063



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Bore Censuses - Groundwater Use Surrounding the Project

FIGURE 5-32

5.6 Groundwater Usage – Environmental

5.6.1 Groundwater Dependent Ecosystems

A GDE is one in which the plant and/or animal community is dependent on the availability of groundwater to maintain its structure and function.

5.6.1.1 National Atlas of Groundwater Dependent Ecosystems

Desktop mapping of potential aquatic and terrestrial GDEs indicates that areas with possible high, moderate and low potential for groundwater interaction occur in the vicinity of the Project Area (BoM, 2017). Isolated areas of high and moderate potential GDE's occur within the Project Area, with low potential GDE's identified predominantly around the Project Area boundaries. The GDE Atlas classifies ecosystems based on the potential for dependence on groundwater through multiple lines of scientific evidence. Ecosystems have been mapped as either:

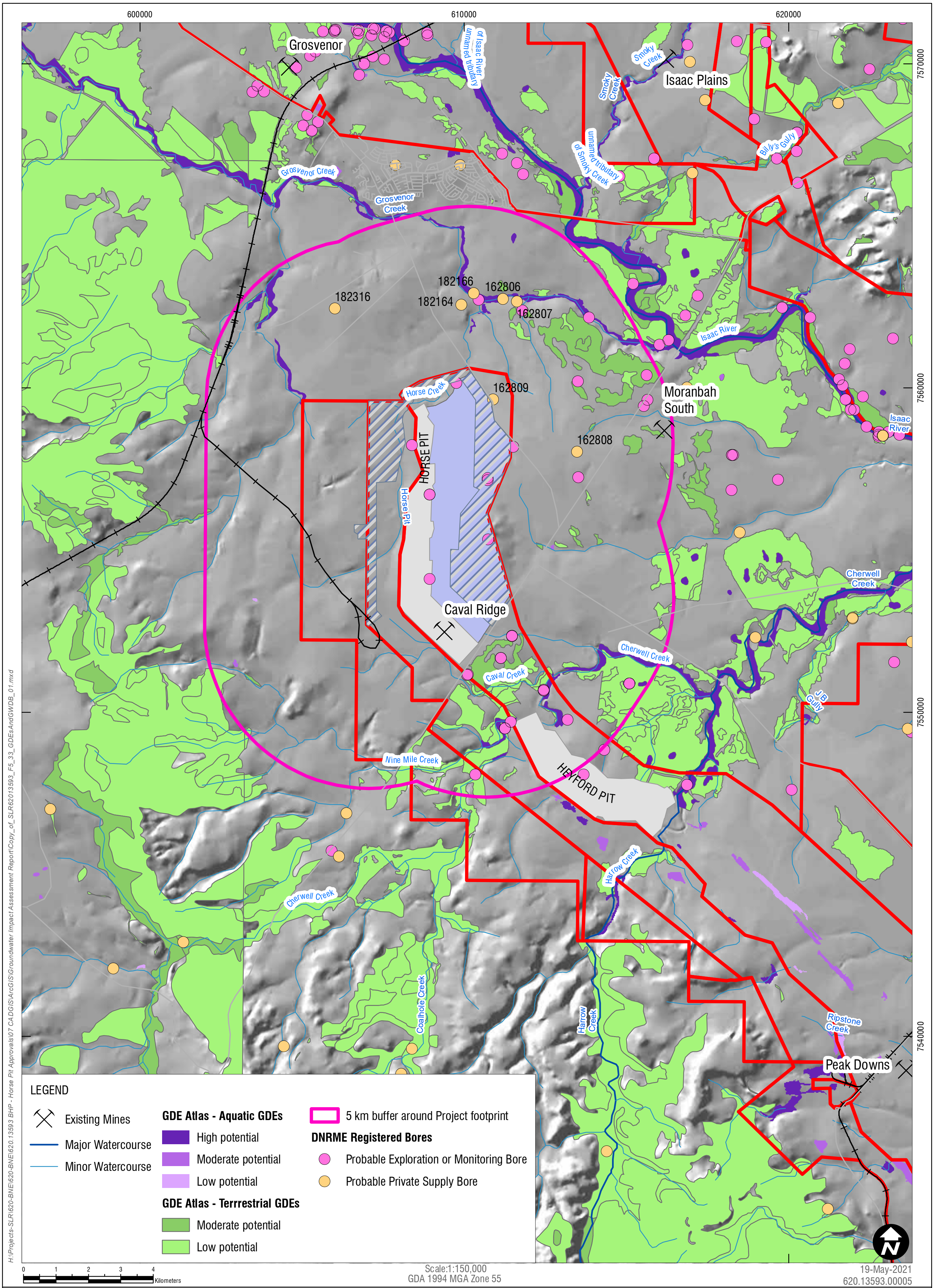
- High potential for groundwater dependence (indicating a strong possibility the ecosystem is interacting with groundwater);
- Moderate potential for groundwater dependence; or
- Low potential for groundwater dependence (indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

Surface ecosystems near the Project that may be reliant on the surface expression of groundwater are shown in **Figure 5-33**. The desktop GDE mapping indicates:

- Terrestrial vegetation associated with the Isaac River and downstream extent of Cherwell Creek are mapped as having a high potential to be dependent on subsurface expression of groundwater.
- Aquatic habitat associated with the Isaac River, Cherwell Creek and downstream extent of Harrow Creek is mapped as having a high potential to be dependent surface expression of groundwater.
- Terrestrial vegetation and aquatic habitat associated with a number of palustrine wetlands surrounding the Olive Downs Project is mapped as having a moderate potential to be associated with the surface expression of groundwater.
- All other terrestrial vegetation and aquatic habitat within the Project locality, is broadly mapped as having a low to moderate potential of being associated with the presence of groundwater (BoM, 2017).

5.6.1.2 CVM GDE Studies

A remote sensing terrestrial GDE assessment was undertaken by 2rog (2021) as part of broader GDE assessments across BHP tenements within the region. Using the IESC recommended remote sensing approach, Landsat ETM imagery was selected following relatively wet and dry seasons and was analysed to identify areas of vegetation that were shown to be persistently wetter and greener than the surrounding areas. No potential terrestrial GDEs were identified in the vicinity of CVM using the remote sensing method, with the closest terrestrial GDE mapped using the IESC approach located approximately 45km to the east of the Project Area.



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GDEs and DoR GWDB

FIGURE 5-33

Ecological Service Professionals (ESP, 2020) undertook a field environment assessment of the condition of the aquatic ecosystems in the vicinity of the Project Area in April 2020. The results of aquatic indicators surveyed as part of the assessment were consistent with results from previous aquatic ecology surveys at CVM and in the broader region. Field assessments concluded that aquatic habitat condition at mapped potential surface-expression GDE sites in the vicinity of the Project were representative of ephemeral waterway and wetland sites, with no obvious surface-expression of groundwater at these sites. The assessment found that the aquatic ecological value of mapped potential surface-expression expression GDEs was low to moderate at wetland sites and waterway sites. No differences were observed in aquatic ecological indicators between sites on mapped potential surface-expression GDEs compared with those that are not mapped (ESP, 2020)

E2M Consulting (E2M) undertook a field survey in December 2020 to verify and characterise the presence, extent and condition of potential terrestrial and aquatic GDEs in the vicinity of the Project Area (E2M, 2021b). Possible GDEs within and/or directly adjacent to the disturbance footprint were found to be vegetation communities occurring on Land Zone 3 (Quaternary alluvial systems) and containing canopy species known elsewhere to have dependence on groundwater (e.g. E. *tereticornis, E. camaldulensis*). Within the Project Area, possible terrestrial GDE communities were found to be restricted to RE 11.3.2 and RE 11.3.25 (E2M, 2021a). Mapped as a low potential GDE in the GDE Atlas, the field assessment classified RE 11.5.3 as a potential GDE due to the species potential able to access groundwater between 10 to 20mbgl. Field survey information was then compared to depth to groundwater (depth to water table) predictions from the Project groundwater model (see **Section 6**) with respect of literature information on rooting depths of the observed species. This analysis has identified that for the most part, the pre-Project water table lies beyond the reach of the observed vegetation communities, and therefore those communities can not be considered GDEs. Exceptions to this are the riparian vegetation along Horse Creek to the north of the Project Area and Caval and Cherwell Creeks to the south of the Project Area (including on areas of ML 1775), which were found to contain communities that, on the basis of species type and predicted water table depth, may be considered GDEs. However, E2M (2021b) also found that in these particular areas, the vegetation communities observed were likely to be facultive and be dependant on surface water flow within their respective watercourses.

5.6.1.3 Other relevant GDE Studies

In the vicinity of the Project Area, a detailed desktop assessment of potential GDEs was undertaken for the nearby Moorvale South Project in June 2019 (Kleinfelder, 2019), and field verification of GDE mapping was also undertaken as part of the Olive Downs Project EIS (DPM Envirosciences, 2018a). These studies found that the majority of the terrestrial vegetation associated with the Isaac River, Phillips Creek, North Creek and Cherwell Creek is unlikely to be dependent on groundwater, given the vegetation communities present along these features are known to occur more widely across the landscape and are not restricted to areas where they could potentially access groundwater. DMP Envirosciences (2018a) note that areas of RE 11.3.25, RE 11.3.27 and RE 11.3.4 along the Isaac River which contain Queensland Blue Gum (*Eucalyptus tereticornis*) and River Oak (*Casuarina cunninghamiana*) have the potential to be reliant on access to groundwater (Doody *et al.*, 2018). Based on the depth to groundwater within the Study Area being greater than 10 mbgl, DPM Envirosciences (2018a) concluded that these communities have a low likelihood of being reliant on access to groundwater. The depth to groundwater in the vicinity of mapped terrestrial GDE’s within the Project Area is also greater than 10 mbgl, and in line with the DPM Envirosciences (2018a) findings, also unlikely to be reliant on access to groundwater.

Consistent with the IESC (Doody *et al.*, 2018) *Assessing Groundwater-Dependent Ecosystems: IESC Information Guidelines Explanatory Note*, the ephemeral nature of the aquatic habitat associated with Isaac River, Phillips Creek, North Creek and Cherwell Creek indicates that these habitats have a low likelihood of being dependent on groundwater. Conditions within the Project Area are similar to those as part of these previous studies, with a low likelihood of being dependent on groundwater also expected.

Similarly, investigations by Kleinfelder (2019) found that due to the shallow rooting and drought resistance of the dominant tree species, it is unlikely any of the other REs present would be dependent on groundwater. It was found that certain species on the first banks of streams could be dependent on groundwater, but their drought resistance could mean little impact by changes to the groundwater flow.

A review of open-cut mines in the region of the as part of the Moorvale South Project assessment showed that none of the vegetation communities appeared to be impacted by the open-cut mines even when the mine had diverted watercourses upstream of the vegetation communities. This outcome shows the lack of dependence of most vegetation types in the region on groundwater and their drought resistance.

5.6.2 Stygofauna

ESP (2020) undertook stygofauna sampling in April 2020 within the Project Area. Sampling was completed at thirteen bores. No stygofauna communities were recorded from bores sampled during the field survey. This was consistent with the findings of the desktop assessment which concluded that the aquifer formations in the vicinity of the Project are unlikely to support diverse stygofauna communities.

DPM Envirosciences (2018b) undertook stygofauna sampling in 2017 in the vicinity of the Project Area, as part of the Olive Downs Project groundwater assessment. DPM Envirosciences concluded the generally poor groundwater quality within the regolith material (indicated by EC levels up to 26,800 µs/cm) suggested the groundwater environment is unsuitable for stygofauna. DPM Envirosciences also concluded that the available water quality data for the relevant bores (GW01 and GW18) indicated that stygofauna could potentially occur in the unconsolidated sediments (alluvium) associated with the Isaac River. However, no stygofauna were encountered during sampling.

5.6.3 Springs

A spring vent is a point where there is a surface expression of groundwater, with groundwater flow occurring intermittently or continuously. The Queensland Government maintains an inventory of identified springs in the Queensland Springs Database (DES, 2019). No springs have been identified within the Study Area.

5.6.4 Internationally and Nationally Important Wetlands

A search of the EPBC Act 'Protected Matters' database (DEE, 2019) found that there are no Internationally or Nationally Important Wetlands within the Project Area. The closest wetlands of international importance are located approximately 220 km south-east of the Project and include those of the Shoalwater and Corio Bays Area. Lake Elphinstone is the closest nationally important wetland, located 70 km north (upstream) of the Project. Due to their distance from site, no internationally and nationally important wetlands will be impacted by the Project.

5.7 Conceptual Model

A conceptual model of the groundwater regime has been developed based on the review of the hydrogeological data for the Project and surrounds. It is important to note that the conceptual hydrogeological model presented herein represents an evolution of the hydrogeological understanding at CVM, with the conceptual model having first been developed during the CVM EIS (URS, 2009) and then further updated by GHD (2017).

The Project is located within the northern part of the Bowen Basin, which comprises Permian aged coal measures that have been folded into a syncline structure that strikes in a north-west to south-east direction. The geology of the Project site comprises the stratified sequences of the Moranbah Coal Measures at the westernmost extent of the syncline that dip towards the east. The Project targets the coal seams of the Moranbah Coal Measures, that occur at subcrop, and underlie the Rewan Group east of the Project site with depth increasing toward the Isaac River. The Triassic Rewan Group strata that unconformably overlie the coal measures east of the Project can reach up to 300 m thick within the Study Area. Surficial cover at the Project site includes the Cherwell Creek alluvium, a tributary of the Isaac River, as well as regolith material comprising Quaternary to Tertiary sediments and Tertiary Basalt. The main hydrogeological features at the Project include:

- Cainozoic sediments:
    - Quaternary alluvium – unconfined aquifer (water-bearing strata of permeable rock, sand, or gravel) localised along the eastern reaches of Cherwell Creek, becoming relatively prolific to the northeast and east of the Project;
    - Quaternary to Tertiary alluvium, colluvium and weathered units (regolith) – unconfined and largely unsaturated unit bordering alluvium;
    - Tertiary Basalt – variable groundwater bearing unit overlying Permian coal measures across much of the Project Area;
- Permian coal measures with:
    - Hydrogeologically ‘tight’ interburden units with aquitard properties; and
    - Coal sequences that exhibit water bearing properties associated with secondary porosity through cracks and fissures.

Along Cherwell Creek immediately adjacent the Project, the alluvium comprises between 6 to 9m of clay and silt which is underlain by up to 10m of fine to coarse sand and gravel. It should be noted that the surface alluvium extent is minor within the Project Area and there is no direct interception of the alluvium by the proposed pit extents.

The Isaac River alluvium occurs 10 km northeast of the Project at its closest, and comprises a heterogeneous distribution of fine to coarse grained sands interspersed with lenses of clays and gravels. The hydraulic properties of the alluvium vary due to the variable lithologic composition, with field tests from nearby resource project groundwater assessments indicating horizontal hydraulic conductivity can range between 1.4 x10^{-2} m/day and 8.7 m/day. Groundwater occurs within the alluvium at depths of around 11 mbgl to 17 mbgl, typically disconnected from the riverbed elevation. Regionally, groundwater flow within the alluvium is a subdued reflection of topography, with groundwater flowing in a south easterly direction consistent with the alignment of the Isaac River. However, local groundwater levels within the alluvium are highest close to the Isaac River, indicating a potential local flow direction away from the Isaac River. This also indicates potential losing conditions from the Isaac River to the underlying alluvium during flow periods. Spatially, the alluvium is variably saturated. Localised perched water tables are also evident where waterbodies continue to hold water throughout the dry period (e.g. pools in the Isaac River and wetlands) occurring where clay layers slow the percolation of surface water.

Recharge to the alluvium is considered to be primarily from stream flow or flooding (losing streams), with direct infiltration of rainfall also occurring rapidly where there are no substantial clay barriers in the shallow sub-surface. On a regional scale, discharge is via evapotranspiration from vegetation growing along creek beds and minor short duration baseflow events after significant rainfall/flooding. Infiltration to underlying formations is limited to areas with relatively high hydraulic conductivity units (e.g. coal seams). General downwards recharge to deeper units is limited by the low hydraulic conductivity (confining) coal measure interburden sequences and, east of the Project, the Rewan Group.

Water quality data for the alluvium within the Study Area indicates it can be fresh to saline and highly spatially and temporally variable. The alluvium across the Study Area is mostly suitable for stock water supply and irrigation but is not suitable for drinking water and freshwater aquatic ecosystems. Alluvial bores within the Project monitoring network were found to be on average, not be suitable for long-term irrigation, with concentrations of iron, chromium, and manganese exceeding guideline levels. Review of the Queensland GWDB and a landholder census indicates alluvial groundwater associated with the Isaac River is used by local landholders, predominantly for stock water supply. Based on previous ecological studies, it was identified that riparian vegetation along the Isaac River has a low likelihood of dependence on alluvial groundwater (DPM Envirosciences, 2018a).

Tertiary-Quaternary aged sediments (regolith) and basalt present across the Project Area form the base of the unconfined shallow groundwater system. The groundwater flow processes are similar to those of the alluvium, however the fluxes are expected to be significantly lower due to the dominance of clay within the sediments. Within the Study Area, near the Isaac River and creeks, water has been detected within the regolith material at depths of around 8 mbgl to 19 mbgl. Outside of these areas the regolith material was found to be largely unsaturated. Groundwater within the Tertiary Basalt at the Project site was generally encountered at the base of the unit at depths ranging of between 14 mbgl and 37m bgl. Water quality data for the regolith indicates it is generally highly saline but can be brackish to moderately saline. Water within the regolith is generally of poor quality and not considered suitable for stock, irrigation, aquatic ecosystems or drinking water. Water quality within the basalt, where saturated, is generally of poor quality but is considered suitable for stock and short term irrigation.

In the Permian strata, groundwater is encountered mainly in the coal seams, and occasionally in the sandstone/siltstone units of lower hydraulic conductivity. As with the rest of the Bowen Basin, the coal seams are the main groundwater bearing units within the Permian sequences, with low hydraulic conductivity interburden generally confining the individual seams. The coal seams are dual porosity in nature with a primary matrix porosity and a secondary (dominant) porosity provided by fractures (joints and cleats). Hydraulic conductivity of the coal decreases with depth due to increasing overburden pressure reducing the aperture of fractures. Vertical movement of groundwater (including recharge) is limited by the confining interburden layers, meaning that groundwater flow is primarily horizontal through the seams with recharge only occurring at subcrop.

Review of fault behaviour within the Study Area and from external studies has identified that faults can increase vertical hydraulic conductivity parallel to the fault trace and reduce it perpendicular to the fault trace. However, any increases in vertical hydraulic conductivity is limited to small vertical horizons (<20 m) and is variable between faults dependent on localised hydrothermal activity and mineralisation in-filling pore spaces. Hydraulic testing of faults within the Study Area indicate that faulting zones intercepted are not pathways for preferential flow.

Regionally, groundwater within the Permian coal measures flows in a south-easterly direction. Review of water quality data indicates water within the Permian coal measures is generally saline within the Project Area but can range between fresh to highly saline. Groundwater within the coal measures of the Project Area is only considered suitable for some stock, with the type of stock dependent on the TDS range (i.e. beef cattle or sheep). Some bores screened within the interburden and the coal seams display highly variable concentrations of aluminium and nickel, exceeding the guidelines for stock watering.

A conceptual cross-section, made from the east-west section (see **Figure 4-3**) through the Project Area, of the hydrogeological system is presented in **Figure 5-34** to **Figure 5-36** illustrating the conceptual model of the area prior to, during and following the Project.

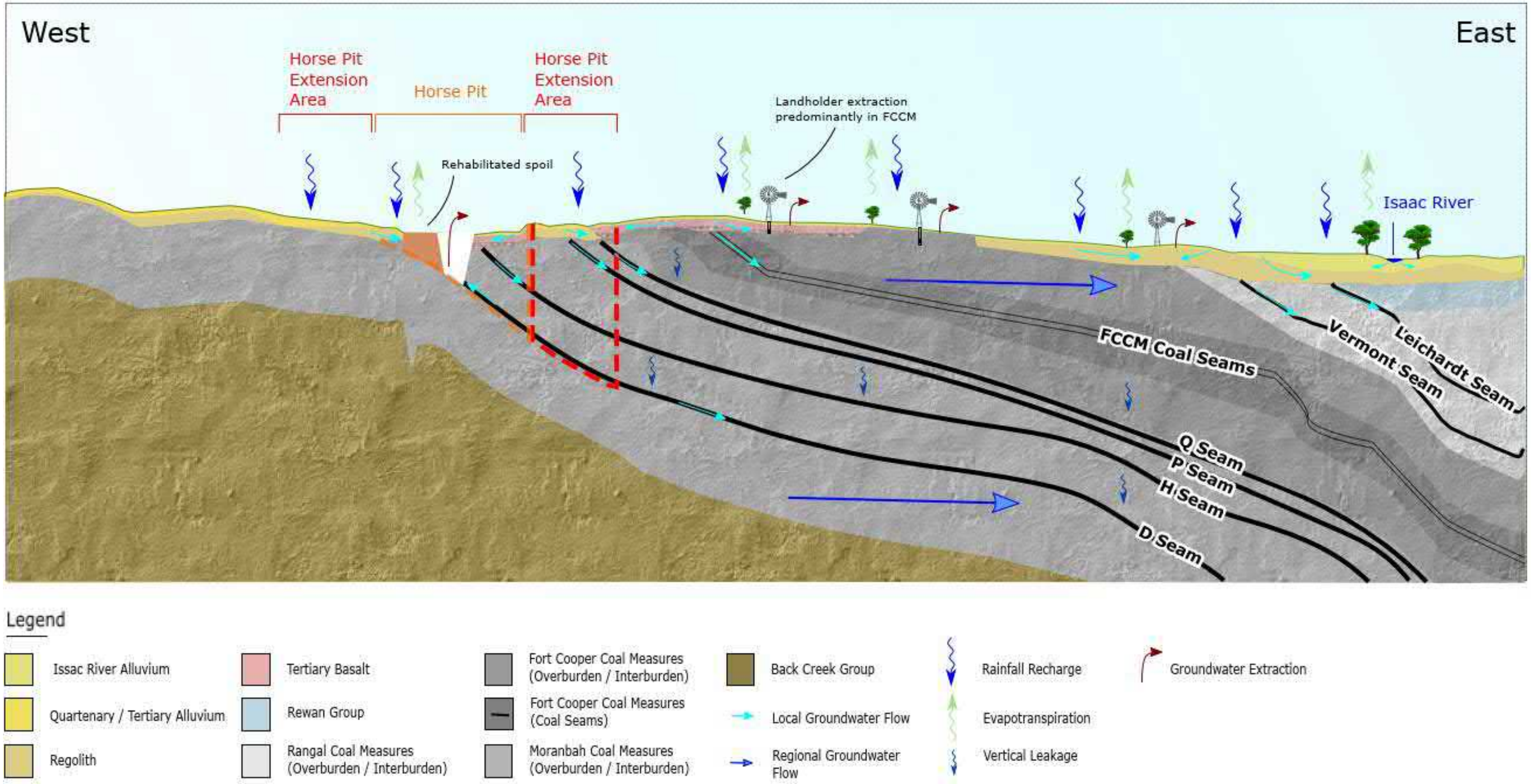


Figure 5-34 **Conceptual Model of the Groundwater System Pre-Project**

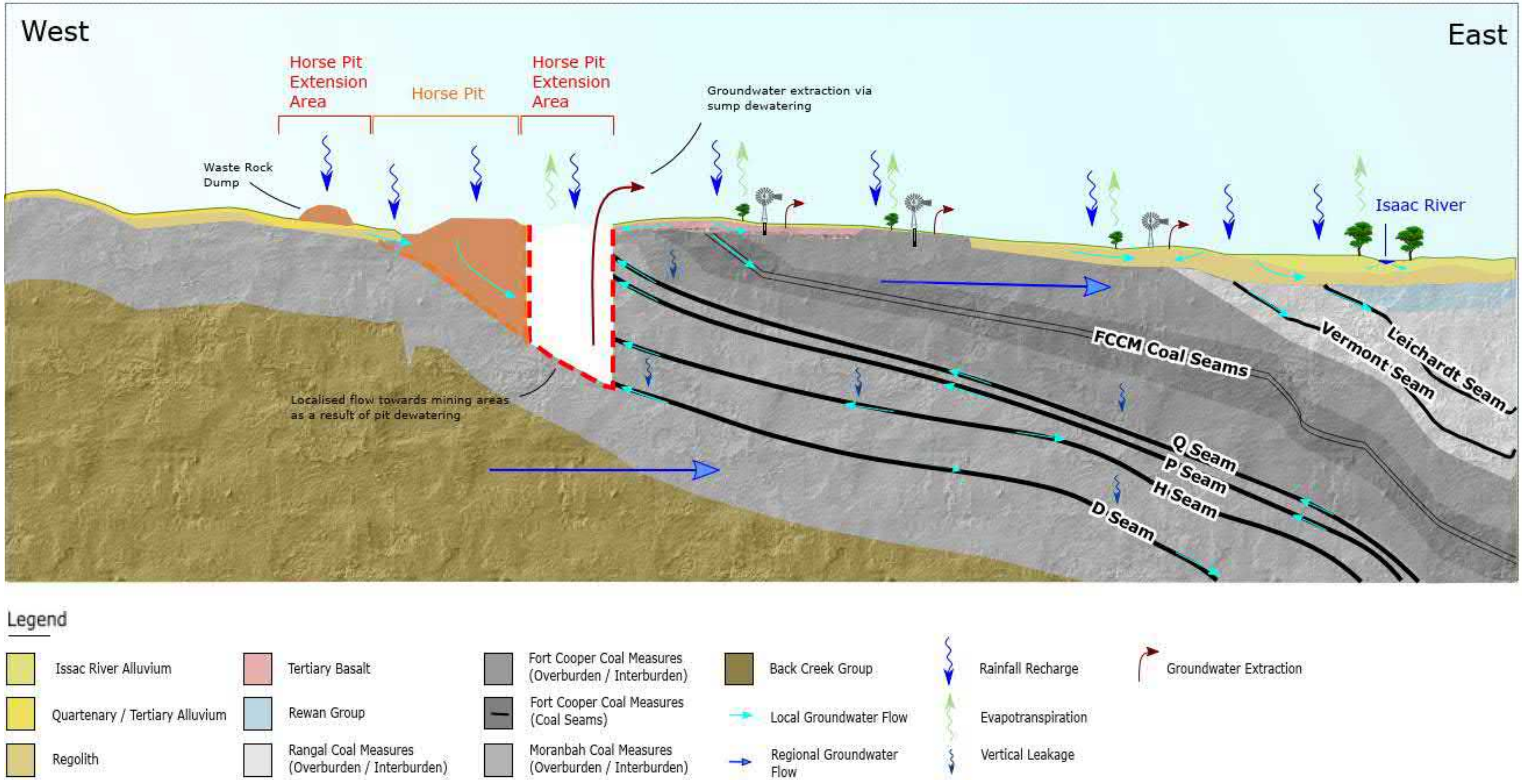


Figure 5-35 Conceptual Model of the Groundwater System During Project

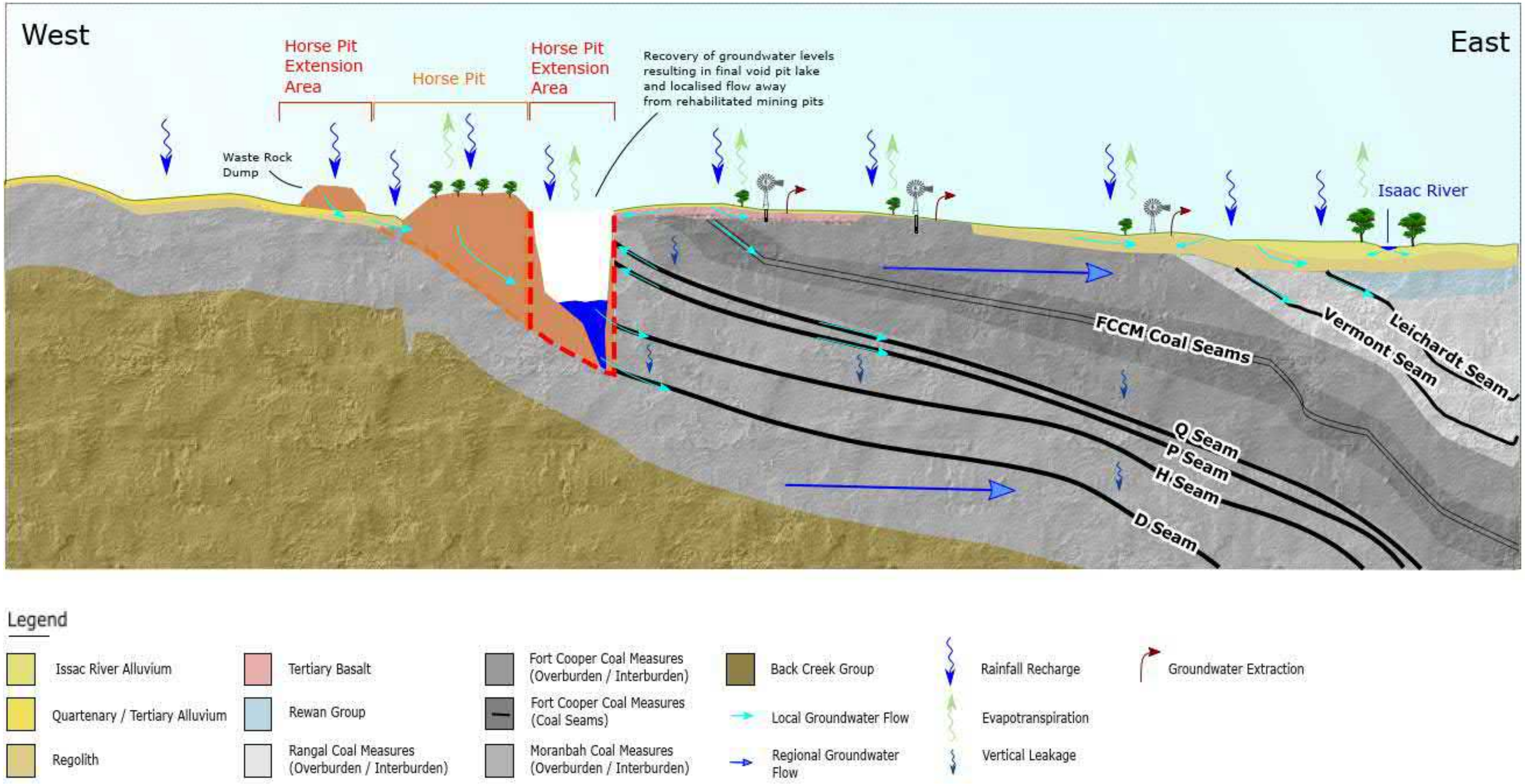


Figure 5-36 Conceptual Model of the Groundwater System Post Project

6 Groundwater Simulation Model

6.1 Model Details

This section provides a summary of the design and development of the numerical groundwater model used to support this groundwater assessment. Full details of the numerical groundwater model are included within **Appendix B**.

6.1.1 Model Objectives

Numerical modelling was undertaken in support of the groundwater assessment for the Project to evaluate the potential impacts of the Project on the local groundwater regime. The objectives of the predictive modelling were to:

- Assess the groundwater inflow to the mine workings as a function of mine position and timing;
- Simulate and predict the extent and area of influence of dewatering, and the level and rate of drawdown at specific locations; and
- Identify areas of potential risk, where groundwater impact mitigation/control measures may be necessary.

6.1.2 Model Design

The numerical groundwater model was developed based on the conceptual groundwater model, presented within **Section 5.7**. Conceptualisation of the groundwater regime and the calibration of the model against observed data are key to achieving a reliable numerical model. Conceptualisation is a simplified overview of the groundwater regime (i.e. the distribution and flow of groundwater) based on available data and experience. Consistency between numerical model results and the conceptual understanding of the groundwater regime increases the credibility of the numerical model predictions.

The numerical model was developed using a Geographic Information System (GIS) in conjunction with MODFLOW-USG, which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a relatively new version of the popular MODFLOW code (McDonald and Harbaugh, 1988) developed by the USGS. MODFLOW is the most widely used code for groundwater modelling and has long been considered an industry standard.

The numerical groundwater model for the Project builds on the Olive Downs Project EIS model (the foundational regional Bowen Basin model) (HydroSimulations, 2018b). The foundational model was subsequently updated for the Moorvale South Project in 2019 (SLR, 2019b), for the Winchester South Project EIS in 2020 (SLR, 2020), and most recently for the Lake Vermont North Project (in conjunction with the Project). BMA has established groundwater data sharing agreements with the owners of each of these projects/mines, which allows for the sharing of groundwater data, models and documentation. Under these agreements, the groundwater models developed as part of each project/mine's groundwater assessment have been adopted as a base for the Project groundwater assessment where relevant. Of note, the current update of the groundwater model reported herein is the first iteration to include data and information from the Lake Vermont North Project as well as a number of BHP sites (CVM, Poitrel, Daunia and Saraji).

A range of model updates were deemed required to ensure the regional Bowen Basin model is fit for purpose for the Project. The updates to the model design from that reported in SLR (2020) included:

- Model extent and grid – revised grid extent and refinement around CVM pits.
- Model layers – updated layers to deepest mined seams at CVM, capture stratification of alluvium and update model layers to match CVM geological model surfaces and update LiDAR data.
- Timing – updated calibration model to extend to December 2020 and refined timing to capture seasonality and mine progression changes.
- Boundary Conditions – updated model boundary conditions with revised grid extent and regional flows.
- Stresses – Maintained inputs, but with updates from more recent and site-specific data.

Previous groundwater modelling for CVM includes the GHD (2017) numerical groundwater model, developed for Associated Water Take reporting to DoR. The GHD (2017) model was built on the site geological model and reported on model calibration, predicted mine inflows, predicted drawdown extents. The GHD model however did not simulate cumulative impacts from the neighbouring mines. Elements of the GHD work have been included within the Project conceptual hydrogeological model as discussed in **Section 5.7**. However, for the purposes of the Project, minimal other elements from the GHD numerical model have been carried forward into the Project numerical model given the availability of the more recently updated regional Bowen Basin model.

6.1.3 Model Calibration

The numerical model includes a transient calibration (2008 to 2020). Both the steady-state and transient calibrations capture historical mining at Peak Downs, CVM, Saraji, Lake Vermont, Eagle Downs, Poitrel and Daunia Mines. Mining was represented in the model using the MODFLOW drain package, with the drain cells set to the base of the target coal seam for each pit, and within the target coal seam for underground mines. Calibration of the model was carried out with the objective being to replicate the groundwater levels measured in the CVM, Lake Vermont, Winchester South, Olive Downs Project, Moorvale South Project, Eagle Downs Mine and the Project monitoring networks and available privately-owned bores, in accordance with Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Steady-state calibration for the model achieved a 6.7% scaled root mean square (SRMS) error, which is within the acceptable limits (i.e. 10%) recommended by the Australian groundwater modelling guidelines (Barnett et al., 2012). Observations from recently installed Project site bores have been included in the transient calibration statistics. Project site bore residuals were calculated as the difference between the observed water level and simulated head for the corresponding time period in the predictive model. With the Project site bore residuals included, the transient calibration achieved a 5.2% SRMS error, which is also within the acceptable limit of 10%. A detailed description of the calibration procedure is provided in **Appendix B**.

6.1.4 Model Performance and Limitations

The groundwater modelling was conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al. 2012), the MDBC Groundwater Flow Modelling Guideline (MDBC, 2001) and the released IESC Explanatory Note for Uncertainty Analysis (IESC, 2018). These are mostly generic guides and do not include specific guidelines on special applications, such as underground coal mine modelling.

The 2012 guide has replaced the model complexity classification of the previous guideline by a "model confidence level" (Class 1, Class 2 or Class 3 in order of increasing confidence) typically depending on:

- Available data (and the accuracy of that data) for the conceptualisation, design and construction.
- Calibration procedures that are undertaken during model development.

- Consistency between the calibration and predictive analysis.
- Level of stresses applied in predictive models.

It is generally expected that a model confidence level of Class 2 is required for mining environmental impact assessment. **Table 6-1** (based on Table 2.1, Barnett et al. 2012) summarises the classification criteria and shows a scoring system allowing model classification. Based on **Table 6-1**, the groundwater model developed for this Groundwater Assessment may be classified as primarily Class 2 (effectively "medium confidence") with some items meeting Class 3 criteria, which is considered an appropriate level for this Project context.

Table 6-1 Groundwater Model Classification Table

Class	Data	Calibration	Prediction	Indicators	Total
1	Not much. Spares. **Not metered usage.** Remote climate data.	Not Possible. Large error statistics. Inadequate data spread. Targets incompatible with model purpose.	Timeframe>>calibration. Long stress periods. Transient prediction but steady state calibration. Bad verification.	Timeframe>10x. Stresses>5x. Mass balance>1% (or single 5%). Properties<>Field. Bad discretisation. No review.	
Count	1	0	0	0	1
2	**Some.** **Poor coverage**. Some usage info. Baseflow estimates.	**Partial performance.** Long-term trends wrong. Short time record. **Weak seasonal replication.** No use of targets compatible with model purpose.	**Timeframe>calibration.** **Long stress periods.** New stresses not in calibration. Poor verification.	**Timeframe=3-10x.** **Stresses=2-5x.** **Mass balance<1%.** **Properties<>Field measurements.** **Some key coarse discretisation.** **Reviewed by hydrogeo.**	
Count	2	2	2	6	12
3	Lots. Good aquifer geometry. Good usage info. **Local climate info.** **K measurements** **Hi –res DEM.**	Good performance stats. Long-term trends replicated. Seasonal fluctuations OK. **Present day data targets.** **Head and flux targets.**	Timeframe~calibration. Similar stress periods. Similar stresses to those in calibration. Steady state prediction consistent with steady state calibration. Good verification.	Timeframe<3x. Stresses<2x. **Mass balance<0.5%** Properties~Field measurements. Some key coarse discretisation. **Reviewed by modeller.**	
Count	3	1	0	2	6

6.1.5 Model Predictions

Transient predictive modelling was undertaken to simulate both the proposed mining at the Project and surrounding mines from January 2021 to January 2056. The model timing used annual stress period durations as mining progressed into the future. Three numerical model scenarios were run:

- Null Run – No future mining within the Study Area.
- Approved – Approved and foreseeable mining within the Study Area.
- Cumulative – Approved and foreseeable mining plus the Project.

6.2 Predicted Groundwater Interception

The predicted inflows for Approved mining at Horse Pit plus the Project, and the total Horse Pit inflows are presented in **Figure 6-1**.

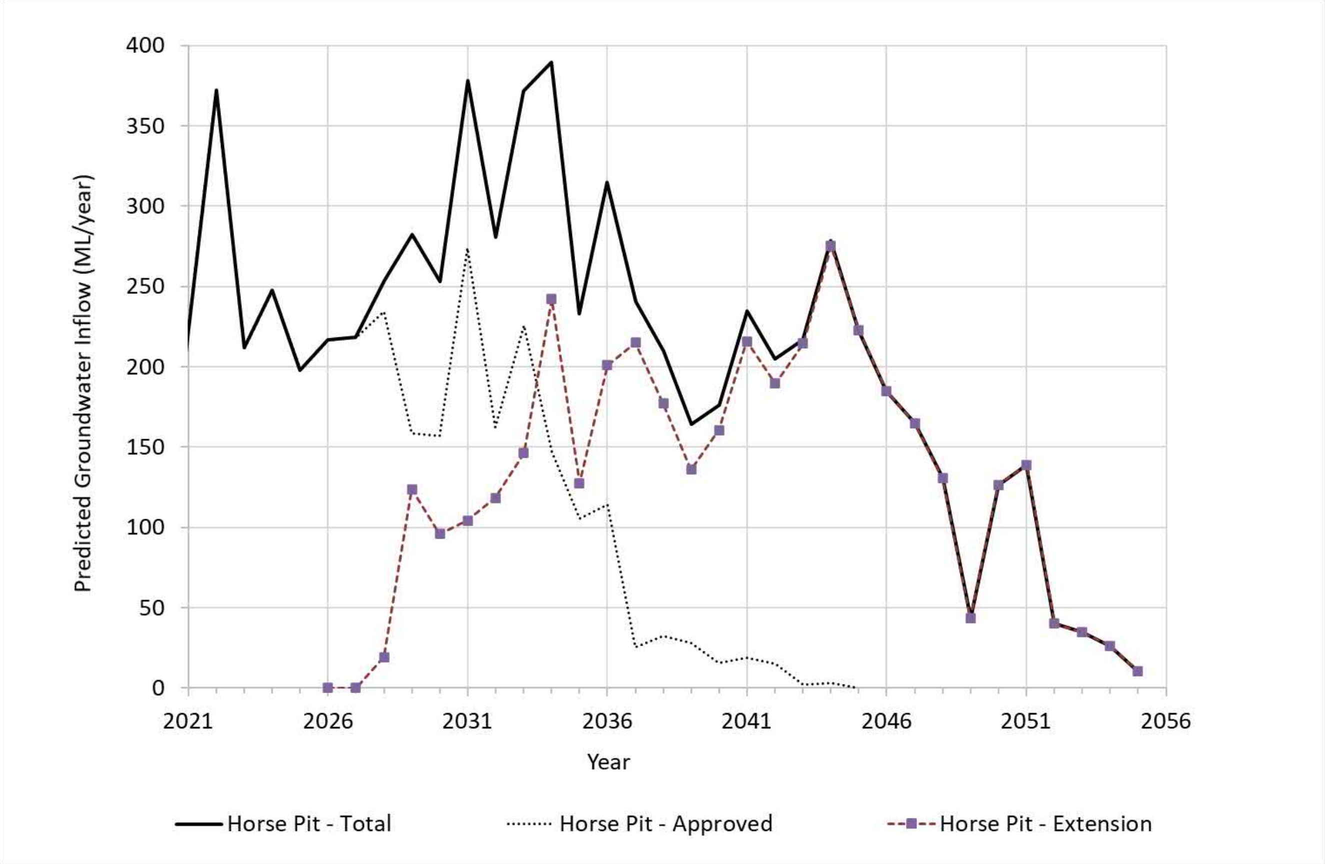


Figure 6-1 Predicted Project Mine Inflows

The predicted average total inflow rate over the duration of mining is 198.1 ML/year (0.55 ML/day).

As shown, inflows to the Project are predicted to reach a maximum peak in year 2044, with 275.2 ML total inflow predicted for the year (0.75 ML/day). The average inflow rate due to the Project is 133.9 ML/year (0.36 ML/day). The predicted inflows are within the same order of magnitude as the groundwater inflows recorded at Horse Pit and Heyford Pit during 2018/2019 (**Table 5-5**). The modelled inflow volumes are therefore believed to realistic predictions for the Project.

The GHD (2017) model for CVM predicted an average inflow of 1,461 ML/year (4 ML/day) which is higher than the predicted inflows in the current model. The difference in the predicted inflows may relate to updates to the model structure from site geological information, the updates to the calibrated hydraulic properties based on more recent observation data (noting the GHD model's reported calibration performance was relatively poor with an SRMS of 19% compared to 5.2% in the current model), and the implementation of the coal depth dependence function in the current model.

The Water Plan (Fitzroy Basin) 2011 groundwater area consists of the following (refer **Section 2.1.2**):

- Groundwater Unit 1 (containing aquifers of the Quaternary alluvium); and

- Groundwater Unit 2 (sub-artesian aquifers).

Planned mining operations at the Project will not intercept Quaternary alluvium. As such, all direct groundwater take predicted by the model is from Groundwater Unit 2.

6.3 Predicted Maximum Drawdowns

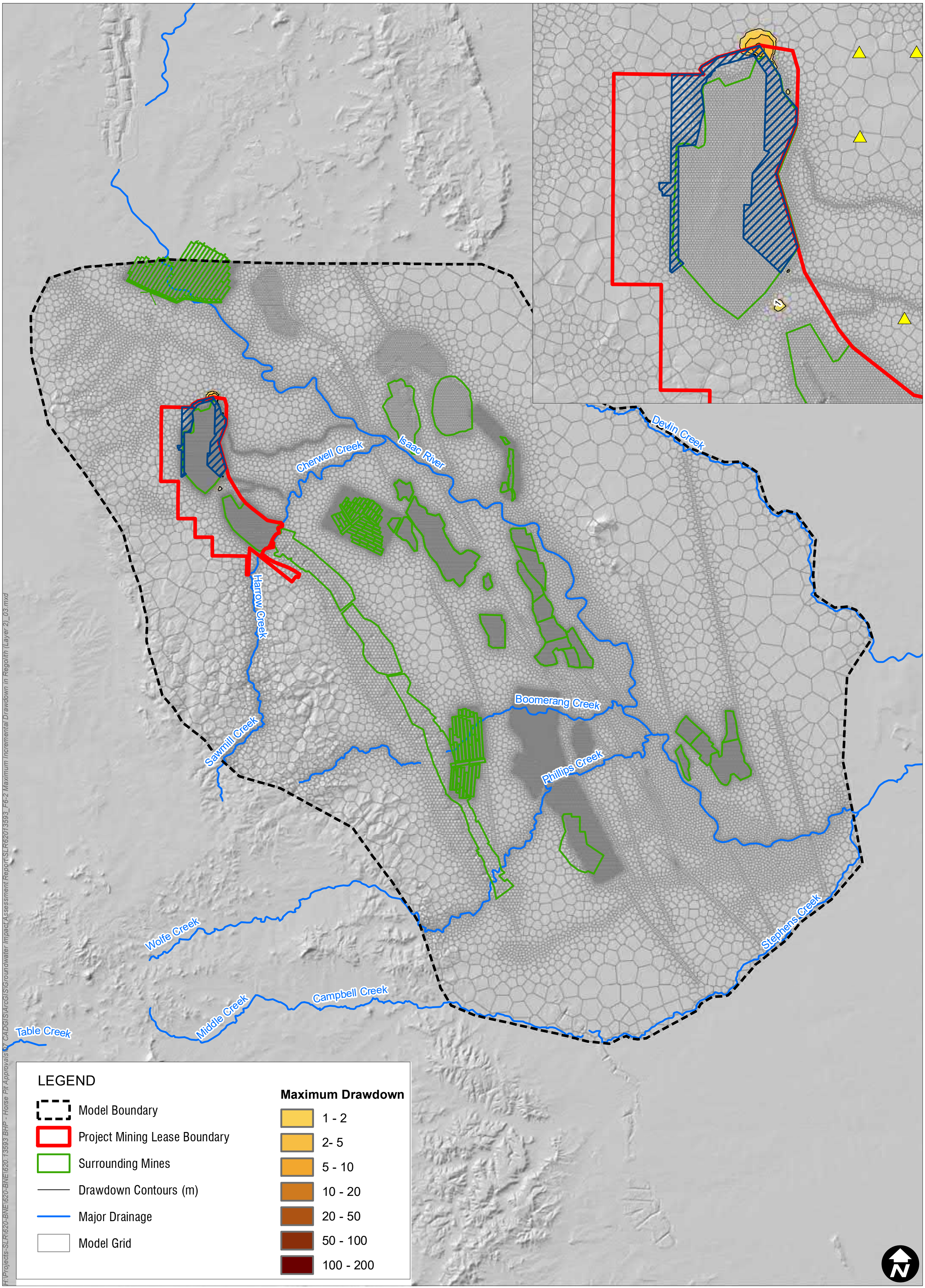
The process of mining reduces water levels in surrounding groundwater units due to interception of groundwater in the mined geology. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown. Aquifer drawdown is greatest at the working coal-face, and generally, gradually decreases with distance from the mining operations.

Maximum drawdown due to the Project is obtained by comparing the difference in groundwater levels for different aquifers in the Approved model run and the Cumulative model run. The maximum drawdown is a combination of the maximum drawdown values recorded at each model cell at any time over the duration of the predictive model. Figures showing predicted drawdowns feature the locations of privately-owned bores within the model domain. Discussion on the maximum predicted groundwater level drawdown at the privately-owned bores is included in **Section 7.2**. Predicted drawdown figures (**Figure 6-2** to **Figure 6-6**) show where maximum drawdown impacts are predicted to exceed 1 m. In areas within the 1 m drawdown contour, the unit is considered impacted by drawdown. Figures include the locations of known private bores intercepting the relevant layers if present. Note that no private bores are predicted to be impacted as a result of mining activities at the Project.

No drawdown impacts are predicted for the Quaternary alluvium as a result of the Project. This prediction is consistent with the GHD (2017) model where no water table drawdown was predicted due to mining at CVM.

The maximum predicted drawdown associated with the Project within the regolith is shown in **Figure 6-2**. The drawdown extent within the regolith (Layer 2) is largely confined to the Project Area, and is influenced by the distribution of predicted saturated zones in the regolith. At the northern end of the CVM mining lease, 1 m drawdown influence is predicted to extend up to 2.9 km north of the lease boundary in the regolith. Review of SDSG mapping shows that the predicted drawdown intercepts basalt deposits located to the north east of the Project Area. As shown in **Figure 6-2** no groundwater users are located within the predicted drawdown extent. In the vicinity of the Project Area there are therefore no known relevant potential receptors located within this zone.

The coal seams of the Moranbah Coal Measures are the primary groundwater bearing units intercepted by the Project, and will experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents. **Figure 6-3** to **Figure 6-6** show the maximum predicted incremental drawdown for Q, P, H and D seam in the Moranbah Coal Measures. The figures show the extent of maximum predicted depressurization of the Permian coal measures is limited to the west of the Project area due to the structural geology (i.e. coal seams subcrop and the units do not exist west of the subcrop). The extents of maximum predicted incremental drawdown in the Moranbah Coal Measures seams are between 10 to 12 km to the east and north east of the Project boundary. The cone of depression is predicted to be steepest at the working coal face. The predicted drawdown extents are consistent with the previous predictions by GHD (2017) for the CVM operations.



H:\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\7 CADGIS\ArcGIS\Groundwater Impact Assessment Report\SLR62013593_F6-2 Maximum Incremental Drawdown in Regolith (Layer 2)_03.mxd

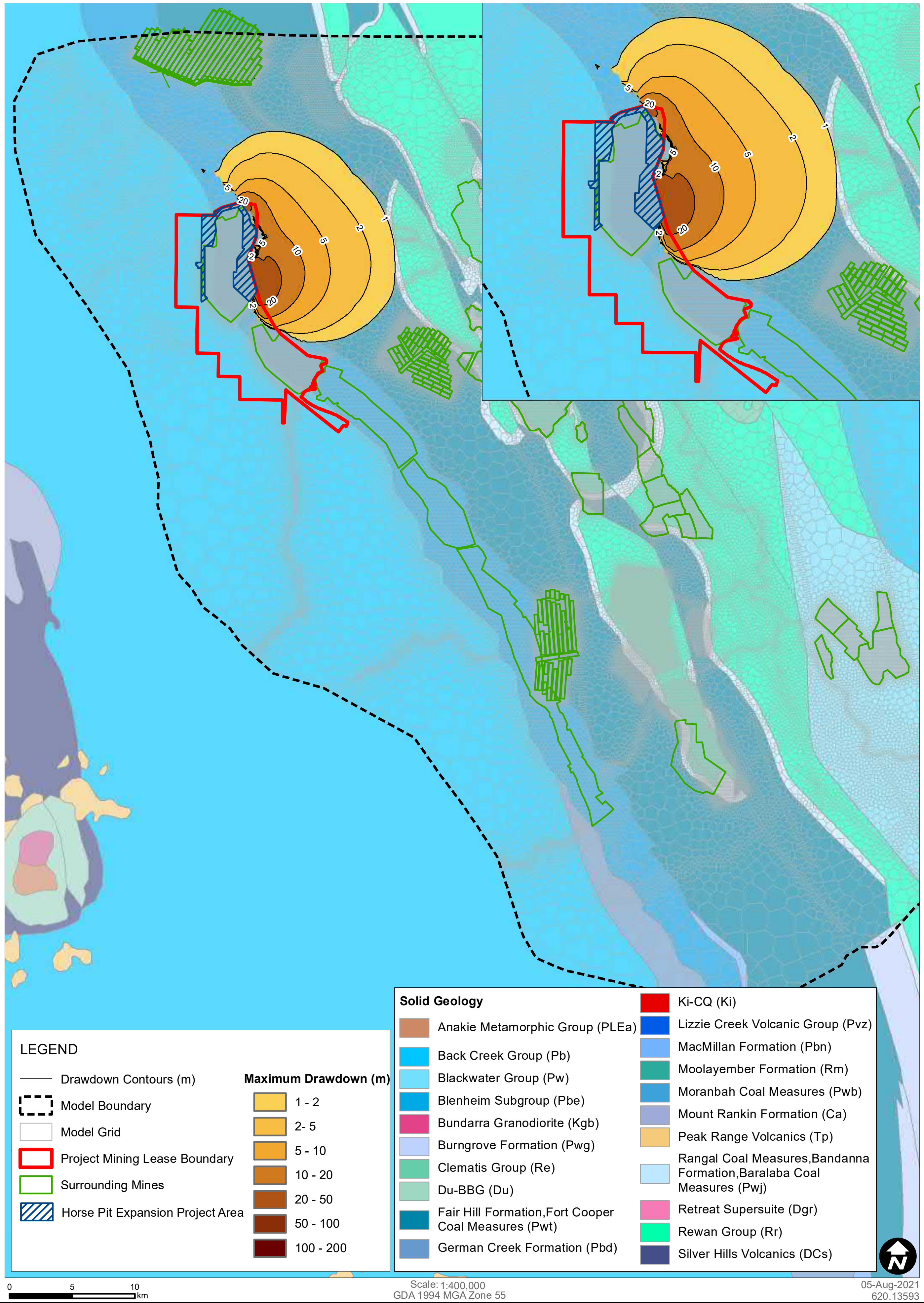
Scale 1:500,000
GDA 1994 MGA Zone 55

25-Aug-2021
620.13593

SLR

Maximum Incremental Drawdown in Regolith (Layer 2)

FIGURE 6-2



Scale: 1:400,000
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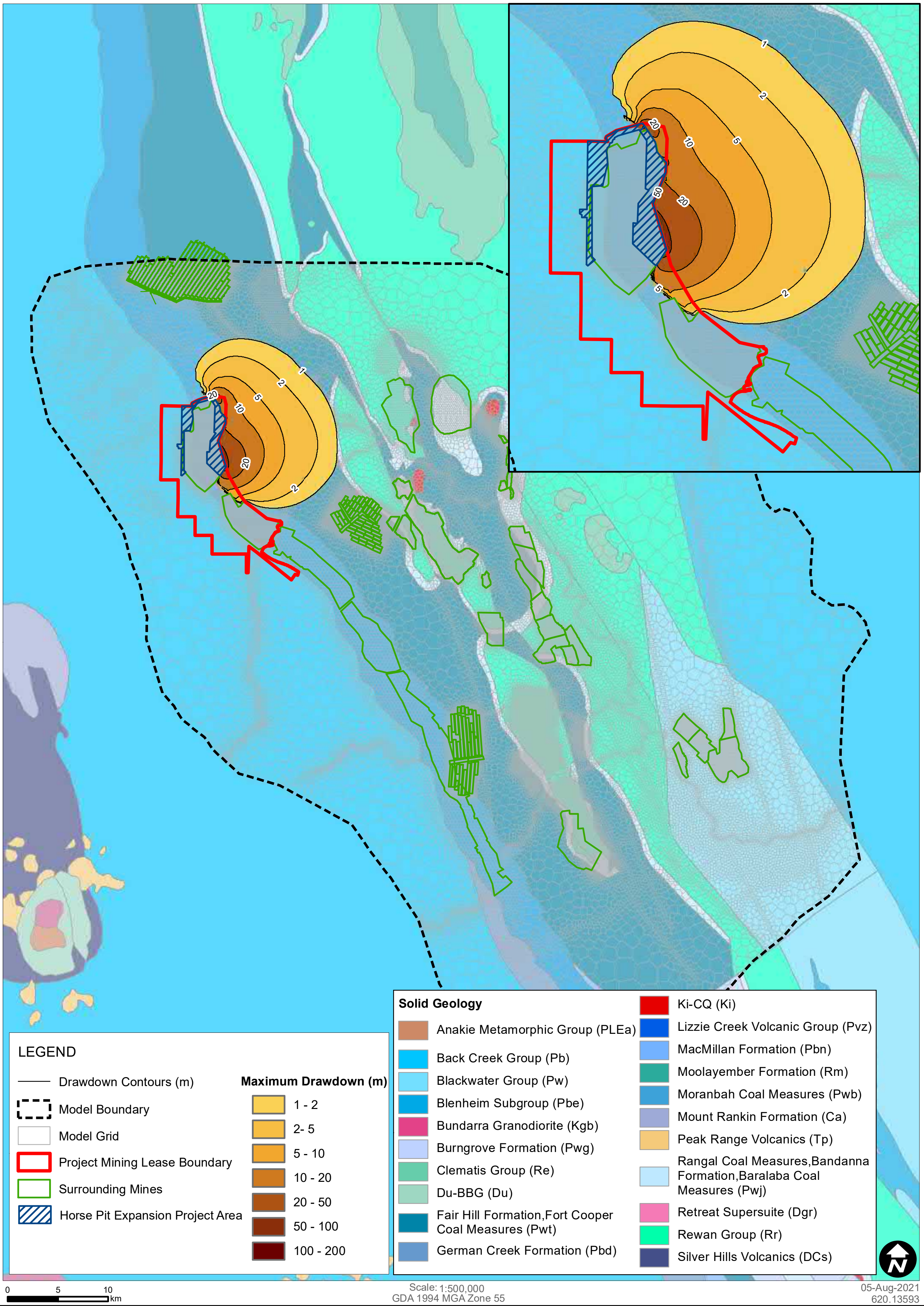
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Impact Assessment Report\SLR62013593_F6-3 Maximum Incremental Drawdown in Q Seam (Layer 12).mxd

SLR

Maximum Incremental Drawdown in Q Seam (Layer 12)

FIGURE 6-3



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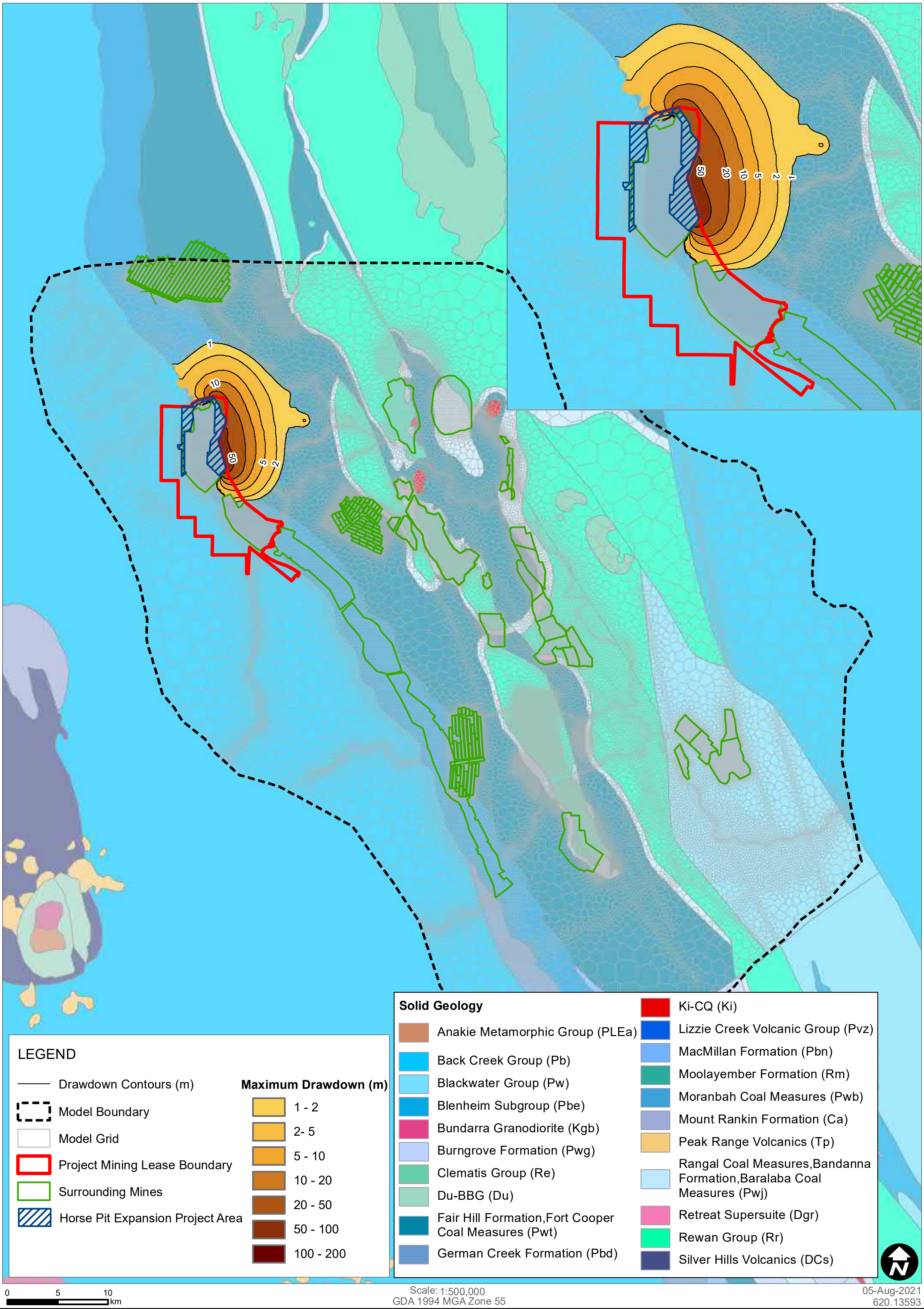
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Impact Assessment Report\SLR62013593_F6-4 Maximum Incremental Drawdown in P Seam (Layer 14).mxd

SLR

Maximum Incremental Drawdown in P Seam (Layer 14)

FIGURE 6-4



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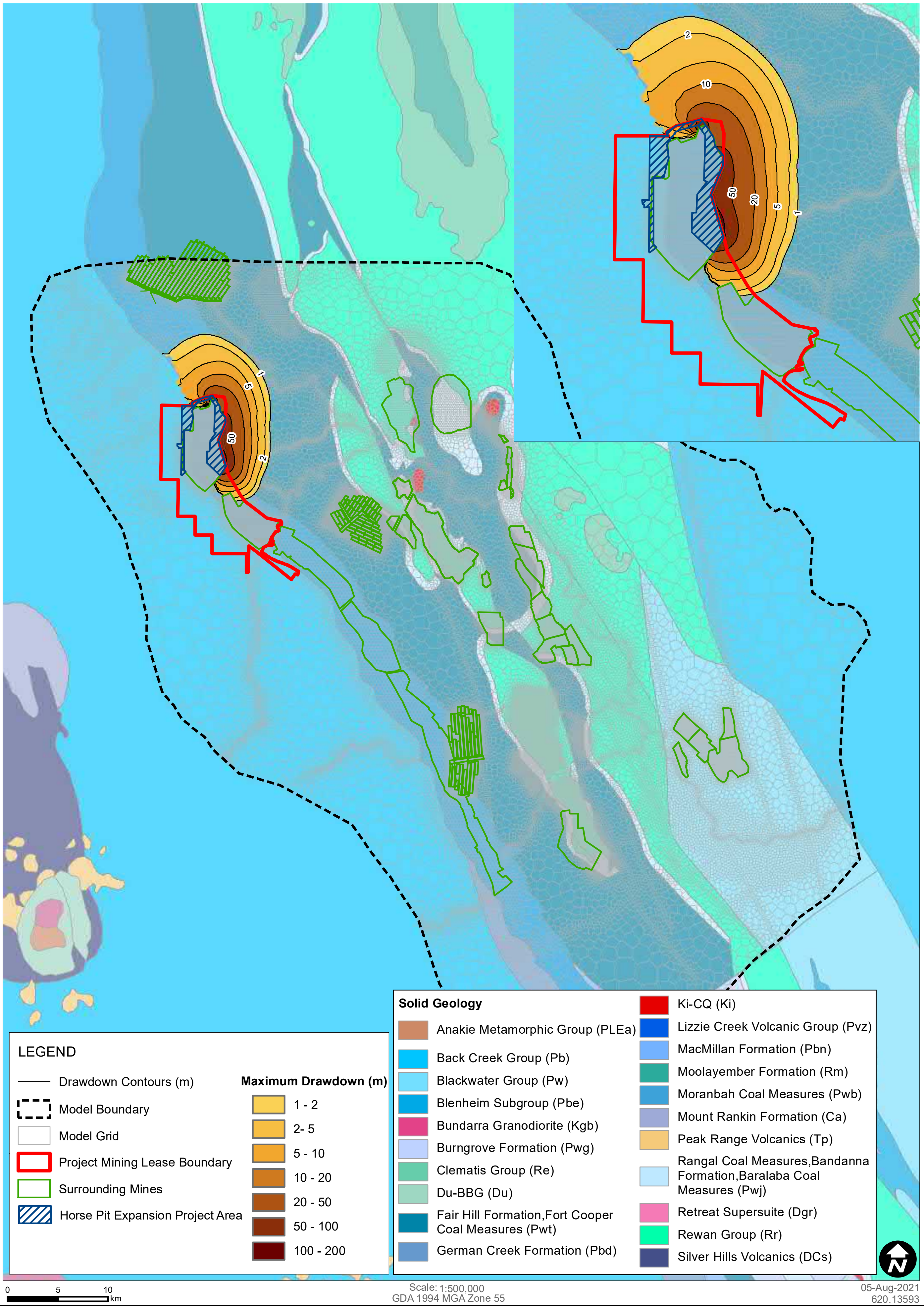
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Impact Assessment Report\SLR62013593_F6-5 Maximum Incremental Drawdown in H Seam (Layer 16).mxd

Maximum Incremental Drawdown in H Seam (Layer 16)

FIGURE 6-5



SLR

Maximum Incremental Drawdown in D Seam (Layer 18)

FIGURE 6-6

6.4 Incidental Water Impacts

6.4.1 Influence on Alluvium

As discussed previously, there would be no direct interception of the alluvium, including that associated with the Isaac River, by the proposed open cut pit for the Project (refer **Section 6.2**). Any predicted interference of alluvial groundwater therefore largely relates to the potential for increased leakage from the alluvium to the underlying Permian coal measures that are depressurised as a result of the Project. Over the extent of Quaternary alluvium, model predictions show that there is zero predicted loss of water from the alluvium as a result of exercising the underground water rights for the Project (see **Section 3.6.1** of **Appendix B**). That is, there is no predicted direct or indirect interference with alluvial groundwater as a result of the Project.

6.4.2 Influence on Baseflow

The predicted change in water levels induced by mining could increase the hydraulic gradient between the Isaac River itself and the underlying alluvium. As outlined within the conceptual model (**Section 5.7**), the Isaac River is largely a losing system in the Study Area, with seepage of surface water into the underlying alluvium. The model predicts that over the life of mine, the change in the average rate of seepage from the River to the alluvium is insignificant and considered within the error threshold of model predictions (less than 3.65 ML/year).

The Isaac River is ephemeral in nature, with flows following rainfall events that generate runoff. On average, when the Isaac River flows, 161,863 ML/year of surface water is discharged downstream. An estimate of less than 0.01% increased seepage from the Isaac River to the alluvium as a result of mining at the Project, therefore, represents an insignificant potential for flow rate reduction. The number of days that the Isaac River runs dry is not predicted to increase with the addition of the Project.

Harrow Creek and Cherwell Creek located within the within the vicinity of the Project Area are both set up in the model with a stage height of 0.0 m which means they are simulated as potentially gaining systems (i.e., negative net flow). Comparing the river flow budgets for Harrow Creek and Cherwell Creek in the Cumulative against the Approved Case indicates no change in the net flow in these two creeks due to the Project.

6.5 Cumulative Impacts

Cumulative impacts associated with approved and foreseeable open cut and underground coal mines surrounding the Project were modelled in accordance with IESC requirements (refer **Table 2-1**). The simulated cumulative drawdown predictions presented in this section show the impacts on different aquifers due to the existing approved works and entitlements within the model domain. The simulated cumulative drawdown predictions also shows whether the zone of impact from the approved neighbouring operations is predicted to interact with the zone of impact from the Project in the different aquifers.

Together with all approved and proposed CVM mining, the surrounding mines included within the model are the Olive Downs Project (Olive Downs South and Willunga), Moorvale South Project, Poitrel Mine, Daunia Mine, Peak Downs Mine, Grosvenor Mine, Lake Vermont Mine, Eagle Downs Mine, Saraji Mine, Saraji East Project and the Winchester South Project. The vast majority of the predicted cumulative drawdown impacts are not related to the Project but result from these other existing and approved mining activities represented in the model.

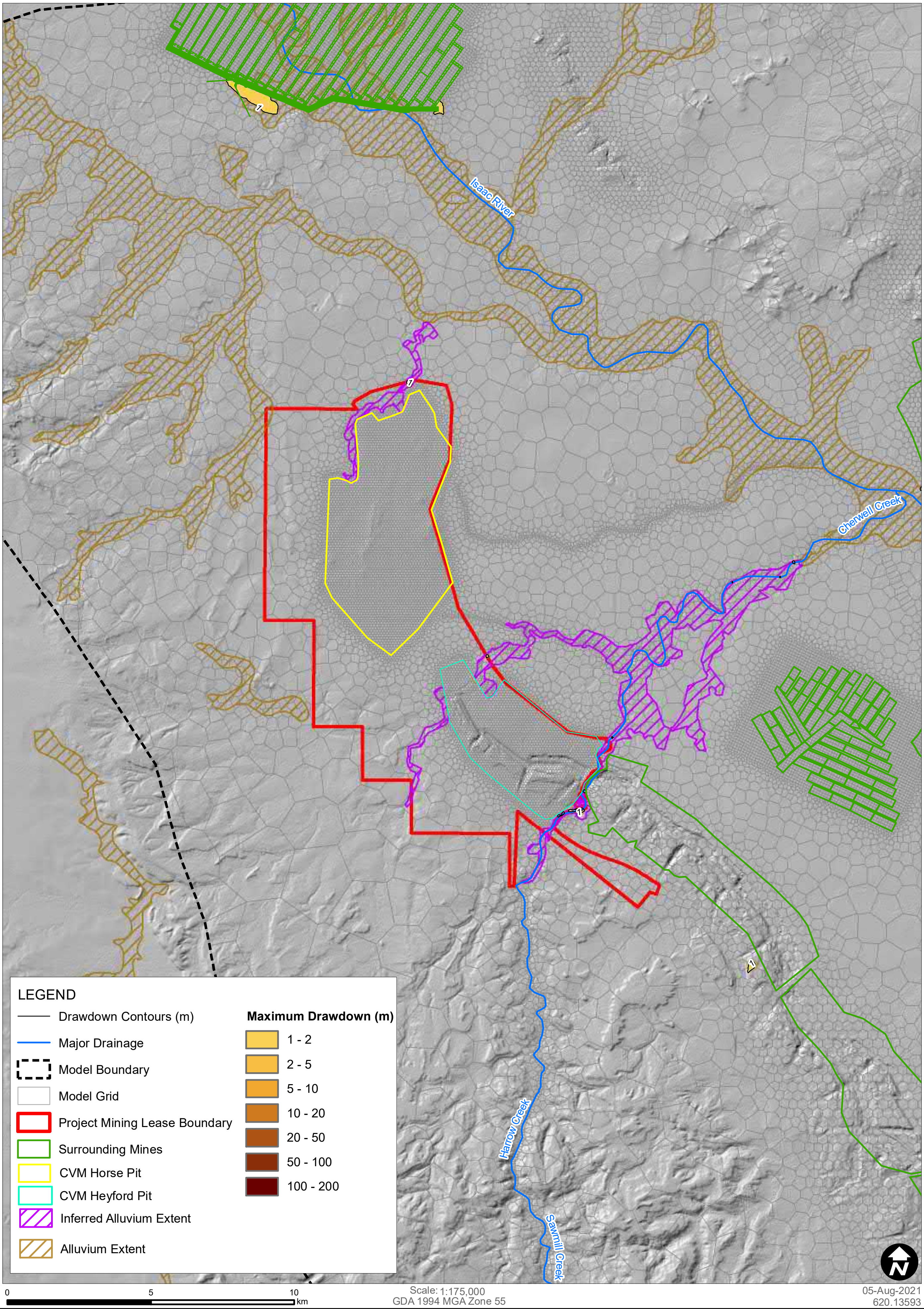
Maximum Cumulative drawdown impact predictions are shown in **Figure 6-7** through **Figure 6-14**. These drawdowns represent the total impact of mining to model groundwater levels by comparing the maximum difference in aquifer groundwater levels for the Cumulative model scenario with those in a theoretical "No Mining" or Null Run scenario, for all times during the predictive model period.

There are no cumulative drawdown impacts predicted for the Quaternary alluvium within or around the CVM area (**Figure 6-7**). Maximum predicted cumulative drawdown impacts are predicted within the extents of the Isaac River alluvium in the south of the model domain near the Olive Downs South operations, more than 32 km south east from the Project.

Cumulative impacts within the regolith can be seen connecting the Project-related drawdown to drawdown impacts at Peak Downs, south of the Project (**Figure 6-8**). For the Leichhardt and Vermont coal seams, there is no drawdown interaction between the Project and the neighbouring mines that target the Rangal Coal Measures which are not present at the CVM area (**Figure 6-9** and **Figure 6-10**).

Figure 6-11 to **Figure 6-14** show the maximum predicted cumulative drawdown in the Q, P, H and D seams of the Moranbah Coal Measures. As shown in the figures Project cumulative drawdown is predicted to interact with the zone of impact from the Peak Downs open pits, Saraji open cut, Eagle Downs and Grosvenor underground operations. The extents of maximum predicted cumulative drawdown in the Moranbah Coal Measures coal seams are approximately 13 km to the east and 10 km to the north of the Project.

Assessment of cumulative impacts associated with the approved Bowen Gas Project was undertaken as a sensitivity analysis for the Olive Downs Project numerical groundwater model (HydroSimulations, 2018) (**Figure 6-15**). The Bowen Gas Project targets coal seams within the Rangal Coal Measures and Moranbah Coal Measures. As the Project shares much the same Study Area as the Olive Downs Project, results from the Olive Downs Project sensitivity analysis are equally applicable to the Project. Results of the assessment were presented in HydroSimulations (2018) and indicate that the assessment of cumulative impacts in the model is sensitive to the inclusion of the Bowen Gas Project, with cumulative drawdown extents in the Rangal Coal Measures extending significantly to the east across the model domain with the inclusion CSG extraction. Cumulative drawdown extents from the Bowen Gas Project are considered conservative and were predicted to be greater than the impacts produced by the Olive Downs Project alone (HydroSimulations, 2018).



Scale: 1:175,000
GDA 1994 MGA Zone 55

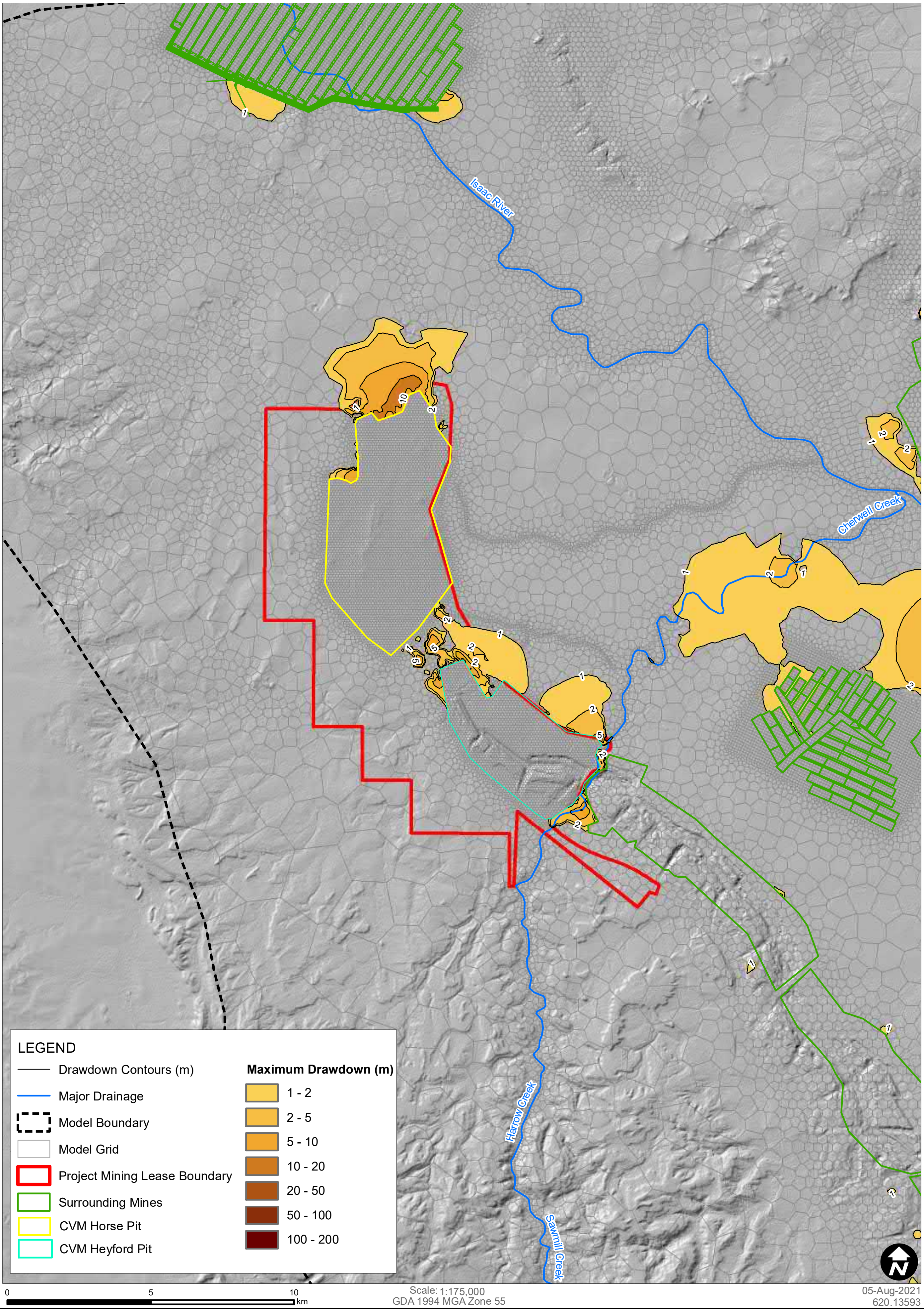
05-Aug-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Impact Assessment Report\SLR62013593_F6-7 Maximum Cumulative Drawdown in Quaternary Alluvium (Layer 1)_02.mxd

SLR

Maximum Cumulative Drawdown in Quaternary Alluvium (Layer 1)

FIGURE 6-7



Scale: 1:175,000
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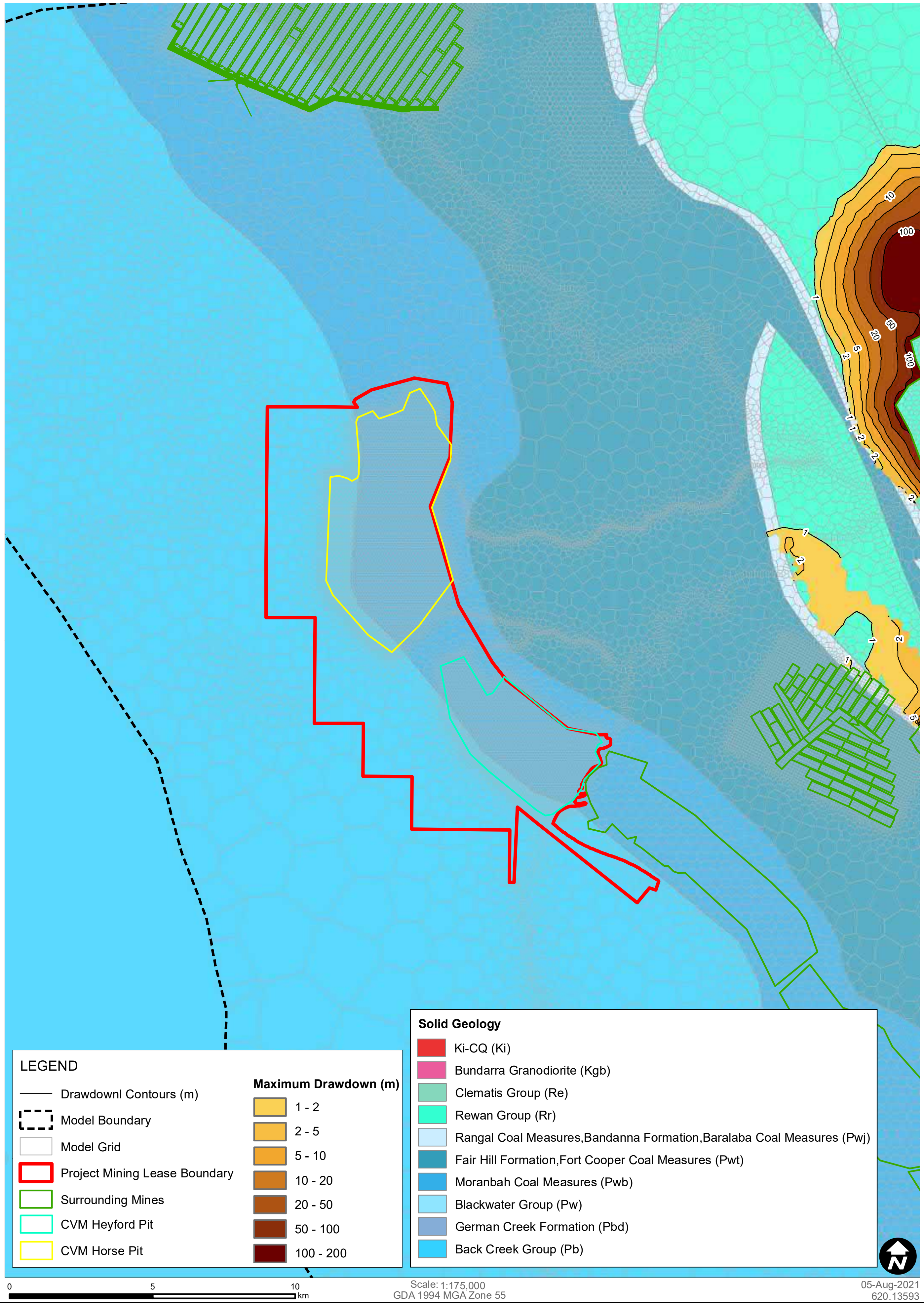
SLR

Maximum Cumulative Drawdown in Regolith (Layer 2)

FIGURE 6-8



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Scale: 1:175,000
GDA 1994 MGA Zone 55

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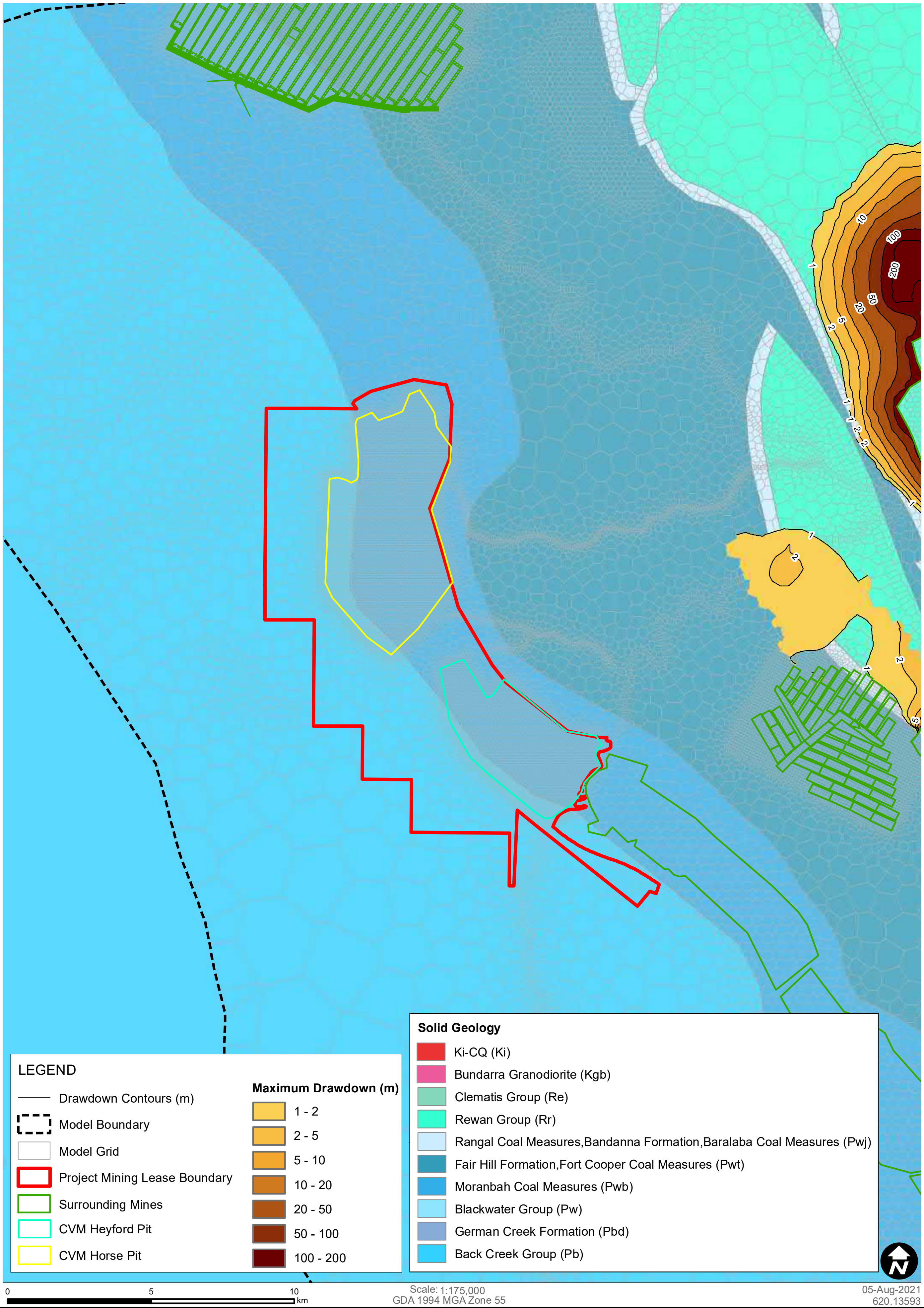
SLR

Maximum Cumulative Drawdown in Leichhardt Seam (Layer 5)

FIGURE 6-9

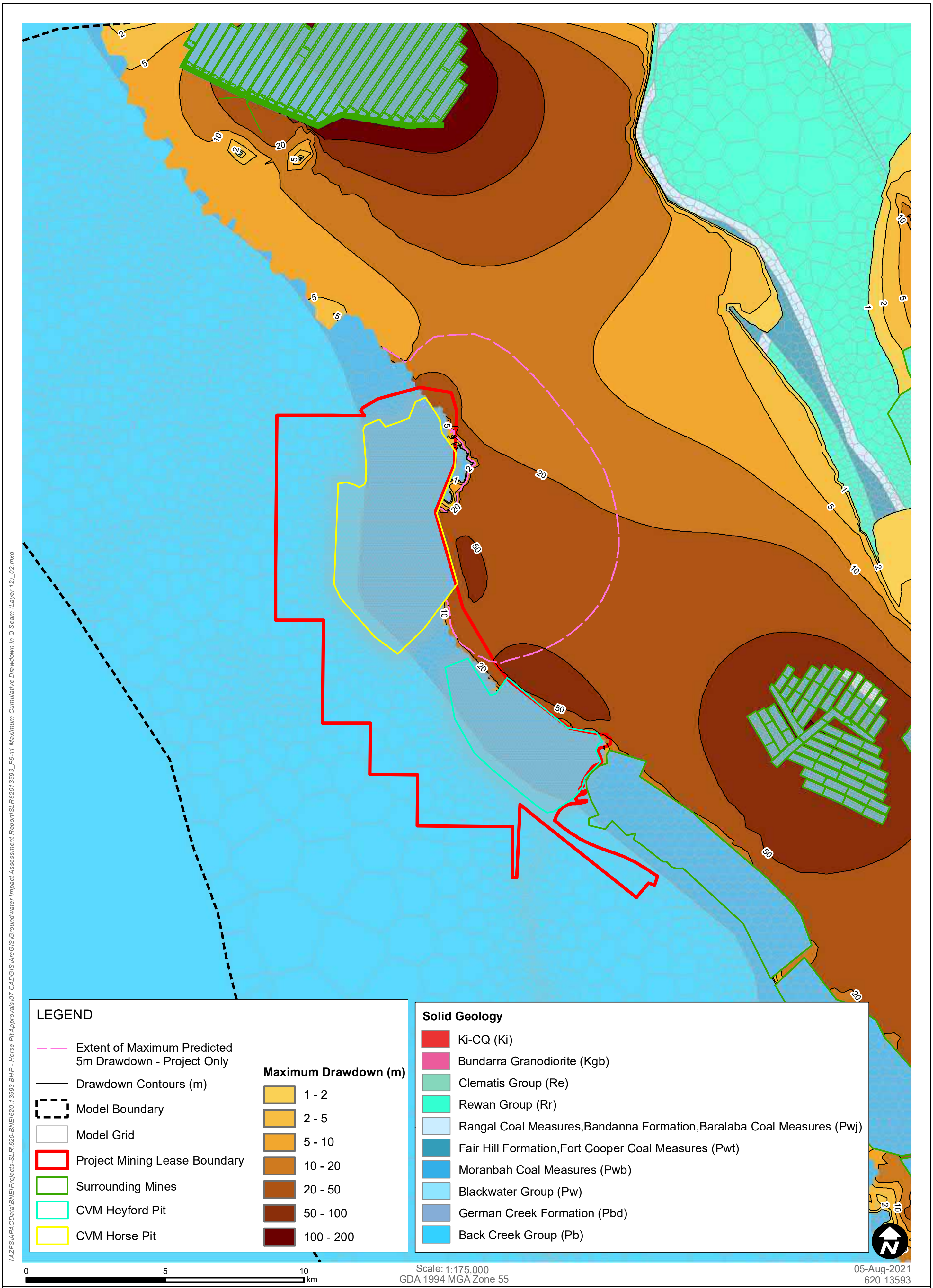


H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Impact Assessment Report\SLR62013593_F6-10 Maximum Cumulative Drawdown in Vermont Seam (Layer 7)_02.mxd

SLR

Maximum Cumulative Drawdown in Vermont Seam (Layer 7)

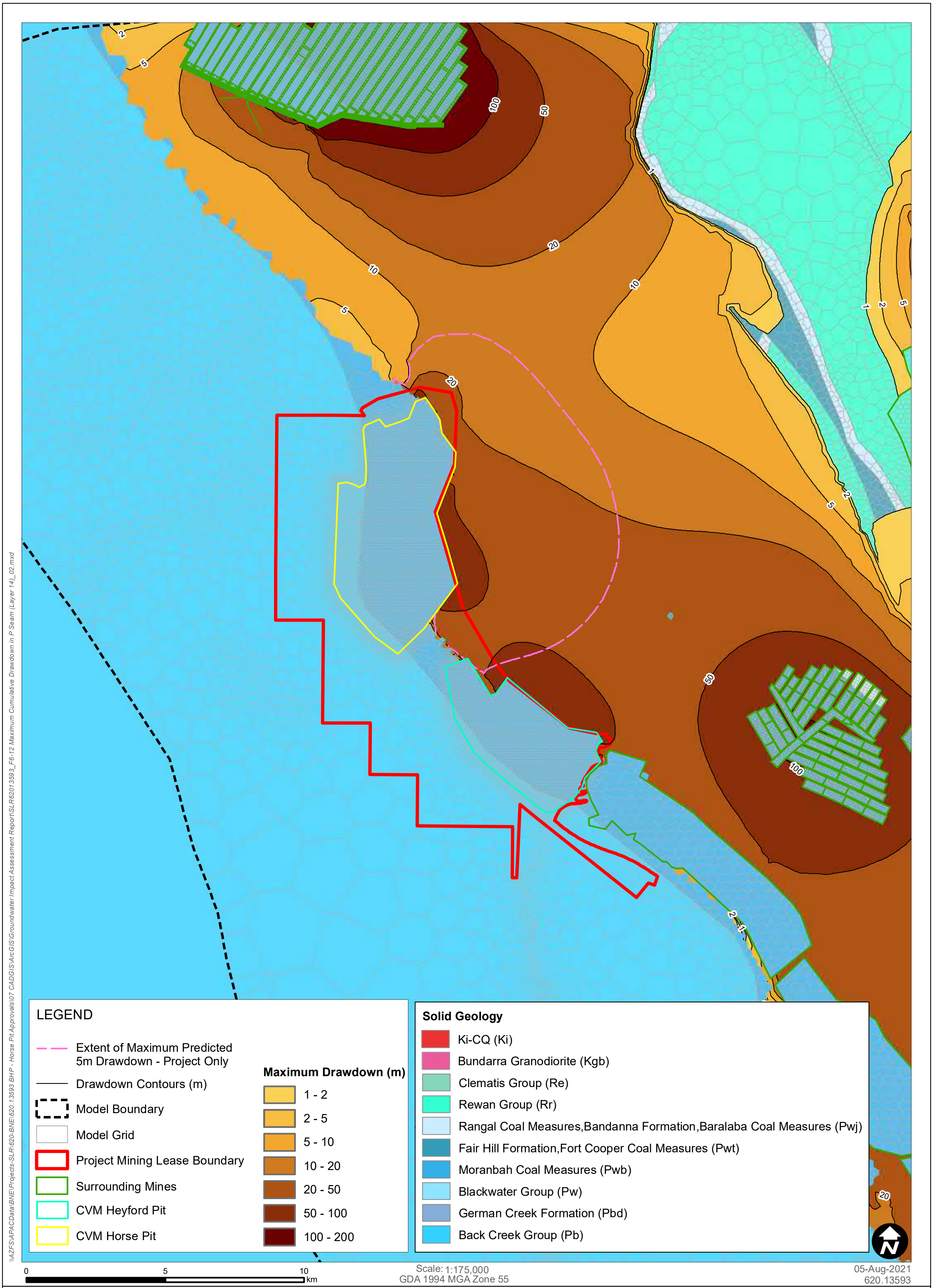
FIGURE 6-10



SLR

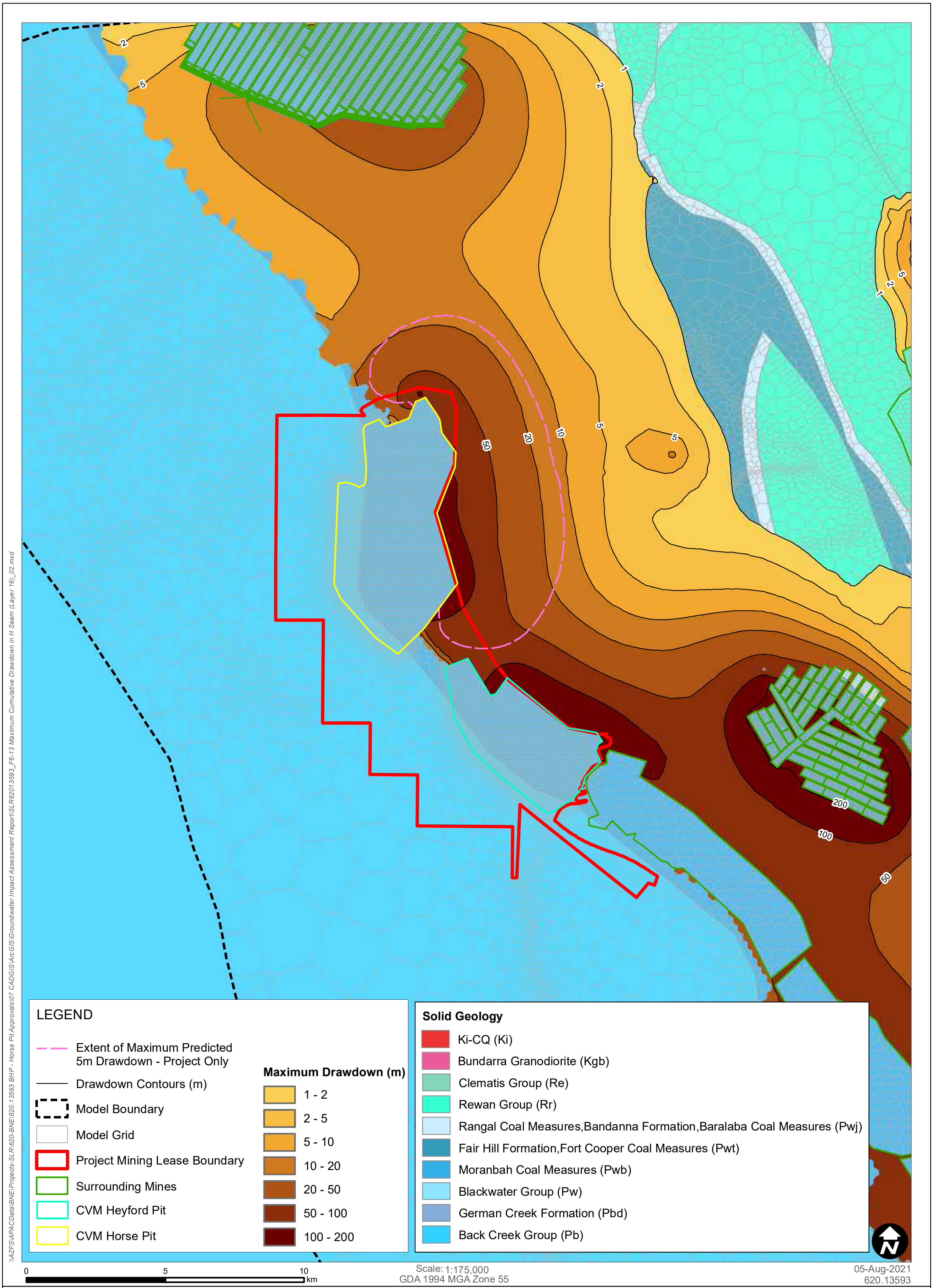
Maximum Cumulative Drawdown in Q Seam (Layer 12)

FIGURE 6-11



Maximum Cumulative Drawdown in P Seam (Layer 14)

FIGURE 6-12

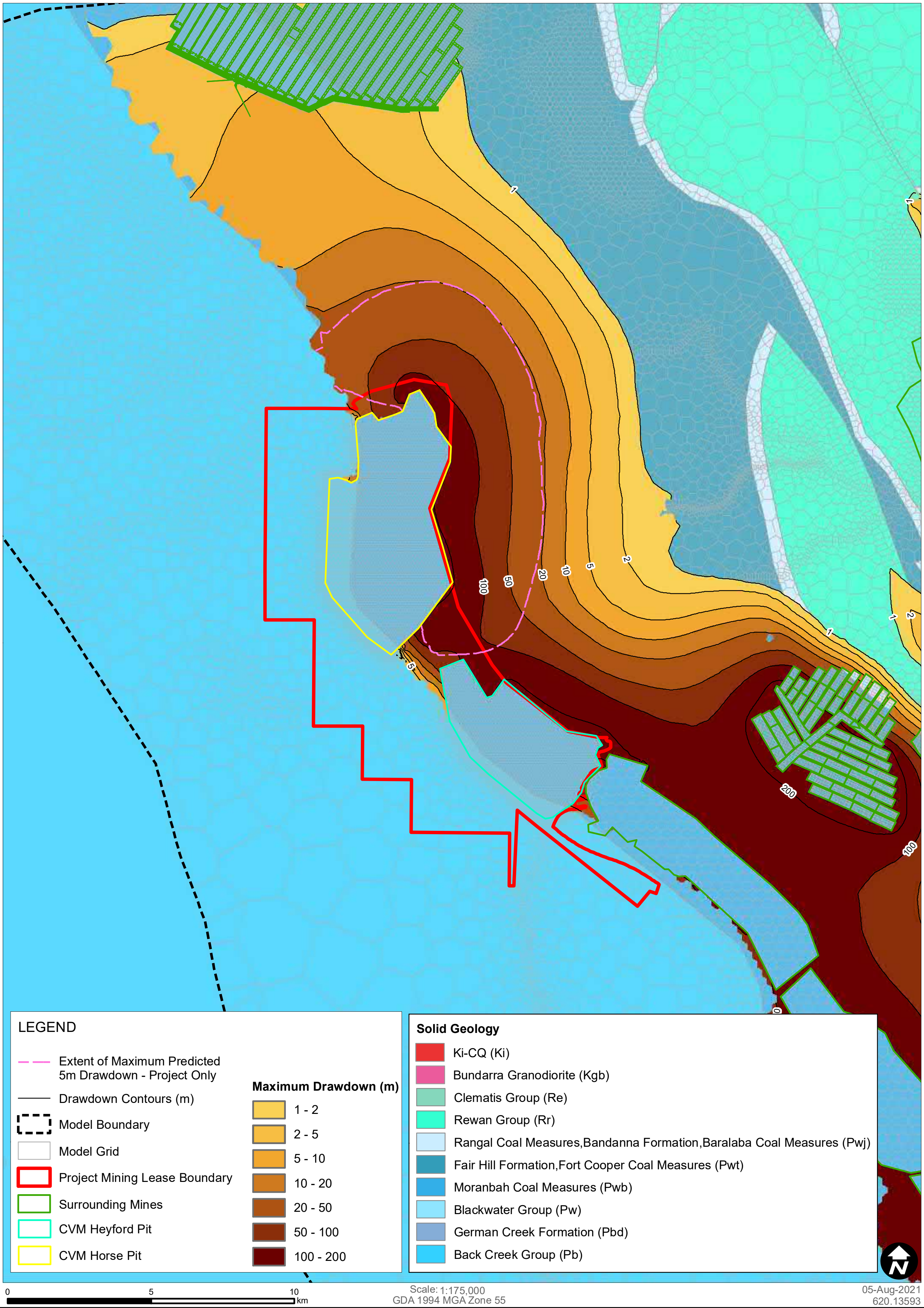


\\AZFS\APACData\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Impact Assessment Report\SLR62013593_F6-13 Maximum Cumulative Drawdown in H Seam (Layer 16)_02.mxd

SLR

Maximum Cumulative Drawdown in H Seam (Layer 16)

FIGURE 6-13



Scale: 1:175,000
GDA 1994 MGA Zone 55

05-Aug-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Impact Assessment Report\SLR62013593_F6-14 Maximum Cumulative Drawdown in D Seam (Layer 18)_02.mxd

SLR

Maximum Cumulative Drawdown in D Seam (Layer 18)

FIGURE 6-14

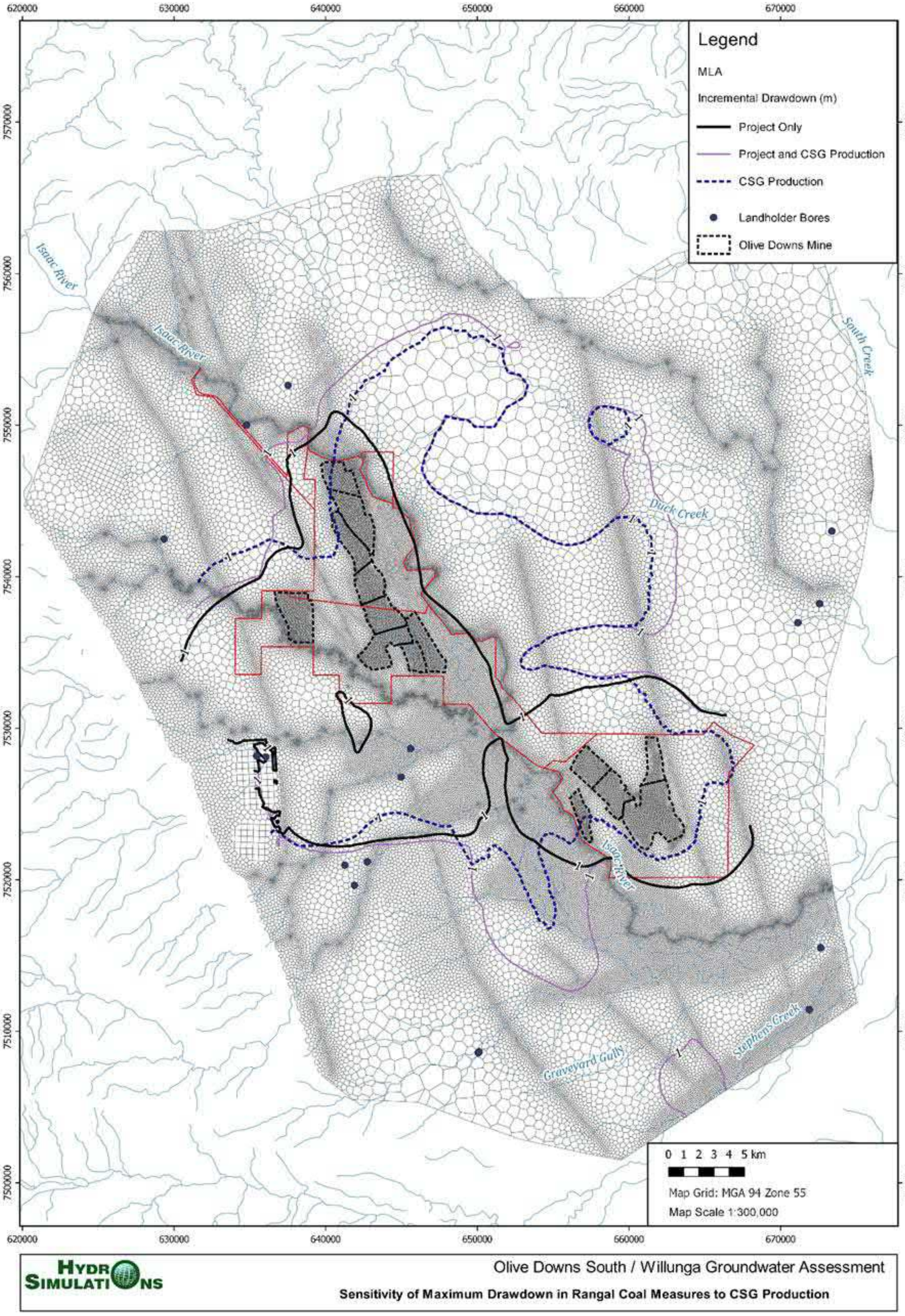


Figure 6-15 Sensitivity of Maximum Drawdown in Rangal Coal Measures to CSG Production (HydroSimulations, 2018)

6.6 Post-Mining Equilibrium

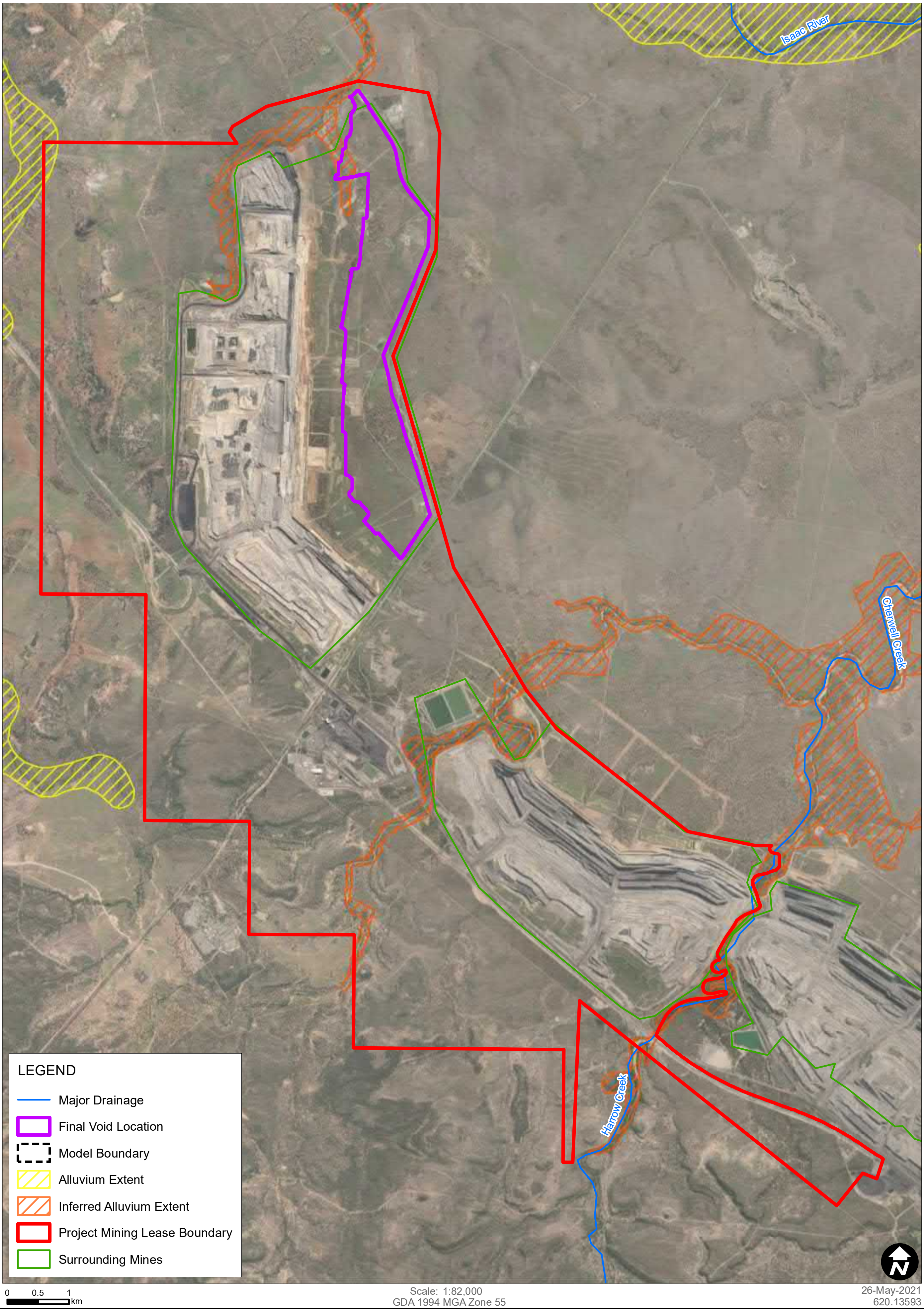
Post-mining impacts were investigated with a Project recovery model, commencing from the end of mining at the Project and simulations were run for 200 years. The model used post-mining predicted groundwater levels as the starting heads, and removed all drain cells simulating the proposed mining area to allow groundwater levels to equilibrate. At the end of mining, the properties of the final void cells were converted to values representative of void values. The location of the final void for the Project is shown on **Figure 6-16**.

The final void will accumulate water over time due to rainfall and inflows from recovered groundwater levels. The equilibrated final void water level was determined by the balance between the direct rainfall, and rainfall runoff from the surrounding catchment against the evaporation loss from the lake surface. This was achieved through surface water balance modelling conducted by SLR (2021). A time variant constant head boundary condition was then used to implement the predicted final void water level at equilibrium obtained from the final void water balance model into the groundwater recovery model. This recovery model was then re-run for 200 years to maintain consistency with the Surface Water and Flooding Assessment prepared for the Project (SLR, 2021).

Figure 6-17 illustrates the predicted recovery of water levels in the Project final void. The graph shows that the void water level recovery is a slow process with the recovery rate declining as it reaches equilibrium conditions. The long-term equilibrated water level in the final void achieved after 142 years would be about 120 mAHD. Freeboard, i.e. the difference in elevation between the long-term equilibrated water level in the final void (above) and the surrounding crest elevation, is approximately 100 m.

The long-term equilibrated water levels predicted as part of the numerical groundwater modelling is generally consistent with the results of the final void modelling undertaken for the Surface Water and Flooding Assessment (SLR, 2021).

The predicted equilibrium water levels (at 200 years) for the Quaternary alluvium (Layer 1), the regolith (Layer 2) and the Q Seam, P Seam, H Seam and D Seam of the Moranbah Coal Measures (Layer 12, 14, 16 and 18 respectively) are shown in **Figure 6-18** through to **Figure 6-23**. Groundwater levels around the Project final void range from approximately 125 mAHD in the H Seam and D Seam, to 215 mAHD in the regolith. This range is above the predicted lake water levels in the void of 120 mAHD, indicating that the void is predicted to behave as a groundwater sink with an inwards hydraulic gradient from all surrounding aquifers, and therefore unlikely to impact on water quality within the surrounding strata.



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GDA 1994 MGA Zone 55

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SLR

Final Void Location

FIGURE 6-16

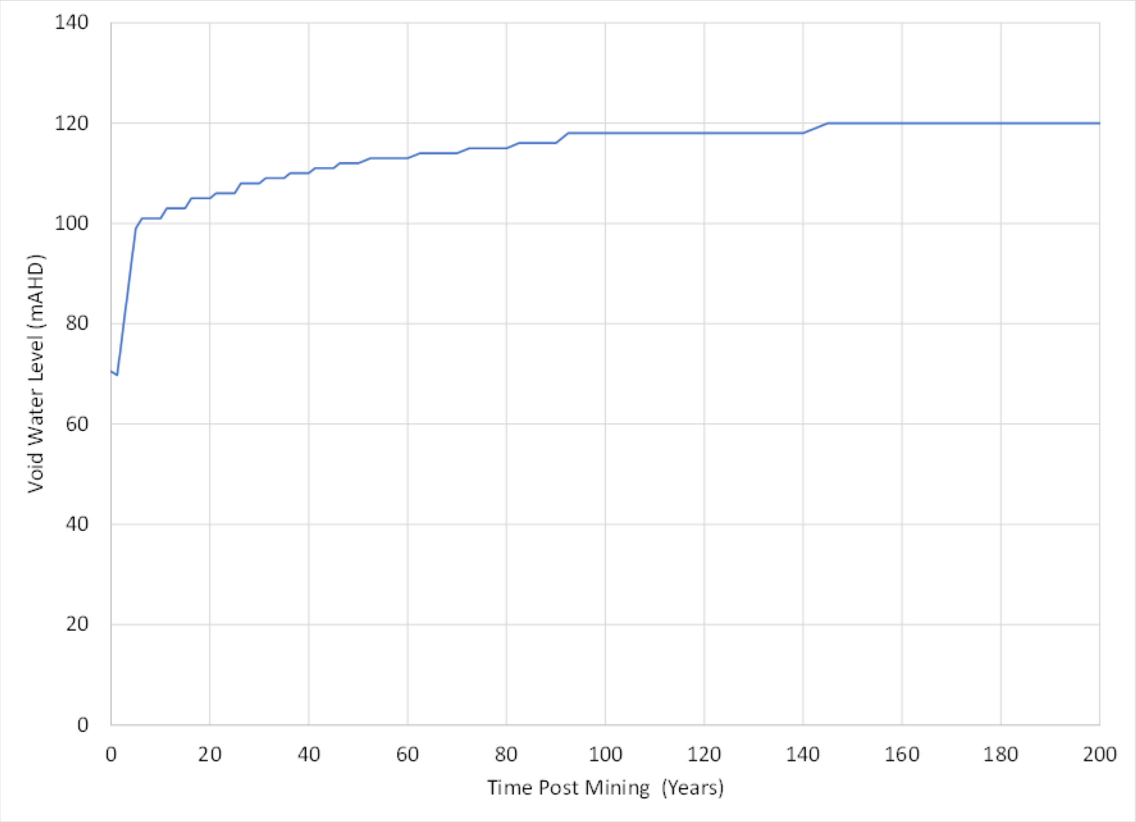
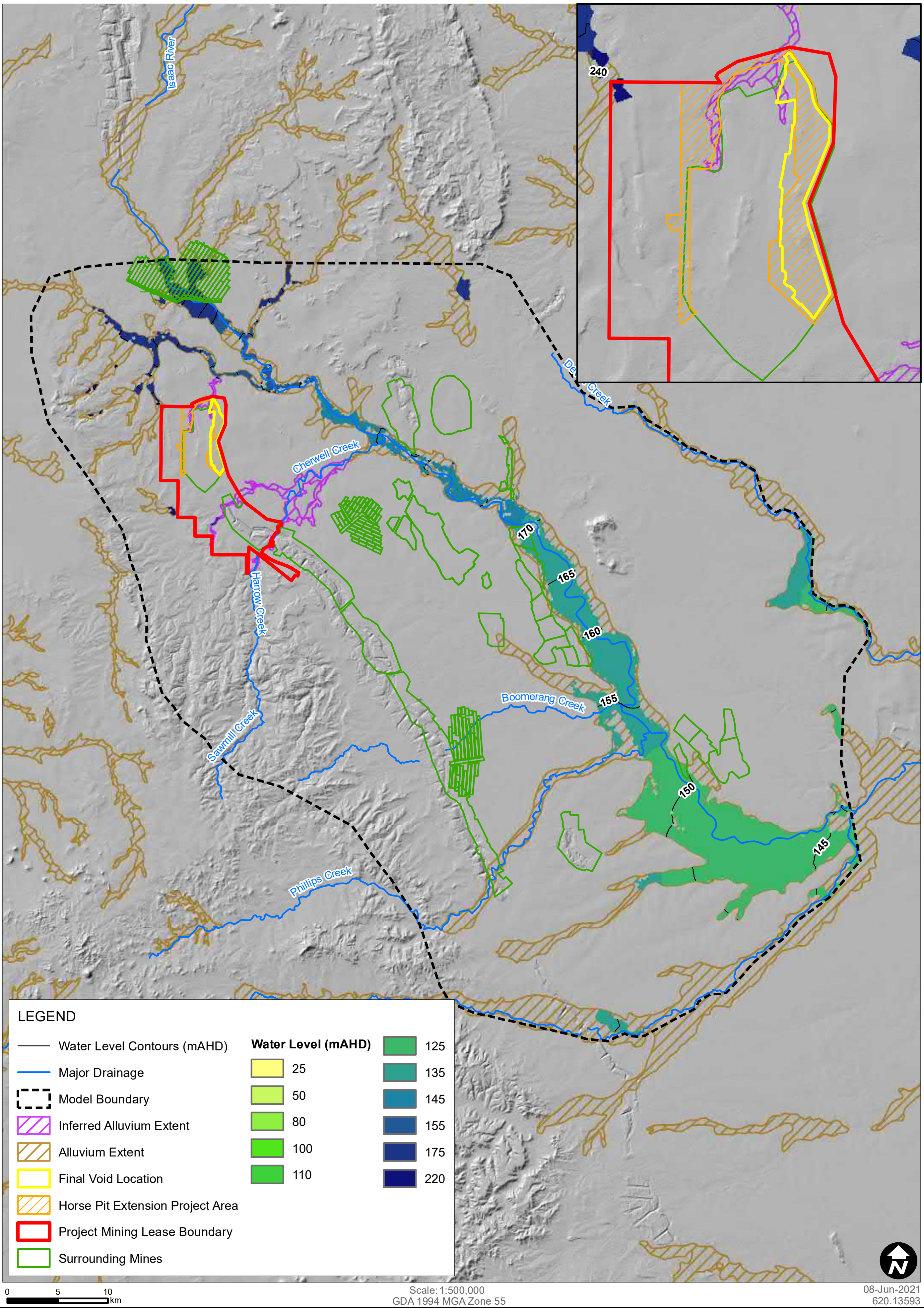


Figure 6-17 Project Final Void Water Level Recovery over Time



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GDA 1994 MGA Zone 55

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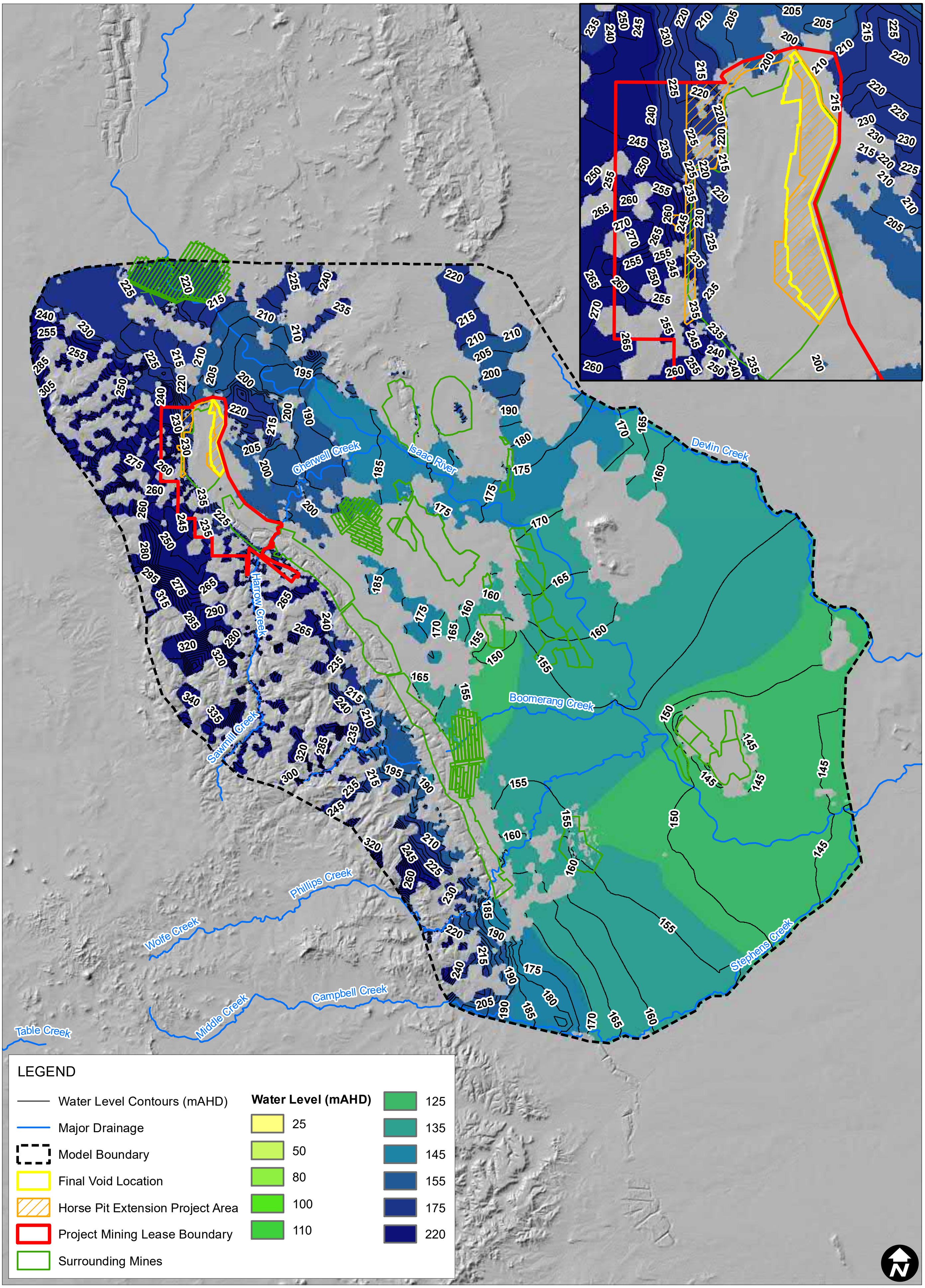
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Impact Assessment Report\62013593 F 6-18 Predicted Groundwater Levels in Alluvium (Layer 1) – Post Mining Equilibrium.mxd

SLR

**Predicted Groundwater Levels in Alluvium (Layer 1) –
Post Mining Equilibrium**

FIGURE 6-18



0 5 10 km

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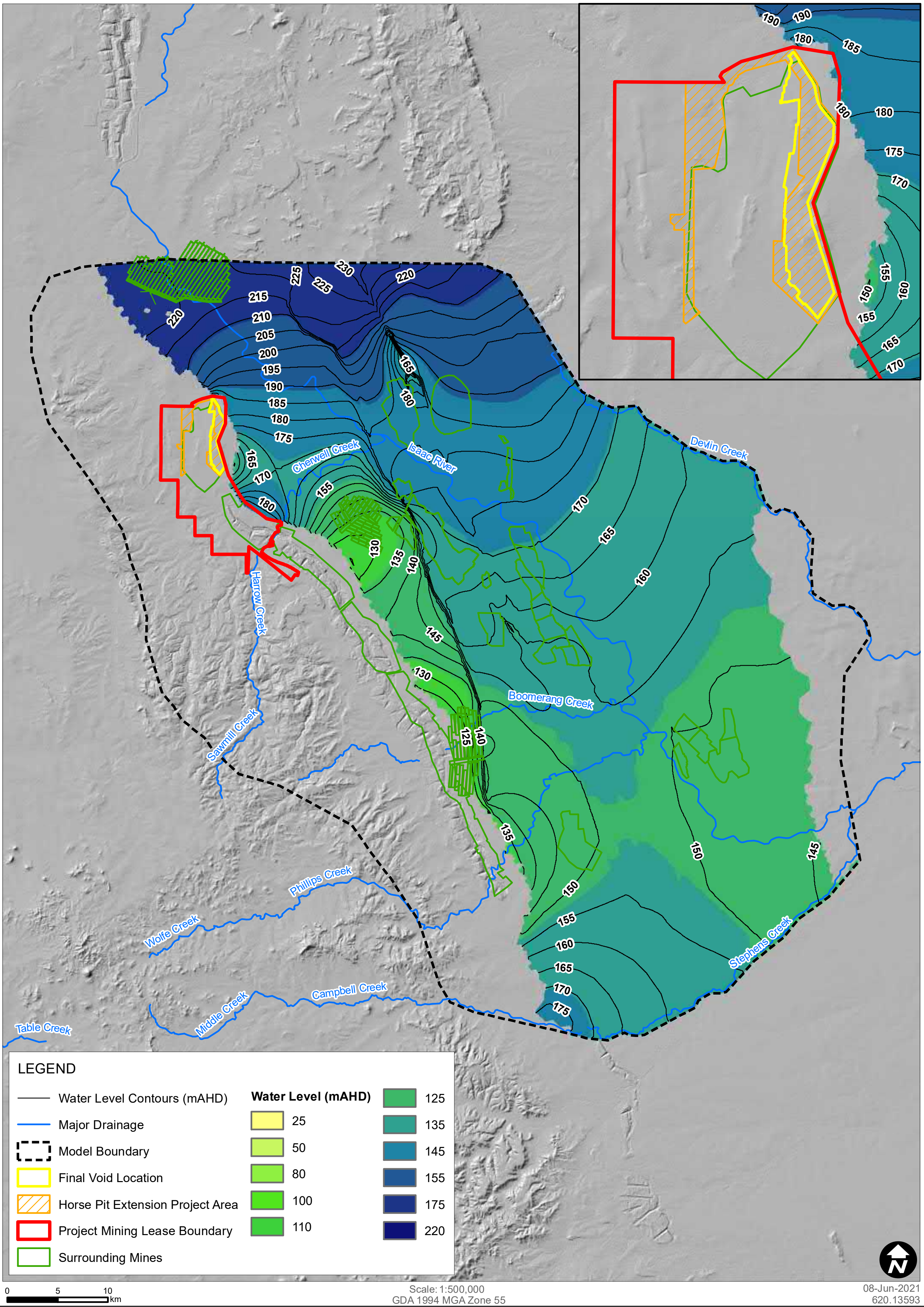
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Impact Assessment Report\62013593 F 6-19 Predicted Groundwater Levels in Regolith (Layer 2) – Post Mining Equilibrium.mxd

Predicted Groundwater Levels in Regolith (Layer 2) – Post Mining Equilibrium

FIGURE 6-19



Scale: 1:500,000
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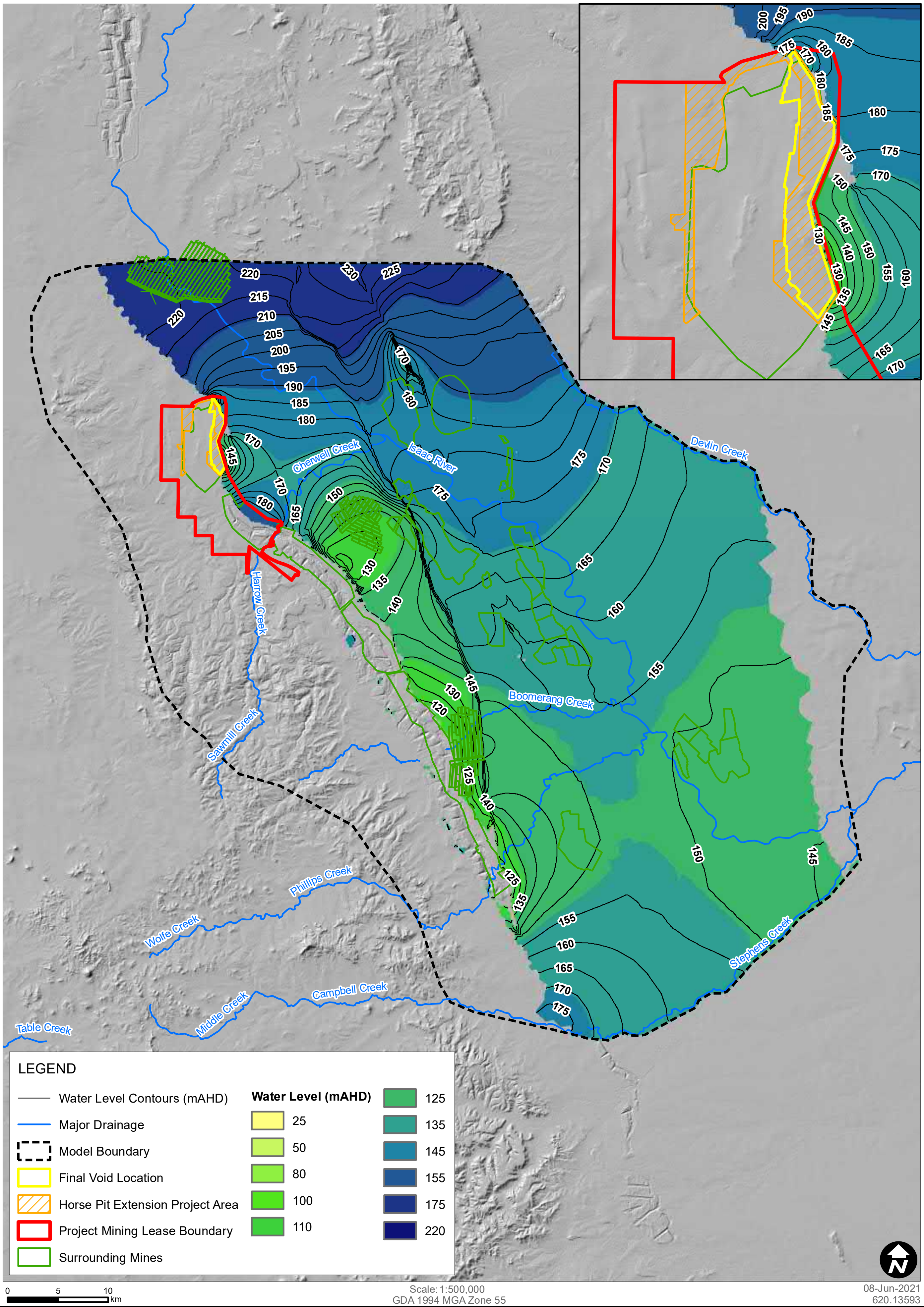
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Impact Assessment Report\62013593 F 6-20 Predicted Groundwater Levels in Q Seam (Layer 12) – Post Mining Equilibrium.mxd

SLR

Predicted Groundwater Levels in Q Seam (Layer 12) – Post Mining Equilibrium

FIGURE 6-20



Scale: 1:500,000
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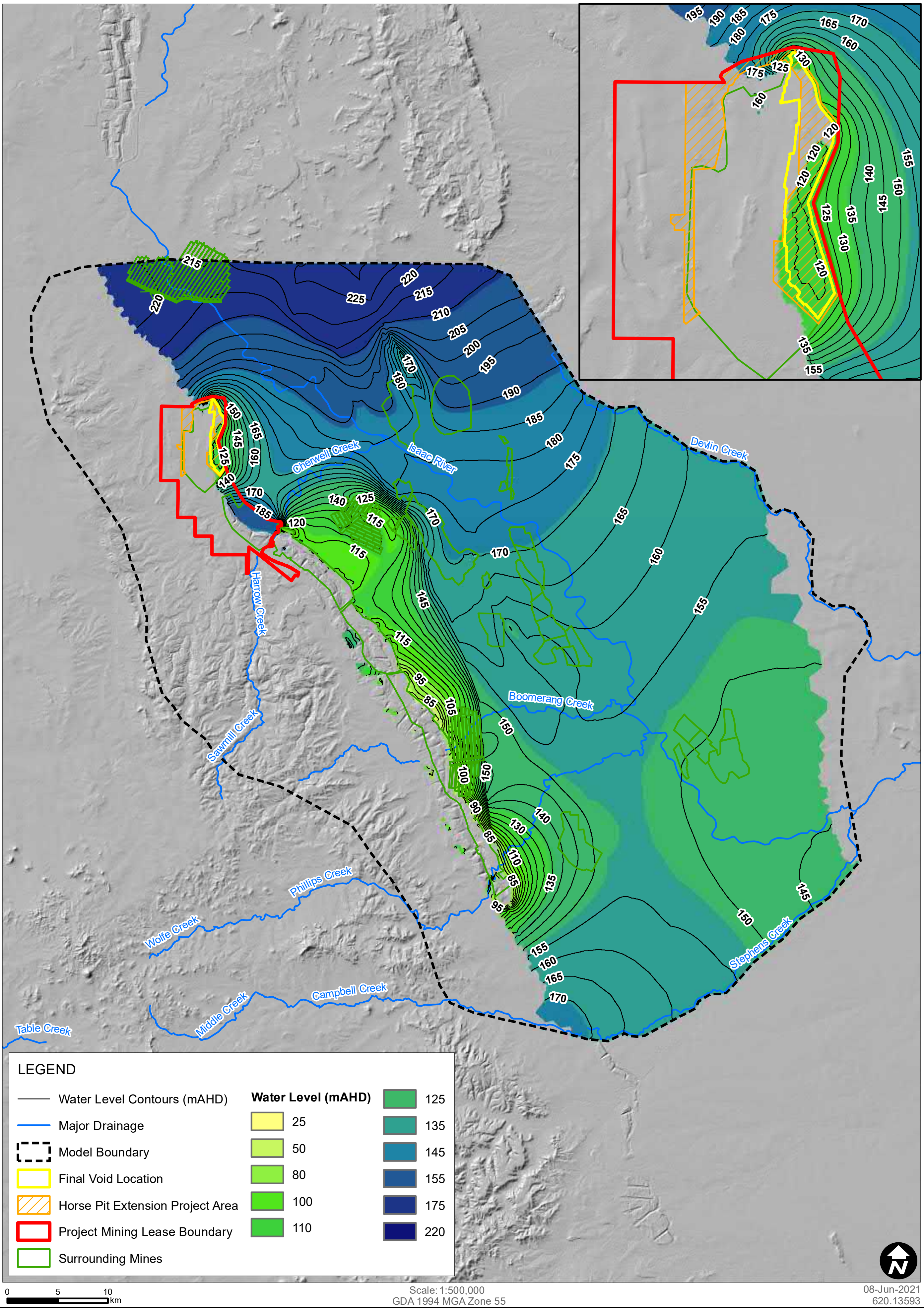
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Impact Assessment Report\62013593 F 6-21 Predicted Groundwater Levels in P Seam (Layer 14) – Post Mining Equilibrium.mxd

Predicted Groundwater Levels in P Seam (Layer 14) – Post Mining Equilibrium

FIGURE 6-21



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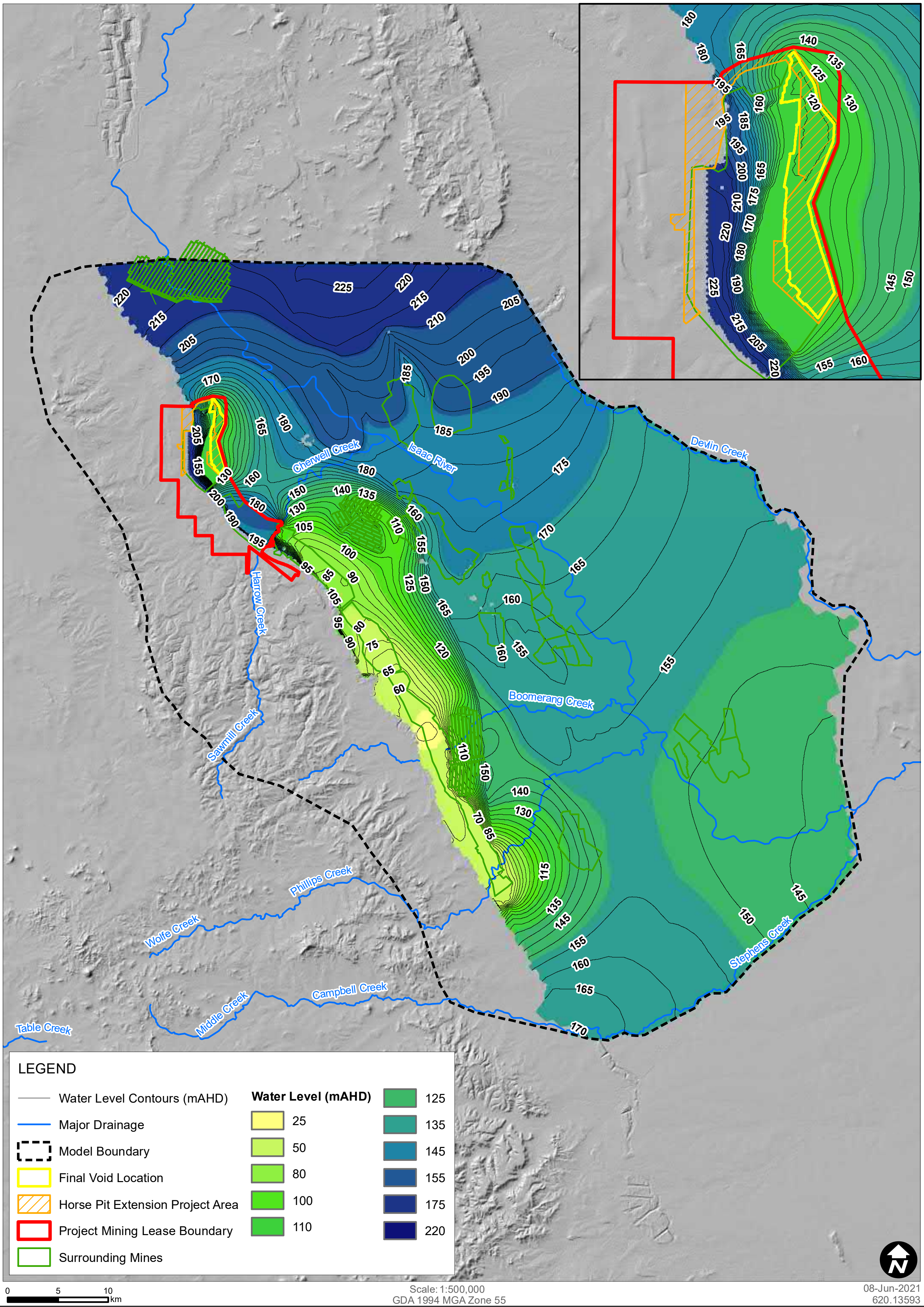
SLR

Predicted Groundwater Levels in H Seam (Layer 16) – Post Mining Equilibrium

FIGURE 6-22



Scale: 1:500,000
GDA 1994 MGA Zone 55

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H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Impact Assessment Report\62013593 F 6-23 Predicted Groundwater Levels in D Seam (Layer 18) – Post Mining Equilibrium.mxd

SLR

Predicted Groundwater Levels in D Seam (Layer 18) – Post Mining Equilibrium

FIGURE 6-23

6.7 Uncertainty Analysis

A Type 3 Monte Carlo uncertainty analysis (IESC, 2018) was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis.

Parameter ranges explored during the sensitivity and uncertainty analysis are presented in **Appendix B.** Parameters were assumed to possess a log-Normal distribution, with the Latin Hypercube Sampling (LHS) method used to create random realisations from parameter distribution**.** Distributions. The parameter distribution for the converged and calibrated model runs are also provided within **Appendix B**.

6.7.1 Uncertainty of Mine Inflows

Figure 6-24 presents the uncertainty of groundwater inflow into the mine due to the Project from start of the Project (January 2025) to the end of the prediction model (January 2056). The figure shows the predicted inflows for the base case model and different percentiles including 5th, 50th and 95th prediction bounds. Based on the IESC (2018) guidelines these represent:

- 5th percentile indicates it is very likely the outcome is larger than this value, the
- 33 - 67th percentile indicates it is as likely as not that the outcome is larger or smaller than this value and the
- 95th percentile indicates it is very unlikely the outcome is larger than this value.

The bounds in the figure demonstrate the uncertainty within the predicted inflow rate. The bounds show that the calibrated base case model is below the 50th percentile.

Figure 6-24 shows that, while the realisations created in uncertainty analysis provide a reasonable fit to calibration datasets, they generally predict higher inflows than what is reported for the basecase (See **Appendix B**). This can be seen in the figure by comparing the predicted inflow in the basecase and the 50th percentile predicted inflow. The difference between the base case inflow and the 50th percentile is likely due to specific yield values in the basecase. The specific yield values in the calibrated model were generally at the lower end of the parameter range (0.1%). While the value of 0.1% for specific yield for coal seam and interburden is reasonable and consistent with the literature, there were no measured inflow data was available to constrain this parameter during the calibration. Therefore, the uncertainty analysis has tested the model with higher values for specific yield and this resulted in higher 50th percentile inflow comparing to the basecase (See **Appendix B**).

As shown in **Figure 6-24**, The maximum mine inflow in the uncertainty analysis was 1800 ML/year (4.92 ML/day) (very unlikely outcome is larger than this value). The 5th to 95th range in mine inflows for the 2025 to 2056 period was 14.7 ML/year (0.04 ML/day) to 589.11 ML/year (1.61 ML/day).

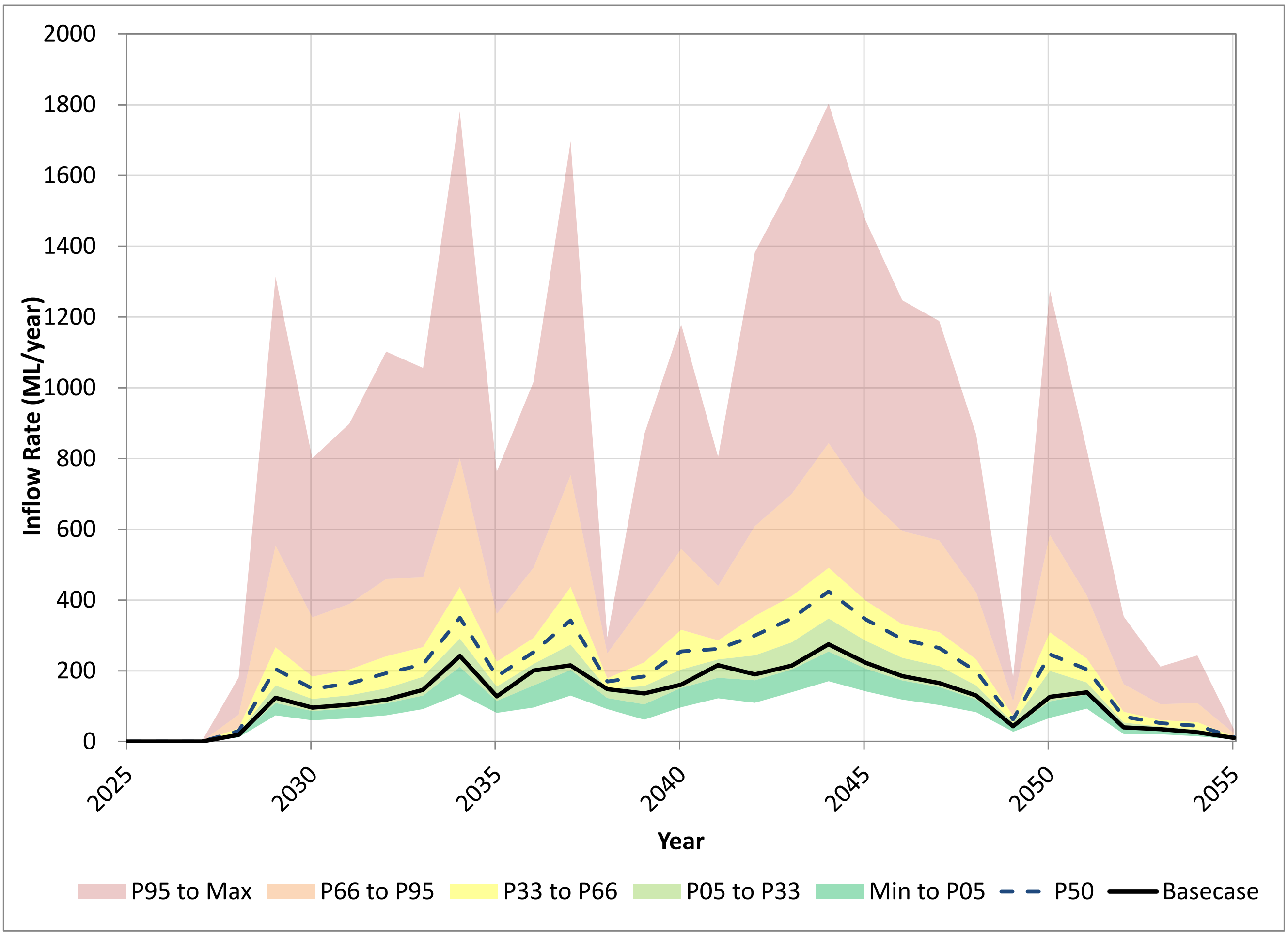


Figure 6-24 **Mine Inflow Uncertainty**

6.7.2 Groundwater Drawdowns

To illustrate the level of uncertainty in the extent of predicted drawdown, the base case maximum drawdown, the 50th percentile maximum drawdown extent was compared to the maximum drawdown extent for the 5th and 95th percentiles.

The uncertainty analysis results did not show any incremental drawdown impacts above 1m for the Quaternary alluvium as a result of mining at the Project.

Figure 6-25 shows the uncertainty in the extent of predicted 1 m maximum incremental drawdown in regolith. As shown in the figure the 5th and 95th percentile maximum drawdown in the regolith are localised in the northern boundary of the Project area.

Figure 6-26 and **Figure 6-27** show the uncertainty in the extent of predicted 1 m maximum incremental drawdown in the Q Seam and H Seam. The figures show that the 95th percentile drawdown in Q Seam and H Seam extends between 10 and 12 km to the north and east of the Project area (down-dip).

6.7.3 Uncertainty of Drawdown at Water Supply Bores

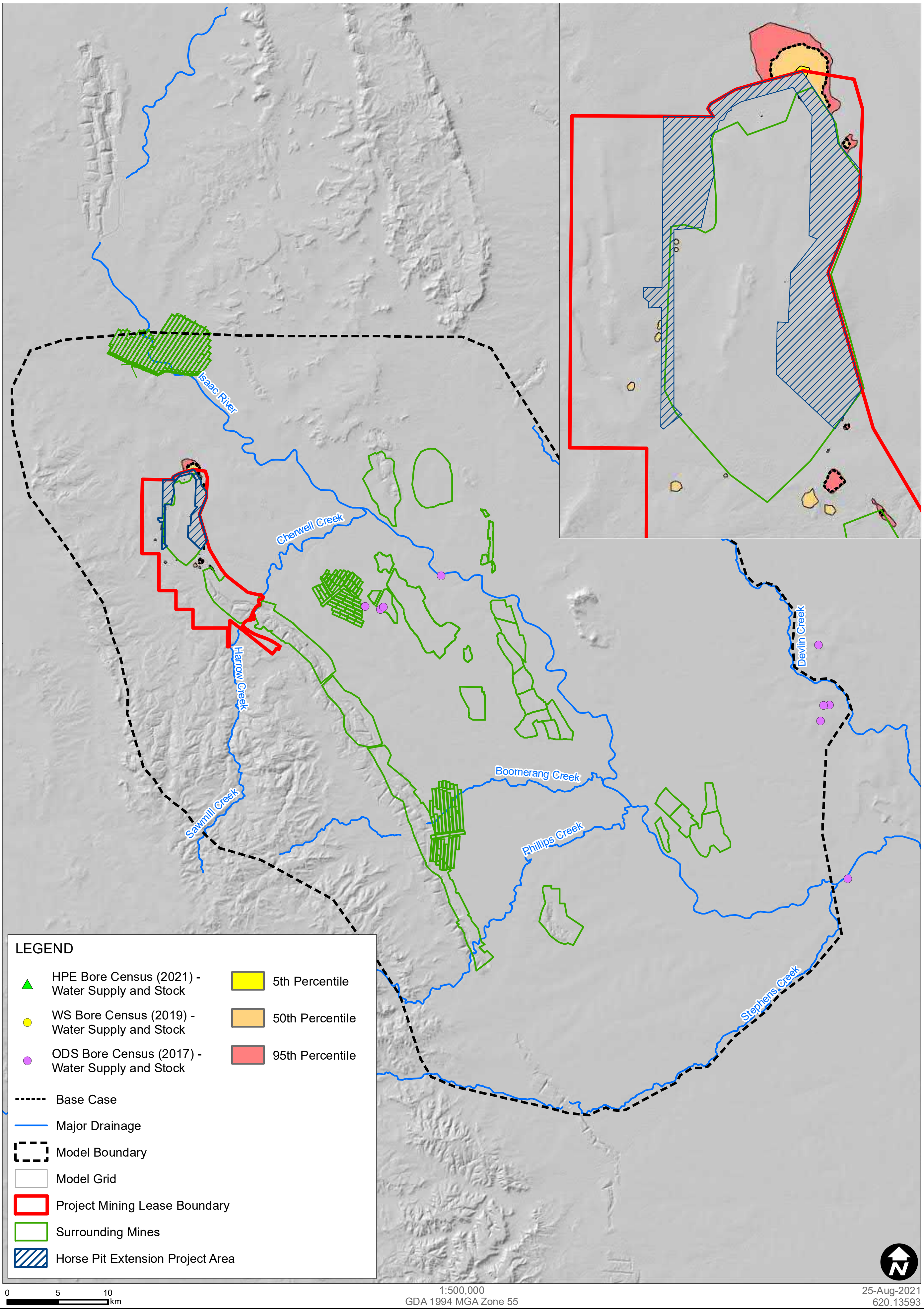
Table 6-2 summarises the 95th percentile maximum drawdown at water supply bores predicted to be impacted during mining to 2056. The locations of the bores that may be impacted are shown in **Figure 6-28**. Both bores are interpreted to be screened within the lower Fort Cooper Coal Measures. Predicted maximum drawdown at these bores from the Project remains below the relevant Water Act bore trigger threshold of 5 m, even at the 95th percentile.

The uncertainty results showed no water supply bores in the alluvium are predicted to experience drawdowns greater than 1 m due to the Project.

Table 6-2 Predicted Drawdown at Water Supply Bores

Bore	Easting	Northing	Model Layer	Geology	Baseline Water Level (mbgl)*	Simulated pre-mining Water Level (mAHD)	95th percentile Maximum Drawdown Due to Project (m)	95th percentile Maximum Cumulative Drawdown (m)
Coolibah Downs 01	617388	617388	11	FCCM	191.5	205.6	1.5	6.4
Winchester Downs 01	618483	618483	11	FCCM	195.7	202.5	1.3	8.7

Note: Coordinates in GDA94 Z55
*Baseline water level from SLR (2020)

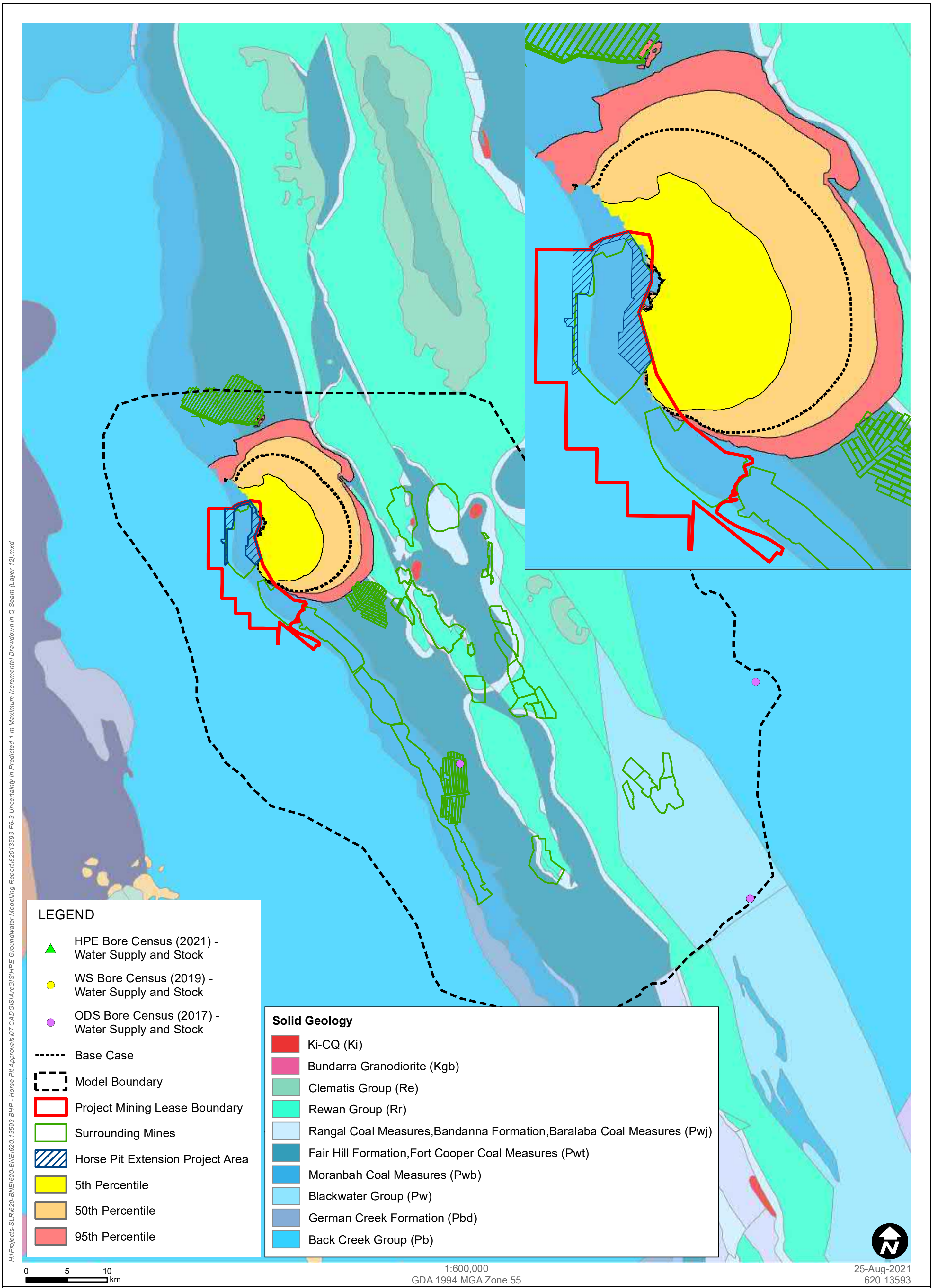


H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\62013593 F6-2 Uncertainty in Predicted 1 m Maximum Incremental Drawdown in Regolith.mxd

SLR

Uncertainty in Predicted 1m Maximum Incremental Drawdown in Regolith

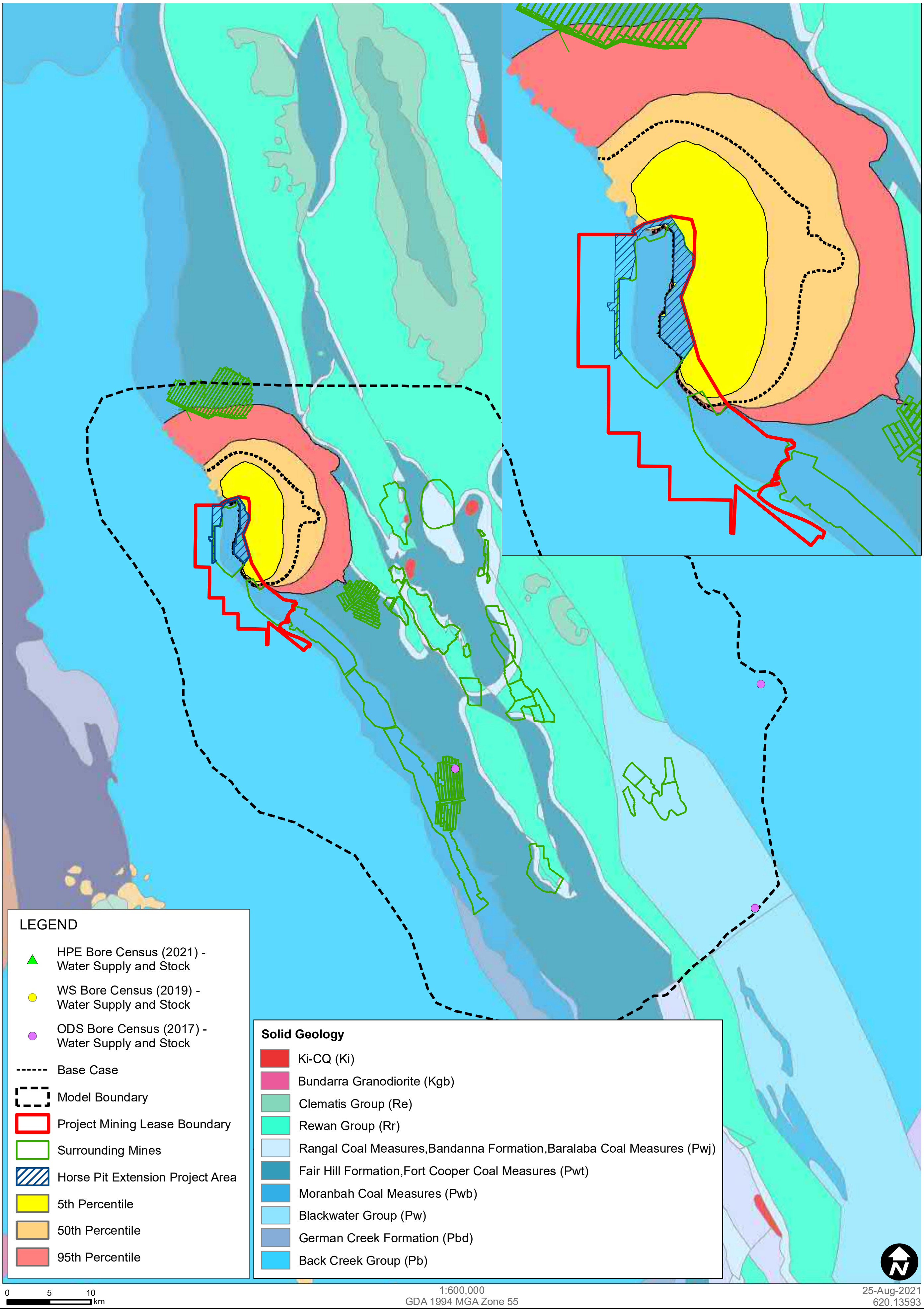
FIGURE 6-25



SLR

Uncertainty in Predicted 1m Maximum Incremental Drawdown in Q Seam (Layer 12)

FIGURE 6-26

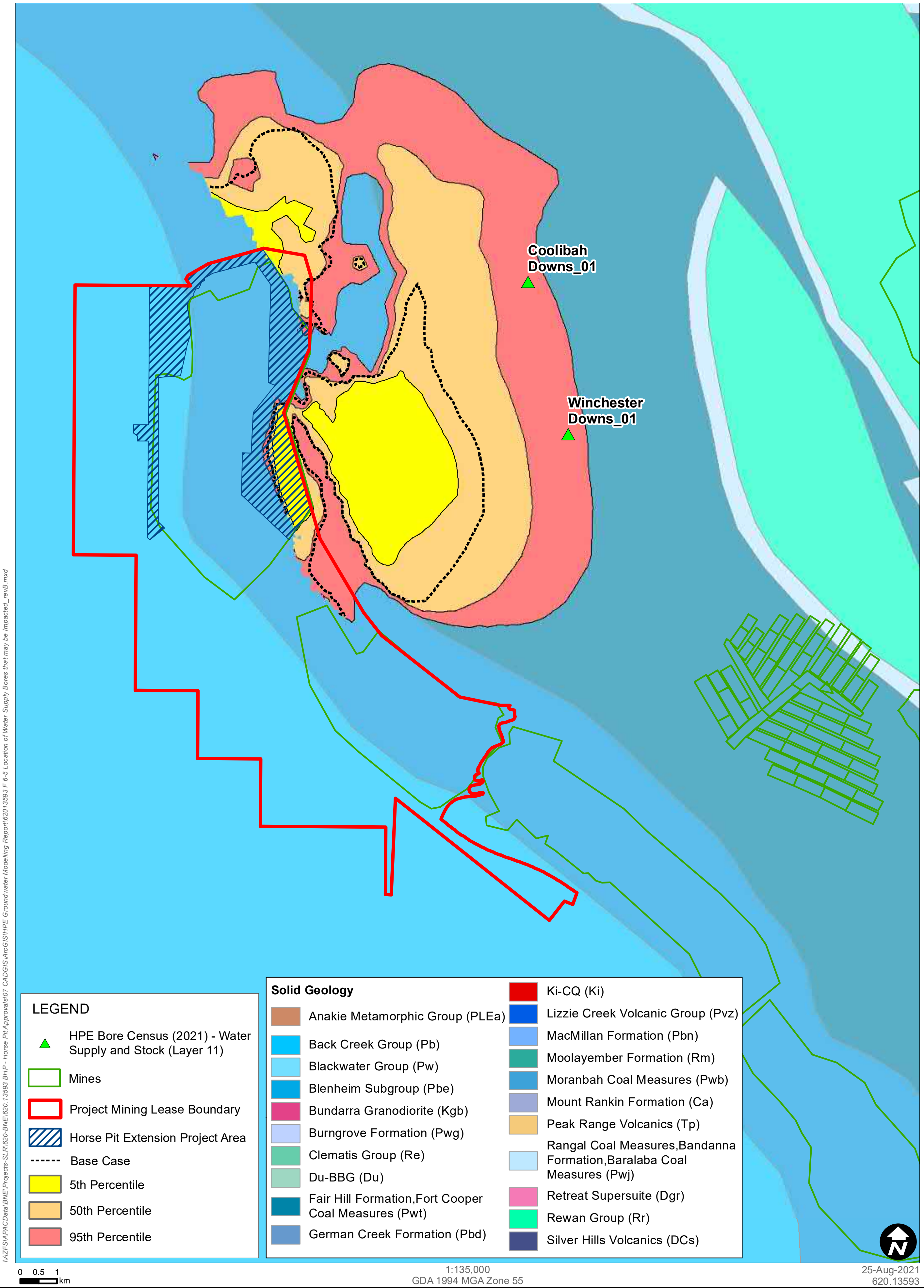


H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\62013593 F6-4 Uncertainty in Predicted 1 m Maximum Incremental Drawdown in H Seam (Layer 16).mxd

SLR

Uncertainty in Predicted 1m Maximum Incremental Drawdown in H Seam (Layer 16)

FIGURE 6-27



SLR

Location of Water Supply Bores that may be Impacted and Uncertainty in Predicted 1m Maximum Incremental Drawdown in lower FCCM (Layer 11)

FIGURE 6-28

6.7.4 Number of realisations

As discussed above, 250 realisations met the calibration criteria and were selected as calibrated realisations. The predictive model was run using the 250 parameters sets. The results from the predictive model were used to conduct statistical analyses to assess if additional realisations were likely to provide results that would significantly change the reported predictive results. The 95% confidence interval was calculated for the mine inflows and the maximum drawdown.

Figure 6-29 and **Figure 6-30** show the 95% confidence intervals of the median and maximum drawdown and predicted inflows, as well as the variance of the median and maximum drawdown and predicted inflows as more realisations are added to the uncertainty analysis. For example, the 95% confidence interval for the maximum drawdown is calculated by first estimating the maximum drawdown for each realisation and then calculating the 95% confidence interval of the maximum drawdowns as each realisation is added to the dataset. As shown in **Figure 6-29** and **Figure 6-30**, additional realisations are unlikely to significantly increase or decrease the confidence intervals of predictions of mine inflows and maximum drawdowns. Therefore, the results from the 250 realisations are considered representative and used for predicted drawdown and indirect water take (alluvium and surface water).

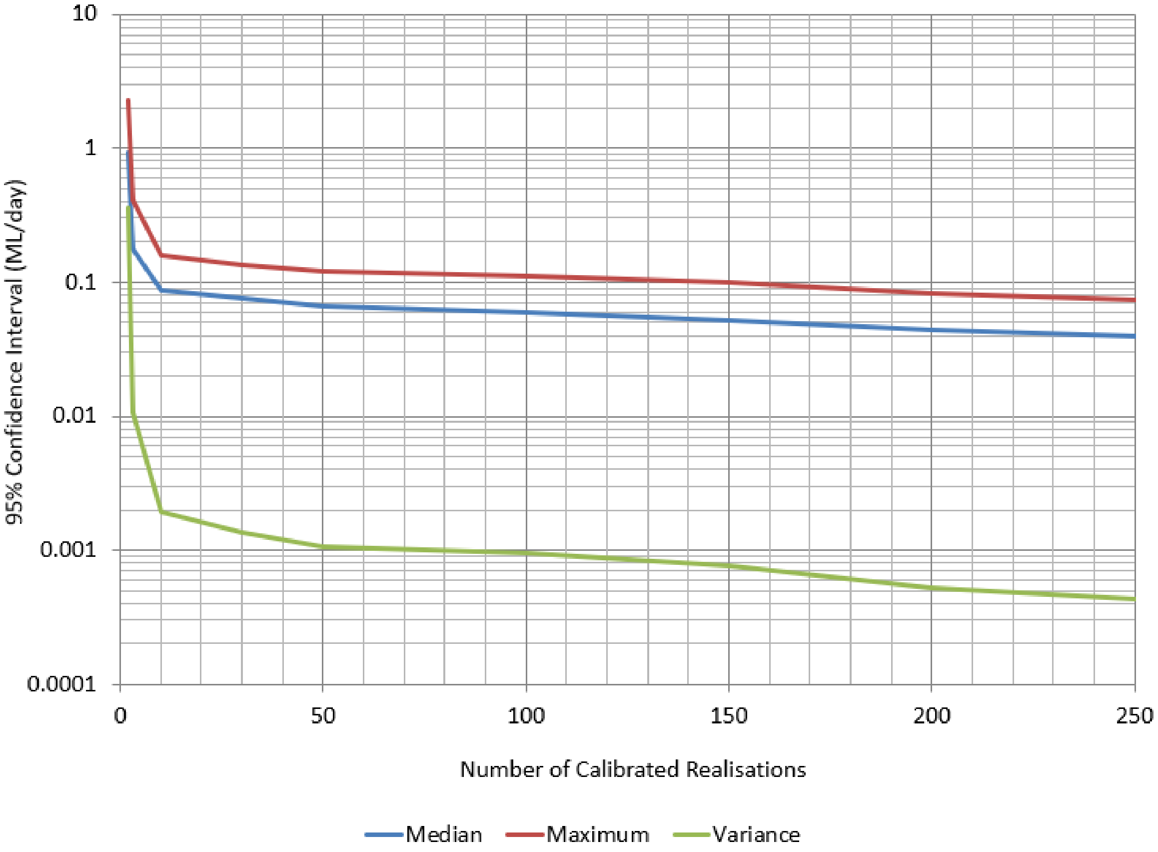


Figure 6-29 95% Confidence Interval for Pit Inflows

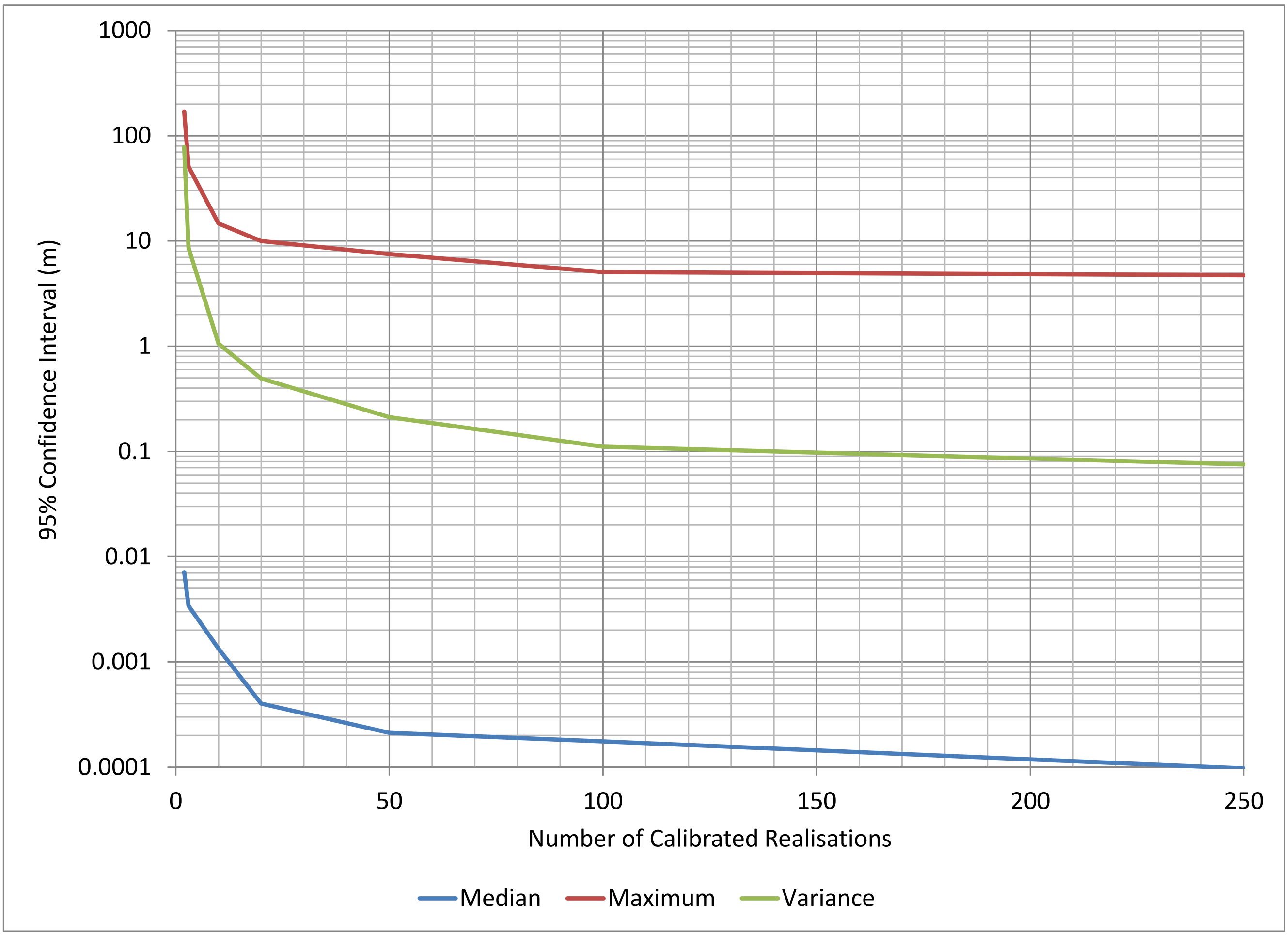


Figure 6-30 95% Confidence Interval for Maximum Drawdowns

6.7.5 Uncertainty of Influence on Alluvium and Surface Water Flow

The uncertainty analysis results showed that even the 95th percentile prediction, which is a very unlikely the outcome, the indirect take from the alluvium and the change in Isaac River flow loss due to the Project were insignificant.

7 Impacts on Groundwater Resources

7.1 Isaac Connors Groundwater Management Area

The Project does not directly intercept groundwater from Isaac Connors Groundwater Unit 1 (Quaternary alluvium) under the Water Plan (Fitzroy Basin) 2011, meaning, all direct groundwater take by the open cut pits for the Project is from Isaac Connors Groundwater Unit 2 (sub-artesian aquifers). The predicted direct take over time is presented in **Section 6.2**, which indicates the Project groundwater take would be in the order of up to 275.2 ML/year (average 133.9 ML/year) from Groundwater Unit 2. The model predicts that for the long-term equilibrium condition post mining, there is negligible groundwater take from Groundwater Unit 1, and there is 146.5 ML/year groundwater take from Groundwater Unit 2 to the final voids.

7.2 Potential Impact on Groundwater Users

7.2.1 Privately-Owned Supply Bores

Chapter 3 of the *Water Act 2000* provides bore drawdown threshold triggers of 2 m for unconsolidated aquifers, and 5 m for consolidated aquifers. As shown in **Figure 6-2** through **Figure 6-6**, there are no known privately-owned bores within the unconsolidated (Alluvium and Regolith) or consolidated (Permian coal measures) aquifers that lie within the predicted extent of Project related drawdown greater than 1 m.

The uncertainty results showed that no water supply bores in the alluvium are predicted to experience drawdowns greater than 1 m due to the Project even at the 95th percentile confidence interval.

The uncertainty results showed that the 95th percentile maximum cumulative drawdown is predicted to be greater than 5m at two water supply bores. Both bores are located to the west of the Project and are screened within the Fort Cooper Coal Measures. As per Table 2 of the IESC 2020, in terms of likelihood of exceedance, a percentile greater than 90% means that it is very unlikely that the maximum cumulative drawdown will be greater than 5m at these bores.

7.2.2 Ecological Sites

Potential Project impacts to GDEs are assessed in full in Chapter 13 of the EA Amendment Application using a multi-disciplinary approach. The following provides a summary.

The aquatic in-stream ecosystems associated with the Isaac River and Cherwell Creek are largely not dependent on the surface expression of groundwater. The wetlands and farm dams in the locality are not likely to be aquatic GDEs. Modelling has shown that the Project would result in negligible increased leakage from surface flows of the Isaac River to the underlying alluvium. Therefore, impacts to surface flows and subsequently aquatic ecosystems downstream of the Project area are not expected (Ecological Service Professionals, 2020).

There would be negligible drawdown in the alluvium along the Isaac River and Cherwell Creek outside ML 1775 as a result of the Project, as well as no impacts to groundwater quality. Therefore, there would be no adverse impacts to riparian vegetation associated with the Isaac River and Cherwell Creek outside ML 1775 as a result of the Project.

Any dependency on groundwater for riparian vegetation surrounding ephemeral wetlands on Isaac River or Cherwell Creek is likely to be facultative. These ephemeral wetlands are not likely to be aquatic GDEs as these wetlands do not receive groundwater discharge, rather, the clay-rich substrates of these wetlands are likely to hold surface water run-off for extended periods (E2M, 2020). Further, as there would be no impacts on groundwater quality and resources, there would be no adverse impacts to riparian vegetation surrounding these ephemeral wetlands.

Terrestrial GDE communities have been assessed within the extent of predicted drawdown (extent of 1m water table drawdown) from the Project (E2M, 2021b). Field survey information describing the vegetation communities present has been compared to depth to groundwater (depth to water table) predictions from the Project groundwater model with respect of literature information on rooting depths of the observed species. This analysis has identified that for the most part, the pre-Project water table across the predicted Project-related groundwater drawdown extent lies beyond the reach of the vegetation communities, and therefore those communities can not be considered GDEs. Only two locations within the 1m water table drawdown extent were determined to be potential or likely GDEs; riparian vegetation along a small section of Horse Creek at the northern extent of the Project area including onto ML 1775 (likely GDE), and riparian vegetation along a small section of Caval and Cherwell Creeks at the southern extent of the Project area wholly within ML 1775 (possible GDE). However, in both cases the communities in these areas were also determined to be facultative, with vegetative condition and persistence likely to have dependence on surface flows.

There would be no impacts to vegetation on the Isaac River, Horse Creek and Cherwell Creek floodplains (outside of wetlands) that may access water from the alluvium, as there would be negligible drawdown to the alluvium and no changes to groundwater quality within the alluvium.

In summary, the Project is not predicted to have any material impacts on potential or actual GDEs due to changes in groundwater quality or resources.

7.3 Potential Impacts on Surface Drainage

The Isaac River is the major drainage feature of the region. It is located to the east of the Project and flows north-west to south-east in the vicinity of the Project.

A natural hydraulic gradient exists between the Isaac River and the associated alluvium that results in seepage from the Isaac River to the alluvium (i.e. a losing system). The change in water levels induced by mining has the potential to increase the hydraulic gradient between the Isaac River and associated alluvium. However the model predicts that the average rate of seepage from the Isaac River to the alluvium will increase by an insignificant amount, considered within the error threshold of predictions (less than 3.65 ML/year) over the life of the Project. This insignificant volume is itself considered a conservative over-estimate as the groundwater model does not represent an unsaturated zone that can form between the bed of the river and the underlying groundwater unit, which would serve to limit the hydraulic gradient and interconnectivity.

The Isaac River is ephemeral in nature, with flows only occurring after rainfall events that generate runoff. On average, when the Isaac River flows, 161,863 ML/year of surface water is discharged downstream. The conservative estimate of less than 3.65 ML/year increased seepage from the Isaac River to the alluvium as a result of the Project therefore represents an insignificant potential reduction in flow (including shallow sub-surface flow). The number of days that the Isaac River runs dry is not predicted to increase with the addition of the Project.

7.4 Potential Impacts on Groundwater Quality

This section describes the potential sources and pathways of groundwater contamination associated with the Project.

7.4.1 Out of Pit Waste Rock Emplacement Areas

As the mining operations progress, waste rock material would be placed within selected out-of-pit waste rock emplacement areas (refer **Figure 1-3**). The out-of-pit waste rock emplacement areas may produce seepage as a result of rainfall inundation, that theoretically could alter the existing groundwater quality. Runoff from disturbed areas outside the open cut pit and infrastructure areas, such as waste rock emplacement areas (both active and under rehabilitation) would be captured in the sediment and mine-affected water dams and managed under the mine water management system (SLR, 2021). The system would be designed to capture and reuse water, and operated to minimise off-site discharges including discharge to groundwater.

As outlined in **Section 5.4.4**, a geochemical assessment has been prepared by Terrenus Earth Sciences (2021) for the Project that included leachate analysis of waste rock material within the Project Area and built upon previous geochemical studies (Terrenus 2009). The analysis found that waste rock material is generally non-acid forming, with the leachate generally averaging an EC of 391 µS/cm (i.e. generally fresh as described in **Section 5.4.4**) and low in sulfur content. It is important to note that the results presented in Terrenus Earth Sciences (2021) represent an ‘assumed worst case’ scenario as the samples analysed had a long equilibration period or had a very high surface area compared to likely materials in the field.

The inward hydraulic flow gradients from the waste emplacement areas to the open cut void would inhibit seepage to the alluvium. Also, the *in-situ* Cainozoic sediments present between the alluvium and regolith and the out-of-pit waste rock emplacements generally comprise surficial soil and clays, up to 10 m in thickness (**Section 4.2**). The surficial clays would inhibit potential seepage from the out-of-pit waste rock emplacement to the underlying regolith and alluvium. Therefore, there would be no mechanism for seepage from the out-of-pit waste rock emplacement to impact on groundwater quality in the alluvium and regolith.

Notwithstanding, the seepage (i.e. leachate from the out-of-pit waste rock emplacement) would generally be fresh and low in sulfur content, minimising the potential for a change in groundwater quality should the seepage enter the groundwater system.

7.4.2 In Pit Waste Rock Emplacement Areas

The in-pit waste rock emplacement areas would be rehabilitated progressively as the mining operations progress. The Project would involve progressively backfilling the open cut pit as space becomes available with water levels within backfilled areas predicted to recover back towards pre-mining levels.

7.4.3 Final Void

A final void is proposed within the Project Area to remain in perpetuity. Modelling predicts that the final void water levels would equilibrate to 120 mAHD.

The predicted equilibrated final void water levels are between approximately 70 m and 90 m below the pre-mining groundwater levels, which means the final void would act as a sink to groundwater flow. The predicted final void equilibrated water level is generally consistent with the results of the final void modelling undertaken for the Surface Water Assessment (SLR, 2021).

Water within the final void would evaporate from the final void water body surface and draw in groundwater from the surrounding strata and runoff from the final void catchment areas. As the final void would act as a sink, evaporation from the final void water body would overtime concentrate salts in the final void water body. However, the gradual increase in salinity of the final void water body would not pose a risk to the surrounding groundwater regime as the final void would remain as a groundwater sink in perpetuity.

Notwithstanding, the Surface Water Assessment prepared by SLR (2021) for the Project has modelled the equilibrated water levels as well as the potential accumulation of salt in the final void, with TDS concentrations of the final void water estimated to be between 35,000 µS/cm and 37,000 µS/cm.

7.4.4 Workshops and Storage

All workshop and fuel/chemical storage areas at CVM are developed in accordance with current Australian Standards. This includes refuelling areas and chemical storage areas to be designed with adequate bunding and equipped for immediate spill clean-up. These controls represent standard practice and a legislated requirement at mining operations for preventing the contamination of the groundwater regime. Therefore, there is considered to be limited potential for groundwater contamination to occur with relation to workshops and fuel/chemical storage.

8 Management and Mitigation Measures

8.1 Mitigation Measures

8.1.1 Mine-Affected Water

The mine plan for the Project includes strategies to manage mine-affected water for the life of the Project.

Waste rock material would be emplaced in-pit as the space becomes available and will in some areas form the walls of the final voids. As outlined in **Section 7.4.3**, groundwater within the final void is predicted to remain below pre-mining levels. Therefore, it is anticipated the final void would act as a groundwater sink, capturing water associated with in-pit rejects.

Where not able to be managed via passive evaporation, groundwater inflows to the open cut pits would be pumped via in-pit sumps where necessary to ensure safe operating conditions. The groundwater inflows would be collected and contained within mine water management system.

As documented in SLR (2021), an up-catchment diversion system would also be developed to divert surface water flows away from the disturbed areas associated with the Project. Temporary flood levees designed to an 0.1% Annual Exceedance Probability (AEP) flood event would also be developed to prevent inundation of the open cut pits.

8.1.2 Groundwater Use

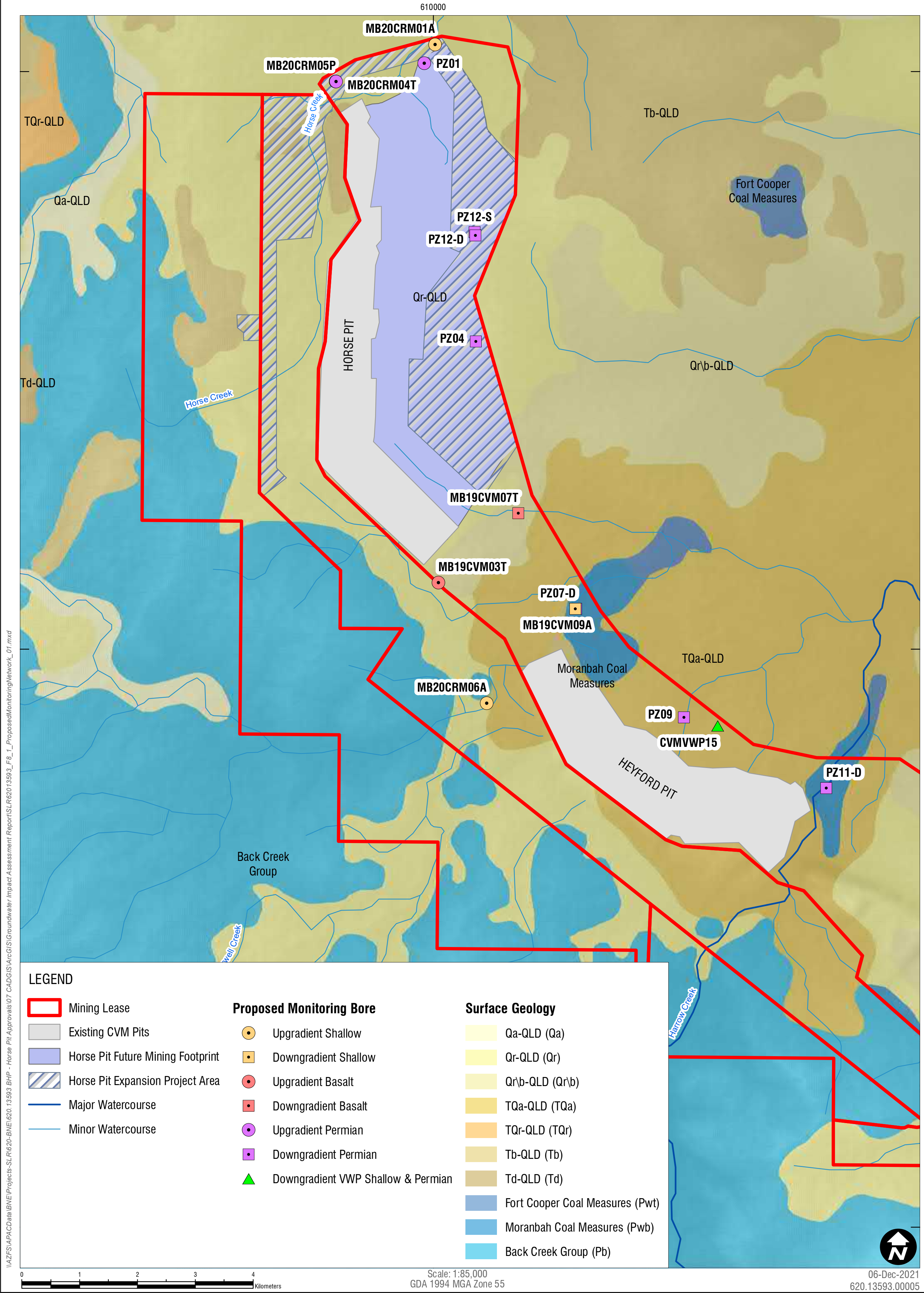
The potential impacts on groundwater users (privately-owned bores) are described in **Section 7.2**. No privately-owned bores are predicted to exceed relevant bore trigger thresholds in the Chapter 3 of the Water Act and therefore there are no existing privately-owned bores that would be impacted by the Project.

It remains possible that in the future, privately-owned bores may be installed within the extent of drawdown related to the Project. In accordance with Chapter 3 of the Water Act, any impacts on such bore users that exceed the magnitude of impacts predicted in this groundwater assessment would require “make good provisions” for the additional impacts to ensure the bore user has access to a similar quantity and quality of water for the authorised purpose. This may include deepening a bore to increase its pumping capacity, constructing a new water supply bore, providing water from an alternative source or financial compensation.

8.2 Management

8.2.1 Groundwater Monitoring Program

A groundwater monitoring program is conducted at CVM in accordance with Schedule I of the current EA EPML00562013. BMA are currently working with the Queensland Department of Environment and Science (DES, the administrators of the EA) regarding revisions to Schedule I including in relation to the Project. The proposed EA mandated groundwater monitoring network is shown on **Figure 8-1** and in **Table 8-1**. The groundwater monitoring schedule would continue as per Schedule I of the current EA.



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Proposed Groundwater Monitoring Network

FIGURE 8-1

Table 8-1 Proposed EA Groundwater Monitoring Network

Bore ID	Easting	Northing	Surface Elevation (m AHD)	Screen Top Elevation (m AHD)	Screen Base Elevation (m AHD)	Monitored Unit	Location
PZ01	609841	7560145	220.33	137.83	134.83	Permian	Upgradient
PZ04	610731	7555326	279.27	192.17	186.17	Permian	Downgradient
PZ07-D	612465	7550704	226.17	185.17	182.17	Permian	Downgradient
PZ09	614326	7548822	224.82	153.82	147.82	Permian	Downgradient
PZ11-D	616791	7547600	218.77	163.77	160.77	Permian	Downgradient
PZ12-S	610712	7557219	242.24	215.44	212.44	Permian	Downgradient
PZ12-D	610721	7557164	241.79	189.79	192.79	Permian	Downgradient
MB19CVM03T	610087	7551152	245.81	216.81	210.81	Basalt	Upgradient
MB19CVM07T	611464	7552357	233.87	212.87	206.87	Basalt	Downgradient
MB19CVM09A	612448	7550698	226.94	211.44	208.44	Shallow	Downgradient
MB20CRM01A	610028	7560466	217.88	212.88	209.88	Shallow	Upgradient
MB20CRM04T	608307	7559829	230.82	208.82	202.82	Basalt	Upgradient
MB20CRM05P	608312	7559824	230.68	191.68	185.68	Permian	Upgradient
MB20CRM06A	610921	7549067	231.89	220.14	214.14	Shallow	Upgradient
CVMVWP15[1]	614909	7548676	227.52	213.02[2] 159.52[2] 82.52[2] 17.52[2]		Shallow Permian Permian Permian	Downgradient

1. VWP installation – groundwater levels only
2. Sensor installation elevation (mAHD)

The groundwater monitoring program would continue throughout the life of the Project. Recording of groundwater levels from existing monitoring bores would continue and would allow natural groundwater level fluctuations (such as responses to rainfall) to be distinguished from potential groundwater level impacts due to depressurisation resulting from proposed mining activities. Groundwater quality sampling of existing monitoring bores would continue in order to provide longer term baseline groundwater quality at the Project, and to detect any changes in groundwater quality during and post-mining.

8.2.2 Impact Assessment Criteria

Once agreed with DES, groundwater monitoring criteria will be formalised in the EA to monitor for impacts on both environmental values and predicted changes in groundwater quality. Impact assessment criteria for the site will be documented in the EA. Groundwater quality trigger levels are being developed by BMA in consultation with DES and in consideration of the DES guideline on *Using monitoring data to assess groundwater quality and potential environmental impacts* (DES, 2021). The trigger levels will be established on the basis of a statistically significant baseline dataset for the monitoring network. As per the DES (2021) guidelines, the triggers will be established in consideration of the *Water Plan (Fitzroy Basin) 2011* WQOs, ANZECC and ARMCANZ (2000) criteria and site-specific conditions. Trigger criteria will be established for each groundwater unit potentially impacted by the Project, being alluvium, regolith and the Permian coal measures.

8.2.3 Data Management and Reporting

Routine groundwater monitoring would be conducted in accordance with the EA. Data will be stored within a consolidated groundwater database maintained by the CVM site environment department. Quality assurance and quality control procedures would be put in place to help ensure the accuracy of data entered within the database. The database would include automated identification of any groundwater quality EA trigger exceedances. Investigation into the cause of any exceedance and development of an action plan to mitigate potential environmental harm would be conducted by suitably qualified personnel as required by the EA.

9 Limitations

The model geology away from the Project Area, Lake Vermont Project, Winchester South Project, Olive Downs Project and Moorvale South Project (i.e. beyond the limits of the respective site geological models) is interpolated and estimated from publicly available data and regional scale mapping (e.g. Queensland Government mapping and EIS documentation [including the Bowen Gas Project]). Consequently, the depths, thickness and extents of the model layers away from the Project may not closely replicate reality. This is of particular note when simulating the cumulative impacts of surrounding mines. The coal seams of the Fort Cooper Coal Measures and Moranbah Coal Measures are simplified to single seams with aggregated seam thickness; as mining is applied conservatively to the base of this simplified seam, the depths of the surrounding mines may not be accurate and the stresses exaggerated.

Similarly, the timing and extent of surrounding mine activities have been largely inferred from publicly available data, and therefore an over- or under-estimation of impacts, or timing of impacts, may result due to this.

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Appendix A1 – CVM and Project Groundwater Monitoring Network

Bore ID	E_GDA94z56	N_GDA94z56	RL (mAHD)	Elevation Source	Type	Install Date	Target Aquifer	Aquifer Unit	Top Screen (mBGL)	Base Screen (mBGL)	Bore Status
Pz-01	609954	7560323	220.33	Survey	Monitoring Bore	May-08	Coal Seam D04	D coal seam group	82.5	85.5	Active
Pz-02	608553	7558420	221.95	LiDAR	Monitoring Bore	May-08	Basalt	Basalt	24	35	Decommissioned
Pz-03-S	609028	7556894	217.45	LiDAR	Monitoring Bore	May-08	Basalt	Basalt	17.5	26.5	Decommissioned
Pz-03-D	609029	7556890	246.11	Survey	Monitoring Bore	May-08	Coal Seam D04	D coal seam group	39.8	42.8	Decommissioned
Pz-04	610844	7555504	279.27	Survey	Monitoring Bore	May-08	Coal Seam Q	Q coal seam group	87.1	93.1	Active
Pz-05	609030	7554296	229.57	LiDAR	Monitoring Bore	May-08	Coal Seam D04	D coal seam group	115	118	Decommissioned
Pz-06-S	611237	7551854	241.87	LiDAR	Monitoring Bore	May-08	Basalt	Basalt	22	31	Active
Pz-06-D	611241	7551856	241.77	LiDAR	Monitoring Bore	May-08	Coal Seam P02	P coal seam group	81	84	Decommissioned
Pz-07-S	612584	7550881	226.16	Survey	Monitoring Bore	May-08	Alluvium	TQ alluvium	9	15	Active
Pz-07-D	612578	7550882	226.17	Survey	Monitoring Bore	May-08	Coal Seam Q01	Q coal seam group	41	44	Active
Pz-08-S	611524	7549887	230.58	Survey	Monitoring Bore	May-08	Alluvium	TQ alluvium	9	15	Active
Pz-08-D	611526	7549891	230.64	LiDAR	Monitoring Bore	May-08	Sandstone Interburden	Non-coal Permian	60	63	Decommissioned
Pz-09	614439	7549000	224.82	Survey	Monitoring Bore	May-08	Coal Seam P08	P coal seam group	71	77	Active
Pz-10	613792	7548262	182.51	LiDAR	Monitoring Bore	May-08	Coal Seam H08	H coal seam group	77	83	Decommissioned
Pz-11-S	616904	7547778	219.01	LiDAR	Monitoring Bore	May-08	Alluvium	TQ alluvium	6	9	Active
Pz-11-D	616904	7547778	218.77	Survey	Monitoring Bore	May-08	Coal Seam P08	P coal seam group	55	58	Active
Pz-12s	610825	7557397	242.24	Survey	Monitoring Bore	Oct-13	Sandstone / siltstone	Regolith	26.8	29.8	Active
Pz-12D	610834	7557342	241.79	Survey	Monitoring Bore	Oct-13	Siltstone	Non-coal Permian	49	52	Active
MB19CVM01A	610443	7548264	238.06	Survey	Monitoring Bore	Mar-19	Alluvium / weathered sandstone	TQ alluvium	7	13	Active
MB19CVM02P	611538	7549885	242	Survey	Monitoring Bore	Mar-19	Coal/siltstone	D coal seam group	30	36	Active
MB19CVM03T	610214	7551338	245.81	Survey	Monitoring Bore	Mar-19	Basalt	Basalt	29	35	Active
MB19CVM04P	610215	7551344	245.94	Survey	Monitoring Bore	Mar-19	Coal	D coal seam group	41	47	Active
MB19CVM05T	611082	7551428	240.82	Survey	Monitoring Bore	Mar-19	Basalt/basal sands	Basalt	39.5	45.5	Active
MB19CVM06P	611075	7551429	240.87	Survey	Monitoring Bore	Mar-19	Coal/siltstone	H coal seam group	67	73	Active
MB19CVM07T	611578	7552537	233.87	Survey	Monitoring Bore	Mar-19	Basalt	Basalt	21	27	Active
MB19CVM08P	611579	7552526	233.78	Survey	Monitoring Bore	Mar-19	Coal/siltstone	H coal seam group	157.5	163.5	Active
MB19CVM09A	612560	7550879	226.94	Survey	Monitoring Bore	Feb-19	Alluvium	TQ alluvium	15.5	18.5	Active
MB19CVM10P	613294	7549948	230.61	Survey	Monitoring Bore	Feb-19	Coal/siltstone	H coal seam group	123.5	129.5	Active
MB20CVM01A	610028	7560466	217.88	LiDAR	Monitoring Bore	Apr-20	Alluvium / weathered sandstone	TQ alluvium	5	8	Active
MB20CVM04T	608307	7559829	230.82	LiDAR	Monitoring Bore	Apr-20	Basalt	Basalt	22	28	Active
MB20CVM05P	608312	7559824	230.68	LiDAR	Monitoring Bore	Apr-20	Coal Seam D01	D coal seam group	39	45	Active
MB20CVM06T	610921	7549067	231.89	LiDAR	Monitoring Bore	Apr-20	Sand / weathered sandstone	Regolith	11.75	17.75	Active

Bore ID	E_GDA94z56	N_GDA94z56	RL (mAHD)	Elevation Source	Type	Install Date	Target Aquifer	Aquifer Unit	Top Screen (mBGL)	Base Screen (mBGL)	Bore Status
MB20CVM02A	613208.6862	7551216.139	224.86	Survey	Monitoring Bore	Nov-20	Basalt	Basalt	16.5	19.5	Active
MB20CVM03P	613210.6862	7551207.14	255.15	Survey	Monitoring Bore	Nov-20	Coal Seam P	P coal seam group	100	103	Active
CVMPB07_01	611564.7004	7552523.129	235.72	Survey	Pumping Bore	Dec-20	Basalt	Basalt	22	28	Active
CVMPB07_02	611564.7003	7552540.129	236.68	Survey	Pumping Bore	Dec-20	Coal	P coal seam group	111	117	Active
CVMVWP01_01_V1	610027.6824	7560450.015	217.84	Survey	VWP	Nov-20	Coal	H coal seam group	49.5	49.5	Active
CVMVWP01_01_V2	610027.6824	7560450.015	217.84	Survey	VWP	Nov-20	Coal	D coal seam group	82	82	Active
CVMVWP07_R01_V1	611565.7002	7552559.129	234.06	Survey	VWP	Nov-20	Coal	P coal seam group	112	112	Active
CVMVWP07_R01_V2	611565.7002	7552559.129	234.06	Survey	VWP	Nov-20	Coal	H coal seam group	179	179	Active
CVMVWP07_R01_V3	611565.7002	7552559.129	234.06	Survey	VWP	Nov-20	Coal	D coal seam group	256.5	256.5	Active
CVMVWP15_01_V1	614908.688	7548676.193	227.52	Survey	VWP	Nov-20	Sand / weathered sandstone	Regolith	14.5	68	Active
CVMVWP15_01_V2	614908.688	7548676.193	227.52	Survey	VWP	Nov-20	Coal	P coal seam group	68	145	Active
CVMVWP15_01_V3	614908.688	7548676.193	227.52	Survey	VWP	Nov-20	Coal	H coal seam group	145	210	Active
CVMVWP15_01_V4	614908.688	7548676.193	227.52	Survey	VWP	Nov-20	Coal	D coal seam group	210	210	Active
CVMMB16_01	611256.6745	7558498.036	237.3	Survey	Monitoring Bore	Nov-20	weathered sandstone / mudstone	Regolith	10.9	13.9	Active
CVMMB16_02	611247.6747	7558493.036	237.41	Survey	Monitoring Bore	Nov-20	Coal	H coal seam group	63.8	69.8	Active

Appendix A2 - Groundwater Quality

Appendix A2

Bore	Aquifer	Statistic	In-situ pH	In-situ EC	TDS	Ca	Mg	Na	K	Cl	SO4	Carbonate Alkalinity as CaCO3	Carbonate Alkalinity as CO3-	Bicarbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as HCO3-	Fe	Al	Ag	As	Hg	Sb	Mo	Se	Total Petroleum Hydrocarbons C10-C36 Fraction(sum)
MB20CVM01A	Alluvium	Count	11	11	10	10	10	10	10	10	10	10.0	10.0	10.0	10.0	10	10	10	10	10	10	10	10	10
MB20CVM01A	Alluvium	Min	6.96	3959	3480	36	72	18.7	0.0005	1170	101	0.5	0.3	1150.0	1403.0	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.005	0.025
MB20CVM01A	Alluvium	Max	8.48	8388	4310	50	103	1440	2	1610	163	0.5	0.3	1400.0	1708.0	1.33	0.01	0.005	1220	0.00005	0.003	0.004	0.03	550
MB20CVM01A	Alluvium	Avg	7.26	6572	3808	43.8	85.6	1144.87	1.80005	1330	126.5	0.5	0.3	1330.0	1622.6	0.1555	0.0055	0.00095	122.0027	0.00005	0.0008	0.0029	0.008	57.5485
MB20CVM01A	Alluvium	20th percentile	7.01	6449	3620	41.8	79.8	1154	2	1216	108.4	0.5	0.3	1306.0	1593.3	0.025	0.005	0.0005	0.001	0.00005	0.0005	0.002	0.005	0.025
MB20CVM01A	Alluvium	80th percentile	7.43	7174	3988	46.4	93.2	1332	2	1420	138.6	0.5	0.3	1392.0	1698.2	0.025	0.005	0.0005	0.005	0.00005	0.0006	0.0032	0.006	5.248
MB20CVM01A	Alluvium	95th percentile	7.99	7919	4288	49.1	102.55	1395	2	1560.5	153.1	0.5	0.3	1400.0	1708.0	0.74275	0.00775	0.002975	671.0058	0.00005	0.0021	0.004	0.021	313.75
MB20CVM01A	Alluvium	Stdev	0.99	6771	4616	201.1875	252.2143	1029.7605	15.83956	2325.878	431.1338	47.4	28.6	302.4	369.0	1.934196	0.031474	0.001083	337.5311	3.51E-05	0.004969	0.007573	0.004373	45.89304481
PZ07-S	Alluvium	Count	14.00	13	9	12	12	12	12	12	12	12.0	12.0	12.0	12.0	11	11	0	12	12	11	11	11	0
PZ07-S	Alluvium	Min	4.76	351	376	27	16	14	6	26	6	0.5	0.3	80.0	97.6	0.23	0.005	0	0.0005	0.00005	0.0005	0.0005	0.005	0
PZ07-S	Alluvium	Max	7.25	1205	771	72	39	51	11	193	48	2.5	1.5	150.0	183.0	1.48	0.04	0	0.003	0.00005	0.0005	0.0005	0.005	0
PZ07-S	Alluvium	Avg	6.43	658	495	51.41667	28	27.5	8.416667	129.0833	24.83333	0.8	0.5	115.3	140.6	0.721818	0.011818	#DIV/0!	0.001042	0.00005	0.0005	0.0005	0.005	#DIV/0!
PZ07-S	Alluvium	20th percentile	6.33	443	398	36.2	20.6	20.4	7.2	58.2	7	0.5	0.3	91.6	111.8	0.47	0.005	#NUM!	0.0005	0.00005	0.0005	0.0005	0.005	#NUM!
PZ07-S	Alluvium	80th percentile	6.82	828	580	59.8	33	31	9.8	186	41.8	0.5	0.3	133.2	162.5	0.97	0.02	#NUM!	0.0018	0.00005	0.0005	0.0005	0.005	#NUM!
PZ07-S	Alluvium	95th percentile	7.07	1042	702	69.25	36.25	40.55	10.45	192.45	46.9	2.5	1.5	150.0	183.0	1.3	0.035	#NUM!	0.00245	0.00005	0.0005	0.0005	0.005	#NUM!
PZ07-S	Alluvium	Stdev	1.00	6867	4665	200.9403	252.8886	1042.9312	15.73957	2344.418	432.2705	47.3	28.5	285.6	348.5	1.929023	0.031483	0.001074	333.3291	3.5E-05	0.004965	0.007575	0.004232	36.29517773
PZ08-S	Alluvium	Count	42.00	42	38	41	41	41	41	41	41	40.0	40.0	41.0	41.0	40	40	20	41	41	40	40	40	20
PZ08-S	Alluvium	Min	5.01	1070	685	39	30	138	11	176	40	0.5	0.3	220.0	268.4	0.025	0.005	0.0005	0.0005	0.000025	0.0005	0.0005	0.0005	0.025
PZ08-S	Alluvium	Max	7.97	5313	3340	239	184	554	26	1400	217	340.0	204.0	549.0	669.8	0.83	0.02	0.0005	0.001	0.0005	0.005	0.005	0.005	0.2
PZ08-S	Alluvium	Avg	6.82	2024	1244	75	58.46341	251.5122	18.41463	439.9268	89.63415	10.8	6.5	327.0	398.9	0.1037	0.00575	0.0005	0.000512	5.61E-05	0.000725	0.000725	0.0041	0.03625
PZ08-S	Alluvium	20th percentile	6.51	1489	875	51	41	184	16	280	61	0.5	0.3	260.0	317.2	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.0041	0.025
PZ08-S	Alluvium	80th percentile	7.10	2374	1451	94	74	288	22	568	106	2.5	1.5	397.0	484.3	0.13	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ08-S	Alluvium	95th percentile	7.78	3449	2132	129	88	402	25	884	169	5.1	3.1	448.0	546.6	0.1625	0.00575	0.0005	0.0005	0.00005	0.000725	0.00115	0.005	0.0575
PZ08-S	Alluvium	Stdev	0.98	6831	4640	197.8195	249.5525	1036.1754	15.35208	2329.466	425.5873	48.2	29.1	277.2	338.2	1.893984	0.030665	0.001046	325.209	3.9E-05	0.004846	0.0074	0.004159	35.31939158
PZ12-S	Regolith	Count	22.00	22	22	22	22	22	22	22	22	22.0	22.0	22.0	22.0	22	22	22	22	22	22	22	22	22
PZ12-S	Regolith	Min	6.51	5970	3290	74	114	18.6	0.0005	1270	119	0.5	0.3	661.0	806.4	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ12-S	Regolith	Max	8.40	6851	4385	108	164	1200	13	1590	143	125.0	75.0	1000.0	1220.0	0.56	0.005	0.005	1050	0.00005	0.001	0.004	0.023	25
PZ12-S	Regolith	Avg	7.18	6426	3672	88.59091	144.5455	1019.4364	9.318205	1475.909	129.1364	6.2	3.7	924.0	1127.3	0.178182	0.005	0.000705	47.73084	0.00005	0.000523	0.0015	0.005818	2.310227273
PZ12-S	Regolith	20th percentile	6.69	6206	3430	86	140.2	1002	9	1452	123.2	0.5	0.3	887.4	1082.6	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.001	0.005	0.025
PZ12-S	Regolith	80th percentile	7.91	6638	3716	90.8	149	1122	10	1520	133.6	0.5	0.3	983.6	1200.0	0.25	0.005	0.0005	0.0078	0.00005	0.0005	0.002	0.005	0.025
PZ12-S	Regolith	95th percentile	8.08	6850	4384	96.95	155.9	1177.5	12.9	1549.5	142.65	0.5	0.3	999.9	1219.9	0.338	0.005	0.0005	0.0158	0.00005	0.0005	0.00395	0.005	23.7675
PZ12-S	Regolith	Stdev	0.99	6715	4575	199.2203	249.4423	1019.7605	15.61997	2306.057	428.2118	47.1	28.5	290.6	354.5	1.916383	0.031142	0.001066	333.0802	3.47E-05	0.004917	0.0075	0.004258	35.25389077
MB20CVM06T	Regolith	Count	10.00	10	9	9	9	9	9	9	9	9.0	9.0	9.0	9.0	9	9	9	9	9	9	9	9	9
MB20CVM06T	Regolith	Min	6.36	18761	1110	52	41	36.5	0.0005	493	151	0.5	0.3	84.0	102.5	0.025	0.005	0.0005	0.003	0.00005	0.0005	0.003	0.005	0.18
MB20CVM06T	Regolith	Max	6.54	22073	14700	498	708	3930	99	6470	2110	0.5	0.3	560.0	683.2	11.2	0.02	0.005	3140	0.00005	0.001	0.007	0.02	360
MB20CVM06T	Regolith	Avg	6.48	20807	12679	400.3333	568.7778	2627.7222	74.88894	5607	1811.222	0.5	0.3	453.6	553.3	7.741667	0.006667	0.001056	348.8924	0.00005	0.000556	0.004444	0.006667	54.64111111
MB20CVM06T	Regolith	20th percentile	6.46	20474	13240	421.6	608.4	1963.2	59.8	6030	1966	0.5	0.3	445.8	543.9	6.88	0.005	0.0005	0.004	0.00005	0.0005	0.0036	0.005	0.222
MB20CVM06T	Regolith	80th percentile	6.51	21264	14640	460.6	641.2	3320	95	6364	2048	0.5	0.3	542.2	661.5	9.842	0.005	0.0007	0.0044	0.00005	0.0005	0.005	0.005	52.198
MB20CVM06T	Regolith	95th percentile	6.54	21737	14700	485.2	688	3698	97.4	6430	2090	0.5	0.3	558.4	681.2	11	0.014	0.0034	1884.002	0.00005	0.0008	0.0062	0.014	268
MB20CVM06T	Regolith	Stdev	1.00	6942	4729	202.2693	255.7573	1056.6184	18.06553	2361.289	471.6971	47.4	28.6	281.7	343.7	2.151951	0.031505	0.001084	358.8879	3.51E-05	0.004974	0.007583	0.004287	40.95870608
MB19CVM03T	Basalt	Count	17.00	17	18	18	18	18	18	18	18	18.0	16.0	18.0	18.0	18	18	18	18	18	18	18	18	18
MB19CVM03T	Basalt	Min	7.61	2776	1440	2	2	44.6	0.0005	610	44	0.5	0.3	0.5	0.3	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.004	0.0005	0.025
MB19CVM03T	Basalt	Max	11.38	3511	1920	28	70	635	13	704	147	311.0	186.6	768.0	937.0	0.1	0.02	0.005	575	0.00005	0.007	0.042	0.005	25
MB19CVM03T	Basalt	Avg	8.25	3113	1698	16.44444	50.5	539.2	5.611139	667.8889	58.72222	50.6	32.0	514.3	627.4	0.04	0.006667	0.000778	31.94636	0.00005	0.002861	0.01	0.00475	2.815555556
MB19CVM03T	Basalt	20th percentile	7.77	2934	1624	12	41.2	540.4	5	646.8	46.4	0.5	0.3	433.2	528.5	0.025	0.005	0.0005	0.002	0.00005	0.001	0.0058	0.005	0.025
MB19CVM03T	Basalt	80th percentile	8.42	3197	1752	23.4	67	588.2	6	690.2	62.2	46.4	28.8	647.8	790.3	0.066	0.005	0.0005	0.002	0.00005	0.004	0.01	0.005	0.076
MB19CVM03T	Basalt	95th percentile	9.36	3429	1869	28	70	629.9	7.05	702.3	94.3	213.3	134.9	735.7	897.6	0.0745	0.02	0.0016	86.25255	0.00005	0.007	0.0182	0.005	25
MB19CVM03T	Basalt	Stdev	1.01	6802	4634	201.4212	251.9759	1029.944	15.72512	2329.655	430.7443	49.5	30.0	280.8	342.6	1.924013	0.031255	0.001072	332.3137	3.48E-05	0.00495	0.007759	0.00421	35.44119132
MB19CVM05T	Basalt	Count	17.00	17	18	18	18	18	18	18	18	18.0	17.0	18.0	18.0	17	18	18	18	18	18	18	18	18
MB19CVM05T	Basalt	Min	7.27	1406	745	36	60	25.5	0.0005	222	42	0.5	0.3	0.5	0.6	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.0005	0.025
MB19CVM05T	Basalt	Max	8.67	1634	854	52	66	190	5	408	102	376.0	225.6	408.0	497.8	0.11	0.02	0.005	173	0.00005	0.002	0.006	0.005	25
MB19CVM05T	Basalt	Avg	7.68	1488	802	45.16667	62.22222	165.97222	4.72225	250.7778	47.72222	24.6	15.0	362.0	441.7	0.051176	0.006667	0.00075	9.612472	0.00005	0.000611	0.003222	0.00475	2.916388889
MB19CVM05T	Basalt	20th percentile	7.55	1455	784	43.4	60.4	164.4	5	233.8	43.4	0.5	0.3	376.8	459.7	0.025	0.005	0.0005	0.001	0.00005	0.0005	0.003	0.005	0.025
MB19CVM05T	Basalt	80th percentile	7.70	1507	826	46.6	63.6	181.2	5	250.6	45	8.0	0.3	394.0	480.7	0.088	0.005	0.0005	0.002	0.00005	0.0005	0.004	0.005	0.536
MB19CVM05T	Basalt	95th percentile	8.10	1554	851	51.15	65.15	185.75	5	280.5	61.2	81.9	59.5	399.5	487.4	0.102	0.02	0.001175	25.9517	0.00005	0.00115	0.0043	0.005	25
MB19CVM05T	Basalt	Stdev	0.99	6849	4663	200.6339	251.6745	1040.3041	15.73991	2342.061	431.0048	49.5	29.9	280.2	341.9	1.925143	0.031255	0.001072	331.6288	3.48E-05	0.004934	0.007519	0.00421	35.44050109
MB19CVM06T	Basalt	Count	0.00	0	1	1	1	1	1	1	1	1.0	1.0	1.0	1.0	1	1	1	1	1	1	1	1	1
MB19CVM06T	Basalt	Min	0.00	0	13600	476	621	35.8	90	6010	2110	0.5	0.3	464.0	566.1	7.54	0.005	0.005	3050	0.00005	0.0005	0.005	0.029	0.11
MB19CVM06T	Basalt	Max	0.00	0	13600	476	621	35.8	90	6010	2110	0.5	0.3	464.0	566.1	7.54	0.005	0.005	3050	0.00005	0.0005	0.005	0.029	0.11
MB19CVM06T	Basalt	Avg	#DIV/0!	#DIV/0!	13600	476	621	35.8	90	6010	2110	0.5	0.3	464.0	566.1	7.54	0.005	0.005	3050	0.00005	0.0005	0.005	0.029	0.11
MB19CVM06T	Basalt	20th percentile	#NUM!	#NUM!	13600	476	621	35.8	90	6010	2110	0.5	0.3	464.0	566.1	7.54	0.005	0.005	3050	0.00005	0.0005	0.005	0.029	0.11
MB19CVM06T	Basalt	80th percentile	#NUM!	#NUM!	13600	476	621	35.8	90	6010	2110	0.5	0.3	464.0	566.1	7.54	0.005	0.005	3050	0.00005	0.0005	0.005	0.029	0.11
MB19CVM06T	Basalt	95th percentile	#NUM!	#NUM!	13600	476	621	35.8	90	6010	2110	0.5	0.3	464.0	566.1	7.54	0.005	0.005	3050	0.00005	0.0005	0.005	0.029	0.11
MB19CVM06T	Basalt	Stdev	1.00	6828	4660	201.9563	253.7847	1038.0853	16.17253	2342.091	439.2814	47.7	28.8	283.2	345.5	1.966287	0.031732	0.001096	360.0432	3.54E-05	0.005009	0.007637	0.004394	36.24442421
MB19CVM07T	Basalt	Count	17.00	17	18	18	18	18	18	17	17	17.0	16.0	17.0	17.0	17	18	18	18	18	18	18	18	18
MB19CVM07T	Basalt	Min	7.44	1141	656	41	42	144	0.0005	87	12	0.5	0.3	446.0	544.1	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.005	0.025

Appendix A2

Bore	Aquifer	Statistic	In-situ pH	In-situ EC	TDS	Ca	Mg	Na	K	Cl	SO4	Carbonate Alkalinity as CaCO3	Carbonate Alkalinity as CO3-	Bicarbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as HCO3-	Fe	Al	Ag	As	Hg	Sb	Mo	Se	Total Petroleum Hydrocarbons C10-C36 Fraction(sum)
MB19CVM07T	Basalt	Max	8.34	1342	820	56	48	177	5	108	24	24.0	9.6	524.0	639.3	0.27	0.005	0.0005	0.004	0.00005	0.002	0.003	0.005	25
MB19CVM07T	Basalt	Avg	7.56	1219	707	47.66667	45.5	159.5	4.222278	96.29412	16.29412	3.5	1.4	492.0	600.2	0.091471	0.005	0.0005	0.000889	0.00005	0.000667	0.002167	0.005	2.8
MB19CVM07T	Basalt	20th percentile	7.46	1194	684	45	43.4	152.8	4	92.2	14.2	0.5	0.3	472.0	575.8	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.005	0.025
MB19CVM07T	Basalt	80th percentile	7.57	1237	733	50.6	47	165.8	5	100	17.8	0.5	0.3	512.0	624.6	0.14	0.005	0.0005	0.001	0.00005	0.0005	0.002	0.005	0.025
MB19CVM07T	Basalt	95th percentile	7.76	1275	762	52.6	48	173.6	5	104.8	20.8	17.6	8.3	523.2	638.3	0.198	0.005	0.0005	0.00145	0.00005	0.002	0.003	0.005	25
MB19CVM07T	Basalt	Stdev	0.99	6858	4667	200.5716	252.0814	1040.5054	15.75211	2346.895	431.9304	47.1	28.4	279.1	340.5	1.924551	0.031252	0.001049	331.5992	3.48E-05	0.004934	0.007519	0.004205	35.44130422
MB20CVM02A	Basalt	Count	2.00	2	2	2	2	2	2	2	2	2.0	2.0	2.0	2.0	2	2	2	2	2	2	2	2	2
MB20CVM02A	Basalt	Min	6.79	1404	731	45	35	223	6	169	60	0.5	0.3	402.0	490.4	0.025	0.005	0.0005	0.001	0.00005	0.00005	0.0005	0.005	0.05
MB20CVM02A	Basalt	Max	8.47	1692	899	47	39	253	6	224	72	10.0	6.0	450.0	549.0	0.22	0.005	0.0005	0.002	0.00005	0.0005	0.002	0.005	25
MB20CVM02A	Basalt	Avg	7.63	1548	815	46	37	238	6	196.5	66	5.3	3.2	426.0	519.7	0.1225	0.005	0.0005	0.0015	0.00005	0.000275	0.00125	0.005	12.525
MB20CVM02A	Basalt	20th percentile	7.13	1462	765	45.4	35.8	229	6	180	62.4	2.4	1.4	411.6	502.2	0.064	0.005	0.0005	0.0012	0.00005	0.00014	0.0008	0.005	5.04
MB20CVM02A	Basalt	80th percentile	8.13	1634	865	46.6	38.2	247	6	213	69.6	8.1	4.9	440.4	537.3	0.181	0.005	0.0005	0.0018	0.00005	0.00041	0.0017	0.005	20.01
MB20CVM02A	Basalt	95th percentile	8.39	1678	891	46.9	38.8	251.5	6	221.25	71.4	9.5	5.7	447.6	546.1	0.21025	0.005	0.0005	0.00195	0.00005	0.000478	0.001925	0.005	23.7525
MB20CVM02A	Basalt	Stdev	1.00	6830	4654	201.6864	253.3967	1037.715	15.85528	2340.52	433.2004	47.7	28.8	282.9	345.2	1.944999	0.031703	0.001071	336.2733	3.53E-05	0.005005	0.00763	0.004267	36.20775589
MB19CVM09A	Basalt	Count	17.00	17	19	19	19	19	19	19	19	19.0	19.0	19.0	19.0	19	19	19	19	19	19	19	19	19
MB19CVM09A	Basalt	Min	6.19	2328	782	46	32	55	0.0005	233	80	0.5	0.3	232.0	283.0	0.025	0.005	0.0005	0.001	0.00005	0.0005	0.0005	0.001	0.025
MB19CVM09A	Basalt	Max	7.76	3693	2620	127	120	678	15	871	386	0.5	0.3	660.0	805.2	1.24	0.57	0.005	298	0.00005	0.012	0.01	0.005	25
MB19CVM09A	Basalt	Avg	6.65	2838	1692	93	86.26316	356.58947	11.73687	576.1579	179.2105	0.5	0.3	473.2	577.3	0.711316	0.036579	0.000974	30.16134	0.00005	0.001895	0.002868	0.004579	2.989473684
MB19CVM09A	Basalt	20th percentile	6.34	2615	1472	77	66	306.2	11	490.4	143.8	0.5	0.3	398.0	485.6	0.296	0.005	0.0005	0.002	0.00005	0.0005	0.0005	0.005	0.025
MB19CVM09A	Basalt	80th percentile	6.77	3127	1896	111.8	107.6	423.8	14	680.4	185.4	0.5	0.3	556.8	679.3	1.038	0.007	0.0005	0.006	0.00005	0.0024	0.0054	0.005	1.108
MB19CVM09A	Basalt	95th percentile	7.58	3566	2269	127	116.4	604.2	15	845.8	368.9	0.5	0.3	636.6	776.7	1.24	0.075	0.005	277.3	0.00005	0.0057	0.0082	0.005	25
MB19CVM09A	Basalt	Stdev	0.99	6809	4634	199.518	251.0503	1034.5225	15.63249	2331.857	428.2045	47.0	28.4	279.3	340.8	1.916011	0.039285	0.001093	331.585	3.48E-05	0.004952	0.007531	0.004208	35.39187967
MB20CVM04T	Basalt	Count	11.00	11	10	10	10	10	10	10	10	10.0	10.0	10.0	10.0	10	10	10	10	10	10	10	10	10
MB20CVM04T	Basalt	Min	7.04	10437	6650	120	295	56	0.0005	3200	363	0.5	0.3	594.0	724.7	0.13	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.0005	0.025
MB20CVM04T	Basalt	Max	7.91	13173	7880	160	398	1820	16	3920	470	0.5	0.3	660.0	805.2	1.68	0.005	0.005	1730	0.00005	0.0005	0.001	0.005	25
MB20CVM04T	Basalt	Avg	7.17	11595	7011	138.2	336.8	1563.6	13.30005	3493	404.3	0.5	0.3	631.3	770.2	1.222	0.005	0.001	173.0005	0.00005	0.0005	0.00065	0.00455	5.02
MB20CVM04T	Basalt	20th percentile	7.07	10684	6736	129.2	299	1656	14	3270	373	0.5	0.3	611.4	745.9	1.058	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
MB20CVM04T	Basalt	80th percentile	7.15	12317	7156	146.6	362.8	1786	15.2	3710	429.8	0.5	0.3	649.8	792.8	1.524	0.005	0.0006	0.0005	0.00005	0.0005	0.001	0.005	5.02
MB20CVM04T	Basalt	95th percentile	7.55	13109	7565	155.05	383.6	1815.5	16	3861.5	460.55	0.5	0.3	658.7	803.6	1.617	0.005	0.0032	951.5002	0.00005	0.0005	0.001	0.005	25
MB20CVM04T	Basalt	Stdev	0.99	6770	4610	200.2173	251.5243	1031.0769	15.74491	2321.333	429.6129	47.4	28.6	281.5	343.4	1.930559	0.031475	0.001083	341.3608	3.51E-05	0.004969	0.00758	0.004241	35.82500418
MB20CVM04T	Basalt	Count	11.00	11	10	10	10	10	10	10	10	10.0	10.0	10.0	10.0	10	10	10	10	10	10	10	10	10
MB20CVM04T	Basalt	Min	7.04	10437	6650	120	295	56	0.0005	3200	363	0.5	0.3	594.0	724.7	0.13	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.0005	0.025
MB20CVM04T	Basalt	Max	7.91	13173	7880	160	398	1820	16	3920	470	0.5	0.3	660.0	805.2	1.68	0.005	0.005	1730	0.00005	0.0005	0.001	0.005	25
MB20CVM04T	Basalt	Avg	7.17	11595	7011	138.2	336.8	1563.6	13.30005	3493	404.3	0.5	0.3	631.3	770.2	1.222	0.005	0.001	173.0005	0.00005	0.0005	0.00065	0.00455	5.02
MB20CVM04T	Basalt	20th percentile	7.07	10684	6736	129.2	299	1656	14	3270	373	0.5	0.3	611.4	745.9	1.058	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
MB20CVM04T	Basalt	80th percentile	7.15	12317	7156	146.6	362.8	1786	15.2	3710	429.8	0.5	0.3	649.8	792.8	1.524	0.005	0.0006	0.0005	0.00005	0.0005	0.001	0.005	5.02
MB20CVM04T	Basalt	95th percentile	7.55	13109	7565	155.05	383.6	1815.5	16	3861.5	460.55	0.5	0.3	658.7	803.6	1.617	0.005	0.0032	951.5002	0.00005	0.0005	0.001	0.005	25
MB20CVM04T	Basalt	Stdev	0.99	6770	4610	200.2173	251.5243	1031.0769	15.74491	2321.333	429.6129	47.4	28.6	281.5	343.4	1.930559	0.031475	0.001083	341.3608	3.51E-05	0.004969	0.00758	0.004241	35.82500418
Pz02	Basalt	Count	2.00	2	0	3	3	3	3	3	3	3.0	3.0	3.0	3.0	2	2	0	3	3	2	2	2	0
Pz02	Basalt	Min	7.58	2180	0	29	33	243	4	114	92	0.5	0.3	531.0	647.8	0.014	0.005	0	0.001	0.00005	0.0005	0.024	0.005	0
Pz02	Basalt	Max	7.87	2580	0	40	52	413	10	352	168	0.5	0.3	633.0	772.3	0.2	0.02	0	0.006	0.00005	0.0005	0.026	0.005	0
Pz02	Basalt	Avg	7.73	2380	#DIV/0!	35	42	325	7.333333	199	118	0.5	0.3	567.3	692.1	0.107	0.0125	#DIV/0!	0.002667	0.00005	0.0005	0.025	0.005	#DIV/0!
Pz02	Basalt	20th percentile	7.64	2260	#NUM!	31.8	36.2	273.4	5.6	120.8	92.8	0.5	0.3	533.8	651.2	0.0512	0.008	#NUM!	0.001	0.00005	0.0005	0.0244	0.005	#NUM!
Pz02	Basalt	80th percentile	7.81	2500	#NUM!	38.4	47.6	375.4	9.2	263.6	138.4	0.5	0.3	595.0	725.9	0.1628	0.017	#NUM!	0.004	0.00005	0.0005	0.0256	0.005	#NUM!
Pz02	Basalt	95th percentile	7.86	2560	#NUM!	39.6	50.9	403.6	9.8	329.9	160.6	0.5	0.3	623.5	760.7	0.1907	0.01925	#NUM!	0.0055	0.00005	0.0005	0.0259	0.005	#NUM!
Pz02	Basalt	Stdev	1.00	6827	4652	201.6708	253.3086	1037.3021	15.84319	2340.796	432.8427	47.6	28.8	282.7	344.9	1.945027	0.031705	0.001074	335.9754	3.53E-05	0.005005	0.007746	0.004267	36.29517773
Pz03-S	Basalt	Count	28.00	29	23	26	26	26	26	26	26	26.0	26.0	26.0	26.0	25	25	11	26	26	25	25	25	11
Pz03-S	Basalt	Min	5.46	10690	6842	140	400	1980	7	4200	294	0.5	0.3	635.0	774.7	0.017	0.005	0.0005	0.0005	0.000025	0.0005	0.001	0.0005	0.025
Pz03-S	Basalt	Max	8.23	16390	16256	211	667	2470	17	5280	497	2.5	1.5	1020.0	1244.4	1.38	0.03	0.0005	0.002	0.00005	0.005	0.005	0.024	0.11
Pz03-S	Basalt	Avg	6.98	13680	9201	175.5769	529.2692	2186.1538	12	4675.385	409.6923	0.7	0.4	902.5	1101.0	0.18268	0.0072	0.0005	0.000558	4.81E-05	0.00072	0.00216	0.00522	0.040454545
Pz03-S	Basalt	20th percentile	6.70	12868	8446	158	499	2090	10	4470	364	0.5	0.3	866.0	1056.5	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.005	0.025
Pz03-S	Basalt	80th percentile	7.54	14572	9430	190	569	2310	14	4840	459	0.5	0.3	956.0	1166.3	0.32	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.005	0.025
Pz03-S	Basalt	95th percentile	8.14	15496	10436	208.25	624.75	2430	15	5197.5	489.5	2.0	1.2	986.0	1202.9	0.424	0.02	0.0005	0.0005	0.00005	0.001	0.0038	0.005	0.11
Pz03-S	Basalt	Stdev	0.99	6735	4614	197.3368	254.6032	1030.7118	15.5357	2323.66	423.6546	46.7	28.2	290.3	354.2	1.912787	0.031074	0.001059	329.3341	3.46E-05	0.004906	0.007475	0.004268	35.74863335
Pz06-S	Basalt	Count	18.00	17	13	16	16	16	16	16	16	16.0	16.0	16.0	16.0	15	15	0	16	16	15	15	15	0
Pz06-S	Basalt	Min	4.35	1480	961	30	69	215	3.5	250	25	0.5	0.3	462.0	563.6	0.025	0.005	0	0.0005	0.000025	0.0005	0.009	0.0005	0
Pz06-S	Basalt	Max	8.21	2151	9523	51	90	320	6.9	336	58	2.5	1.5	584.0	712.5	0.3	0.05	0	0.004	0.00005	0.005	0.014	0.005	0
Pz06-S	Basalt	Avg	7.44	1720	1823	40	76.625	240.9375	4.3125	283.125	33.5625	1.0	0.6	528.5	644.8	0.1116	0.016	#DIV/0!	0.001281	4.38E-05	0.001133	0.010933	0.0038	#DIV/0!
Pz06-S	Basalt	20th percentile	7.46	1610	1032	38	74	222	4	271	29	0.5	0.3	508.0	619.8	0.025	0.005	#NUM!	0.0005	0.000025	0.0005	0.01	0.0005	#NUM!
Pz06-S	Basalt	80th percentile	7.78	1798	1336	42	79	250	4	296	35	2.5	1.5	550.0	671.0	0.252	0.034	#NUM!	0.002	0.00005	0.001	0.012	0.005	#NUM!
Pz06-S	Basalt	95th percentile	8.03	2025	4978	46.5	86.25	284	6.675	312.75	42.25	2.5	1.5	571.3	696.9	0.293	0.05	#NUM!	0.0025	0.00005	0.0043	0.0126	0.005	#NUM!
Pz06-S	Basalt	Stdev	1.00	6842	4650	200.887	251.5943	1037.8749	15.76244	2341.019	431.6151	47.1	28.4	279.4	340.9	1.927023	0.031477	0.001074	332.1729	3.5E-05	0.00495	0.007648	0.004235	36.29517773
MB20CVM05P	D Seam	Count	11.00	11	10	10	10	10	10	10	10	10.0	10.0	10.0	10.0	10	10	10	10	10	10	10	10	10
MB20CVM05P	D Seam	Min	6.58	14463	8520	203	354	15.7	0.0005	4490	679	0.5	0.3	404.0	492.9	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
MB20CVM05P	D Seam	Max	8.28	20006	13300	357	533	3200	29	6370	870	0.5	0.3	582.0	710.0	1.7	0.005	0.005	2970	0.00005	0.004	0.005	0.014	25
MB20CVM05P	D Seam	Avg	6.81	18772	11922	322.2	496.2	2658.57	24.20005	5997	814	0.5	0.3	540.5	659.4	1.1085	0.005	0.00095	297.0032	0.00005	0.00085	0.0011	0.0059	5.02

Appendix A2

Bore	Aquifer	Statistic	In-situ pH	In-situ EC	TDS	Ca	Mg	Na	K	Cl	SO4	Carbonate Alkalinity as CaCO3	Carbonate Alkalinity as CO3-	Bicarbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as HCO3-	Fe	Al	Ag	As	Hg	Sb	Mo	Se	Total Petroleum Hydrocarbons C10-C36 Fraction(sum)
MB20CVM05P	D Seam	20th percentile	6.61	18768	11520	319	487	2800	25	5838	807	0.5	0.3	529.8	646.4	1.046	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
MB20CVM05P	D Seam	80th percentile	6.77	19381	12800	343.2	523.4	3112	28.2	6306	841.4	0.5	0.3	578.4	705.6	1.268	0.005	0.0005	0.0068	0.00005	0.0005	0.001	0.005	5.02
MB20CVM05P	D Seam	95th percentile	7.55	19724	13255	352.95	529.4	3182	29	6370	857.85	0.5	0.3	581.1	708.9	1.592	0.005	0.002975	1633.512	0.00005	0.002425	0.0032	0.00995	25
MB20CVM05P	D Seam	Stdev	0.99	6895	4685	200.6418	253.4097	1051.0944	15.8093	2361.192	433.1739	47.4	28.6	281.0	342.8	1.930434	0.031475	0.001083	356.0119	3.51E-05	0.00497	0.00758	0.004253	35.82500418
PZ01	D Seam	Count	44.00	44	41	44	44	44	44	44	44	44.0	44.0	44.0	44.0	43	43	22	44	44	43	43	43	22
PZ01	D Seam	Min	5.71	3550	1016	111	95	17.9	0.0005	3	95	0.5	0.3	357.0	435.5	0.025	0.005	0.0005	0.0005	0.000025	0.0005	0.0005	0.0005	0.025
PZ01	D Seam	Max	7.29	24100	15424	411	610	3120	20	6700	860	21.0	12.6	708.0	863.8	1.11	0.02	0.005	2630	0.0002	0.005	0.001	0.011	25
PZ01	D Seam	Avg	6.70	15499	9675	247.1364	337.8409	2469.2705	13.09092	4826.432	528.7727	1.4	0.8	617.1	752.9	0.385698	0.005512	0.000705	59.77325	4.89E-05	0.000686	0.000651	0.004198	2.301363636
PZ01	D Seam	20th percentile	6.58	14306	8900	200	256.4	2384	11	4492	456.8	0.5	0.3	547.6	668.1	0.164	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.0023	0.025
PZ01	D Seam	80th percentile	6.90	17363	11000	296.8	423.4	2794	16	5452	592.6	1.3	0.8	670.0	817.4	0.562	0.005	0.0005	0.0005	0.00005	0.0005	0.001	0.005	0.025
PZ01	D Seam	95th percentile	7.20	17867	11600	323.05	477.95	2982	17.85	5684	609.4	2.5	1.5	692.7	845.1	0.833	0.005	0.0005	0.001	0.00005	0.001	0.001	0.005	23.755
PZ01	D Seam	Stdev	0.97	6820	4617	194.9685	246.3674	1055.8209	15.31823	2334.736	419.3232	46.0	27.8	275.3	335.9	1.882522	0.030584	0.001066	341.2878	3.47E-05	0.004832	0.007381	0.00416	35.2539656
PZ03-D	D Seam	Count	34.00	35	29	32	32	32	32	32	32	32.0	32.0	32.0	32.0	31	31	11	32	32	31	31	31	11
PZ03-D	D Seam	Min	5.27	6452	4129	121	228	1020	9	1830	279	0.5	0.3	278.0	339.2	0.025	0.005	0.0005	0.0005	0.000025	0.0005	0.0005	0.0005	0.025
PZ03-D	D Seam	Max	8.27	38600	24704	372	803	4300	38	7970	1130	2.5	1.5	950.0	1159.0	5.5	0.25	0.001	0.025	0.00025	0.005	0.005	0.05	0.025
PZ03-D	D Seam	Avg	6.78	20223	13108	285.4688	650.6875	3140.625	23.1875	6477.5	797.8125	0.9	0.6	714.9	872.2	2.503548	0.013548	0.000545	0.001641	5.31E-05	0.000823	0.001113	0.0065	0.025
PZ03-D	D Seam	20th percentile	6.34	16454	9852	187.6	530.4	2500	15.4	5140	410	0.5	0.3	662.4	808.1	0.21	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.0005	0.025
PZ03-D	D Seam	80th percentile	7.17	23392	14986	345.8	749.6	3574	29.8	7540	1008	2.1	1.3	866.0	1056.5	3.47	0.005	0.0005	0.001	0.00005	0.0005	0.002	0.005	0.025
PZ03-D	D Seam	95th percentile	7.83	24974	16325	358.15	781.7	4112	33.45	7918	1089	2.5	1.5	919.0	1121.2	4.885	0.015	0.00075	0.0029	7.25E-05	0.003	0.0025	0.0215	0.025
PZ03-D	D Seam	Stdev	0.99	7237	4885	197.6798	264.3921	1104.5685	15.61802	2454.938	435.8756	46.5	28.1	282.0	344.1	1.956592	0.032508	0.001058	327.6653	3.55E-05	0.004883	0.007448	0.004799	35.74870267
PZ05	D Seam	Count	5.00	5	1	4	4	4	4	4	4	4.0	4.0	4.0	4.0	3	3	1	4	4	3	3	3	1
PZ05	D Seam	Min	7.18	1075	20300	64	35	94	1	1	3	0.5	0.3	289.0	352.6	0.025	0.02	0.0025	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ05	D Seam	Max	7.46	26800	20300	705	760	3870	33	9140	1130	0.5	0.3	667.0	813.7	0.46	0.03	0.0025	0.007	0.00005	0.0025	0.0025	0.025	0.025
PZ05	D Seam	Avg	7.28	11374	20300	315.75	316.25	1696.75	15	3744.75	388.75	0.5	0.3	432.5	527.7	0.305	0.025	0.0025	0.002625	0.00005	0.001167	0.001167	0.011667	0.025
PZ05	D Seam	20th percentile	7.20	1605	20300	73.6	35	99.4	1	89.2	10.8	0.5	0.3	305.2	372.3	0.187	0.022	0.0025	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ05	D Seam	80th percentile	7.35	16264	20300	530.4	565	3180	28.2	7070	695.6	0.5	0.3	541.6	660.8	0.448	0.028	0.0025	0.0043	0.00005	0.0017	0.0017	0.017	0.025
PZ05	D Seam	95th percentile	7.43	24166	20300	661.35	711.25	3697.5	31.8	8622.5	1021.4	0.5	0.3	635.7	775.5	0.457	0.0295	0.0025	0.006325	0.00005	0.0023	0.0023	0.023	0.025
PZ05	D Seam	Stdev	1.00	6859	4692	202.5498	253.9871	1043.9041	15.86243	2356.408	433.7084	47.6	28.8	282.7	344.9	1.943186	0.031691	0.001076	335.6782	3.53E-05	0.005	0.007624	0.004349	36.24446038
Pz06-D	P Seam	Count	3.00	3	0	2	2	2	2	2	2	2.0	2.0	2.0	2.0	1	1	0	2	2	1	1	1	0
Pz06-D	P Seam	Min	4.34	1691	0	36	41	298	4	256	75	0.5	0.3	474.0	578.3	0.4	0.005	0	0.0005	0.00005	0.0005	0.004	0.005	0
Pz06-D	P Seam	Max	6.89	1981	0	36	43	347	4	365	105	0.5	0.3	484.0	590.5	0.4	0.005	0	0.005	0.00005	0.0005	0.004	0.005	0
Pz06-D	P Seam	Avg	6.01	1828	#DIV/0!	36	42	322.5	4	310.5	90	0.5	0.3	479.0	584.4	0.4	0.005	#DIV/0!	0.00275	0.00005	0.0005	0.004	0.005	#DIV/0!
Pz06-D	P Seam	20th percentile	5.33	1740	#NUM!	36	41.4	307.8	4	277.8	81	0.5	0.3	476.0	580.7	0.4	0.005	#NUM!	0.0014	0.00005	0.0005	0.004	0.005	#NUM!
Pz06-D	P Seam	80th percentile	6.86	1914	#NUM!	36	42.6	337.2	4	343.2	99	0.5	0.3	482.0	588.0	0.4	0.005	#NUM!	0.0041	0.00005	0.0005	0.004	0.005	#NUM!
Pz06-D	P Seam	95th percentile	6.88	1964	#NUM!	36	42.9	344.55	4	359.55	103.5	0.5	0.3	483.5	589.9	0.4	0.005	#NUM!	0.004775	0.00005	0.0005	0.004	0.005	#NUM!
Pz06-D	P Seam	Stdev	1.01	6830	4652	201.7166	253.3814	1037.413	15.86023	2340.087	433.1361	47.7	28.8	282.9	345.1	1.946193	0.031732	0.001074	336.2733	3.53E-05	0.005009	0.007636	0.004271	36.29517773
MB19CVM06P	H Seam	Count	12.00	12	18	18	18	18	18	18	18	18.0	18.0	18.0	18.0	17	18	18	18	18	18	18	18	18
MB19CVM06P	H Seam	Min	5.97	16780	1600	636	854	17	0.0005	683	82	0.5	0.3	216.0	263.5	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.0005	0.025
MB19CVM06P	H Seam	Max	8.07	20242	17200	822	1140	2020	17	8030	2500	191.0	114.6	402.0	490.4	7	0.005	0.005	1920	0.00005	0.0005	0.002	0.02	25
MB19CVM06P	H Seam	Avg	6.37	18739	13061	741.0556	1033.556	1617.4667	15.00003	6159.611	1198.278	11.1	6.7	350.6	427.7	5.389118	0.005	0.001	207.2259	0.00005	0.0005	0.000944	0.005583	2.8
MB19CVM06P	H Seam	20th percentile	6.18	17446	12840	675.2	970	1662	15	5940	1030	0.5	0.3	351.8	429.2	5.16	0.005	0.0005	0.001	0.00005	0.0005	0.0005	0.005	0.025
MB19CVM06P	H Seam	80th percentile	6.32	20060	14540	791.2	1112	1910	16	6880	1304	0.5	0.3	372.6	454.6	6.206	0.005	0.0005	0.0056	0.00005	0.0005	0.001	0.005	0.025
MB19CVM06P	H Seam	95th percentile	7.13	20217	16265	808.4	1140	1952	17	7137.5	1556.5	29.1	17.4	389.3	474.9	6.616	0.005	0.005	1826.5	0.00005	0.0005	0.002	0.00725	25
MB19CVM06P	H Seam	Stdev	1.00	6899	4791	219.7653	285.1885	1027.6111	15.63261	2395.485	455.4162	47.6	28.8	280.0	341.7	2.076027	0.031252	0.001094	348.6263	3.48E-05	0.004934	0.007528	0.004257	35.44130422
MB19CVM08P	H Seam	Count	10.00	10	12	12	12	12	12	11	11	11.0	10.0	11.0	11.0	11	12	12	12	12	12	12	12	12
MB19CVM08P	H Seam	Min	8.41	3560	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.5	0.3	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
MB19CVM08P	H Seam	Max	12.54	9553	3200	433	52	899	139	1050	160	250.0	150.0	348.0	424.6	0.09	0.13	0.0005	0.015	0.00005	0.056	0.098	0.005	1.06
MB19CVM08P	H Seam	Avg	11.35	5735	2250	166.125	9.041667	659.04167	41.54167	831.7727	76.13636	83.5	52.9	63.6	77.4	0.034091	0.042917	0.0005	0.002417	0.00005	0.012875	0.037875	0.005	0.25
MB19CVM08P	H Seam	20th percentile	11.05	3587	1774	8.6	0.5	616.6	9.6	816	43	20.0	9.7	0.5	0.3	0.025	0.005	0.0005	0.0005	0.00005	0.0016	0.0128	0.005	0.025
MB19CVM08P	H Seam	80th percentile	12.10	8628	3136	379	4.9	798.2	47.8	972	102	116.0	76.4	5.0	6.1	0.025	0.076	0.0005	0.0034	0.00005	0.019	0.0534	0.005	0.322
MB19CVM08P	H Seam	95th percentile	12.41	9315	3200	416.5	48.7	861.05	115.35	1035	151	211.5	129.2	345.5	421.5	0.075	0.1025	0.0005	0.00895	0.00005	0.0362	0.07985	0.005	0.697
MB19CVM08P	H Seam	Stdev	1.14	6788	4632	201.3718	253.2687	1031.1442	17.0997	2331.449	431.6116	49.4	29.9	287.5	350.7	1.93325	0.032293	0.001057	333.3291	3.5E-05	0.005669	0.00994	0.004228	35.69919042
MB19CVM10P	H Seam	Count	17.00	17	19	19	19	19	19	19	19	19.0	14.0	19.0	19.0	19	19	19	19	19	19	19	19	19
MB19CVM10P	H Seam	Min	7.91	1781	1050	0.5	0.5	18.3	0.0005	294	102	0.5	0.3	0.5	0.3	0.025	0.005	0.0005	0.002	0.00005	0.0005	0.001	0.0005	0.025
MB19CVM10P	H Seam	Max	11.92	3519	2200	25	18	547	37	573	184	376.0	225.6	344.0	419.7	0.09	0.1	0.005	492	0.0006	0.067	0.031	0.022	25
MB19CVM10P	H Seam	Avg	9.48	2654	1414	9.473684	7.157895	432.92632	13.00003	504.7368	146.4737	145.1	110.8	156.6	191.0	0.033158	0.019474	0.000974	51.37279	1E-04	0.012605	0.009684	0.005658	2.911315789
MB19CVM10P	H Seam	20th percentile	8.04	2467	1302	2.6	0.5	425.8	7	478.4	132.4	21.4	26.5	0.5	0.3	0.025	0.005	0.0005	0.0026	0.00005	0.0005	0.0036	0.005	0.025
MB19CVM10P	H Seam	80th percentile	10.78	2751	1450	17.4	13.4	515.6	19	566	170.2	291.4	177.6	331.0	403.8	0.025	0.04	0.0005	0.007	0.00005	0.0214	0.0142	0.005	0.806
MB19CVM10P	H Seam	95th percentile	11.66	3382	1624	20.5	16.2	522.7	29.8	567.6	184	317.5	200.3	338.6	413.1	0.072	0.064	0.005	484.8	0.00033	0.04	0.0211	0.0067	25
MB19CVM10P	H Seam	Stdev	1.09	6814	4642	201.6148	253.1157	1032.3564	15.69981	2333.913	428.6047	57.5	34.9	286.4	349.4	1.922831	0.031614	0.001093	332.2969	4.35E-05	0.006228	0.007727	0.004267	35.39235265
PZ10	H Seam	Count	2.00	2	0	2	2	2	2	2	2	2.0	2.0	2.0	2.0	1	1	0	2	2	1	1	1	0
PZ10	H Seam	Min	7.24	1718	0	45	25	122	4	169	71	0.5	0.3	139.0	169.6	1.58	0.005	0	0.0005	0.00005	0.0005	0.003	0.019	0
PZ10	H Seam	Max	7.40	9090	0	140	124	771	11	1210	626	0.5	0.3	176.0	214.7	1.58	0.005	0	0.0005	0.00005	0.0005	0.003	0.019	0
PZ10	H Seam	Avg	7.32	5404	#DIV/0!	92.5	74.5	446.5	7.5	689.5	348.5	0.5	0.3	157.5	192.2	1.58	0.005	#DIV/0!	0.0005	0.00005	0.0005	0.003	0.019	#DIV/0!
PZ10	H Seam	20th percentile	7.27	3192	#NUM!	64	44.8	251.8	5.4	377.2	182	0.5	0.3	146.4	178.6	1.58	0.005	#NUM!	0.0005	0.00005	0.0005	0.003	0.019	#NUM!
PZ10	H Seam	80th percentile	7.37	7616	#NUM!	121	104.2	641.2	9.6	1001.8	515	0.5	0.3	168.6	205.7	1.58	0.005	#NUM!	0.0005	0.00005	0.0005	0.003	0.019	#NUM!

Appendix A2

Bore	Aquifer	Statistic	In-situ pH	In-situ EC	TDS	Ca	Mg	Na	K	Cl	SO4	Carbonate Alkalinity as CaCO3	Carbonate Alkalinity as CO3-	Bicarbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as HCO3-	Fe	Al	Ag	As	Hg	Sb	Mo	Se	Total Petroleum Hydrocarbons C10-C36 Fraction(sum)
PZ10	H Seam	95th percentile	7.39	8721	#NUM!	135.25	119.05	738.55	10.65	1157.95	598.25	0.5	0.3	174.2	212.5	1.58	0.005	#NUM!	0.0005	0.00005	0.0005	0.003	0.019	#NUM!
PZ10	H Seam	Stdev	1.00	6822	4652	201.5901	253.3085	1037.1983	15.85358	2338.997	433.0679	47.7	28.8	283.6	346.0	1.946116	0.031732	0.001074	336.2733	3.53E-05	0.005009	0.007636	0.004313	36.29517773
MB20CVM03P	P Seam	Count	2.00	2	2	2	2	2	2	2	2	2.0	2.0	2.0	2.0	2	2	2	2	2	2	2	2	2
MB20CVM03P	P Seam	Min	7.32	6980	4210	140	83	1140	7	1910	238	0.5	0.3	200.0	244.0	0.025	0.005	0.0005	0.0005	0.00005	0.00005	0.001	0.005	0.05
MB20CVM03P	P Seam	Max	8.12	7430	4340	165	91	1210	7	2150	276	0.5	0.3	275.0	335.5	0.025	0.02	0.0005	0.001	0.00005	0.0005	0.003	0.005	25
MB20CVM03P	P Seam	Avg	7.72	7205	4275	152.5	87	1175	7	2030	257	0.5	0.3	237.5	289.8	0.025	0.0125	0.0005	0.00075	0.00005	0.000275	0.002	0.005	12.525
MB20CVM03P	P Seam	20th percentile	7.48	7070	4236	145	84.6	1154	7	1958	245.6	0.5	0.3	215.0	262.3	0.025	0.008	0.0005	0.0006	0.00005	0.00014	0.0014	0.005	5.04
MB20CVM03P	P Seam	80th percentile	7.96	7340	4314	160	89.4	1196	7	2102	268.4	0.5	0.3	260.0	317.2	0.025	0.017	0.0005	0.0009	0.00005	0.00041	0.0026	0.005	20.01
MB20CVM03P	P Seam	95th percentile	8.08	7408	4334	163.75	90.6	1206.5	7	2138	274.1	0.5	0.3	271.3	330.9	0.025	0.01925	0.0005	0.000975	0.00005	0.000478	0.0029	0.005	23.7525
MB20CVM03P	P Seam	Stdev	1.00	6816	4644	201.4781	253.2602	1035.7589	15.85315	2335.995	432.8179	47.7	28.8	283.3	345.7	1.945176	0.031705	0.001071	336.2733	3.53E-05	0.005005	0.00763	0.004267	36.20775589
PZ09	P Seam	Count	45.00	43	41	42	42	42	42	41	41	41.0	41.0	41.0	41.0	41	41	22	42	42	41	41	41	22
PZ09	P Seam	Min	5.60	1689	7398	43	25	16.3	0.0005	163	70	0.5	0.3	91.0	111.0	0.025	0.005	0.0005	0.0005	0.000025	0.0005	0.0005	0.0005	0.025
PZ09	P Seam	Max	7.85	24230	15507	833	621	3100	52	6300	1800	2.5	1.5	440.0	536.8	5.14	0.05	0.005	2020	0.00005	0.006	0.002	0.028	25
PZ09	P Seam	Avg	6.86	15785	10814	613.9048	452.8095	2079.6595	26.7143	5169.829	962.3415	0.7	0.4	237.9	290.2	2.642439	0.007854	0.000909	92.85762	4.7E-05	0.000646	0.000549	0.005341	2.295454545
PZ09	P Seam	20th percentile	6.60	14216	9790	541.4	368	1874	18	4810	758	0.5	0.3	121.0	147.6	1.61	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ09	P Seam	80th percentile	7.15	17948	12301	715.4	540	2560	39.8	5800	1130	0.5	0.3	382.0	466.0	4	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ09	P Seam	95th percentile	7.37	20469	13800	822.8	592.6	2797	47.95	6280	1300	2.5	1.5	430.0	524.6	4.67	0.02	0.004775	0.0005	0.00005	0.0005	0.0005	0.005	23.75125
PZ09	P Seam	Stdev	0.97	6865	4687	223.6793	251.346	1034.4941	15.89605	2357.547	447.3461	46.1	27.9	282.6	344.7	1.956205	0.030726	0.001089	343.2206	3.42E-05	0.004841	0.007395	0.00432	35.25401763
PZ11-D	P Seam	Count	32.00	32	30	33	33	33	33	33	33	33.0	33.0	33.0	33.0	32	32	12	33	33	32	32	32	12
PZ11-D	P Seam	Min	6.54	6510	554	121	60	507	6	978	161	0.5	0.3	60.0	73.2	0.005	0.005	0.0005	0.0005	0.000025	0.0005	0.0005	0.0005	0.025
PZ11-D	P Seam	Max	8.33	14900	9536	539	156	1530	15	3290	353	2.5	1.5	156.0	190.3	13	0.02	0.0005	0.015	0.00005	0.002	0.005	0.019	0.37
PZ11-D	P Seam	Avg	7.23	9073	5744	323.7879	131.697	1348.0909	8.706061	2890.242	249.4848	0.9	0.5	80.9	98.7	0.857813	0.005781	0.0005	0.000939	4.55E-05	0.000563	0.002047	0.004594	0.08125
PZ11-D	P Seam	20th percentile	6.85	8595	5460	280	130	1294	7.28	2884	222.4	0.5	0.3	73.4	89.5	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.005	0.025
PZ11-D	P Seam	80th percentile	7.52	9278	6232	355.8	138	1410	10	3092	267.6	0.5	0.3	84.6	103.2	0.868	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.005	0.157
PZ11-D	P Seam	95th percentile	8.00	11242	7269	478	146.2	1500	11	3160	308	2.5	1.5	101.4	123.7	1.6335	0.01	0.0005	0.0005	0.00005	0.000725	0.004	0.005	0.271
PZ11-D	P Seam	Stdev	0.98	6645	4530	198.7757	247.8034	1008.4689	15.5075	2274.447	422.4552	46.4	28.0	291.3	355.4	1.965809	0.030872	0.001057	327.3896	3.45E-05	0.004875	0.00743	0.00422	35.6999679
PZ04	Q Seam	Count	23.00	21	18	21	21	21	21	21	21	21.0	21.0	21.0	21.0	20	20	18	21	21	20	20	20	18
PZ04	Q Seam	Min	5.09	1107	6190	29	11	14.8	0.0005	0.5	3	0.5	0.3	111.0	135.4	0.025	0.0005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ04	Q Seam	Max	8.28	20300	13000	348	654	3120	79	6990	504	0.5	0.3	662.0	807.6	18	0.26	0.005	2260	0.00005	0.0005	0.001	0.029	25
PZ04	Q Seam	Avg	6.90	11685	8169	228.0476	261.6667	1758.9429	25.6905	3722.69	388.619	0.5	0.3	527.0	642.9	2.46475	0.031275	0.00075	107.62	0.00005	0.0005	0.000625	0.0062	2.8
PZ04	Q Seam	20th percentile	6.50	10223	6752	159	235	1540	20	3220	375	0.5	0.3	522.0	636.8	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ04	Q Seam	80th percentile	7.62	14781	9060	319	315	2360	35	4810	495	0.5	0.3	625.0	762.5	2.522	0.022	0.0005	0.002	0.00005	0.0005	0.001	0.005	0.025
PZ04	Q Seam	95th percentile	8.22	14960	9906	330	334	2520	46	4900	500	0.5	0.3	650.0	793.0	6.7235	0.1745	0.001175	0.003	0.00005	0.0005	0.001	0.0062	25
PZ04	Q Seam	Stdev	0.99	6783	4600	199.0339	250.1131	1035.0953	16.05377	2327.537	426.5198	46.9	28.3	279.4	340.8	2.066754	0.033673	0.001072	343.4429	3.47E-05	0.004926	0.007518	0.004318	35.44130422
PZ07-D	Q Seam	Count	43.00	42	36	40	40	40	40	40	40	40.0	40.0	40.0	40.0	39	39	20	40	40	39	39	39	20
PZ07-D	Q Seam	Min	4.81	2685	1718	33	43	21.1	3	312	51	0.5	0.3	285.0	347.7	0.005	0.005	0.0005	0.0005	0.000025	0.0005	0.0005	0.0005	0.025
PZ07-D	Q Seam	Max	7.70	6628	4130	202	194	912	10	1670	314	39.0	23.4	546.0	666.1	0.91	0.07	0.005	869	0.00005	0.02	0.003	0.005	25
PZ07-D	Q Seam	Avg	6.95	4732	2934	106.35	106.85	653.0075	7.335	1097.225	178.8	2.4	1.5	484.2	590.8	0.312821	0.007949	0.00095	42.32555	4.63E-05	0.001077	0.001141	0.004179	2.52925
PZ07-D	Q Seam	20th percentile	6.80	3943	2450	81.4	83	613.8	6	934.4	138	0.5	0.3	466.2	568.8	0.1	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.0042	0.025
PZ07-D	Q Seam	80th percentile	7.16	6075	3700	146.4	158.4	794.2	9	1500	276	0.9	0.5	514.2	627.3	0.474	0.005	0.0005	0.0005	0.00005	0.0005	0.002	0.005	0.025
PZ07-D	Q Seam	95th percentile	7.51	6479	4018	176.6	186.2	853.7	9	1631.5	308.1	3.7	2.2	528.8	645.1	0.583	0.02	0.005	41.2019	0.00005	0.0012	0.002	0.005	25
PZ07-D	Q Seam	Stdev	0.97	6681	4556	196.7733	247.674	1016.0724	15.47383	2295.5	422.4593	46.2	27.9	273.8	334.0	1.889757	0.030793	0.001091	328.7452	3.43E-05	0.004908	0.007396	0.004157	35.34723492
PZ08-D	Non Coal Permian	Count	19.00	17	14	16	16	16	16	16	16	16.0	16.0	16.0	16.0	15	15	0	16	16	15	15	15	0
PZ08-D	Non Coal Permian	Min	5.03	11320	1520	300	270	1700	34	3140	858	0.5	0.3	397.0	484.3	0.4	0.005	0	0.0005	0.000025	0.0005	0.0005	0.0005	0
PZ08-D	Non Coal Permian	Max	6.93	14260	9126	401	630	2600	48	4110	1350	2.5	1.5	448.0	546.6	2.98	0.05	0	0.002	0.00005	0.001	0.001	0.025	0
PZ08-D	Non Coal Permian	Avg	6.48	12484	7632	366.25	370.25	2003.125	42	3803.125	1161.75	0.9	0.5	417.9	509.9	1.927333	0.009333	#DIV/0!	0.000781	4.53E-05	0.000533	0.000533	0.005433	#DIV/0!
PZ08-D	Non Coal Permian	20th percentile	6.43	11816	7596	346	340	1890	36	3590	1090	0.5	0.3	407.0	496.5	1.548	0.005	#NUM!	0.0005	0.00005	0.0005	0.0005	0.0041	#NUM!
PZ08-D	Non Coal Permian	80th percentile	6.82	13248	8552	384	371	2050	47	4000	1260	0.5	0.3	430.0	524.6	2.382	0.006	#NUM!	0.001	0.00005	0.0005	0.0005	0.005	#NUM!
PZ08-D	Non Coal Permian	95th percentile	6.88	13740	8856	399.5	440.25	2247.5	48	4102.5	1305	2.5	1.5	437.5	533.8	2.973	0.029	#NUM!	0.002	0.00005	0.00065	0.00065	0.011	#NUM!
PZ08-D	Non Coal Permian	Stdev	1.00	6750	4607	200.699	250.9536	1029.8381	16.26285	2314.019	446.2441	47.1	28.4	279.6	341.1	1.9296	0.03138	0.001074	332.1729	3.49E-05	0.004947	0.00755	0.004315	36.29517773
PZ12-D	Non Coal Permian	Count	21.00	21	21	21	21	21	21	21	21	21.0	21.0	21.0	21.0	21	21	21	21	21	21	21	21	21
PZ12-D	Non Coal Permian	Min	6.65	5380	3000	40	78	18.3	0.0005	1160	109	0.5	0.3	882.0	1076.0	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.0005	0.025
PZ12-D	Non Coal Permian	Max	8.20	6444	4124	70	103	1240	9	1520	142	42.0	25.2	1060.0	1293.2	0.07	0.005	0.005	1040	0.00005	0.0005	0.002	0.005	25
PZ12-D	Non Coal Permian	Avg	7.21	5822	3319	55.28571	89.66667	1029.2048	7.047643	1281.905	120.1905	4.5	2.7	965.1	1177.5	0.027143	0.005	0.000714	49.52429	0.00005	0.0005	0.000595	0.004786	2.427142857
PZ12-D	Non Coal Permian	20th percentile	6.76	5533	3070	48	81	979	7	1190	113	0.5	0.3	911.0	1111.4	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.025
PZ12-D	Non Coal Permian	80th percentile	7.69	6110	3510	62	98	1170	8	1350	125	0.5	0.3	1010.0	1232.2	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.0005	0.005	0.16
PZ12-D	Non Coal Permian	95th percentile	8.12	6220	3937	70	102	1190	8	1450	139	18.0	10.8	1040.0	1268.8	0.025	0.005	0.0005	0.0005	0.00005	0.0005	0.001	0.005	25
PZ12-D	Non Coal Permian	Stdev	0.99	6729	4586	200.1514	250.6794	1020.5894	15.6672	2311.582	428.6583	46.9	28.3	292.4	356.7	1.920362	0.031169	0.001068	333.3132	3.47E-05	0.004921	0.007513	0.004198	35.30036411

Appendix A3 - CVM Bore Census Surveys

16 December 2020

620.13593-L01-v1.0 2020 LH Bore Survey.docx

BHP
Level 14, 480 Queen Street
Brisbane, QLD, 4035 Australia

Attention: **Katy Steele**

Dear Katy

BHP - Horse Pit Approvals
November 2020 Bore Survey

1 Introduction

As part of the groundwater study for the EA Amendment and EPBC Approval, a detailed Gap Analysis and Forward Work Plan (SLR, 2020a[1]) was developed to review the available technical information and inform the remainder of the groundwater assessment, with a particular focus on identifying additional field data collection requirements. The Gap Analysis and Forward Work Plan identified that further knowledge of anthropogenic groundwater users is required to meet the relevant guidelines for the Project's groundwater assessment.

Following a subsequent detailed review of data related to groundwater users near to the Project area (SLR, 2020b[2]), a third party bore baseline assessment program (BAP) was prepared to characterise the nature of neighbouring anthropogenic groundwater use. A total of 31 individual cadastral parcels within 5 km of the Project were identified for conducting baseline assessments. The BAP also outlined the methodology and requirements for implantation of field surveys.

Landholders of each parcel identified in the BAP were then contacted by BHP to determine if there are groundwater bores located on each property, and how many. From this, a total of 18 bores located across six (6) properties were identified as requiring assessment (**Table 1**).

Thereafter, BHP requested that SLR provide a proposal to conduct the field works associated with implementation of the BAP on these properties.

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[1] SLR, 2020a, *Caval Ridge Mine, Horse Pit Expansion Project, Groundwater Approvals Gap Analysis and Forward Work Plan*, Ref 620.13593.00005-L01-v4.0

[2] SLR, 2020b, *Caval Ridge Mine, Horse Pit Expansion Project, Bore Baseline Assessment Program*, Ref 620.13593.00005-M01-v1.0

Table 1 CVM HPE BAP Bore Summary

Property ID	Lot/Plan	Owner	GWDB Bores (RN)	Bores to be Assessed
Winchester Downs	8/SP26274, 7/CP906162	B.A Neilsen	162815	4
Coolibah Downs	5/GV148	Anglo Coal Pty Ltd	103210	2
Grosvenor Downs	6/SP260061	Anglo Coal Pty Ltd & Exxaro Australia Pty Ltd	182164, 182166, 162806, 162807, 162808, 162140, 162141, 162142, 162143	9 – to be confirmed
Moranbah Airport	17/GV130	BHP Coal	-	1
Kurrali Park	5/RP853653	B.P. Braithwaite	182316	1 – to be confirmed
Pownall (Skyville Homestead)	1/RP616025	Pownall (Skyville Homestead)	-	1 – to be confirmed
			Total Bores	**18**

The BAP was developed to be consistent with the baseline assessment guidelines set out by the Queensland Department of Environment and Science (DES)[3] .

This report documents the results of the BAP. It is a factual report intended to present the information collected during the baseline survey, and does not enter into analysis of any potential project related impacts, which will be the subject of a further work program if required in the future.

2 Field Assessment

2.1 Aims and Objectives

The overall aims and objectives of the field-based bore baseline assessment survey was to:

- Identify the nature of actual third party groundwater usage in the HPE project area, specifically target aquifers and extraction rates.
- Identify baseline (pre-development) water levels and water quality at each third party groundwater bore in the HPE project area.
- Compile an inventory of groundwater use from which to identify anthropogenic groundwater receptors required to be assessed for potential impacts in the project’s groundwater impact assessment.

2.2 Methodology

The procedures outlined in the Queensland Government Department of Environment and Science Guideline - Baseline assessments (DES, July 2017) were used to guide the methodology of the field surveys. Specific field data collection requirements specified in the guideline include:

- Bore identification and general site information (BHP bore ID, landholder bore ID, bore coordinates);

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[3] Department of Environment and Science, 2017, *Guideline Bore Assessment*, Document reference: ESR/2016/2005 Version 5.02

- Bore construction details (casing type, diameter, depth, screen details, bore logs, drilling logs);
- Bore equipment and condition (bore type, operational status, pumping equipment, power source, headworks);
- Bore supply (bore purpose, bore usage – pumping rates / regime / peak usage, operating capacity);
- Standing water level at time of assessment;
- Water quality in the bore (record of field pH, EC and temperature and collection of a laboratory sample to analyse for major ions, dissolved and total metals, alkalinity and hardness);
- Bore head gases (measurement of carbon dioxide, methane and hydrogen sulphide); and
- Photograph of the bore headworks, associated equipment and general location.

3 Survey Results

The BAP was undertaken between the 24th and 27th November 2020 by a Tertiary-qualified SLR hydrogeologist with 10 years professional experience.

A total of 18 bores were initially scheduled to be visited. A total of 26 bores were subject to assessment during the survey. The details of these bores are presented in **Table 1**. Bores that were not assessed during the survey and the reason why they weren't assessed are included in **Table 3**. The location of all bores is presented in **Figure 1**.

Table 2 Bore Assessment Survey – Assessed Bore Details

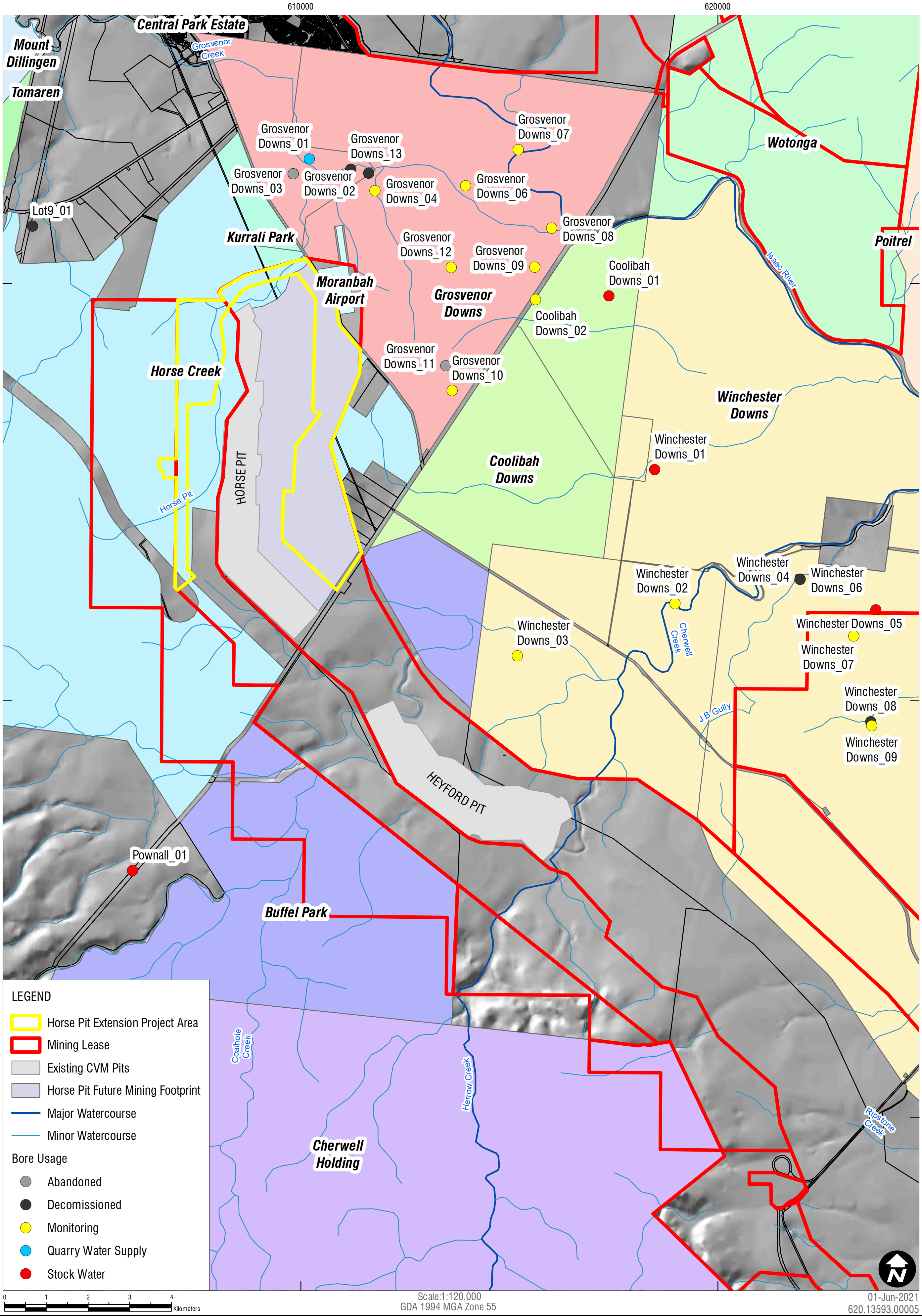
Property	Bore ID	RN	Easting (Z55 GDA94)	Northing (Z55 GDA94)	Bore Use	Total Depth (m bgl)	Screen Interval (m bgl)	Aquifer Screened
Coolibah Downs	Coolibah Downs_01	103210	617388	7559702	Stock Water Supply	68.58	UNK	Blackwater Coal Measures*
Coolibah Downs	Coolibah Downs_02	162045	615633	7559619	Monitoring	82.37	71 – 83*	Fort Cooper Coal Measures / Sandstone*
Grosvenor Downs	Grosvenor Downs_01	182166	610203	7562986	Quarry Water Supply	30	15-30*	Sands and Gravels / Alluvium*
Grosvenor Downs	Grosvenor Downs_02	-	609815	7562637	Abandoned Water Supply	25.92	UNK	UNK
Grosvenor Downs	Grosvenor Downs_03	182164	609814	7562636	Abandoned Water Supply	162.51	36-58*	Basalt*
Grosvenor Downs	Grosvenor Downs_04	162142	611779	7562223	Mine Monitoring	136.64	131 – 137*	Moranbah Coal Measures*
Grosvenor Downs	Grosvenor Downs_05	162807	611622	7562654	Abandoned Domestic Supply	11.5	UNK	Regolith?
Grosvenor Downs	Grosvenor Downs_06	162141	613955	7582352	Mine Monitoring	11.16	8 – 11*	Quaternary Sand (undefined)*
Grosvenor Downs	Grosvenor Downs_07	162144	615208	7563211	Mine Monitoring	16.87	10.5 - 16.5*	Isaac River Alluvium*
Grosvenor Downs	Grosvenor Downs_08	162143	616016	7561328	Mine Monitoring	21.85	16.7 – 22.7*	Fort Cooper Coal Measures*

Property	Bore ID	RN	Easting (Z55 GDA94)	Northing (Z55 GDA94)	Bore Use	Total Depth (m bgl)	Screen Interval (m bgl)	Aquifer Screened
Grosvenor Downs	Grosvenor Downs_09	162044	615610	7560395	Monitoring	71.39	60 – 72*	Basalt*
Grosvenor Downs	Grosvenor Downs_10	162048	613629	7557428	Monitoring	72.18	66 – 72*	Basalt*
Grosvenor Downs	Grosvenor Downs_11	162808	613475	7558034	Abandoned	31.735	UNK	UNK
Grosvenor Downs	Grosvenor Downs_12	162043	613612	7560385	Monitoring	72.22	60 – 74*	Basalt*
Grosvenor Downs	Grosvenor Downs_13	162806	611199	7562743	Abandoned	Blocked at 2 m btoc	UNK	UNK
Winchester Downs	Winchester Downs_01	162815	618483	7555537	Stock Water Supply	158.88	UNK	UNK
Winchester Downs	Winchester Downs_02	1621816	618973	7552320	Monitoring	66.42	UNK	UNK
Winchester Downs	Winchester Downs_03	162145	615193	7551070	Monitoring	22.67	16.7 – 22.7*	Fort Cooper Coal Measures*
Winchester Downs	Winchester Downs_04	162825	621970	7552911	Abandoned Stock Water Supply	40.41	UNK	UNK
Winchester Downs	Winchester Downs_05	162459	623792	7552167	Stock Water Supply	120	85 – 120?	Fort Cooper Coal Measures*
Winchester Downs	Winchester Downs_06	162824	621970	7552896	Abandoned	21.12	UNK	UNK
Winchester Downs	Winchester Downs_07	141385	623255	7551544	Monitoring	50.55	47.5 – 50.5*	Shale*
Winchester Downs	Winchester Downs_08	162829	623255	7551544	Abandoned	UNK	UNK	UNK
Winchester Downs	Winchester Downs_09	141384	623686	7549391	Monitoring	50.59	47.5 – 50.5*	Shale*
Pownall	Pownall_01	85499	605963	7545921	Stock Water and Domestic	53.6*	Open hole from 12.2*	Blenheim Formation*
Bielby	Bielby_01		603569	7561387	Abandoned Camp Bore	49.72	UNK	UNK

Notes:

* As recorded on DNRME bore report

UNK – Unknown / Information not given by landholder or present on bore report



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Baseline Bore Assessment
Surveyed Bores

FIGURE 1

Table 3 Summary of bores unable to be assessed

Property	RN	Easting (Z55 GDA94)	Northing (Z55 GDA94)	Reason not assessed
Grosvenor Downs	162140	610436	7562717	Bore buried beneath stockpile.

3.1 Water Levels

Groundwater levels were measured where possible using an electronic dip meter. Due to the presence of existing bore infrastructure, water levels could not be obtained from all bores assessed as part of the survey. A summary of the water levels collected is presented in **Table 4**.

Table 4 Bore Assessment Water Level Summary

Property	Bore ID	SWL (m btoc)	Casing stickup (m)
Coolibah Downs	Coolibah Downs_01	26.39	0.44
Coolibah Downs	Coolibah Downs_02	21.905	0.8
Grosvenor Downs	Grosvenor Downs_01	13.69	0.67
Grosvenor Downs	Grosvenor Downs_02	2.04	0.61
Grosvenor Downs	Grosvenor Downs_03	2.11	0.6
Grosvenor Downs	Grosvenor Downs_04	38.13	0.69
Grosvenor Downs	Grosvenor Downs_05	10.37	0.39
Grosvenor Downs	Grosvenor Downs_06	11.86	0.74
Grosvenor Downs	Grosvenor Downs_07	12.02	0.57
Grosvenor Downs	Grosvenor Downs_08	12.5	0.68
Grosvenor Downs	Grosvenor Downs_09	30.07	0.36
Grosvenor Downs	Grosvenor Downs_10	17.06	0.42
Grosvenor Downs	Grosvenor Downs_11	25.25	0.415
Grosvenor Downs	Grosvenor Downs_12	22.9	0.43
Grosvenor Downs	Grosvenor Downs_13	blocked at 2m	0.2
Winchester Downs	Winchester Downs_01	11.46	0.62
Winchester Downs	Winchester Downs_02	7.85	0.74
Winchester Downs	Winchester Downs_03	20.695	0.52
Winchester Downs	Winchester Downs_04	10.48	0.41
Winchester Downs	Winchester Downs_05	Unable to dip	0.57
Winchester Downs	Winchester Downs_06	10.54	0.29
Winchester Downs	Winchester Downs_07	37.30	0.47
Winchester Downs	Winchester Downs_08	Blockage at 1.36m	Casing bent
Winchester Downs	Winchester Downs_09	16.47	0.56
Pownall	Pownall_01	Artesian	
Bielby	Bielby_01	17.72	0.285

3.2 Water Quality

3.2.1 Field Measurements

The field water quality parameter results measured at the end of purging of the assessed bores is given in **Table 5** below.

Table 5 Field measurement summary

Property	Bore ID / Sample ID	Sample Date	pH	Temperature (°C)	Electrical Conductivity (µS/cm)
Coolibah Downs	Coolibah Downs_01 / CD_01	24-11-2020	6.5	27.85	2,592
Grosvenor Downs	Grosvenor Downs_01 / GD_01	24-11-2020	8.17	28.94	3,082
Pownall	Pownall_01 / Pownall_01	27-11-2020	7.65	29.82	5,332
Winchester Downs	Winchester Downs_05 / WD_05	26-11-2020	7.23	27.91	2,122

3.2.2 Laboratory Analysis

Collected samples were tested for all analytes presented in Table 1 of the DES bore assessment guidelines. On collection samples were stored on ice and sent to the nominated NATA accredited laboratory, ALS, as soon as practicably possible. Sample receipts confirm that all samples were appropriately stored and were received by the laboratory within the holding times for each analyte with the exception of pH.

A summary of groundwater chemistry analytical results is presented in **Table 6** (major ions) and **Table 7** (dissolved metals). The full laboratory reports are presented in **Attachments A – F** for each respective landholder.

Table 6 Major Ion Summary

Property	Bore ID / Sample ID	Geological Unit Screened	Date of Sampling	Total Dissolved Solids (mg/L)	Na^+ (mg/L)	Ca^+ (mg/L)	Mg^+ (mg/L)	K^+ (mg/L)	Cl^- (mg/L)	$SO4^{2-}$ (mg/L)	Total Alkalinity as CaO3 (mg/L)
Coolibah Downs	Coolibah Downs_01 / CD_01	Blackwater Group / Coal	27-11-2020	1,480	396	66	71	4	490	41	699
Grosvenor Downs	Grosvenor Downs_01 / GD_01	Alluvium	27-11-2020	1,400	214	103	153	4	402	60	677
Pownall	Pownall_01 / Pownall_01	Blenheim Formation	26-11-2020	1,240	346	64	40	16	434	287	213

Property	Bore ID / Sample ID	Geological Unit Screened	Date of Sampling	Total Dissolved Solids (mg/L)	Na^+ (mg/L)	Ca^+ (mg/L)	Mg^+ (mg/L)	K^+ (mg/L)	Cl^- (mg/L)	$SO4^{2-}$ (mg/L)	Total Alkalinity as CaO3 (mg/L)
Winchester Downs	Winchester Downs_05 / WD_05	Fort Cooper Coal Measures	27-11-2020	3,760	658	214	187	17	1400	256	494

Table 7 Dissolved Metals Summary

Analyte	Unit	Property / Sample ID			
		Coolibah Downs / CD_01	Grosvenor Downs / GD_01	Pownall / Pownall_01	Winchester Downs / WD_05
Al	mg/L	0.04	<0.01	<0.01	<0.01
As	mg/L	<0.001	0.001	<0.001	<0.001
B	mg/L	0.39	0.24	0.41	0.36
Ba	mg/L	0.801	0.07	0.035	0.341
Be	mg/L	<0.001	<0.001	<0.001	<0.001
Cd	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Cr	mg/L	<0.001	<0.001	<0.001	<0.001
Co	mg/L	<0.001	<0.001	<0.001	<0.001
Cu	mg/L	0.008	<0.001	<0.001	<0.001
Fe	mg/L	0.06	0.35	2.54	1.24
Hg	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Mn	mg/L	0.054	0.164	0.018	0.131
Mo	mg/L	0.003	<0.001	<0.001	<0.001
Ni	mg/L	<0.001	0.002	<0.001	0.002
Pb	mg/L	<0.001	<0.001	<0.001	0.002
Se	mg/L	<0.01	<0.01	<0.01	<0.01
U	mg/L	<0.001	0.003	<0.001	<0.001
V	mg/L	<0.01	0.01	<0.01	<0.01
Zn	mg/L	0.006	<0.005	<0.005	<0.005

3.2.3 QA/QC

Water sampling was conducted under the QA/QC protocols outlined in the DES Baseline Assessment Guidelines. These protocols are outlined in Table 8below.

Table 8 Water Quality QA/QC

Method	Sample Reference	Frequency	Description
Primary	LandholderName_# (BHP Bore ID)	1 per bore	Primary sample from each bore for laboratory analysis.
Blind Duplicate	LandholderName_DUP	1 per landholder	Duplicate sample collected in the same manner as the primary sample. Used to assess the precision/repeatability of the sampling procedure and laboratory analysis.
Equipment Rinsate Blank	LandholderName_RB	1 per day of sampling	De-ionised water blank sample collected in the field under identical conditions to primary samples following sampling equipment decontamination. Used to verify appropriate decontamination of field equipment between different bores.
Field Blank	LandholderName_FB	1 per day of sampling	De-ionised water blank sample collected in the field under identical conditions to primary samples. Used to verify a high standard of sampling procedure and identify if any contamination is being introduced during sampling.

The results for the QA/QC process are provided in **Attachments A – F** for each respective landholder along with the results of the primary sample analysis.

Blind duplicate samples were collected from the first bore sampled on each property e.g. Pokier_01. The laboratory results show little variance between the primary and blind duplicate samples, validating the results of the primary sample and providing confidence in the primary sample analysis result.

Field and equipment blanks were collected at the end of the sampling day. For the blank samples collected at parameter values at or below the limit of reporting for the blank samples, validating the sampling and equipment decontamination methods as appropriate, aiding further confidence in the primary sample analysis results.

4 Summary

SLR undertook a groundwater baseline assessment in November 2020 to assist in the preparation of the Caval Ridge Horse Pit Expansion Project. The assessment was completed to understand pre-development third-party groundwater usage on the lease. A total of 26 bores were assessed during the survey. One bore was unable to be assessed because it could not be found or had been destroyed.

The assessment comprised a discussion with each bore owner about the history, construction and usage of the bore and, where possible, the measurement of standing water levels and bore water quality. The survey found groundwater use to be predominantly for stock watering. Review of available bore lithology and construction records showed that there is no predominant lithology the bores assessed are screened within.

Groundwater level measurements were consistent across the bores however as no survey elevation data exists groundwater elevations could not be determined. Water quality across the bores was consistent with the groundwater sampled found to be generally slightly acidic to neutral and fresh to slightly brackish.

A review of the DNRME registered bore database suggests that additional bores located on the lease are potentially screened within the deeper hydrostratigraphic units however due to landholder access constraints these were not able to be visited during the time of the survey.

Yours sincerely

DUNCAN DAWSON
Senior Hydrogeologist

Checked/
Authorised by: DL

Enclosed

Attachment A	Coolibah Downs Bore Baseline Assessment
Attachment B	Grosvenor Downs Bore Baseline Assessment
Attachment C	Winchester Downs Bore Baseline Assessment
Attachment D	Pownall Bore Baseline Assessment
Attachment E	Bielby Bore Baseline Assessment

ATTACHMENT A

COOLIBAH DOWNS BORE BASELINE ASSESSMENT

COOLIBAH DOWNS 01

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Hoare	Given name(s) Ron
Phone	Mobile 0428417630
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number MDL277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Coolibah Downs 01	
Bore registration number (RN)[4] 103210	Bore RN comments Bore location and casing matches informaiton in report
Local bore name Solar Bore / River Paddock Bore	
Property name Coolibah Downs	
Lot 23	Plan GV148
Date of site assessment 24/11/2020	
Bore geographic location (GDA94)	
Latitude 22 03.815	Longitude 148 08.263
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Beale B	Date of bore construction (drilled date) 22/09/1999
Type of casing PVC	Casing diameter (mm) 140
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Blackwater Group (Coal)
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - low confidence as screen unknown
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☒ Yes	☐ No → go to Part D.
Pump type	Pump make and model
2HP Submersible	Unknown
Pump setting depth (m) (depth from ground)	
~50m	
Is the bore equipped with a meter?	
☐ Yes → description:	☒ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☒ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.44m PVC stick up with steel bore plate. 50mm steel elbow connected from bore plate to PVC T-piece with sample tap and seized flow gauge. Flow gauge connected to 50mm plastic elbow joint. Elbow connected to 45mm pvc pipe running directly down to ground. Pipe runs underground to tank ~ 25m from bore head.
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance
Pump has been replaced 3 times in the last few years due to blocakges causing burnout. Current pump is cleaned every 2-3months due to prevent blockages.

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☒ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☐ Other → description:				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year)
	1.6
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6])
	Based on usage of 200hd beef cattle (45 L per head per day) over 6 months

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Bore utilisation
How often is the bore utilised (estimated hours pumped per day)? During daylight hours (varies with season). Max usuage in summer of 9hrs / day
Describe the operational capacity, including seasonal variation Only used when cattle in paddox. ~6 month period
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore. Peak usage to water 200hd of cattle
Are there any historical water use records available for this bore? ☐ Yes → attach them to this form. ☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 26.39
	Current conditions relevant to the water level measurement Bore regularily pumping prior to measurement
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods During daylight hours
	Maximum pumping rate (L/s) Unknown
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.44	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples

Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94)
At bore head

Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point)
Pump run for 5 minutes prior to sampling

Was the sample taken after full purging of the bore casing and discharge piping?

☒ Yes	
☐ No →	Provide details of the pumping history including when the bore was last used

Is pumping equipment in place at the bore?

☒ Yes	
☐ No →	**Attach photo** showing the bore and sampling set up

Field parameters

Were water quality field measurements taken?

☒ Yes →

Physical parameters

pH	Temperature (°C)	Electrical conductivity (µS/cm)
6.5	27.85	2592

Alkalinity and hardness (mg/L)

Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$

Total hardness as $CaCO_3$

Field gas measurements (multi-parameter gas detector)

CO_2 (ppm_v)	H_2S (ppm_v)	CH_4 (%LEL)
2000	0	0.5

☐ No → Reason not measured

Are historical water quality field records available for this bore?
☐ Yes ☒ No

Laboratory water quality

Were water quality samples taken for submission to a laboratory?

☒ Yes	
☐ No →	Reason not samples not taken

Were dissolved gas samples taken for submission to a laboratory?

☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method Reason method chosen
☒ No →	Reason not measured Gas not identified as present by bore holder and not detected at significant levels in bore head

Are the laboratory results for the samples indicated above supplied with this baseline assessment?	
☒ Yes	
☐ No →	Reason not supplied
Are historical water quality laboratory records available for this bore? ☐ Yes → attach them to this form. ☒ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Hoare	Given name(s) Ron
Phone 0428 417 630	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Coolibah Downs 01

Queensland Government

Groundwater Information

Report Date: 03/11/2020 16:02

GWDB8250

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
103210	Sub-Artesian Facility	Existing	22/09/1999	Emerald	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	RIVER PADDOCK BORE		
Driller Name	BEALE B		
Drill Company	WATER DRILL		
Const Method	ROTARY		
Bore Line			
D/O File No	50-1940	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles	Water Supply		

Location

Latitude	22-03-38	**Basin**	1304
Longitude	148-07-58	**Sub-area**	
GIS Latitude	-22.060717485	**Lot**	23
GIS Longitude	148.1326539	**Plan**	GV148
Easting	616869		
Northing	7560018	**Map Scale**	104 - 1: 100 000
Zone	55	**Map Series**	M - Metric Series
Accuracy	SKET	**Map No**	8553
GPS Accuracy		**Map Name**	GROSVENOR DOWNS
Checked	Yes	**Prog Section**	

Casing

1 ***records for RN*** **103210**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	22/09/1999	1			Polyvinyl Chloride			140

Strata Logs

7 ***records for RN*** **103210**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	0.61	TOPSOIL

Rec	Top (m)	Bottom (m)	Strata Description
2	0.61	20.42	SHALE
3	20.42	25.91	SHALE & COAL
4	25.91	27.43	SHALE
5	27.43	62.48	SHALE & COAL
6	62.48	65.53	COAL
7	65.53	68.58	COAL & SHALE

Stratigraphies

0 ***records for RN*** 103210

Aquifers

2 ***records for RN*** 103210

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	25.91	27.43	SHLE - Shale	22/09/1999	-19.81	N	POTABLE	0.38	Y	FR	BLACKWATER GROUP
2	62.48	65.53	SHLE - Shale	22/09/1999	-19.81	N	POTABLE	0.78	Y	FR	BLACKWATER GROUP

Pump Tests Part 1

0 ***records for RN*** 103210

Pump Tests Part 2

0 ***records for RN*** 103210

Bore Conditions

0 ***records for RN*** 103210

Elevations

1 ***records for RN*** 103210

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	24/02/2006	215.00	GPS	Global Positioning System	AHD - Aust. Height Datum	R	Reference Point	ISAAC PLAINS BORE CENSUS

Water Analysis Part 1

0 ***records for RN*** 103210

Water Analysis Part 2

0 ***records for RN*** 103210

Report Date: 03/11/2020 16:02

Bore Report

From Year:

Water Levels

1 ***records for RN*** **103210**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	24/02/2006		-21.78	R	Reference Point		ACT	Actual	NR	XX	Unknown	130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **103210**

Field Measurements

0 ***records for RN*** **103210**

Special Water Analysis

0 ***records for RN*** **103210**

Bore Report

From Year:

User Licence and Conditions

Disclaimer

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 2/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com
☑BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: ALSEnviro.Gladstone@alsglobal.com
☐MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740 Ph: 07 4952 5795 E: ALSEnviro.Mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 13 Carlton Street, Kirwan QLD 4812 ...
...ng NSW 2500

Environmental Division
Brisbane
Work Order Reference
EB2031461

Telephone : + 61-7-3243 7222

CLIENT: BHP
OFFICE: BRISBANE
PROJECT: HPC BAP PROJECT NO.:
ORDER NUMBER: PURCHASE ORDER NO.: 4510264491
PROJECT MANAGER: KATY STEELE CONTACT PH: 0448 888 893
SAMPLER: DUNCAN DAWSON / SLR SAMPLER MOBILE: 0419987617
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed): PM + ddawson@slrconsulting.com
Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☑ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.:
COUNTRY OF ORIGIN: AUSTRALIA
COC SEQUENCE NUMBER (Circle)
COC: [✓ 1] 2 3 4 5 6 7
OF: 1 [✓ 2] 3 4 5 6 7

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:
Duncan Dawson	Martin	
DATE/TIME: 27/11/2020	DATE/TIME: 27/11/2020 18:45	DATE/TIME:

FOR LABORATORY		
Custody Seal Intact?	No	N/A
Free ice / frozen ice bric	No	N/A
Random Sample Tempe	°C	
Other comment:		

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).											Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	ph	EC	TDS	Major ions: Ca, K Cl, Na, F, SO4	Alkalinity - HCO3, CO3, hydroxide as CaCO3		Total hardness as CaCO3	Total + Dissolved Al, As, Ba, Be, B, Pb, Mg, Ni, Se Mn, Hg, Mo, U, V Cd, Cr, Co, Fe, Zn				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	GD01	24/11/2020 10:20	W	1xP 2xAP	3	X	X	X	X	X	X	X	X	X	X	X	~~Can you please~~ ~~[illegible]~~
2	QA01	24/11/2020	↓	↓	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
3	GD01	24/11/2020 16:40			3												PTO for More Samples
4	QA02	24/11/2020			3												
5	FB01	24/11/2020 11:50			3												
6	RB01	24/11/2020 11:59			3												
7	Pownall01	26/11/2020 07:33			3												
8	QA03	26/11/2020			3												
9	FB03	26/11/2020			3												
10	RB03	26/11/2020			3												
11	FB02	25/11/2020 18:50			3												
12	RB02	25/11/2020 18:57															
16 Samples Total (PTO for continuation of CoC)					TOTAL												

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CoC 2/2

SAMPLER Duncan Dawson Relinquished 2 27/11/2020

SAMPLE ID	DATE / TIME	MATRIX	TYPE + PRESERVATIVE	Bottles	PH	EC	TDS	MAJOR IONS	ALKALINITY	Total hardness as CaCO3	DISS + To [illegible], Al, As, B B, Cd, Cr, Co, Fe, Ni, Se, [illegible], Zn
13 WD05	27/11/2020 10:50	W	1X P 2X AP	3	X	X	X	X	X	X	X
14 QA04	27/11/2020	W	↓	3	X	X	X	X	X	X	X
15 FB04	27/11/2020 13:00	↓	↓	3	X	X	X	X	X	X	X
16 RB04	27/11/2020 13:00	↓	↓	3	X	X	X	X	X	X	X

ANALYSIS

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **EB2031461-AF**
Amendment : **3**
Client : **BM ALLIANCE LTD**
Contact : MS KATY STEELE
Address : L11 480 QUEEN STREET
BRISBANE QLD 4000
Telephone : ----
Project : HPE BAP
Order number : 4510264491
C-O-C number : ----
Sampler : DUNCAN DAWSON / SLR
Site : ----
Quote number : BN/448/15 V24
No. of samples received : 2
No. of samples analysed : 2

Page : 1 of 5
Laboratory : Environmental Division Brisbane
Contact : Nidhi Bhimani
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 27-Nov-2020 18:45
Date Analysis Commenced : 30-Nov-2020
Issue Date : 18-Dec-2020 11:10

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Amendment (18/12/2020): This report has been amended and re-released to allow the reporting of additional analytical data. Total and Dissolved Copper results are now included.
- Amendment (17.12.2020): This report has been amended as a result of the change of quote from EN/222 to BN/448/15 v24 as requested by client. All analysis results are as per the previous report
- Amendment (18/12/2020): This report has been amended as a result of a request to split samples #1-2, #3-6, #7-10, #11-12 and #13-16 into separate COA reports. All analysis results are as per the previous report
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**CD01**	**QA01**	**----**	**----**	**----**
			Sampling date / time	24-Nov-2020 10:20	24-Nov-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031461-001**	**EB2031461-002**	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.47**	**7.37**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2520**	**2500**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**1480**	**1430**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**699**	**678**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**699**	**678**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**41**	**41**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**490**	**490**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**66**	**71**	----	----	----
Magnesium	7439-95-4	1	mg/L	**71**	**77**	----	----	----
Sodium	7440-23-5	1	mg/L	**396**	**420**	----	----	----
Potassium	7440-09-7	1	mg/L	**4**	**4**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**457**	**494**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.664**	**0.706**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.008**	**0.008**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.045**	**0.048**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	**0.002**	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**CD01**	**QA01**	----	----	----
			Sampling date / time	24-Nov-2020 10:20	24-Nov-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031461-001**	**EB2031461-002**	--------	--------	--------
				Result	Result	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.006**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.32**	**0.36**	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.04**	**0.03**	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.801**	**0.797**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.012**	**0.012**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.054**	**0.052**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.003**	**0.002**	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.006**	**0.007**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.39**	**0.41**	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.06**	**0.07**	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**	**0.3**	----	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**28.6**	**28.2**	----	----	----
ø **Total Cations**	----	0.01	meq/L	**26.5**	**28.2**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**CD01**	**QA01**	**----**	**----**	**----**
			Sampling date / time	24-Nov-2020 10:20	24-Nov-2020 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031461-001**	**EB2031461-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EN055: Ionic Balance - Continued								
ø **Ionic Balance**	----	0.01	%	**3.95**	**0.05**	**----**	**----**	**----**

ALS Environmental

QUALITY CONTROL REPORT

Work Order : **EB2031461-AF**
Amendment : **3**

Page : 1 of 9

Client : **BM ALLIANCE LTD**
Contact : MS KATY STEELE
Address : L11 480 QUEEN STREET
BRISBANE QLD 4000
Telephone : ----
Project : HPE BAP
Order number : 4510264491
C-O-C number : ----
Sampler : DUNCAN DAWSON / SLR
Site : ----
Quote number : BN/448/15 V24
No. of samples received : 2
No. of samples analysed : 2

Laboratory : Environmental Division Brisbane
Contact : Nidhi Bhimani
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 27-Nov-2020
Date Analysis Commenced : 30-Nov-2020
Issue Date : 18-Dec-2020

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 3394837)									
EB2031425-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.99	7.02	0.428	0% - 20%
EB2031461-005	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	5.67	5.64	0.530	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 3394838)									
EB2031425-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	4030	4030	0.00	0% - 20%
EB2031461-005	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1	0.00	No Limit
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 3391122)									
EB2031316-002	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	43300	43900	1.30	0% - 20%
EB2030889-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	253	260	2.72	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 3394840)									
EB2031425-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	481	476	1.09	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	481	476	1.09	0% - 20%
EB2031461-005	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	1	<1	0.00	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3392563)									
EB2031418-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	9	8	0.00	No Limit
EB2031461-008	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	287	298	3.76	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3392564)									
EB2031418-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	29	29	0.00	0% - 20%
EB2031461-008	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	433	437	0.872	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 3390964)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED093F: Dissolved Major Cations (QC Lot: 3390964) - continued									
EB2031461-003	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	103	106	2.98	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	153	154	0.00	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	214	217	1.47	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.00	No Limit
EB2031461-013	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	214	238	10.6	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	187	212	12.9	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	658	720	9.02	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	7	7	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390965)									
EB2031461-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.067	0.067	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.163	0.164	0.00	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.01	0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.22	0.23	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.10	0.10	0.00	No Limit
EB2031461-013	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.269	0.308	13.7	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.115	0.132	13.8	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390965) - continued									
EB2031461-013	Anonymous	EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.32	0.34	5.42	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	1.06	1.22	14.1	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390966)									
EB2031461-003	Anonymous	EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.002	0.002	0.00	No Limit
EB2031461-013	Anonymous	EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3391102)									
EB2031461-001	CD01	EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EB2031461-010	Anonymous	EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3391103)									
EB2031461-001	CD01	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.801	0.804	0.339	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.012	0.011	0.00	0% - 50%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.054	0.052	2.45	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.006	0.006	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.04	0.02	61.3	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.39	0.42	7.40	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.06	0.06	0.00	No Limit
EB2031461-010	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020T: Total Metals by ICP-MS (QC Lot: 3391103) - continued									
EB2031461-010	Anonymous	EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 3390963)									
EB2031432-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2031432-013	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3391105)									
EB2031336-023	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2031461-006	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3394839)									
EB2031425-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EB2031461-005	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EA005P: pH by PC Titrator (QCLot: 3394837)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	100	98.0	102
EA010P: Conductivity by PC Titrator (QCLot: 3394838)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	220 µS/cm	102	91.0	107
				<1	12890 µS/cm	99.4	91.0	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 3391122)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2460 mg/L	103	88.0	112
				<10	293 mg/L	107	88.0	112
				<10	2000 mg/L	99.3	80.9	118
ED037P: Alkalinity by PC Titrator (QCLot: 3394840)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	103	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3392563)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	101	85.0	118
				<1	100 mg/L	98.4	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 3392564)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.9	90.0	115
				<1	1000 mg/L	104	90.0	115
ED093F: Dissolved Major Cations (QCLot: 3390964)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	106	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	108	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	105	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	96.5	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	93.3	79.0	118
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	96.2	88.0	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	91.2	81.0	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	94.6	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	90.7	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	93.0	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	93.4	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	90.8	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.9	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	93.3	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	99.8	89.0	112

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965) - continued								
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	92.3	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.1	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	97.7	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	93.0	87.0	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	101	81.0	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	96.4	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390966)								
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	93.7	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391102)								
EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	107	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391103)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	98.3	80.0	114
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	111	88.0	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	95.4	81.0	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	102	70.0	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	101	88.0	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	101	89.0	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	105	89.0	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	109	88.0	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	104	89.0	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	104	88.0	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	111	90.0	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	108	88.0	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	106	79.0	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	114	87.0	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	103	84.0	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	105	82.0	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	113	82.0	118
EG035F: Dissolved Mercury by FIMS (QCLot: 3390963)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	105	84.0	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391105)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	100	84.0	118
EK040P: Fluoride by PC Titrator (QCLot: 3394839)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	94.0	80.0	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3392563)							
EB2031418-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	85.3	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3392564)							
EB2031418-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	114	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965)							
EB2031461-002	QA01	EG020A-F: Arsenic	7440-38-2	1 mg/L	98.2	70.0	130
		EG020A-F: Beryllium	7440-41-7	1 mg/L	89.7	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	93.5	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	92.5	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	92.0	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	90.3	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	88.0	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	94.0	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	93.9	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	90.4	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	96.0	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	93.3	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391103)							
EB2031461-002	QA01	EG020A-T: Arsenic	7440-38-2	1 mg/L	112	70.0	130
		EG020A-T: Beryllium	7440-41-7	1 mg/L	110	70.0	130
		EG020A-T: Barium	7440-39-3	1 mg/L	101	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	104	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	107	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	109	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	106	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	109	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	114	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	106	70.0	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	124	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	102	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 3390963)							
EB2031432-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	89.2	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391105)							
EB2031336-024	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	93.1	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 3394839)							
EB2031425-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	80.4	70.0	130

Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2031461**	Page	: 1 of 11
Amendment	: **3**		
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KATY STEELE	Telephone	: +61-7-3243 7222
Project	: HPE BAP	Date Samples Received	: 27-Nov-2020
Site	: ----	Issue Date	: 18-Dec-2020
Sampler	: DUNCAN DAWSON / SLR	No. of samples received	: 16
Order number	: 4510264491	No. of samples analysed	: 16

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
CD01,	QA01,	----	----	----	01-Dec-2020	24-Nov-2020	**7**
GD01,	QA02,						
FB01,	RB01						
Clear Plastic Bottle - Natural							
FB02,	RB02	----	----	----	01-Dec-2020	26-Nov-2020	**5**
Clear Plastic Bottle - Natural							
Pownall 01,	QA03,	----	----	----	01-Dec-2020	26-Nov-2020	**5**
FB03,	RB03						
Clear Plastic Bottle - Natural							
WD05,	QA04,	----	----	----	01-Dec-2020	27-Nov-2020	**4**
FB04,	RB04						

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Total Mercury by FIMS	1	21	4.76	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container */ Client Sample ID(s)*		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*

Matrix: **WATER**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Nov-2020	✘
Clear Plastic Bottle - Natural (EA005-P) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	26-Nov-2020	✘
Clear Plastic Bottle - Natural (EA005-P) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	26-Nov-2020	✘
Clear Plastic Bottle - Natural (EA005-P) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	27-Nov-2020	✘
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	01-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	02-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	03-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	04-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container** / Client Sample ID(s)*		***Sample Date***	*Extraction / Preparation* ***Date extracted***	*Due for extraction*	*Evaluation*	*Analysis* ***Date analysed***	*Due for analysis*	*Evaluation*
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P) CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	08-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) FB02,	RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	09-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	10-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	11-Dec-2020	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G) CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**30-Nov-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) FB02,	RB02	**25-Nov-2020**	**----**	----	----	**30-Nov-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**30-Nov-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**30-Nov-2020**	25-Dec-2020	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**30-Nov-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) FB02,	RB02	**25-Nov-2020**	**----**	----	----	**30-Nov-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**30-Nov-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**30-Nov-2020**	25-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container** / Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	26-May-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**01-Dec-2020**	23-May-2021	✓	**01-Dec-2020**	23-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) FB02, RB02	**25-Nov-2020**	**01-Dec-2020**	24-May-2021	✓	**01-Dec-2020**	24-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**01-Dec-2020**	25-May-2021	✓	**01-Dec-2020**	25-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) WD05, QA04, FB04, RB04	**27-Nov-2020**	**01-Dec-2020**	26-May-2021	✓	**01-Dec-2020**	26-May-2021	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method **Container** / Client Sample ID(s)		**Sample Date**	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	**Date analysed**	Due for analysis	Evaluation
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
FB02,	RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	4	34	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	3	21	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	6	33	**18.18**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	21	**4.76**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

COOLIBAH DOWNS 02

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Hoare	Given name(s) Ron
Phone	Mobile 0428417630
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Coolibah Downs 02	
Bore registration number (RN)[4] 162045	Bore RN comments Bore location 200m NE of Registered bore and casing information and bore depth matches informaiton in report
Local bore name MB08	
Property name Coolibah Downs	
Lot 23	Plan GV148
Date of site assessment 24/11/2020	
Bore geographic location (GDA94)	
Latitude 22 03.860	Longitude 148 07.243
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) James Leslie Sinclair - Lucas Drilling	Date of bore construction (drilled date) 17/06/2012
Type of casing PVC	Casing diameter (mm) 115
Details of perforated intervals and/or screens that have been installed 71 -81m	
Details of any seals and cement grouting installed in the bore annulus Grout - 0 to 67m, bentoite seal 67 to 69m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Not reported on DNRME bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Fort Cooper Coal Measures (Sandstone)
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - moderate confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type N//A	Pump make and model N/A
Pump setting depth (m) (depth from ground) N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.8m PVC stick up encased in lockable steel monument.
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Monitoring Bore				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)? N/A	
Describe the operational capacity, including seasonal variation N/A	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore. N/A	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 21.91
	Current conditions relevant to the water level measurement Monitoring bore - assumed not purger at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.8	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.2 %	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.4%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.	☐ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname Hoare	Given name(s) Ron
Position title (if applicable) Manager	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Hoare	Given name(s) Ronald
Phone 0428417630	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Coolibah Downs 02

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162045	Sub-Artesian Facility	Existing	17/06/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB08B		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	27/06/2012	**Data Owner**	
Roles	Mine Monitoring		

Location

Latitude	22-03-57	**Basin**	1304
Longitude	148-07-11	**Sub-area**	
GIS Latitude	-22.06596137	**Lot**	23
GIS Longitude	148.1196562	**Plan**	GV148
Easting	615524		
Northing	7559448	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

5 *records for RN* **162045**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	17/06/2012	1	0.00	83.00	Polyvinyl Chloride	7.800	WT - Wall Thickness	115
A	17/06/2012	2	71.00	83.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	
X	17/06/2012	3	0.00	67.00	Grout			200
X	17/06/2012	4	67.00	69.00	Bentonite Seal			
X	17/06/2012	5	69.00	91.00	Gravel Pack	3.000	GR - Gravel Size	

Strata Logs

12 ***records for RN*** **162045**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	2.00	TOP SOIL: BLACK
2	2.00	13.00	SANDS, SOFT
3	13.00	15.00	SILTSTONE
4	15.00	16.00	SHALE
5	16.00	21.00	SANDSTONE
6	21.00	25.00	COAL, SANDS, SOFT
7	25.00	32.00	SANDSTONE: SOFT
8	32.00	33.00	COAL
9	33.00	41.00	SANDSTONE
10	41.00	82.00	SANDSTONE
11	82.00	83.00	COAL
12	83.00	91.00	SANDSTONE (SOAK ONLY)

Stratigraphies

0 ***records for RN*** **162045**

Aquifers

1 ***records for RN*** **162045**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	71.00	83.00	SDST - Sandstone				COND 1760		Y	PS	FORT COOPER COAL MEASURES

Pump Tests Part 1

0 ***records for RN*** **162045**

Pump Tests Part 2

0 ***records for RN*** **162045**

Bore Conditions

0 ***records for RN*** **162045**

Elevations

2 ***records for RN*** **162045**

Pipe	Date	Elevation (m)	Precision	Datum	Meas	Point	Survey Source
A	01/07/2012	228.93	SVY Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT
X	01/07/2012	228.43	SVY Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 ***records for RN*** 162045

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	19/08/2012	1	XXX	XXX			GB	1970	8.2		1492.99	1160.56	136	537	0.2	15.0	8.02

Water Analysis Part 2

1 ***records for RN*** 162045

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	19/08/2012	1	401.0	4.0	31.0	14.0	0.07	654.0	2.11		385.0	0.40			0.02	1.16	0.23	

Water Levels

1 ***records for RN*** 162045

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	01/08/2012		-22.47	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130 Data is of unknown quality

Wire Line Logs

0 ***records for RN*** 162045

Field Measurements

1 ***records for RN*** 162045

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	17/06/2012		1440							AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 ***records for RN*** 162045

Bore Report

From Year:

User Licence and Conditions

ATTACHMENT B

GROSVENOR DOWNS BORE BASELINE ASSESSMENT

GROSVENOR DOWNS 01

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) Anglo Coal (Grosvenor Management) Pty Ltd	ABN/ACN (if applicable) 82 081 022 344
Principal contact	
Surname Burgess	Given name(s) Dean
Phone 0428 125 811	Mobile
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 377
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 01	
Bore registration number (RN)[4] 182166	Bore RN comments Bore location 115m north west of RN location. Bore information and casing matches information in DNRME bore report
Local bore name The Bore	
Property name Grosvenor Downs	
Lot 2	Plan RP616987
Date of site assessment 24/11/2020	
Bore geographic location (GDA94)	
Latitude 22.02061	Longitude 148.04207
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Don Irvine - Capricorn Coast Drilling	Date of bore construction (drilled date) 04/12/2018
Type of casing PVC	Casing diameter (mm) 140
Details of perforated intervals and/or screens that have been installed 15-30m	
Details of any seals and cement grouting installed in the bore annulus 0-6m Grout, 6-7m Bentonite	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 0.7 L/s	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Alluvium (sand and gravel)
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - moderate confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☒ Yes	☐ No → go to Part D.
Pump type	Pump make and model
4" electro - submersible (2HP)	Franklin Electric - 2823618119
Pump setting depth (m) (depth from ground)	
~30m	
Is the bore equipped with a meter?	
☐ Yes → description:	☒ No

Power source					
☐ Electric motor	☒ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.38m PVC stick up with steel bore plate. T-piece at bore plate connected to pressure gauge and 40mm flexihose running to diaphragm one way and 45mm dia steel pipe the other. Steel pipe connected to gate valve which is connected to 55mm polypipe. Polypipe runs down into ground and towards quarry.
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance
Pump is 2yrs old and is due to be replaced soon.

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Conditioning (washing) quarry gravel				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) 6.57
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) Based on bore utilisation and pump rate - 219 d/yr, 10hr/d, 3000 L/hr

Bore utilisation
How often is the bore utilised (estimated hours pumped per day)?
Used all year round, 60-70% of the time
Describe the operational capacity, including seasonal variation
Can be used up to 12hrs a day in summer. Used throughout the year.
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
12hrs a day over summer months / drier conditions.

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 13.69
	Current conditions relevant to the water level measurement Bore pumping prior to measurement.
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods Unknown
	Maximum pumping rate (L/s) 0.83 (anecdotal bore pumps at 3000 L/hr)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.67	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) At bore head	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point)	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used Bore pumping continously prior to assessment therefore full purging completed prior to arrival.
Is pumping equipment in place at the bore?	
☒ Yes	
☐ No →	**Attach photo** showing the bore and sampling set up

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	8.17	28.94	3082
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$)	H_2S (ppm$_v$)	CH_4 (%LEL)
	0.6	0	0.7
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes		☒ No	
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☒ Yes			
☐ No →	Reason not samples not taken		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method		
	☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured Gas not identified as present by bore holder and not detected at significant levels in bore head		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☒ Yes			
☐ No →	Reason not supplied		
Are historical water quality laboratory records available for this bore?			
☐ Yes → attach them to this form.		☒ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Zarb	Given name(s) Joe
Phone 0427195408	Alternative phone
Fax	Email jzarb@quarrico.com.au
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 01

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
182166	Sub-Artesian Facility	Existing	04/12/2018	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name	IRVINE, DON		
Drill Company	CAPRICORN COAST DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No	MAC/520/000 (0072)	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	18/12/2018	**Data Owner**	
Roles	Water Supply		

Location

Latitude	22-02-06	**Basin**	1304
Longitude	148-04-07	**Sub-area**	
GIS Latitude	-22.03494661	**Lot**	2
GIS Longitude	148.06871264	**Plan**	RP616987
Easting	610291		
Northing	7562919	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

6 ***records for RN*** **182166**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	04/12/2018	1	0.00	30.00	Polyvinyl Chloride	5.500	WT - Wall Thickness	140
A	04/12/2018	2	15.00	30.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	140
X	04/12/2018	3	0.00	6.00	Grout			183
X	04/12/2018	4	6.00	7.00	Bentonite Seal			183

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	04/12/2018	5	7.00	30.00	Gravel Pack			183
X	04/12/2018	6	0.00	15.00	Centraliser			

Strata Logs

5 ***records for RN*** **182166**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	2.00	RED SURFACE SOILS
2	2.00	7.00	GREY CLAY
3	7.00	12.00	CREAM CLAY
4	12.00	15.00	RED SAND: FINE
5	15.00	30.00	SAND AND GRAVEL: CONSOLIDATED

Stratigraphies

0 ***records for RN*** **182166**

Aquifers

1 ***records for RN*** **182166**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	15.00	30.00	SAGR - Sand and Gravel	04/12/2018	-12.00	N	POTABLE	3.51	Y	PS	

Pump Tests Part 1

1 ***records for RN*** **182166**

Pipe	Date	Rec	RN of Pumped Bore	Top (m)	Bottom (m)	Dist (m)	Meth	Test Types	Pump Type	Suction Set (m)	Q Prior to Test (l/s)	Dur of Q PR (mins)	Pres on Arriv (m)	Q on Arriv (l/s/)
A	04/12/2018	1	182166	15.00	30.00		PUM		AIR	30.00				

Pump Tests Part 2

1 ***records for RN*** **182166**

Pipe	Date	Rec	Test	SWL(m)	Recov	Resid	Max DD	Q at	Time to	Max Q	Calc	Design	Design	Suct.	Tmsy	Stor

			Dur (mins)		Time (mins)	DD (m)	or P RED (m)	Max DD (l/s)	Max DD (mins)	(l/s)	Stat HD (m)	Yield (l/s)	BP (m)	Set (m)	(m2/Day)
A	04/12/2018	1	90	-12.00			18.00	3.51						30.00	

Bore Conditions

0 *records for RN* 182166

Elevations

0 *records for RN* 182166

Water Analysis Part 1

0 *records for RN* 182166

Water Analysis Part 2

0 *records for RN* 182166

Water Levels

0 *records for RN* 182166

Wire Line Logs

0 *records for RN* 182166

Field Measurements

1 *records for RN* 182166

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	04/12/2018		2100	9.1						AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 *records for RN* 182166

Bore Report

From Year:

User Licence and Conditions

7/12

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 3/1 Burma Road Pooraka SA 5095
Ph: 08 8162 5130 E: adelaide@alsglobal.com

☑BRISBANE 2 Byth Street Stafford QLD 4053
Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

☐GLADSTONE 46 Callemondah Drive Gladstone QLD 4680
Ph: 07 4978 7944 E: ALSEnviro.Gladstone@alsglobal.com

☐MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740
Ph: 07 4952 5795 E: ALSEnviro.Mackay@alsglobal.com

☐MELBOURNE 2-4 Westall Road Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850
Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304
Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

☐NOWRA 4/13 Geary Place North Nowra NSW 2541
Ph: 02 4423 2063 E: nowra@alsglobal.com

☐PERTH 10 Hod Way Malaga WA 6090
Ph: 08 9209 7655 E: samples.perth@alsglobal.com

☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

☐TOWNSVILLE 13 Carlton Street Kirwan QLD 4817

Environmental Division
Brisbane
Work Order Reference
EB2031461

Telephone : + 61-7-3243 7222

CLIENT: BHP
OFFICE: BRISBANE
PROJECT: HPE BAP
PROJECT NO.:
ORDER NUMBER:
PURCHASE ORDER NO.: 4510264491
PROJECT MANAGER: KATY STEELE
CONTACT PH: 0448 888 893
SAMPLER: DUNCAN DAWSON / SLR
SAMPLER MOBILE: 0419987617
COC Emailed to ALS? (YES / NO)
EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed): PM + ddawson@slrconsulting.com
Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☑ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.:
COUNTRY OF ORIGIN: AUSTRALIA
COC SEQUENCE NUMBER (Circle)
COC: [✓ 1] 2 3 4 5 6 7
OF: 1 [✓ 2] 3 4 5 6 7

FOR LABORATORY
Custody Seal Intact? No N/A
Free ice / frozen ice bric No N/A
Random Sample Tempe °C
Other comment:

RELINQUISHED BY: Duncan Dawson
DATE/TIME: 27/11/2020
RECEIVED BY: Martin
DATE/TIME: 27/11/2020 18:45
RELINQUISHED BY:
DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).											Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	ph	EC	TDS	Major ions: Ca, K Cl, Na, F, SO4	Alkalinity - HCO3, CO3, hydroxide as CaCO3		Total hardness as CaCO3	Total + Dissolved Al, As, Ba, Be, B, Pb, Mg, Ni, Se Mn, Hg, Mo, U, V Cd, Cr, Co, Fe, Zn				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	GD01	24/11/2020 10:20	W	1xP 2x AP	3	X	X	X	X	X	X	X	X	X	X	X	~~Can you please~~ ~~[illegible]~~
2	QA01	24/11/2020			3												
3	GD01	24/11/2020 16:40			3												PTO for More Samples
4	QA02	24/11/2020			3												
5	FB01	24/11/2020 11:50			3												
6	RB01	24/11/2020 11:59			3												
7	Pownall01	26/11/2020 07:33			3												
8	QA03	26/11/2020			3												
9	FB03	26/11/2020			3												
10	RB03	26/11/2020			3												
11	FB02	25/11/2020 18:50			3												
12	RB02	25/11/2020 18:57															
16 Samples Total (PTO for continuation of CoC)				TOTAL													

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CoC 2/2 SAMPLER Duncan Dawson Relinquished 27/11/2020

SAMPLE ID	DATE / TIME	MATRIX	TYPE + PRESERVATIVE	Bottles	PH	EC	TDS	MAJOR IONS	ALKALINITY	Total hardness as CaCO3	DISS + To ~~[illegible]~~, Al, As, B B, Cd, Cr, Co, Fe, Ni, Se, [illegible], Zn
13 WD05	27/11/2020 10:50	W	1X P 2X AP	3	X	X	X	X	X	X	X
14 QA04	27/11/2020	W	↓	3	X	X	X	X	X	X	X
15 FB04	27/11/2020 13:00	↓	↓	3	X	X	X	X	X	X	X
16 RB04	27/11/2020 13:00	↓	↓	3	X	X	X	X	X	X	X

CERTIFICATE OF ANALYSIS

Work Order : **EB2031461-AG**
Page : 1 of 5
Amendment : **3**
Client : **BM ALLIANCE LTD**
Laboratory : Environmental Division Brisbane
Contact : MS KATY STEELE
Contact : Nidhi Bhimani
Address : L11 480 QUEEN STREET
BRISBANE QLD 4000
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : ----
Telephone : +61-7-3243 7222
Project : HPE BAP
Date Samples Received : 27-Nov-2020 18:45
Order number : 4510264491
Date Analysis Commenced : 30-Nov-2020
C-O-C number : ----
Issue Date : 18-Dec-2020 11:10
Sampler : DUNCAN DAWSON / SLR
Site : ----
Quote number : BN/448/15 V24
No. of samples received : 4
No. of samples analysed : 4

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Amendment (18/12/2020): This report has been amended and re-released to allow the reporting of additional analytical data. Total and Dissolved Copper results are now included.
- Amendment (17.12.2020): This report has been amended as a result of the change of quote from EN/222 to BN/448/15 v24 as requested by client. All analysis results are as per the previous report
- Amendment (18/12/2020): This report has been amended as a result of a request to split samples #1-2, #3-6, #7-10, #11-12 and #13-16 into separate COA reports. All analysis results are as per the previous report
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit					
			Sample ID	**GD01**	**QA02**	**FB01**	**RB01**	**----**
			Sampling date / time	24-Nov-2020 16:40	24-Nov-2020 00:00	24-Nov-2020 11:50	24-Nov-2020 11:59	----
				EB2031461-003	**EB2031461-004**	**EB2031461-005**	**EB2031461-006**	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.60**	**7.43**	**5.67**	**5.65**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2230**	**2240**	<1	<1	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**1400**	**1420**	<10	<10	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**677**	**680**	**1**	<1	----
Total Alkalinity as CaCO3	----	1	mg/L	**677**	**680**	**1**	<1	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**60**	**60**	<1	<1	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**402**	**402**	<1	<1	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**103**	**97**	<1	<1	----
Magnesium	7439-95-4	1	mg/L	**153**	**151**	<1	<1	----
Sodium	7440-23-5	1	mg/L	**214**	**237**	<1	<1	----
Potassium	7440-09-7	1	mg/L	**4**	**4**	<1	<1	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**887**	**864**	<1	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.001**	<0.001	<0.001	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Barium	7440-39-3	0.001	mg/L	**0.067**	**0.067**	<0.001	**0.001**	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.163**	**0.150**	<0.001	<0.001	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**GD01**	**QA02**	**FB01**	**RB01**	**----**
			Sampling date / time	24-Nov-2020 16:40	24-Nov-2020 00:00	24-Nov-2020 11:50	24-Nov-2020 11:59	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031461-003**	**EB2031461-004**	**EB2031461-005**	**EB2031461-006**	--------
				Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	**0.002**	<0.001	<0.001	----
Vanadium	7440-62-2	0.01	mg/L	**0.01**	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Boron	7440-42-8	0.05	mg/L	**0.22**	**0.23**	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	**0.10**	**0.10**	<0.05	<0.05	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.07**	<0.01	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	**0.001**	**0.004**	<0.001	<0.001	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Barium	7440-39-3	0.001	mg/L	**0.070**	**0.089**	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.164**	**0.184**	<0.001	<0.001	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	**0.002**	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Uranium	7440-61-1	0.001	mg/L	**0.003**	**0.002**	<0.001	<0.001	----
Vanadium	7440-62-2	0.01	mg/L	**0.01**	**0.02**	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Boron	7440-42-8	0.05	mg/L	**0.24**	**0.28**	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	**0.35**	**4.55**	<0.05	<0.05	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.2**	<0.1	<0.1	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**26.1**	**26.2**	**0.02**	<0.01	----
ø **Total Cations**	----	0.01	meq/L	**27.1**	**27.7**	<0.01	<0.01	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Sample ID	**GD01**	**QA02**	**FB01**	**RB01**	**----**
			Sampling date / time	24-Nov-2020 16:40	24-Nov-2020 00:00	24-Nov-2020 11:50	24-Nov-2020 11:59	----
Compound	CAS Number	LOR	Unit	**EB2031461-003**	**EB2031461-004**	**EB2031461-005**	**EB2031461-006**	**--------**
				Result	Result	Result	Result	----
EN055: Ionic Balance - Continued								
ø **Ionic Balance**	----	0.01	%	**1.93**	**2.79**	**----**	**----**	**----**

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB2031461-AG**	Page	: 1 of 9
Amendment	: **3**		
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KATY STEELE	Contact	: Nidhi Bhimani
Address	: L11 480 QUEEN STREET BRISBANE QLD 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: HPE BAP	Date Samples Received	: 27-Nov-2020
Order number	: 4510264491	Date Analysis Commenced	: 30-Nov-2020
C-O-C number	: ----	Issue Date	: 18-Dec-2020
Sampler	: DUNCAN DAWSON / SLR		
Site	: ----		
Quote number	: BN/448/15 V24		
No. of samples received	: 4		
No. of samples analysed	: 4		

ilac-MRA NATA

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 3394837)									
EB2031425-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.99	7.02	0.428	0% - 20%
EB2031461-005	FB01	EA005-P: pH Value	----	0.01	pH Unit	5.67	5.64	0.530	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 3394838)									
EB2031425-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	4030	4030	0.00	0% - 20%
EB2031461-005	FB01	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1	0.00	No Limit
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 3391123)									
EB2031461-003	GD01	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1400	1430	2.12	0% - 20%
EB2031461-012	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	<10	0.00	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 3394840)									
EB2031425-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	481	476	1.09	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	481	476	1.09	0% - 20%
EB2031461-005	FB01	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	1	<1	0.00	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3392563)									
EB2031418-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	9	8	0.00	No Limit
EB2031461-008	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	287	298	3.76	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3392564)									
EB2031418-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	29	29	0.00	0% - 20%
EB2031461-008	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	433	437	0.872	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 3390964)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED093F: Dissolved Major Cations (QC Lot: 3390964) - continued									
EB2031461-003	GD01	ED093F: Calcium	7440-70-2	1	mg/L	103	106	2.98	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	153	154	0.00	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	214	217	1.47	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.00	No Limit
EB2031461-013	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	214	238	10.6	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	187	212	12.9	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	658	720	9.02	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	7	7	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390965)									
EB2031461-003	GD01	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.067	0.067	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.163	0.164	0.00	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.01	0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.22	0.23	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.10	0.10	0.00	No Limit
EB2031461-013	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.269	0.308	13.7	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.115	0.132	13.8	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390965) - continued									
EB2031461-013	Anonymous	EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.32	0.34	5.42	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	1.06	1.22	14.1	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390966)									
EB2031461-003	GD01	EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.002	0.002	0.00	No Limit
EB2031461-013	Anonymous	EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3391102)									
EB2031461-001	Anonymous	EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EB2031461-010	Anonymous	EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3391103)									
EB2031461-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.801	0.804	0.339	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.012	0.011	0.00	0% - 50%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.054	0.052	2.45	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.006	0.006	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.04	0.02	61.3	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.39	0.42	7.40	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.06	0.06	0.00	No Limit
EB2031461-010	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	***Sample ID***	***Method: Compound***	***CAS Number***	***LOR***	***Unit***	***Original Result***	***Duplicate Result***	***RPD (%)***	***Recovery Limits (%)***
EG020T: Total Metals by ICP-MS (QC Lot: 3391103) - continued									
EB2031461-010	Anonymous	EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 3390967)									
EB2031461-003	GD01	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2031461-013	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3391105)									
EB2031336-023	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2031461-006	RB01	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3394839)									
EB2031425-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EB2031461-005	FB01	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EA005P: pH by PC Titrator (QCLot: 3394837)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	100	98.0	102
EA010P: Conductivity by PC Titrator (QCLot: 3394838)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	220 µS/cm	102	91.0	107
				<1	12890 µS/cm	99.4	91.0	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 3391123)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2460 mg/L	105	88.0	112
				<10	293 mg/L	105	88.0	112
				<10	2000 mg/L	100	80.9	118
ED037P: Alkalinity by PC Titrator (QCLot: 3394840)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	103	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3392563)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	101	85.0	118
				<1	100 mg/L	98.4	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 3392564)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.9	90.0	115
				<1	1000 mg/L	104	90.0	115
ED093F: Dissolved Major Cations (QCLot: 3390964)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	106	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	108	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	105	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	96.5	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	93.3	79.0	118
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	96.2	88.0	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	91.2	81.0	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	94.6	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	90.7	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	93.0	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	93.4	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	90.8	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.9	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	93.3	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	99.8	89.0	112

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965) - continued								
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	92.3	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.1	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	97.7	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	93.0	87.0	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	101	81.0	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	96.4	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390966)								
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	93.7	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391102)								
EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	107	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391103)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	98.3	80.0	114
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	111	88.0	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	95.4	81.0	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	102	70.0	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	101	88.0	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	101	89.0	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	105	89.0	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	109	88.0	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	104	89.0	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	104	88.0	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	111	90.0	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	108	88.0	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	106	79.0	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	114	87.0	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	103	84.0	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	105	82.0	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	113	82.0	118
EG035F: Dissolved Mercury by FIMS (QCLot: 3390967)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	101	84.0	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391105)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	100	84.0	118
EK040P: Fluoride by PC Titrator (QCLot: 3394839)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	94.0	80.0	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	*SpikeRecovery(%)*	*Recovery Limits (%)*	
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3392563)							
EB2031418-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	85.3	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3392564)							
EB2031418-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	114	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965)							
EB2031461-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	98.2	70.0	130
		EG020A-F: Beryllium	7440-41-7	1 mg/L	89.7	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	93.5	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	92.5	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	92.0	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	90.3	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	88.0	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	94.0	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	93.9	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	90.4	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	96.0	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	93.3	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391103)							
EB2031461-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	112	70.0	130
		EG020A-T: Beryllium	7440-41-7	1 mg/L	110	70.0	130
		EG020A-T: Barium	7440-39-3	1 mg/L	101	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	104	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	107	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	109	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	106	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	109	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	114	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	106	70.0	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	124	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	102	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 3390967)							
EB2031461-004	QA02	EG035F: Mercury	7439-97-6	0.01 mg/L	94.0	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391105)							
EB2031336-024	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	93.1	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 3394839)							
EB2031425-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	80.4	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2031461**	Page	: 1 of 11
Amendment	: **3**		
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KATY STEELE	Telephone	: +61-7-3243 7222
Project	: HPE BAP	Date Samples Received	: 27-Nov-2020
Site	: ----	Issue Date	: 18-Dec-2020
Sampler	: DUNCAN DAWSON / SLR	No. of samples received	: 16
Order number	: 4510264491	No. of samples analysed	: 16

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
CD01, GD01, FB01,	QA01, QA02, RB01	----	----	----	01-Dec-2020	24-Nov-2020	**7**
Clear Plastic Bottle - Natural							
FB02,	RB02	----	----	----	01-Dec-2020	26-Nov-2020	**5**
Clear Plastic Bottle - Natural							
Pownall 01, FB03,	QA03, RB03	----	----	----	01-Dec-2020	26-Nov-2020	**5**
Clear Plastic Bottle - Natural							
WD05, FB04,	QA04, RB04	----	----	----	01-Dec-2020	27-Nov-2020	**4**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Total Mercury by FIMS	1	21	4.76	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	***Sample Date***	*Extraction / Preparation*			*Analysis*		
***Container** / Client Sample ID(s)*		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P) CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Nov-2020	✗
Clear Plastic Bottle - Natural (EA005-P) FB02,	RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	26-Nov-2020	✗
Clear Plastic Bottle - Natural (EA005-P) Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	26-Nov-2020	✗
Clear Plastic Bottle - Natural (EA005-P) WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	27-Nov-2020	✗
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P) CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) FB02,	RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Clear Plastic Bottle - Natural (EA015H) CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	01-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) FB02,	RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	02-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	03-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	04-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container*** */ Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	08-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	09-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	10-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	11-Dec-2020	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**30-Nov-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) FB02, RB02	**25-Nov-2020**	**----**	----	----	**30-Nov-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**30-Nov-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**30-Nov-2020**	25-Dec-2020	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**30-Nov-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) FB02, RB02	**25-Nov-2020**	**----**	----	----	**30-Nov-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**30-Nov-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**30-Nov-2020**	25-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container*** */ Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation* ***Date extracted***	 *Due for extraction*	 *Evaluation*	*Analysis* ***Date analysed***	 *Due for analysis*	 *Evaluation*
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	26-May-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container*** */ Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation* ***Date extracted***	 *Due for extraction*	 *Evaluation*	*Analysis* ***Date analysed***	 *Due for analysis*	 *Evaluation*
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**01-Dec-2020**	23-May-2021	✓	**01-Dec-2020**	23-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) FB02, RB02	**25-Nov-2020**	**01-Dec-2020**	24-May-2021	✓	**01-Dec-2020**	24-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**01-Dec-2020**	25-May-2021	✓	**01-Dec-2020**	25-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) WD05, QA04, FB04, RB04	**27-Nov-2020**	**01-Dec-2020**	26-May-2021	✓	**01-Dec-2020**	26-May-2021	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
FB02,	RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	4	34	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	3	21	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	6	33	**18.18**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	21	**4.76**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of \`filterable\` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the libarated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

GROSVENOR DOWNS 02

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) Anglo Coal (Grosvenor Management) Pty Ltd	ABN/ACN (if applicable) 82 081 022 344
Principal contact	
Surname Burgess	Given name(s) Dean
Phone 0428 125 811	Mobile
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 377
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 02	
Bore registration number (RN)[4]	Bore RN comments Bore details do not match any registered bores in area
Local bore name Quarry Bore 1	
Property name Grosvenor Downs	
Lot 2	Plan SP260061
Date of site assessment 24/11/2020	
Bore geographic location (GDA94)	
Latitude 22.02251	Longitude 148.03847
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) Unknown
Type of casing PVC	Casing diameter (mm) 110
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☐ Yes →	Name of source aquifer Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
☒ No →	Reasons source aquifer unknown No bore information available
Is a strata log available for the bore?	
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No
Additional comments Depth to Base - 26.53m	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
N//A	N/A
Pump setting depth (m) (depth from ground)	
N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.61m PVC stick up - no cap and broken around bore opening.
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Drilled for Quarry Water Supply - Abandoned				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)?	
N/A	
Describe the operational capacity, including seasonal variation	
N/A	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.	
N/A	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 2.04
	Current conditions relevant to the water level measurement No bore cap- no antecedant rainfall in 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.61	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.1%	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.3%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore? ☐ Yes ☒ No			
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore? ☒ Yes → attach them to this form. ☐ No			

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable) t	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Zarb	Given name(s) Joe
Phone 0427195408	Alternative phone
Fax	Email jzarb@quarrico.com.au
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 02

GROSVENOR DOWNS 03

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) Anglo Coal (Grosvenor Management) Pty Ltd	ABN/ACN (if applicable) 82 081 022 344
Principal contact	
Surname Burgess	Given name(s) Dean
Phone 0428 125 811	Mobile
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 377
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 03	
Bore registration number (RN)[4] 182164	Bore RN comments Bore location and details matches registered RN bore location
Local bore name Quarry Bore 2	
Property name Grosvenor Downs	
Lot 2	Plan RP616987
Date of site assessment 24/11/2020	
Bore geographic location (GDA94)	
Latitude 22.02252	Longitude 148.03847
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using “groundwater database” as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Don Irvine - Capricorn Coast Drilling	Date of bore construction (drilled date) 24/08/2018
Type of casing PVC	Casing diameter (mm) 150
Details of perforated intervals and/or screens that have been installed 36-58m	
Details of any seals and cement grouting installed in the bore annulus Grout 0 - 6m, bentonite 34-36m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Volcanics (Basalt)
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Moderate - based on information in DNMRE bore report (screen interval vs strata log)
☐ No →	Reasons source aquifer unknown No bore information available
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Depth to Base - 63.11	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
N//A	N/A
Pump setting depth (m) (depth from ground)	
N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No
Power source	
☐ Electric motor ☐ Generator ☐ Direct drive engine	☐ Mains supply ☐ Tractor ☐ Windmill
Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)	
0.61m PVC stick up - no cap and broken around bore opening.	
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance	

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)	
☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply	
☒ Other → description: Drilled for Quarry Water Supply - Abandoned	
Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A
Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)?	
N/A	
Describe the operational capacity, including seasonal variation	
N/A	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.	
N/A	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 2.11
	Current conditions relevant to the water level measurement No bore cap- no antecedant rainfall in 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s) 0.33 (from pumping test details on DNRME bore report)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.6	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.3%	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.4%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.	☐ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone 0419987617	Alternative phone
Fax	Email ddawson@slrconsulting.com

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Zarb	Given name(s) Joe
Phone 0427195408	Alternative phone
Fax	Email jzarb@quarrico.com.au
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner?	
☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 03

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
182164	Sub-Artesian Facility	Existing	24/08/2018	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name	IRVINE, DON		
Drill Company	CAPRICORN COAST DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No	MAC/520/000 (0072)	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	19/09/2018	**Data Owner**	
Roles	Water Supply		

Location

Latitude	22-02-17	**Basin**	1304
Longitude	148-03-54	**Sub-area**	
GIS Latitude	-22.03814179	**Lot**	2
GIS Longitude	148.06495779	**Plan**	RP616987
Easting	609901		
Northing	7562568	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

7 ***records for RN*** **182164**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	24/08/2018	1	0.00	60.00	Polyvinyl Chloride	7.500	WT - Wall Thickness	140
A	24/08/2018	2	36.00	58.00	Perforated or Slotted Casing	3.500	AP - Aperture Size	140
X	24/08/2018	3	0.00	6.00	Grout			184
X	24/08/2018	4	6.00	34.00	Cuttings or other fill between casing and hole wall			184

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	24/08/2018	5	34.00	36.00	Bentonite Seal			184
X	24/08/2018	6	36.00	60.00	Gravel Pack	5.000	GR - Gravel Size	184
X	24/08/2018	7	0.00	30.00	Centraliser			

Strata Logs

5 ***records for RN*** **182164**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	6.00	BROWN GRAVELS
2	6.00	12.00	BLUE GRANITES
3	12.00	35.00	BLUE GREY GRANITES
4	35.00	58.00	WEATHERED FRACTURED VOLCANICS
5	58.00	64.00	DARK GREY SHALES

Stratigraphies

0 ***records for RN*** **182164**

Aquifers

1 ***records for RN*** **182164**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	36.00		VOLC - Volcanic	24/08/2018	-15.00	N	POTABLE	0.33	Y	FR	

Pump Tests Part 1

1 ***records for RN*** **182164**

Pipe	Date	Rec	RN of Pumped Bore	Top (m)	Bottom (m)	Dist (m)	Meth	Test Types	Pump Type	Suction Set (m)	Q Prior to Test (l/s)	Dur of Q PR (mins)	Pres on Arriv (m)	Q on Arriv (l/s/)
A	24/08/2018	1	182164				PUM			40.00				

Pump Tests Part 2

1 ***records for RN*** **182164**

Bore Report

From Year:

Pipe	Date	Rec	Test Dur (mins)	SWL(m)	Recov Time (mins)	Resid DD (m)	Max DD or P RED (m)	Q at Max DD (l/s)	Time to Max DD (mins)	Max Q (l/s)	Calc Stat HD (m)	Design Yield (l/s)	Design BP (m)	Suct. Set (m)	Tmsy (m2/Day)	Stor
A	24/08/2018	1	60	-15.00				0.33						40.00		

Bore Conditions

0 ***records for RN*** **182164**

Elevations

0 ***records for RN*** **182164**

Water Analysis Part 1

0 ***records for RN*** **182164**

Water Analysis Part 2

0 ***records for RN*** **182164**

Water Levels

0 ***records for RN*** **182164**

Wire Line Logs

0 ***records for RN*** **182164**

Field Measurements

0 ***records for RN*** **182164**

Special Water Analysis

0 ***records for RN*** **182164**

Bore Report

From Year:

User Licence and Conditions

GROSVENOR DOWNS 04

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) Anglo Coal (Grosvenor Management) Pty Ltd	ABN/ACN (if applicable) 82 081 022 344
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 377
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 04	
Bore registration number (RN)[4] 162142	Bore RN comments Bore location 166m S of registered bore. Casing information and bore depth matches information in DNRME bore report
Local bore name MB02	
Property name Grosvenor Downs	
Lot 6	Plan RP884515
Date of site assessment 24/11/2020	
Bore geographic location (GDA94)	
Latitude 22.04114	Longitude 148.08318
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using “groundwater database” as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) James Leslie Sinclair - Lucas Drilling	Date of bore construction (drilled date) 08/07/2012
Type of casing PVC	Casing diameter (mm) 115
Details of perforated intervals and/or screens that have been installed 131-137m	
Details of any seals and cement grouting installed in the bore annulus Grout - 0 to 123m, bentonite seal 123 to 125m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 0.02 - reported on DNRME bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Moranbah Coal Measures (Siltstone / sandstone)
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - moderate confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore? ☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type N//A	Pump make and model N/A
Pump setting depth (m) (depth from ground) N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)

0.69m PVC stick up encased in lockable steel monument.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Monitoring Bore				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)? N/A	
Describe the operational capacity, including seasonal variation N/A	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore. N/A	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 38.13
	Current conditions relevant to the water level measurement Monitoring bore - assumed not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.69	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm_v) 0.3 %	H_2S (ppm_v) 0 ppm	CH_4 (%LEL) 0.2%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes		☒ No	
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.		☐ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname Hoare	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 04
5 


Report Date: 27/10/2020 10:54

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162142	Sub-Artesian Facility	Existing	08/07/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB02		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No	MAC/140/000 (0212)	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	23/08/2012	**Data Owner**	DNR
Roles	Mine Monitoring		

Location

Latitude	22-02-23	**Basin**	1304
Longitude	148-04-59	**Sub-area**	
GIS Latitude	-22.03965401	**Lot**	6
GIS Longitude	148.0831639	**Plan**	RP884515
Easting	611779		
Northing	7562387	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

6 *records for RN* **162142**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	07/08/2012	1	0.00	137.00	Polyvinyl Chloride			114
A	07/08/2012	2	131.00	137.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	114
X	07/08/2012	3	0.00	123.00	Grout			200
X	07/08/2012	4	123.00	125.00	Bentonite Seal			200

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	07/08/2012	5	125.00	137.00	Gravel Pack	4.500	GR - Gravel Size	200
X	07/08/2012	6	137.00	138.75	Cuttings or other fill between casing and hole wall			200

Strata Logs

17 *records for RN* 162142

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	SOIL, HIGHLY WEATHERED, DARK BLACK, FINE GRAIN, SOFT
2	1.00	13.00	BASALT, HIGHLY WEATHERED, BROWN, FINE GRAIN, WEAK ROCK, LIMONITIC, PEBBLY
3	13.00	20.00	BASALT, FRESH, DARK BLUE, FINE GRAIN, MODERATELY STRONG
4	20.00	23.00	BASALT, FRESH, DARK BLUE, FINE GRAIN, STRONG ROCK
5	23.00	27.00	CLAY, FRESH, BROWN, FINE GRAIN, SOFT, COHESIVE SOIL, CLAYEY
6	27.00	44.00	BASALT, FRESH DARK BLUE, FINE GRAIN, STRONG ROCK
7	44.00	48.00	BASALT, FRESH, DARK BLUE, FINE GRAIN, CLAYEY
8	48.00	60.00	SILTSTONE, FRESH, BLUE, FINE GRAIN, WEAK ROCK, CLAYEY
9	60.00	61.00	CARBONACEOUS SILTSTONE, FRESH, DARK BLUE, FINE GRAIN, VERY WEAK ROACK, COALY
10	61.00	65.00	SILTSTONE, FRESH, BLUE, FINE GRAIN, VERY WEAK ROCK
11	65.00	85.00	SANDSTONE, FRESH, CREAM, FINE GRAIN, STRONG ROCK
12	85.00	90.00	SILTSTONE, FRESH BLUE, FINE GRAIN, MODERATELY STRONG, SANDSTONE
13	90.00	105.00	SANDSTONE, FRESH, BLUE, FINE GRAIN, STRONG, SILTSTONE
14	105.00	111.00	SILTSTONE, FRESH, BLUE, FINE GRAIN, STRONG, SANDSTONE, COALY
15	111.00	130.00	SILTSTONE, FRESH, BLUE, FINE GRAIN, VERY WEAK ROCK
16	130.00	134.00	SILTSTONE, FRESH, BLUE, FINE GRAIN,VERY WEAK ROCK, SANDSTONE, COALY
17	134.00	139.00	SILTSTONE, FRESH, DARK BLUE, FINE GRAIN, VERY WEAK ROCK, SANDSTONE

Stratigraphies

0 *records for RN* 162142

Aquifers

2 *records for RN* 162142

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	11.00		BSLT - Basic Volcanic						N	WZ	BASALT
2	125.00	139.00	SDST - Sandstone	19/08/2012	-23.70	N	COND 7550	0.02	Y	PS	MORANBAH COAL MEASURES

Pump Tests Part 1

0 ***records for RN*** 162142

Pump Tests Part 2

0 ***records for RN*** 162142

Bore Conditions

0 ***records for RN*** 162142

Elevations

2 ***records for RN*** 162142

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	01/07/2012	216.92	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT
X	01/07/2012	216.45	SVY	Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 ***records for RN*** 162142

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	16/08/2012	1	XXX	XXX			GB	8300	9.8		5027.15	4999.70	114	327	0.0	74.4	4.26

Water Analysis Part 2

1 ***records for RN*** 162142

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	16/08/2012	1	1820.0	57.0	14.0	19.0		54.0		169.0	2890.0	1.40		2.0	0.01	0.10	0.64	

Water Levels

1 ***records for RN*** 162142

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	19/08/2012		-22.71	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162142**

Field Measurements

0 ***records for RN*** **162142**

Special Water Analysis

0 ***records for RN*** **162142**

From Year:

User Licence and Conditions

Disclaimer

GROSVENOR DOWNS 05

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) Anglo Coal (Grosvenor Management) Pty Ltd	ABN/ACN (if applicable) 82 081 022 344
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 377
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 05	
Bore registration number (RN)[4] 162807	Bore RN comments Bore location matches registered bore location.
Local bore name House Windmill Bore	
Property name Grosvenor Downs	
Lot 2	Plan RP616987
Date of site assessment 24/11/2020	
Bore geographic location (GDA94)	
Latitude 22.03725	Longitude 148.08162
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?		
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).	
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) <01/01/1950	
Type of casing Steel	Casing diameter (mm) 110	
Details of perforated intervals and/or screens that have been installed Unknown		
Details of any seals and cement grouting installed in the bore annulus Unknown		
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknownt		
Is the source aquifer of the bore known?		
☐ Yes →	Name of source aquifer	
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)	
☒ No →	Reasons source aquifer unknown No information from landholder representative or on DNRME bore	
Is a strata log available for the bore?		
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No	
Additional comments Bore depth - 11.89m		

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
N//A	N/A
Pump setting depth (m) (depth from ground)	
N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source
☐ Electric motor ☐ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.39m PVC stick up / rusted

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance
Windmill and associated infrastructure removed in 2015

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)
☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply
☒ Other → description: Previously used for domestic supply / decomissioned in 2015

Is the water use from this bore metered?

☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?
N/A

Describe the operational capacity, including seasonal variation
N/A

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
N/A

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 10.37
	Current conditions relevant to the water level measurement Bore open - no cap.
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.39m	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 2 %	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.2%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - Bore abandoned		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A - Bore abandoned		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.	☐ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname Hoare	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

6

Grosvenor Downs 05

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162807	Sub-Artesian Facility	Abandoned but Still Usable	01/01/1950	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	HOUSE WINDMILL BORE		
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-02-14	**Basin**	1304
Longitude	148-04-54	**Sub-area**	
GIS Latitude	-22.03715632	**Lot**	2
GIS Longitude	148.08162563	**Plan**	RP616987
Easting	611622		
Northing	7562665	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

0 ***records for RN*** 162807

Strata Logs

0 ***records for RN*** 162807

Stratigraphies

0 ***records for RN*** 162807

Aquifers

0 ***records for RN*** 162807

Pump Tests Part 1

0 ***records for RN*** 162807

Pump Tests Part 2

0 ***records for RN*** 162807

Bore Conditions

0 *records for RN* 162807

Elevations

1 *records for RN* 162807

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
X	11/09/2004	216.00	MAN	Manual measurement from natural surface	AHD - Aust. Height Datum	N	Natural Surface	

Water Analysis Part 1

0 *records for RN* 162807

Water Analysis Part 2

0 *records for RN* 162807

Water Levels

0 *records for RN* 162807

Wire Line Logs

0 *records for RN* 162807

Field Measurements

0 *records for RN* 162807

Special Water Analysis

0 *records for RN* 162807

Bore Report

From Year:

User Licence and Conditions

GROSVENOR DOWNS 06

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) Anglo Coal (Grosvenor Management) Pty Ltd	ABN/ACN (if applicable) 82 081 022 344
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 377
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 06	
Bore registration number (RN)[4] 162141	Bore RN comments Bore location 215m NE of registered bore. Casing information and bore depth matches information in DNRME bore report
Local bore name MB04 / DEPM 1041252	
Property name Grosvenor Downs	
Lot 6	Plan RP884515
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.03983	Longitude 148.10426
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) James Leslie Sinclair - Lucas Drilling	Date of bore construction (drilled date) 11/08/2012
Type of casing PVC	Casing diameter (mm) 110
Details of perforated intervals and/or screens that have been installed 8-11m	
Details of any seals and cement grouting installed in the bore annulus Grout - 0 to 6m, bentonite seal 6 to 7m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 0.02 - reported on DNRME bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Quaternary - Undefined
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - moderate confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report. Bore Depth - 11.90mbtoc	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
N//A	N/A
Pump setting depth (m) (depth from ground)	
N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.74 PVC stick up encased in lockable steel monument.
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Monitoring Bore				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)?	
N/A	
Describe the operational capacity, including seasonal variation	
N/A	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.	
N/A	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

- a. A datum for standing water level (SWL);
- b. The unique identification number of the bore and the groundwater database registered number (if available);
- c. The bore owner's name;
- d. Property name; and
- e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) .11.86
	Current conditions relevant to the water level measurement Monitoring bore - assumed not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.74	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$)	H_2S (ppm$_v$)	CH_4 (%LEL)
	4.1%	0 ppm	0.3%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes		☒ No	
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method		
	☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.		☐ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 06

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162141	Sub-Artesian Facility	Existing	11/08/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB04		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No	MAC/140/000 (0212)	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	23/08/2012	**Data Owner**	DNR
Roles	Mine Monitoring		

Location

Latitude	22-02-29	**Basin**	1304
Longitude	148-06-12	**Sub-area**	
GIS Latitude	-22.04144308	**Lot**	6
GIS Longitude	148.1032045	**Plan**	RP884515
Easting	613846		
Northing	7562175	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

5 ***records for RN*** **162141**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	09/07/2012	1	0.00	11.00	Polyvinyl Chloride			114
A	09/07/2012	2	8.00	11.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	114
X	09/07/2012	3	0.00	6.00	Grout			200
X	09/07/2012	4	6.00	7.00	Bentonite Seal			200

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	09/07/2012	5	7.00	11.00	Gravel Pack	4.500	GR - Gravel Size	200

Strata Logs

8 ***records for RN*** **162141**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	2.00	SOIL, WEATHERED TO SOIL, DARK BROWN, COHESIVE SOIL
2	2.00	4.00	SOIL, WEATHERED TO SOIL, BROWN, SOFT, COHESIVE, SANDY
3	4.00	7.00	CLAYSTONE, EXTREMELY WEATHERED, BROWN, LOOSE
4	7.00	10.00	SAND, HIGHLY WEATHERED, BROWN, LOOSE
5	10.00	12.00	SAND, HIGHLY WEATHERED, BROWN, LOOSE
6	12.00	14.00	SAND, HIGHLY WEATHERED, BROWN, VERY WEAK ROCK
7	14.00	15.00	COAL, SLIGHTLY WEATHERED, BLACK, VERY WEAK ROCK (FORT COOPER COAL)
901			HOLE COLLAPSED BELOW 11 METRES

Stratigraphies

0 ***records for RN*** **162141**

Aquifers

1 ***records for RN*** **162141**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	8.00	11.00	SAND - Sand				COND 5340		Y	UC	QUATERNARY - UNDEFINED

Pump Tests Part 1

0 ***records for RN*** **162141**

Pump Tests Part 2

0 ***records for RN*** **162141**

Bore Conditions

0 ***records for RN*** **162141**

Elevations

2 ***records for RN*** **162141**

Pipe	Date	Elevation (m)	Precision	Datum	Meas	Point	Survey Source
A	01/07/2012	209.27	SVY Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT
X	01/07/2012	208.75	SVY Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 ***records for RN*** **162141**

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	14/08/2012	1	XXX	XXX			GB	7770	8.0		5215.89	4793.49	1413	682	0.5	14.6	

Water Analysis Part 2

1 ***records for RN*** **162141**

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	14/08/2012	1	1260.0	3.0	114.0	274.0	1.15	831.0	11.80		2490.0	0.80		224.0	0.03	5.60	0.51	

Water Levels

1 ***records for RN*** **162141**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	11/08/2012		-10.97	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130 Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162141**

Field Measurements

0 ***records for RN*** **162141**

Special Water Analysis

0 ***records for RN*** **162141**

From Year:

User Licence and Conditions

Disclaimer

GROSVENOR DOWNS 07

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) Anglo Coal (Grosvenor Management) Pty Ltd	ABN/ACN (if applicable) 82 081 022 344
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 377
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 07	
Bore registration number (RN)[4] 162144	Bore RN comments Bore location matches location of registered bore. Casing information and bore depth matches information in DNRME bore report.
Local bore name MB05B	
Property name Grosvenor Downs	
Lot 6	Plan RP884515
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.03199	Longitude 148.11632
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using “groundwater database” as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) James Leslie Sinclair - Lucas Drilling	Date of bore construction (drilled date) 12/08/2012
Type of casing PVC	Casing diameter (mm) 110
Details of perforated intervals and/or screens that have been installed 10.5-16.5m	
Details of any seals and cement grouting installed in the bore annulus Grout - 0 to 8m, bentonite seal 7 to 9m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 0.02 - reported on DNRME bore report	

Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Isaac River Alluvium
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - high confidence
☐ No →	Reasons source aquifer unknown

Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report. Bore Depth - 17.44mbtoc	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
N//A	N/A
Pump setting depth (m) (depth from ground)	
N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.57 PVC stick up encased in lockable steel monument.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Monitoring Bore				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?
N/A

Describe the operational capacity, including seasonal variation
N/A

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
N/A

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 12.02
	Current conditions relevant to the water level measurement Monitoring bore - assumed not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Monument	
Height of datum above ground level (m) 0.57	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0%	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.4%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore? ☐ Yes ☒ No			
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore? ☒ Yes → attach them to this form. ☐ No			

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 07

Report Date: 15/02/2021 20:42

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162144	Sub-Artesian Facility	Existing	12/08/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB05B		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No	MAC/140/000 (0212)	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	23/08/2012	**Data Owner**	DNR
Roles	Mine Monitoring		

Location

Latitude	22-01-55	**Basin**	1304
Longitude	148-06-59	**Sub-area**	
GIS Latitude	-22.03199535	**Lot**	6
GIS Longitude	148.1163111	**Plan**	RP884515
Easting	615206		
Northing	7563211	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

6 ***records for RN*** **162144**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	12/08/2012	1	0.00	16.50	Polyvinyl Chloride			114
A	12/08/2012	2	10.50	16.50	Perforated or Slotted Casing	1.000	AP - Aperture Size	114
X	12/08/2012	3	0.00	7.00	Grout			200
X	12/08/2012	4	7.00	9.00	Bentonite Seal			200

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	12/08/2012	5	9.00	16.50	Gravel Pack	4.500	GR - Gravel Size	
X	12/08/2012	6	16.50	24.50	Cuttings or other fill between casing and hole wall			200

Strata Logs

5 ***records for RN*** 162144

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	6.00	SOIL, BLACK TOPSOIL 0-1M, SILTY SANDY SOIL 1M-6M
2	6.00	10.00	SAND, BROWN, FINE-COARSE UNCONSOLIDATED SAND
3	10.00	13.00	GRAVEL, CLAYEY, SANDY GRAVEL, WATER BEARING 0.6L/S
4	13.00	22.00	CLAY, GREY CLAY
5	22.00	25.00	CLAY/COAL, SILTY CLAY & COAL BANDS

Stratigraphies

0 ***records for RN*** 162144

Aquifers

1 ***records for RN*** 162144

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	10.50	16.50	CGRY - Clayey Gravel	12/08/2012	-9.60	N	COND 1770	0.08	Y	UC	ISAAC RIVER ALLUVIUM

Pump Tests Part 1

0 ***records for RN*** 162144

Pump Tests Part 2

0 ***records for RN*** 162144

Bore Conditions

0 ***records for RN*** 162144

Elevations

2 ***records for RN*** 162144

Pipe	Date	Elevation (m)	Precision	Datum	Meas Point	Survey Source

From Year:

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	01/07/2012	209.24	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT
X	01/07/2012	208.74	SVY	Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 ***records for RN*** **162144**

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	14/08/2012	1	XXX	XXX			GB	2230	7.6		1647.95	1295.19	604	570	1.0	4.8	

Water Analysis Part 2

1 ***records for RN*** **162144**

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	14/08/2012	1	271.0		80.0	98.0	0.01	694.0			447.0	0.60		57.0	0.02	0.09	0.23	

Water Levels

1 ***records for RN*** **162144**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	19/08/2012		-10.20	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162144**

Field Measurements

0 ***records for RN*** **162144**

Special Water Analysis

0 ***records for RN*** **162144**

From Year:

User Licence and Conditions

GROSVENOR DOWNS 08

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 08	
Bore registration number (RN)[4] 162143	Bore RN comments Bore location matches location of registered bore. Casing information and bore depth matches information in DNRME bore report.
Local bore name MB06	
Property name Grosvenor Downs	
Lot 6	Plan RP884515
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.04895	Longitude 148.12429
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

<table>
<tr><td colspan="3">Are construction details available?</td></tr>
<tr><td colspan="2">☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.</td><td>☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).</td></tr>
<tr><td colspan="2">Drilling contractor (driller name and company name)
James Leslie Sinclair - Lucas Drilling</td><td>Date of bore construction (drilled date)
11/08/2012</td></tr>
<tr><td colspan="2">Type of casing
PVC</td><td>Casing diameter (mm)
115</td></tr>
<tr><td colspan="3">Details of perforated intervals and/or screens that have been installed
16-22m</td></tr>
<tr><td colspan="3">Details of any seals and cement grouting installed in the bore annulus
Grout - 0 to 11m, bentonite seal 11 to 13m</td></tr>
<tr><td colspan="3">Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s)
0.14 - reported on DNRME bore report</td></tr>
<tr><td colspan="3">Is the source aquifer of the bore known?</td></tr>
<tr><td rowspan="2">☒ Yes →</td><td colspan="2">Name of source aquifer
Basalt</td></tr>
<tr><td colspan="2">Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
Information based on DNRME bore report only - high confidence</td></tr>
<tr><td>☐ No →</td><td colspan="2">Reasons source aquifer unknown</td></tr>
<tr><td colspan="3">Is a strata log available for the bore?
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided. ☐ No</td></tr>
<tr><td colspan="3">Additional comments
Strata log within DNRME bore report. Bore Depth - 22.53mbtoc</td></tr>
</table>

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type N//A	Pump make and model N/A
Pump setting depth (m) (depth from ground) N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.57 PVC stick up encased in lockable steel monument.
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Monitoring Bore				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)? N/A	
Describe the operational capacity, including seasonal variation N/A	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore. N/A	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 12.50
	Current conditions relevant to the water level measurement Monitoring bore - assumed not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Monument	
Height of datum above ground level (m) 0.68	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0%	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.3%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.	☐ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 08

Report Date: 17/03/2021 21:47

Queensland Government
Groundwater Information

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162143	Sub-Artesian Facility	Existing	11/08/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB06		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No	MAC/140/000 (0212)	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	23/08/2012	**Data Owner**	DNR
Roles	Mine Monitoring		

Location

Latitude	22-02-56	**Basin**	1304
Longitude	148-07-28	**Sub-area**	
GIS Latitude	-22.04887158	**Lot**	6
GIS Longitude	148.1243079	**Plan**	RP884515
Easting	616018		
Northing	7561336	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

5 *records for RN* **162143**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	03/08/2012	1	0.00	22.00	Polyvinyl Chloride			114
A	03/08/2012	2	16.00	22.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	114
X	03/08/2012	3	0.00	11.00	Grout			200
X	03/08/2012	4	11.00	13.00	Bentonite Seal			200

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	03/08/2012	5	13.00	22.00	Gravel Pack	4.500	GR - Gravel Size	

Strata Logs

5 ***records for RN*** 162143

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	2.00	SOIL, EXTREMELY WEATHERED, MOTTLED RED, STIFF (COHESIVE SOIL) CLAYEY
2	2.00	8.00	SAND, HIGHLY WEATHERED, RED, SOFT, CLAYEY, PEBBLY
3	8.00	12.00	CLAY, HIGHLY WEATHERED, YELLOW, SOFT, SANDY, LIMONITIC, BASALTIC
4	12.00	19.00	CLAY, HIGHLY WEATHERED, GREEN, SOFT, SANDY, LIMONITIC, BASALTIC
5	19.00	22.00	BASALT, HIGHLY WEATHERED GREY, STRONG, CLAYEY

Stratigraphies

0 ***records for RN*** 162143

Aquifers

1 ***records for RN*** 162143

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	11.00	19.00	BSLT - Basic Volcanic	11/08/2012	-9.30	N	COND 10230	0.14	Y	WZ	BASALT

Pump Tests Part 1

0 ***records for RN*** 162143

Pump Tests Part 2

0 ***records for RN*** 162143

Bore Conditions

0 ***records for RN*** 162143

Elevations

2 ***records for RN*** 162143

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	01/07/2012	206.69	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT

Pipe	Date	Elevation (m)	Precision	Datum	Meas	Point	Survey Source
X	01/07/2012	206.18	SVY Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 ***records for RN*** **162143**

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	14/08/2012	1	XXX	XXX			GB	13400	7.9		9485.84	8760.50	2061	1171	0.4	23.6	

Water Analysis Part 2

1 ***records for RN*** **162143**

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	14/08/2012	1	2460.0	4.0	161.0	403.0	0.03	1427.0	0.19		4370.0	0.60		659.0	0.01	0.02	0.99	

Water Levels

1 ***records for RN*** **162143**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	11/08/2012		-9.48	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130 Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162143**

Field Measurements

0 ***records for RN*** **162143**

Special Water Analysis

0 ***records for RN*** **162143**

From Year:

User Licence and Conditions

Disclaimer

GROSVENOR DOWNS 09

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 09	
Bore registration number (RN)[4] 162044	Bore RN comments Bore location matches location of registered bore. Casing information and bore depth matches information in DNRME bore report.
Local bore name MB07	
Property name Grosvenor Downs	
Lot 6	Plan RP884515
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.05740	Longitude 148.12043
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) James Leslie Sinclair - Lucas Drilling	Date of bore construction (drilled date) 14/05/2012
Type of casing PVC	Casing diameter (mm) 115
Details of perforated intervals and/or screens that have been installed 60-72m	
Details of any seals and cement grouting installed in the bore annulus Grout - 0 to 45m, bentonite seal 45 to 47m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 1.8 - reported on DNRME bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Basalt
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - high confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report. Bore Depth - 71.75mbtoc	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
N//A	N/A
Pump setting depth (m) (depth from ground)	
N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.36 PVC stick up encased in lockable steel monument.
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Monitoring Bore				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year)
	N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6])
	N/A

Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)?	
N/A	
Describe the operational capacity, including seasonal variation	
N/A	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.	
N/A	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 12.50
	Current conditions relevant to the water level measurement Monitoring bore - assumed not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.36	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0%	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.2%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.	☐ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for “sign-off” on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore’s condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 09

Queensland Government
Groundwater Information

Report Date: 17/03/2021 21:49

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162044	Sub-Artesian Facility	Existing	14/05/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB07		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	27/06/2012	**Data Owner**	
Roles	Mine Monitoring		

Location

Latitude	22-03-27	**Basin**	1304
Longitude	148-07-14	**Sub-area**	
GIS Latitude	-22.05738316	**Lot**	6
GIS Longitude	148.120457	**Plan**	RP884515
Easting	615613		
Northing	7560397	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

6 ***records for RN*** **162044**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	15/05/2012	1	0.00	1.50	Steel Casing	6.000	WT - Wall Thickness	250
A	15/05/2012	2	0.00	72.00	Polyvinyl Chloride	7.600	WT - Wall Thickness	115
A	15/05/2012	3	60.00	72.00	Perforated or Slotted Casing	0.400	AP - Aperture Size	115
X	15/05/2012	4	0.00	45.00	Grout			200
X	15/05/2012	5	45.00	47.00	Bentonite Seal			

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	15/05/2012	6	47.00	82.00	Gravel Pack	3.000	GR - Gravel Size	

Strata Logs

13 *records for RN* 162044

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	BLACK SOIL
2	1.00	4.00	BASALT: WEATHERED
3	4.00	7.00	BASALT: SANDY, DECOMPOSED
4	7.00	12.00	BASALT:
5	12.00	13.00	GRAVELLY DECOMPOSED
6	13.00	16.00	BASALT:
7	16.00	17.00	SANDY, DECOMPOSED
8	17.00	18.00	CLAY:
9	18.00	20.00	SANDY SOIL
10	20.00	43.00	CLAY:
11	43.00	70.00	BASALT: *
12	70.00	72.00	CLAY
13	72.00	82.00	SANDSTONE

Stratigraphies

0 *records for RN* 162044

Aquifers

1 *records for RN* 162044

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	47.00	70.00	BSLT - Basic Volcanic	14/05/2012	-30.00	N	COND 1780	1.80	Y	FR	BASALT

Pump Tests Part 1

0 *records for RN* 162044

Bore Report

From Year:

Pump Tests Part 2

0 *records for RN* 162044

Bore Conditions

0 *records for RN* 162044

Elevations

2 *records for RN* 162044

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	01/07/2012	232.18	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT
X	01/07/2012	231.96	SVY	Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 *records for RN* 162044

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	17/08/2012	1	XXX	XXX			GB	1970	8.3		1433.93	1133.52	196	485	0.3	11.1	5.77

Water Analysis Part 2

1 *records for RN* 162044

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	17/08/2012	1	357.0	10.0	24.0	33.0	0.02	591.0	0.15		416.0	0.40		2.0			0.36	

Water Levels

1 *records for RN* 162044

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	01/08/2012		-30.70	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Wire Line Logs

0 *records for RN* 162044

Field Measurements

1 *records for RN* 162044

Pipe	Date	Depth (m)	Conduct	pH	Temp	NO3 (mg/L)	DO2	Eh (mV)	Alkalinity	Samp	Method	Samp	Source

		(uS/cm)		**(C)**	**(mg/L)**	**(mV)**					
A	15/05/2012	2750	8.2				AI	Air Lifting	GB	Groundwater - from Bore	

Special Water Analysis

0 ***records for RN*** **162044**

From Year:

User Licence and Conditions

Disclaimer

GROSVENOR DOWNS 10

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 10	
Bore registration number (RN)[4] 162048	Bore RN comments Bore location 200m NE of DNRME registered bore location. Casing information and bore depth matches information in DNRME bore report.
Local bore name MB12	
Property name Grosvenor Downs	
Lot 6	Plan RP884515
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.08433	Longitude 148.10144
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) James Leslie Sinclair - Lucas Drilling	Date of bore construction (drilled date) 19/06/2012
Type of casing PVC	Casing diameter (mm) 115
Details of perforated intervals and/or screens that have been installed 66-72m	
Details of any seals and cement grouting installed in the bore annulus Grout - 0 to 16m, bentonite seal 16 to 18m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 1.52 - reported on DNRME bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Basalt Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - high confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report. Bore Depth - 72.6mbtoc	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type N//A	Pump make and model N/A
Pump setting depth (m) (depth from ground) N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source
☐ Electric motor ☐ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.42 PVC stick up encased in lockable steel monument.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)
☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply
☒ Other → description: Monitoring Bore

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?
N/A

Describe the operational capacity, including seasonal variation
N/A

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
N/A

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 17.06
	Current conditions relevant to the water level measurement Monitoring bore - assumed not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.42	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0%	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.2%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes		☒ No	
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.		☐ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 10

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162048	Sub-Artesian Facility	Existing	19/06/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB12		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	27/06/2012	**Data Owner**	
Roles	Mine Monitoring		

Location

Latitude	22-05-09	**Basin**	1304
Longitude	148-06-01	**Sub-area**	
GIS Latitude	-22.08595682	**Lot**	6
GIS Longitude	148.1003279	**Plan**	RP884515
Easting	613513		
Northing	7557249	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

6 ***records for RN*** **162048**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	19/06/2012	1	0.00	10.00	Steel Casing	8.000	WT - Wall Thickness	219
A	19/06/2012	2	0.00	72.00	Polyvinyl Chloride	7.800	WT - Wall Thickness	115
A	19/06/2012	4	66.00	72.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	
X	19/06/2012	5	0.00	16.00	Grout			200
X	19/06/2012	6	16.00	18.00	Bentonite Seal			

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	19/06/2012	7	18.00	72.00	Gravel Pack	3.000	GR - Gravel Size	

Strata Logs

6 ***records for RN*** **162048**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	BLACK SOIL
2	1.00	6.00	BASALT: DECOMPOSED
3	6.00	44.00	BASALT: WEATHERED WITH HARD BANDS *
4	44.00	69.00	BASALT: FIRM WITH HARD BANDS
5	69.00	72.00	CLAYSTONE:
6	72.00	74.50	SILTSTONE: OFF WHITE, SOFT

Stratigraphies

0 ***records for RN*** **162048**

Aquifers

1 ***records for RN*** **162048**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	23.00	72.00	BSLT - Basic Volcanic	19/06/2012	-16.70	N	COND 1290	1.52	Y	FR	BASALT

Pump Tests Part 1

0 ***records for RN*** **162048**

Pump Tests Part 2

0 ***records for RN*** **162048**

Bore Conditions

0 ***records for RN*** **162048**

Elevations

2 ***records for RN*** **162048**

Pipe	Date	Elevation (m)	Precision	Datum	Meas Point	Survey Source

Pipe	Date	Elevation (m)	Precision	Datum	Meas	Point	Survey Source
A	01/07/2012	241.23	SVY Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT
X	01/07/2012	241.01	SVY Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 ***records for RN*** **162048**

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	20/08/2012	1	XXX	XXX			GB	1450	8.0		1132.41	807.61	380	524	1.0	3.8	2.89

Water Analysis Part 2

1 ***records for RN*** **162048**

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	20/08/2012	1	170.0	4.0	48.0	63.0	0.82	639.0			193.0	0.30		14.0	0.01	0.03	0.25	

Water Levels

1 ***records for RN*** **162048**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	01/08/2012		-16.79	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130 Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162048**

Field Measurements

1 ***records for RN*** **162048**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	19/06/2012		1700							AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 ***records for RN*** **162048**

Bore Report

From Year:

User Licence and Conditions

Disclaimer

Open Licence (Single Supply)

Permitted use:

- You may use the supplied data for your own purposes (including supply to consultants for a specific consultancy project for you but the consultants must return or destroy the supplied data when the project is finished). You must not sell or distribute the supplied data.
- You must display this copyright notice on any copies of the supplied data however altered, reformatted or redisplayed if you supply to a consultant or copy for back up purposes: "© State of Queensland 2021".
- You may create and distribute hardcopy and digital products based on or containing the supplied data, provided all the following conditions are met:
- You must display this acknowledgment on the product(s): "Based on or contains data provided by the State of Queensland 2021. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws."
- You must include metadata with the product(s) you create that use or incorporate the supplied data and the metadata must incorporate as a minimum the metadata provided with this supplied data.

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- You must not use the data for direct marketing or in breach of the privacy laws.

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GROSVENOR DOWNS 11

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 11	
Bore registration number (RN)[4] 162808	Bore RN comments Bore location matches DNRME registered bore location. Casing information matches information in DNRME bore report.
Local bore name Spell Paddock Bore	
Property name Grosvenor Downs	
Lot 6	Plan SP260061
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.07887	Longitude 148.09990
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) <01/01/1950
Type of casing Steel	Casing diameter (mm) 130
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☐ Yes →	Name of source aquifer Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
☒ No →	Reasons source aquifer unknown No information on bore log
Is a strata log available for the bore?	
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No
Additional comments Bore Depth - 32.15mbtoc	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore
☒ Operational ☐ Decommissioned

Is the bore equipped with a pump?
☐ Yes ☒ No → go to Part D.

Pump type	Pump make and model
N//A	N/A

Pump setting depth (m) (depth from ground)
N/A

Is the bore equipped with a meter?
☐ Yes → description: ☐ No

Power source
☐ Electric motor ☐ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.42 PVC stick up - no cap

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance
Evidence of windmill bore (A-frame and dismantled wood / steel infrastructure) - Date of dismantle unknown

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)
☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply
☒ Other → description: Abandoned - Assumed as previosuly used for stock. Evidence that old bore pumped to storage tank

Is the water use from this bore metered?

☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?
N/A

Describe the operational capacity, including seasonal variation
N/A

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
N/A

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 25.25
	Current conditions relevant to the water level measurement Assumed not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.42	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm_v) 0%	H_2S (ppm_v) 0 ppm	CH_4 (%LEL) 0.1%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☐ Yes → attach them to this form.	☒ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 11

Report Date: 27/10/2020 10:39

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162808	Sub-Artesian Facility	Abandoned but Still Usable	01/01/1950	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	SPELL PADDOCK BORE		
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-04-44	**Basin**	1304
Longitude	148-05-59	**Sub-area**	
GIS Latitude	-22.07891303	**Lot**	6
GIS Longitude	148.09989301	**Plan**	SP260061
Easting	613474		
Northing	7558029	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

1 *records for RN* 162808

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1950	1			Steel Casing			115

Strata Logs

0 *records for RN* 162808

Stratigraphies

0 *records for RN* 162808

From Year:

Aquifers

0 ***records for RN*** **162808**

Pump Tests Part 1

0 ***records for RN*** **162808**

Pump Tests Part 2

0 ***records for RN*** **162808**

Bore Conditions

0 ***records for RN*** **162808**

Elevations

1 ***records for RN*** **162808**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
X	11/09/2004	253.00	MAN	Manual measurement from natural surface	AHD - Aust. Height Datum	N	Natural Surface	

Water Analysis Part 1

0 ***records for RN*** **162808**

Water Analysis Part 2

0 ***records for RN*** **162808**

Water Levels

1 ***records for RN*** **162808**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
X	11/09/2004		-25.07	N	Natural Surface		ACT	Actual	NR	XX	Unknown	XX	1	Good - Actual Manual Measurements

Wire Line Logs

0 ***records for RN*** **162808**

Field Measurements

0 ***records for RN*** **162808**

Special Water Analysis

0 ***records for RN*** **162808**

From Year:

User Licence and Conditions

Disclaimer

Open Licence (Single Supply)

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- You must display this acknowledgment on the product(s): "Based on or contains data provided by the State of Queensland 2020. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws."
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GROSVENOR DOWNS 12

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 12	
Bore registration number (RN)[4] 162043	Bore RN comments Bore location 200m NE of DNRME registered bore location. Casing information and bore depth matches information in DNRME bore report.
Local bore name MB03	
Property name Grosvenor Downs	
Lot 6	Plan RP884515
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.05763	Longitude 148.10107
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using “groundwater database” as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) James Leslie Sinclair - Lucas Drilling	Date of bore construction (drilled date) 10/05/2012
Type of casing PVC	Casing diameter (mm) 115
Details of perforated intervals and/or screens that have been installed 60-74m	
Details of any seals and cement grouting installed in the bore annulus Grout - 0 to 24m, bentonite seal 24 to 26m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 0.8 - reported on DNRME bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Basalt
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - high confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Strata log within DNRME bore report. Bore Depth - 72.65mbtoc	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type N//A	Pump make and model N/A
Pump setting depth (m) (depth from ground) N/A	
Is the bore equipped with a meter?	
☐ Yes → description:	☐ No

Power source					
☐ Electric motor	☐ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)

0.43 PVC stick up encased in lockable steel monument.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Monitoring Bore				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?

N/A

Describe the operational capacity, including seasonal variation

N/A

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.

N/A

Are there any historical water use records available for this bore?

☐ Yes → attach them to this form. ☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 22.90
	Current conditions relevant to the water level measurement Monitoring bore - assumed not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.43	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.2%	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.2%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes		☒ No	
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.		☐ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner?	
☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 12

Bore Report

From Year:

Registered Number	**Facility Type**	**Facility Status**	**Drilled Date**	**Office**	**Shire**
162043	Sub-Artesian Facility	Existing	10/05/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB03		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	27/06/2012	**Data Owner**	
Roles	Mine Monitoring		

Location

Latitude	22-03-33	**Basin**	1304
Longitude	148-05-59	**Sub-area**	
GIS Latitude	-22.05923187	**Lot**	6
GIS Longitude	148.0999584	**Plan**	RP884515
Easting	613496		
Northing	7560208	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

5 ***records for RN*** **162043**

Pipe	**Date**	**Rec**	**Top (m)**	**Bottom (m)**	**Material Description**	**Mat Size (mm)**	**Size Desc**	**Outside Diameter (mm)**
A	10/05/2012	1	0.00	74.00	Polyvinyl Chloride	9.100	WT - Wall Thickness	115
A	10/05/2012	2	60.00	74.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	
X	10/05/2012	3	0.00	24.00	Grout			200
X	10/05/2012	4	24.00	26.00	Bentonite Seal			
X	10/05/2012	5	26.00	74.00	Gravel Pack	3.000	GR - Gravel Size	

Bore Report

From Year:

Strata Logs

11 ***records for RN*** 162043

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	BLACK SOIL
2	1.00	4.00	BASALT: DECOMPOSED
3	4.00	19.00	BASALT: WEATHERED
4	19.00	29.00	BASALT: LIGHTLY WEATHERED
5	29.00	42.00	BASALT: FRESH *
6	42.00	45.00	CLAY: BROWN, SOFT
7	45.00	58.00	BASALT: BLACK, FRESH
8	58.00	62.00	CLAY: GREY, SOFT
9	62.00	68.00	BASALT: LIGHTLY WEATHERED
10	68.00	72.00	CLAY: BROWN, SOFT
11	72.00	74.00	CLAY, GREY BROWN, SILTY

Stratigraphies

0 ***records for RN*** 162043

Aquifers

1 ***records for RN*** 162043

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	30.00	68.00	BSLT - Basic Volcanic	10/05/2012	-20.00	N	COND 1440	0.80	Y	FR	BASALT

Pump Tests Part 1

0 ***records for RN*** 162043

Pump Tests Part 2

0 ***records for RN*** 162043

Bore Conditions

0 ***records for RN*** 162043

Elevations

2 ***records for RN*** 162043

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	01/07/2012	245.64	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT
X	01/07/2012	245.38	SVY	Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 ***records for RN*** **162043**

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	18/08/2012	1	XXX	XXX			GB	1620	8.2		1196.95	906.71	403	469	1.0	4.1	1.31

Water Analysis Part 2

1 ***records for RN*** **162043**

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	18/08/2012	1	190.0	7.0	36.0	76.0	0.01	571.0	0.12		292.0	0.20		24.0	0.02	0.11	0.48	0.01

Water Levels

1 ***records for RN*** **162043**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	01/08/2012		-20.82	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162043**

Field Measurements

1 ***records for RN*** **162043**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	10/05/2012		1830	8.6						AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 ***records for RN*** **162043**

From Year:

User Licence and Conditions

Disclaimer

GROSVENOR DOWNS 13

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Burgess	Given name(s) Dean
Phone	Mobile 0428125811
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Grosvenor Downs 13	
Bore registration number (RN)[4] 162806	Bore RN comments Bore location matches DNRME registered bore location. Casing information matches information in DNRME bore report.
Local bore name House Bore	
Property name Grosvenor Downs	
Lot 2	Plan RP616987
Date of site assessment 26/11/2020	
Bore geographic location (GDA94)	
Latitude 22.03643	Longitude 148.07742
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) <01/01/1950
Type of casing Steel	Casing diameter (mm) 160
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☐ Yes →	Name of source aquifer Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
☒ No →	Reasons source aquifer unknown No information on bore log
Is a strata log available for the bore?	
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No
Additional comments Bore Depth - 2 mbtoc (blockage)	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore

☐ Operational ☒ Decommissioned

Is the bore equipped with a pump?

☐ Yes ☒ No → go to Part D.

Pump type	Pump make and model
N//A	N/A

Pump setting depth (m) (depth from ground)

N/A

Is the bore equipped with a meter?

☐ Yes → description: ☐ No

Power source

☐ Electric motor ☐ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)

0.2 PVC stick up - no cap

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Evidence of windmill infrastructure. Blocakge at 2m indicates it has been decomissioned.

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)

☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply

☒ Other → description: Abandoned -Assumed as previosuly used for domestic supply given name on DNRME bore report.

Is the water use from this bore metered?

☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?

N/A

Describe the operational capacity, including seasonal variation

N/A

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.

N/A

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☐ Yes →	Standing water level (m) (depth from ground)
	Current conditions relevant to the water level measurement
☒ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL) Blocakage at 2m.
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.2	
Are water level and/or pressure records available for this bore?	
☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.3%	H_2S (ppm$_v$) 0 ppm	CH_4 (%LEL) 0.1%
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - not taken		
Are historical water quality laboratory records available for this bore?			
☐ Yes → attach them to this form.	☒ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Burgess	Given name(s) Dean
Phone 0428125811	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Grosvenor Downs 13

Queensland Government
Groundwater Information

Report Date: 27/10/2020 10:38

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162806	Sub-Artesian Facility	Abandoned but Still Usable	01/01/1950	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	HOUSE BORE		
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-02-11	**Basin**	1304
Longitude	148-04-39	**Sub-area**	
GIS Latitude	-22.03645243	**Lot**	2
GIS Longitude	148.07740548	**Plan**	RP616987
Easting	611187		
Northing	7562746	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

1 *records for RN* 162806

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1950	1			Steel Casing			152

Strata Logs

0 *records for RN* 162806

Stratigraphies

0 *records for RN* 162806

Bore Report

From Year:

Aquifers

0 ***records for RN*** **162806**

Pump Tests Part 1

0 ***records for RN*** **162806**

Pump Tests Part 2

0 ***records for RN*** **162806**

Bore Conditions

0 ***records for RN*** **162806**

Elevations

1 ***records for RN*** **162806**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
X	11/09/2004	216.00	MAN	Manual measurement from natural surface	AHD - Aust. Height Datum	N	Natural Surface	

Water Analysis Part 1

0 ***records for RN*** **162806**

Water Analysis Part 2

0 ***records for RN*** **162806**

Water Levels

1 ***records for RN*** **162806**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
X	11/09/2004		-8.30	N	Natural Surface		ACT	Actual	NR	XX	Unknown	XX	1	Good - Actual Manual Measurements

Wire Line Logs

0 ***records for RN*** **162806**

Field Measurements

0 ***records for RN*** **162806**

Special Water Analysis

0 ***records for RN*** **162806**

Bore Report

From Year:

User Licence and Conditions

ATTACHMENT C

WINCHESTER DOWNS BORE BASELINE ASSESSMENT

WINCHESTER DOWNS 01

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Wooley	Given name(s) Dale
Phone	Mobile 0499114085
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 01	
Bore registration number (RN)[4] 162185	Bore RN comments Bore location matches DNRME bore location. Casing matches information in DNRME bore report.
Local bore name Cronock	
Property name Winchester Downs	
Lot 8	Plan SP2777384
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.10116	Longitude 148.14820
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) Unknown
Type of casing PVC	Casing diameter (mm) 160
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☐ Yes →	Name of source aquifer
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
☒ No →	Reasons source aquifer unknown No strata log available.
Is a strata log available for the bore?	
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No
Additional comments	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
4" Electro-submersible	Grundfos
Pump setting depth (m) (depth from ground)	
~59.5m	
Is the bore equipped with a meter?	
☐ Yes → description:	☒ No

Power source					
☐ Electric motor	☒ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.62m PVC stick up with steel bore plate. 90 degree 50mm steel elbow from bore plate to 50mm poly pipe with pressure gauge. Pressure gauge attached to steel gate valve. Gate valve attached to 45mm poly pipe that runs to trough.
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance
Generator is currently being repaired. Plans to install solar bore by the end of 2020.

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☒ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☐ Other → description:				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) 3
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) Average daily consumption og 45L for 300hd cattle over 6months of the year

Bore utilisation
How often is the bore utilised (estimated hours pumped per day)?
As required per conditions
Describe the operational capacity, including seasonal variation
Would be used through out summer and as required through remaining months of the year.
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
Peak usage would be in summer for max 300hd cattle

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 11.46
	Current conditions relevant to the water level measurement Bore not pumped at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.62	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A - no sample taken as no power source available for pump	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A -	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A - no power source available for pump
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$)	H_2S (ppm$_v$)	CH_4 (%LEL)
	0.3%	0	0.3%
☒ No →	Reason not measured N/A - no s30ample taken as no power source available for pump		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - no aample taken as no power source available for pump		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - no aample taken as no power source available for pump		
Are historical water quality laboratory records available for this bore?			
☐ Yes → attach them to this form.	☒ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner?	
☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Winchester Downs 01

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162815	Sub-Artesian Facility	Abandoned but Still Usable		Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-06-04	**Basin**	1304
Longitude	148-08-55	**Sub-area**	
GIS Latitude	-22.1010706	**Lot**	8
GIS Longitude	148.14861944	**Plan**	SP277384
Easting	618483		
Northing	7555539	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

1 *records for RN* **162815**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1900	1			Polyvinyl Chloride			140

Strata Logs

0 *records for RN* **162815**

Stratigraphies

0 *records for RN* **162815**

Bore Report

From Year:

Aquifers
0 ***records for RN*** **162815**

Pump Tests Part 1
0 ***records for RN*** **162815**

Pump Tests Part 2
0 ***records for RN*** **162815**

Bore Conditions
0 ***records for RN*** **162815**

Elevations
1 ***records for RN*** **162815**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	08/02/2006	215.00	GPS	Global Positioning System	AHD - Aust. Height Datum	R	Reference Point	ISAAC PLAINS BORE CENSUS

Water Analysis Part 1
0 ***records for RN*** **162815**

Water Analysis Part 2
0 ***records for RN*** **162815**

Water Levels
1 ***records for RN*** **162815**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	08/02/2006		-12.42	R	Reference Point		ACT	Actual	NR	XX	Unknown		130	Data is of unknown quality

Wire Line Logs
0 ***records for RN*** **162815**

Field Measurements
0 ***records for RN*** **162815**

Special Water Analysis
0 ***records for RN*** **162815**

Bore Report

From Year:

User Licence and Conditions

WINCHESTER DOWNS 02

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Wooley	Given name(s) Dale
Phone	Mobile 0499114085
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 02	
Bore registration number (RN)[4] 162816	Bore RN comments Bore location 16m north of DNRME bore location. Casing matches information in DNRME bore report.
Local bore name	
Property name Winchester Downs	
Lot 8	Plan SP2777384
Date of site assessment 25/11/2020	
Bore geographic location (GDA94)	
Latitude 22.13011	Longitude 148.15360
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using “groundwater database” as a search term.

Part B: Bore construction details

Are construction details available?		
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).	
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) Unknown	
Type of casing PVC	Casing diameter (mm) 140	
Details of perforated intervals and/or screens that have been installed Unknown		
Details of any seals and cement grouting installed in the bore annulus Unknown		
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown		
Is the source aquifer of the bore known?		
☐ Yes →	Name of source aquifer	
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)	
☒ No →	Reasons source aquifer unknown No strata log available.	
Is a strata log available for the bore?		
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No	
Additional comments Bore depth - 67.16m btoc		

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore ☒ Operational	 ☐ Decommissioned
Is the bore equipped with a pump? ☐ Yes	 ☒ No → go to Part D.
Pump type	Pump make and model
Pump setting depth (m) (depth from ground)	
Is the bore equipped with a meter? ☐ Yes → description:	 ☒ No
Power source ☐ Electric motor ☒ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill	
Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter) 0.74m PVC stick up.	
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance	

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner) ☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply ☒ Other → description: Monitoring	
Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year)
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6])
Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)? Abandoned	
Describe the operational capacity, including seasonal variation	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.	
Are there any historical water use records available for this bore? ☐ Yes → attach them to this form. ☒ No	

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner’s name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 7.85
	Current conditions relevant to the water level measurement Bore not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.74	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A - monitoring bore sample not taken	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A -	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☐ No →	Provide details of the pumping history including when the bore was last used
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.3%	H_2S (ppm$_v$) 0	CH_4 (%LEL) 0.3%
☒ No →	Reason not measured N/A - monitoring bore		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		

Laboratory water quality	
Were water quality samples taken for submission to a laboratory?	
☐ Yes	
☒ No →	Reason not samples not taken N/A
Were dissolved gas samples taken for submission to a laboratory?	
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method
	Reason method chosen
☒ No →	Reason not measured N/A
Are the laboratory results for the samples indicated above supplied with this baseline assessment?	
☐ Yes	
☒ No →	Reason not supplied N/A - monitoring bore
Are historical water quality laboratory records available for this bore?	
☐ Yes → attach them to this form.	☒ No

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Winchester Downs 02

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162816	Sub-Artesian Facility	Abandoned but Still Usable		Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-07-49	**Basin**	1304
Longitude	148-09-13	**Sub-area**	
GIS Latitude	-22.1302123	**Lot**	8
GIS Longitude	148.15362569	**Plan**	SP277384
Easting	618975		
Northing	7552309	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

1 ***records for RN*** **162816**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1900	1			Polyvinyl Chloride			140

Strata Logs

0 ***records for RN*** **162816**

Stratigraphies

0 ***records for RN*** **162816**

From Year:

Aquifers

0 ***records for RN*** **162816**

Pump Tests Part 1

0 ***records for RN*** **162816**

Pump Tests Part 2

0 ***records for RN*** **162816**

Bore Conditions

0 ***records for RN*** **162816**

Elevations

1 ***records for RN*** **162816**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	08/02/2006	218.10	GPS	Global Positioning System	AHD - Aust. Height Datum	R	Reference Point	ISAAC PLAINS BORE CENSUS

Water Analysis Part 1

0 ***records for RN*** **162816**

Water Analysis Part 2

0 ***records for RN*** **162816**

Water Levels

1 ***records for RN*** **162816**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	08/02/2006		-7.21	R	Reference Point		ACT	Actual	NR	XX	Unknown		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162816**

Field Measurements

0 ***records for RN*** **162816**

Special Water Analysis

0 ***records for RN*** **162816**

Bore Report

From Year:

User Licence and Conditions

WINCHESTER DOWNS 03

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Wooley	Given name(s) Dale
Phone	Mobile 0499114085
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 03	
Bore registration number (RN)[4] 162145	Bore RN comments Bore location 200m NE of DNRME bore location. Casing matches information in DNRME bore report.
Local bore name MB14	
Property name Winchester Downs	
Lot 8	Plan SP2777384
Date of site assessment 26/11/2020	
Bore geographic location (GDA94)	
Latitude 22.14166	Longitude 148.11705
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) James Leslie Sinclair - Lucas Drilling	Date of bore construction (drilled date) 19/08/2012
Type of casing PVC	Casing diameter (mm) 115
Details of perforated intervals and/or screens that have been installed 16.70 to 22.70	
Details of any seals and cement grouting installed in the bore annulus Grout 0 to 11, Bentonite 11 to 13	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 0.01 L/s reported on bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Fort Cooper Coal Measures (sandstone) Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Based on DNRME bore report - moderate confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore? ☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Bore depth - 23.19m btoc	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore					
☒ Operational			☐ Decommissioned		
Is the bore equipped with a pump?					
☐ Yes			☒ No → go to Part D.		
Pump type			Pump make and model		
Pump setting depth (m) (depth from ground)					
Is the bore equipped with a meter?					
☐ Yes → description:			☒ No		
Power source					
☐ Electric motor	☒ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill
Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter) 0.52m PVC stick up.					
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance					

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☒ Other → description: Monitoring				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A - monitoring bore
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A - monitoring bore
Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)? N/A - monitoring Bore	
Describe the operational capacity, including seasonal variation N/A - monitoring Bore	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore. N/A - monitoring Bore	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 20.695
	Current conditions relevant to the water level measurement Bore not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.52	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A - monitoring bore sample not taken	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A -	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☐ No →	Provide details of the pumping history including when the bore was last used
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.4%	H_2S (ppm$_v$) 0	CH_4 (%LEL) 0.1%
☒ No →	Reason not measured N/A - monitoring bore		
Are historical water quality field records available for this bore?			
☐ Yes		☒ No	
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - monitoring bore		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.		☐ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Winchester Downs 03

Report Date: 03/11/2020 16:10

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162145	Sub-Artesian Facility	Existing	19/08/2012	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	3336 - MORANBAH		
Original Name	MB14		
Driller Name	SINCLAIR, JAMES LESLIE		
Drill Company	LUCAS DRILLING		
Const Method	ROTARY AIR		
Bore Line			
D/O File No	MAC/520/000 (0072)	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	23/08/2012	**Data Owner**	DNR
Roles	Mine Monitoring		

Location

Latitude	22-08-36	**Basin**	1304
Longitude	148-06-58	**Sub-area**	
GIS Latitude	-22.14329029	**Lot**	8
GIS Longitude	148.1159747	**Plan**	SP244492
Easting	615081		
Northing	7550890	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

5 *records for RN* **162145**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	19/08/2012	1	0.00	22.70	Polyvinyl Chloride			114
A	19/08/2012	2	16.70	22.70	Perforated or Slotted Casing	1.000	AP - Aperture Size	114
X	19/08/2012	3	0.00	11.00	Grout			200
X	19/08/2012	4	11.00	13.00	Bentonite Seal			200

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	19/08/2012	5	13.00	23.00	Gravel Pack			200

Strata Logs

5 ***records for RN*** 162145

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	2.00	SOIL, HIGHLY WEATHERED, BROWN, FINE GRAIN, VERY SOFT
2	2.00	7.00	COAL, SOOTY, HIGHLY WEATHERED, YELLOW, FINE GRAIN, VERY SOFT
3	7.00	12.00	BASALT, HIGHLY WEATHERED, BROWN, FINE-MEDIUM GRAIN, WEAK
4	12.00	22.00	SANDSTONE, HIGHLY WEATHERED, GREY, FINE-MEDIUM GRAIN, WEAK CARBONACEOUS MUDSTONE
5	22.00	23.00	COAL, HIGHLY WEATHERED, BROWN, WEAK

Stratigraphies

0 ***records for RN*** 162145

Aquifers

1 ***records for RN*** 162145

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	16.70	22.70	SDST - Sandstone	19/08/2012	-19.70	N	COND 3200	0.01	Y	PS	FORT COOPER COAL MEASURES

Pump Tests Part 1

0 ***records for RN*** 162145

Pump Tests Part 2

0 ***records for RN*** 162145

Bore Conditions

0 ***records for RN*** 162145

Elevations

2 ***records for RN*** 162145

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	01/07/2012	224.59	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	MORANBAH SOUTH GROUNDWATER REPORT

Bore Report

From Year:

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
X	01/07/2012	224.24	SVY	Surveyed	AHD - Aust. Height Datum	N	Natural Surface	MORANBAH SOUTH GROUNDWATER REPORT

Water Analysis Part 1

1 ***records for RN*** **162145**

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	23/08/2012	1	XXX	XXX			GB	4260	7.7		3055.48	2688.49	907	593	0.7	8.5	

Water Analysis Part 2

1 ***records for RN*** **162145**

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	23/08/2012	1	591.0	8.0	190.0	105.0	2.97	722.0	113.00		1100.0	0.40		161.0	0.74	60.90	0.35	0.12

Water Levels

1 ***records for RN*** **162145**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	19/08/2012		-20.41	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130 Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162145**

Field Measurements

0 ***records for RN*** **162145**

Special Water Analysis

0 ***records for RN*** **162145**

Bore Report

From Year:

User Licence and Conditions

WINCHESTER DOWNS 04

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) EXXARO AUSTRALIA PTY LTD	ABN/ACN (if applicable) 26 063 427 369
Principal contact	
Surname Wooley	Given name(s) Dale
Phone	Mobile 0499114085
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML	Tenure number 277
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 04	
Bore registration number (RN)[4] 162825	Bore RN comments Bore location matches DNRME bore location. Casing matches information in DNRME bore report.
Local bore name	
Property name Winchester Downs	
Lot 8	Plan SP2777384
Date of site assessment 27/11/2020	
Bore geographic location (GDA94)	
Latitude 22.12457	Longitude 148.18261
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?		
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).	
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) <01/01/1950	
Type of casing Steel	Casing diameter (mm) 155	
Details of perforated intervals and/or screens that have been installed Unknown		
Details of any seals and cement grouting installed in the bore annulus Unknown		
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown		
Is the source aquifer of the bore known?		
☐ Yes →	Name of source aquifer	
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)	
☒ No →	Reasons source aquifer unknown no strata log available	
Is a strata log available for the bore?		
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No	
Additional comments Bore depth - 40.82m btoc		

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore
☐ Operational ☒ Decommissioned

Is the bore equipped with a pump?
☐ Yes ☒ No → go to Part D.

Pump type	Pump make and model

Pump setting depth (m) (depth from ground)

Is the bore equipped with a meter?
☐ Yes → description: ☒ No

Power source
☐ Electric motor ☒ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.41m Steel stick up.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance
Decomissioned 8yrs ago. Used to be an electric jet pump that ran off mains power. Decomissoned due to poor quality / yield.

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)
☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply
☐ Other → description: Used for stock / domestic prior to decomissioning

Is the water use from this bore metered?

☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?
N/A

Describe the operational capacity, including seasonal variation
N/A

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
N/A

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 10.48
	Current conditions relevant to the water level measurement Bore not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.41	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.2%	H_2S (ppm$_v$) 0	CH_4 (%LEL) 0.1%
☒ No →	Reason not measured N/A		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.	☐ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Winchester Downs 04	
5	
	

Queensland Government

Report Date: 03/11/2020 16:26

Groundwater Information

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162825	Sub-Artesian Facility	Abandoned but Still Usable		Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-07-28	**Basin**	1304
Longitude	148-10-57	**Sub-area**	
GIS Latitude	-22.1245668	**Lot**	8
GIS Longitude	148.18263565	**Plan**	SP277384
Easting	621972		
Northing	7552911	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

1 *records for RN* **162825**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1900	1			Steel Casing			152

Strata Logs

0 *records for RN* **162825**

Stratigraphies

0 *records for RN* **162825**

From Year:

Aquifers

0 ***records for RN*** **162825**

Pump Tests Part 1

0 ***records for RN*** **162825**

Pump Tests Part 2

0 ***records for RN*** **162825**

Bore Conditions

0 ***records for RN*** **162825**

Elevations

1 ***records for RN*** **162825**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	14/02/2006	213.30	GPS	Global Positioning System	AHD - Aust. Height Datum	R	Reference Point	ISAAC PLAINS BORE CENSUS

Water Analysis Part 1

0 ***records for RN*** **162825**

Water Analysis Part 2

0 ***records for RN*** **162825**

Water Levels

1 ***records for RN*** **162825**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	14/02/2006		-11.35	R	Reference Point		ACT	Actual	NR	XX	Unknown		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162825**

Field Measurements

0 ***records for RN*** **162825**

Special Water Analysis

0 ***records for RN*** **162825**

Bore Report

From Year:

User Licence and Conditions

WINCHESTER DOWNS 05

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) CH4 Pty Ltd	ABN/ACN (if applicable) 29 092 501 016
Principal contact	
Surname Wooley	Given name(s) Dale
Phone	Mobile 0499114085
Tenure type ☐ PL ☒ ATP ☐ MDL ☐ ML	Tenure number ATP 1103
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 05	
Bore registration number (RN)[4] 162459	Bore RN comments Bore location matches DNRME bore location. Casing matches information in DNRME bore report.
Local bore name Main Bore	
Property name Winchester Downs	
Lot 8	Plan SP2777384
Date of site assessment 27/11/2020	
Bore geographic location (GDA94)	
Latitude 22.13116	Longitude 148.20034
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) 0106/2005
Type of casing PVC	Casing diameter (mm) 160
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Pumped at 18.94 L/s on bore log.	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Fort Cooper Coal Measures. Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Low - No strata log available.
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore? ☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No
Additional comments	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☒ Yes	☐ No → go to Part D.
Pump type	Pump make and model
Electro-submersible	Unknown
Pump setting depth (m) (depth from ground)	
~120m	
Is the bore equipped with a meter?	
☐ Yes → description:	☒ No

Power source

☐ Electric motor ☐ Generator ☐ Direct drive engine ☒ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)

0.57m PVC stick up with steel bore plate. Steel T-piece at bore plate linking pump to pressure gauge and steel gate valve connected to steel flange. Flange connected to 50mm poly T-piece connected to steel gate valve and 50mm polypipe connected to 5000L plastic storage tank next to bore. Gate valve connected to 50mm polypipe running to 2 x 20,000 L plastic tanks located 550m SW of the bore.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Iron bacteria resulting in pump needing to be regularly removed for cleaning.

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)

☒ Stock ☒ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply

☐ Other → description:

Is the water use from this bore metered?

☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) 4.7
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) Pumps for 6 hours daily at ~6 L/s

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Bore utilisation
How often is the bore utilised (estimated hours pumped per day)?
6 hours daily (1hr on / 3hrs off)
Describe the operational capacity, including seasonal variation
For 3000 hd cattle, fills 2 x 20000 gallon tanks
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
Peak usage to water 3000hd of cattle. Higher usage in summer months.
Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☐ Yes →	Standing water level (m) (depth from ground)
	Current conditions relevant to the water level measurement
☒ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL) Unable to get equipment into bore to measure. PSI at time of assessment 14.1.
	Duration of pumping and rest periods 1hr on / 3hrs off daily
	Maximum pumping rate (L/s) DNRME bore report suggest 18.94L/s, bucket test = 6L/s.
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.57	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples

Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94)

At bore head

Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point)

Was the sample taken after full purging of the bore casing and discharge piping?

☐ Yes

☒ No →	Provide details of the pumping history including when the bore was last used Pump on hour before sampling, assumed fully purged

Is pumping equipment in place at the bore?

☒ Yes

☐ No →	**Attach photo** showing the bore and sampling set up

Field parameters

Were water quality field measurements taken?

☒ Yes →	**Physical parameters**		
	pH 7.65	Temperature (°C) 29.82	Electrical conductivity (µS/cm) 5332
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$)	H_2S (ppm$_v$)	CH_4 (%LEL)
☒ No →	Reason not measured Field gas - unable to access bore head space		

Are historical water quality field records available for this bore?

☐ Yes ☒ No

Laboratory water quality

Were water quality samples taken for submission to a laboratory?

☒ Yes

☐ No →	Reason not samples not taken

Were dissolved gas samples taken for submission to a laboratory?

☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method
	Reason method chosen
☒ No →	Reason not measured No gas identified as present at bore - not required

Are the laboratory results for the samples indicated above supplied with this baseline assessment?	
☒ Yes	
☐ No →	Reason not supplied
Are historical water quality laboratory records available for this bore?	
☐ Yes → attach them to this form.	☒ No

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

6

Winchester Downs 05

Report Date: 03/11/2020 16:23

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162459	Sub-Artesian Facility	Existing	01/06/2005	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	5065 - WINCHESTER		
Original Name	HORSE PADDOCK BORE		
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles	Water Supply		

Location

Latitude	22-07-52	**Basin**	1304
Longitude	148-12-01	**Sub-area**	
GIS Latitude	-22.13110361	**Lot**	8
GIS Longitude	148.2003843	**Plan**	SP277384
Easting	623797		
Northing	7552173	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

1 *records for RN* 162459

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/06/2005	1	0.00	85.00	Polyvinyl Chloride			140

Strata Logs

0 *records for RN* 162459

Stratigraphies

0 *records for RN* 162459

Bore Report

From Year:

Aquifers

1 ***records for RN*** **162459**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	0.00	80.00	SEDI - Sedimentary					18.94	N	WZ	FORT COOPER COAL MEASURES

Pump Tests Part 1

0 ***records for RN*** **162459**

Pump Tests Part 2

0 ***records for RN*** **162459**

Bore Conditions

0 ***records for RN*** **162459**

Elevations

1 ***records for RN*** **162459**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	14/11/2007	222.90	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	EAGLE DOWNS EIS

Water Analysis Part 1

0 ***records for RN*** **162459**

Water Analysis Part 2

0 ***records for RN*** **162459**

Water Levels

1 ***records for RN*** **162459**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	09/02/2006		-22.00	R	Reference Point		ACT	Actual	NR	XX	Unknown		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162459**

Field Measurements

0 ***records for RN*** **162459**

Special Water Analysis

0 ***records for RN*** **162459**

From Year:

User Licence and Conditions

7/12

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 2/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com
☑BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: ALSEnviro.Gladstone@alsglobal.com
☐MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740 Ph: 07 4952 5795 E: ALSEnviro.Mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 13 Carlton Street Kirwan QLD 4812 …
… NSW 2500

Environmental Division
Brisbane
Work Order Reference
EB2031461

Telephone : + 61-7-3243 7222

CLIENT: BHP
OFFICE: BRISBANE
PROJECT: HPC BAP
PROJECT NO.:
ORDER NUMBER:
PURCHASE ORDER NO.: 4510264491
PROJECT MANAGER: KATY STEELE
CONTACT PH: 0448 888 893
SAMPLER: DUNCAN DAWSON /SLR
SAMPLER MOBILE: 0419987617
COC Emailed to ALS? (YES / NO)
EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed): PM + ddawson@slrconsulting.com
Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☑ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.:
COUNTRY OF ORIGIN: AUSTRALIA
COC SEQUENCE NUMBER (Circle)
COC: [✓ 1] 2 3 4 5 6 7
OF: 1 [✓ 2] 3 4 5 6 7

RELINQUISHED BY: Duncan Dawson
DATE/TIME: 27/11/2020
RECEIVED BY: Martin
DATE/TIME: 27/11/2020 18:45
RELINQUISHED BY:
DATE/TIME:

FOR LABORATORY
Custody Seal Intact? No N/A
Free ice / frozen ice bric No N/A
Random Sample Tempe °C
Other comment:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).											Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	pH	EC	TDS	Major ions: Ca, K Cl, Na, F, SO4	Alkalinity – HCO3, CO3, hydroxide as	CaCO3	Total hardness as CaCO3	Total + Dissolved Al, As, Ba, Be, B, Pb, Mg, Ni, Se, Mn, Hg, Mo, U, V, Cd, Cr, Co, Fe, Zn				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	GD01	24/11/2020 10:20	W	1xP 2xAP	3	X	X	X	X	X	X	X	X	X	X	X	~~Can you please~~ [illegible]
2	QA01	24/11/2020	↓	↓	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
3	GD01	24/11/2020 16:40			3												
4	QA02	24/11/2020			3												PTO for More Samples
5	FB01	24/11/2020 11:50			3												
6	RB01	24/11/2020 11:59			3												
7	Pownall01	26/11/2020 07:33			3												
8	QA03	26/11/2020			3												
9	FB03	26/11/2020			3												
10	RB03	26/11/2020			3												
11	FB02	25/11/2020 18:50			3												
12	RB02	25/11/2020 18:57															
16 Samples Total (PTO for continuation of CoC)				TOTAL													

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

COC 2/2 SAMPLER Duncan Dawson Relinquished 2 27/11/2020

SAMPLE ID	DATE / TIME	MATRIX	TYPE + PRESERVATIVE	Bottles	PH	EC	TDS	MAJOR IONS	ALKALINITY	Total hardness as CaCO3	DISS + To [illegible], Al, As, B B, Cd, Cr, Co, Fe, Ni, Se, [illegible], Zn
13 WD05	27/11/2020 10:50	W	1 X P 2 X AP	3	X	X	X	X	X	X	X
14 QA04	27/11/2020	W	↓	3	X	X	X	X	X	X	X
15 FB04	27/11/2020 13:00	↓	↓	3	X	X	X	X	X	X	X
16 RB04	27/11/2020 13:00	↓	↓	3	X	X	X	X	X	X	X

Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: **EB2031461**		
Amendment	: **3**		
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KATY STEELE	Contact	: Nidhi Bhimani
Address	: L11 480 QUEEN STREET BRISBANE QLD 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: katy.steele@bhp.com	E-mail	: nidhi.bhimani@alsglobal.com
Telephone	: ----	Telephone	: +61-7-3243 7222
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: HPE BAP	Page	: 1 of 4
Order number	: 4510264491	Quote number	: EB2015BMALLI0386 (BN/448/15 V24)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: DUNCAN DAWSON / SLR		

Dates

Date Samples Received	: 27-Nov-2020 18:45	Issue Date	: 18-Dec-2020
Client Requested Due Date	: 21-Dec-2020	Scheduled Reporting Date	: **21-Dec-2020**

Delivery Details

Mode of Delivery	: Client Drop Off	Security Seal	: Not Available
No. of coolers/boxes	: 1	Temperature	: 8.5°C - Ice present
Receipt Detail	: MED ESKY	No. of samples received / analysed	: 16 / 16

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- ***SRN Reissued 18/12/2020: Please be advised that Total and Dissovled Copper have now been assigned for reporting. The COA has also been split, as per the email from Duncan Dawson 17/12/2020.***
- ***SRN Reissued 18/12/2020 (#2): As per the email from Duncan Dawson, the samples have been split again into separate COA reports.***
- **17.12.2020: SRN has been resent to acknowledge the change of quote from EN/222 to BN/448/15 v24 as requested by client. For any further information regarding these adjustments please contact client services at ALSEnviro.Brisbane@alsglobal.com.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	WATER - EA005P pH (PCT)	WATER - EA010P Electrical Conductivity (PCT)	WATER - EA015H Total Dissolved Solids - Standard Level	WATER - EG020F Dissolved Metals by ICP/MS	WATER - EG035F Dissolved Mercury	WATER - EG035T Total Mercury	WATER - NT-01D & 02A Major Cations & Anions (Ca, Mg, Na, K, Cl, SO4,
EB2031461-001	24-Nov-2020 10:20	CD01	✓	✓	✓	✓	✓	✓	✓
EB2031461-002	24-Nov-2020 00:00	QA01	✓	✓	✓	✓	✓	✓	✓
EB2031461-003	24-Nov-2020 16:40	GD01	✓	✓	✓	✓	✓	✓	✓
EB2031461-004	24-Nov-2020 00:00	QA02	✓	✓	✓	✓	✓	✓	✓
EB2031461-005	24-Nov-2020 11:50	FB01	✓	✓	✓	✓	✓	✓	✓
EB2031461-006	24-Nov-2020 11:59	RB01	✓	✓	✓	✓	✓	✓	✓
EB2031461-007	26-Nov-2020 07:33	Pownall 01	✓	✓	✓	✓	✓	✓	✓
EB2031461-008	26-Nov-2020 00:00	QA03	✓	✓	✓	✓	✓	✓	✓
EB2031461-009	26-Nov-2020 00:00	FB03	✓	✓	✓	✓	✓	✓	✓
EB2031461-010	26-Nov-2020 00:00	RB03	✓	✓	✓	✓	✓	✓	✓
EB2031461-011	25-Nov-2020 18:50	FB02	✓	✓	✓	✓	✓	✓	✓
EB2031461-012	25-Nov-2020 18:57	RB02	✓	✓	✓	✓	✓	✓	✓
EB2031461-013	27-Nov-2020 10:50	WD05	✓	✓	✓	✓	✓	✓	✓
EB2031461-014	27-Nov-2020 00:00	QA04	✓	✓	✓	✓	✓	✓	✓
EB2031461-015	27-Nov-2020 13:00	FB04	✓	✓	✓	✓	✓	✓	✓
EB2031461-016	27-Nov-2020 13:00	RB04	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	WATER - EG020T Total Metals by ICP/MS (including digestion)
EB2031461-001	24-Nov-2020 10:20	CD01	✓
EB2031461-002	24-Nov-2020 00:00	QA01	✓
EB2031461-003	24-Nov-2020 16:40	GD01	✓
EB2031461-004	24-Nov-2020 00:00	QA02	✓
EB2031461-005	24-Nov-2020 11:50	FB01	✓
EB2031461-006	24-Nov-2020 11:59	RB01	✓
EB2031461-007	26-Nov-2020 07:33	Pownall 01	✓
EB2031461-008	26-Nov-2020 00:00	QA03	✓

			WATER - EG020T Total Metals by ICP/MS (including digestion)
EB2031461-009	26-Nov-2020 00:00	FB03	✓
EB2031461-010	26-Nov-2020 00:00	RB03	✓
EB2031461-011	25-Nov-2020 18:50	FB02	✓
EB2031461-012	25-Nov-2020 18:57	RB02	✓
EB2031461-013	27-Nov-2020 10:50	WD05	✓
EB2031461-014	27-Nov-2020 00:00	QA04	✓
EB2031461-015	27-Nov-2020 13:00	FB04	✓
EB2031461-016	27-Nov-2020 13:00	RB04	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method		**Due for extraction**	**Due for analysis**	**Samples Received**		**Instructions Received**	
Client Sample ID(s)	**Container**			**Date**	**Evaluation**	**Date**	**Evaluation**
EA005-P: pH by PC Titrator							
CD01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
FB01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
FB02	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
FB03	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
GD01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
Pownall 01	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
QA01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
QA02	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
QA03	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
RB01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
RB02	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
RB03	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----

Requested Deliverables

ACCOUNTS PAYABLE (ALS)		
- A4 - AU Tax Invoice (INV)	Email	envirocosting.brisbane@alsglobal.com
BMA ENVIROSYS_DATA		
- EDI Format - BMA (BMA)	Email	BMA_Envirosys_Data@bhpbilliton.com
BMA SUPPORT		
- EDI Format - BMA (BMA)	Email	bma_support@sra.com.au
Cindy Meyers		
- Chain of Custody (CoC) (COC)	Email	cindy.myers@bhp.com
- EDI Format - BMA (BMA)	Email	cindy.myers@bhp.com
KATY STEELE		
- *AU Certificate of Analysis - NATA (COA)	Email	katy.steele@bhp.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	katy.steele@bhp.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	katy.steele@bhp.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	katy.steele@bhp.com
- Chain of Custody (CoC) (COC)	Email	katy.steele@bhp.com
- EDI Format - BMA (BMA)	Email	katy.steele@bhp.com
- EDI Format - ESDAT (ESDAT)	Email	katy.steele@bhp.com
- EDI Format - XTab (XTAB)	Email	katy.steele@bhp.com
RESULTS BWM ENVIRONMENT		
- *AU Certificate of Analysis - NATA (COA)	Email	bwmenvironment@bhpbilliton.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	bwmenvironment@bhpbilliton.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	bwmenvironment@bhpbilliton.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	bwmenvironment@bhpbilliton.com
- Chain of Custody (CoC) (COC)	Email	bwmenvironment@bhpbilliton.com
- EDI Format - BMA (BMA)	Email	bwmenvironment@bhpbilliton.com
- EDI Format - ESDAT (ESDAT)	Email	bwmenvironment@bhpbilliton.com
- EDI Format - XTab (XTAB)	Email	bwmenvironment@bhpbilliton.com

CERTIFICATE OF ANALYSIS

Work Order : **EB2031461-AJ**

Amendment : **3**

Client : **BM ALLIANCE LTD**

Contact : MS KATY STEELE

Address : L11 480 QUEEN STREET
BRISBANE QLD 4000

Telephone : ----

Project : HPE BAP

Order number : 4510264491

C-O-C number : ----

Sampler : DUNCAN DAWSON / SLR

Site : ----

Quote number : BN/448/15 V24

No. of samples received : 4

No. of samples analysed : 4

Page : 1 of 5

Laboratory : Environmental Division Brisbane

Contact : Nidhi Bhimani

Address : 2 Byth Street Stafford QLD Australia 4053

Telephone : +61-7-3243 7222

Date Samples Received : 27-Nov-2020 18:45

Date Analysis Commenced : 30-Nov-2020

Issue Date : 18-Dec-2020 11:10

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Amendment (18/12/2020): This report has been amended and re-released to allow the reporting of additional analytical data. Total and Dissolved Copper results are now included.
- Amendment (17.12.2020): This report has been amended as a result of the change of quote from EN/222 to BN/448/15 v24 as requested by client. All analysis results are as per the previous report
- Amendment (18/12/2020): This report has been amended as a result of a request to split samples #1-2, #3-6, #7-10, #11-12 and #13-16 into separate COA reports. All analysis results are as per the previous report
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**WD05**	**QA04**	**FB04**	**RB04**	**----**
			Sampling date / time	27-Nov-2020 10:50	27-Nov-2020 00:00	27-Nov-2020 13:00	27-Nov-2020 13:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031461-013**	**EB2031461-014**	**EB2031461-015**	**EB2031461-016**	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.40**	**7.38**	**5.73**	**5.48**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**5350**	**5340**	<1	<1	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**3760**	**3780**	<10	<10	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**494**	**493**	<1	<1	----
Total Alkalinity as CaCO3	----	1	mg/L	**494**	**493**	<1	<1	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**256**	**205**	<1	<1	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**1400**	**1390**	<1	<1	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**214**	**222**	<1	<1	----
Magnesium	7439-95-4	1	mg/L	**187**	**194**	<1	<1	----
Sodium	7440-23-5	1	mg/L	**658**	**684**	<1	<1	----
Potassium	7440-09-7	1	mg/L	**7**	**7**	<1	<1	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**1300**	**1350**	<1	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Barium	7440-39-3	0.001	mg/L	**0.269**	**0.282**	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.115**	**0.119**	<0.001	<0.001	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**WD05**	**QA04**	**FB04**	**RB04**	**----**
			Sampling date / time	27-Nov-2020 10:50	27-Nov-2020 00:00	27-Nov-2020 13:00	27-Nov-2020 13:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031461-013**	**EB2031461-014**	**EB2031461-015**	**EB2031461-016**	--------
				Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Boron	7440-42-8	0.05	mg/L	**0.32**	**0.33**	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	**1.06**	**1.10**	<0.05	<0.05	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Barium	7440-39-3	0.001	mg/L	**0.341**	**0.352**	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	**0.011**	**0.009**	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	**0.002**	**0.002**	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.131**	**0.130**	<0.001	<0.001	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.005**	<0.005	<0.005	----
Boron	7440-42-8	0.05	mg/L	**0.36**	**0.39**	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	**1.24**	**1.23**	<0.05	<0.05	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.2**	<0.1	<0.1	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**54.7**	**53.3**	<0.01	<0.01	----
ø **Total Cations**	----	0.01	meq/L	**54.9**	**57.0**	<0.01	<0.01	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Sample ID	**WD05**	**QA04**	**FB04**	**RB04**	**----**
			Sampling date / time	27-Nov-2020 10:50	27-Nov-2020 00:00	27-Nov-2020 13:00	27-Nov-2020 13:00	----
Compound	CAS Number	LOR	Unit	**EB2031461-013**	**EB2031461-014**	**EB2031461-015**	**EB2031461-016**	**--------**
				Result	Result	Result	Result	----
EN055: Ionic Balance - Continued								
ø **Ionic Balance**	----	0.01	%	**0.16**	**3.31**	**----**	**----**	**----**

QUALITY CONTROL REPORT

Work Order	: **EB2031461-AJ**	Page	: 1 of 9
Amendment	: **3**		
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KATY STEELE	Contact	: Nidhi Bhimani
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Project	: HPE BAP	Date Samples Received	: 27-Nov-2020
Order number	: 4510264491	Date Analysis Commenced	: 30-Nov-2020
C-O-C number	: ----	Issue Date	: 18-Dec-2020
Sampler	: DUNCAN DAWSON / SLR		
Site	: ----		
Quote number	: BN/448/15 V24		
No. of samples received	: 4		
No. of samples analysed	: 4		

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 3394837)									
EB2031425-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.99	7.02	0.428	0% - 20%
EB2031461-005	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	5.67	5.64	0.530	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 3394841)									
EB2031550-002	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.89	6.89	0.00	0% - 20%
EB2031461-015	FB04	EA005-P: pH Value	----	0.01	pH Unit	5.73	5.72	0.175	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 3394838)									
EB2031425-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	4030	4030	0.00	0% - 20%
EB2031461-005	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1	0.00	No Limit
EA010P: Conductivity by PC Titrator (QC Lot: 3394842)									
EB2031550-002	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	815	815	0.00	0% - 20%
EB2031461-015	FB04	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	<1	0.00	No Limit
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 3391123)									
EB2031461-003	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1400	1430	2.12	0% - 20%
EB2031461-012	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	<10	0.00	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 3394840)									
EB2031425-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	481	476	1.09	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	481	476	1.09	0% - 20%
EB2031461-005	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	1	<1	0.00	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 3394844)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED037P: Alkalinity by PC Titrator (QC Lot: 3394844) - continued									
EB2031550-002	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	134	132	1.72	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	134	132	1.72	0% - 20%
EB2031461-015	FB04	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.00	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3392563)									
EB2031418-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	9	8	0.00	No Limit
EB2031461-008	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	287	298	3.76	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3392564)									
EB2031418-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	29	29	0.00	0% - 20%
EB2031461-008	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	433	437	0.872	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 3390964)									
EB2031461-003	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	103	106	2.98	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	153	154	0.00	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	214	217	1.47	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.00	No Limit
EB2031461-013	WD05	ED093F: Calcium	7440-70-2	1	mg/L	214	238	10.6	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	187	212	12.9	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	658	720	9.02	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	7	7	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390965)									
EB2031461-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.067	0.067	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.163	0.164	0.00	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.01	0.01	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390965) - continued									
EB2031461-003	Anonymous	EG020A-F: Boron	7440-42-8	0.05	mg/L	0.22	0.23	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.10	0.10	0.00	No Limit
EB2031461-013	WD05	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.269	0.308	13.7	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.115	0.132	13.8	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.32	0.34	5.42	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	1.06	1.22	14.1	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390966)									
EB2031461-003	Anonymous	EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.002	0.002	0.00	No Limit
EB2031461-013	WD05	EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3391102)									
EB2031461-001	Anonymous	EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EB2031461-010	Anonymous	EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3391103)									
EB2031461-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.801	0.804	0.339	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.012	0.011	0.00	0% - 50%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.054	0.052	2.45	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.006	0.006	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.04	0.02	61.3	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 3391103) - continued									
EB2031461-001	Anonymous	EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.39	0.42	7.40	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.06	0.06	0.00	No Limit
EB2031461-010	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 3390967)									
EB2031461-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2031461-013	WD05	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3391105)									
EB2031336-023	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2031461-006	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3391106)									
EB2031461-016	RB04	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3394839)									
EB2031425-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EB2031461-005	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3394843)									
EB2031587-003	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EB2031461-015	FB04	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EA005P: pH by PC Titrator (QCLot: 3394837)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	100	98.0	102
EA005P: pH by PC Titrator (QCLot: 3394841)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	101	98.0	102
				----	7 pH Unit	101	98.0	102
EA010P: Conductivity by PC Titrator (QCLot: 3394838)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	220 µS/cm	102	91.0	107
				<1	12890 µS/cm	99.4	91.0	107
EA010P: Conductivity by PC Titrator (QCLot: 3394842)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	2100 µS/cm	97.4	91.0	107
				<1	24800 µS/cm	99.4	91.0	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 3391123)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2460 mg/L	105	88.0	112
				<10	293 mg/L	105	88.0	112
				<10	2000 mg/L	100	80.9	118
ED037P: Alkalinity by PC Titrator (QCLot: 3394840)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	103	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 3394844)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	102	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3392563)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	101	85.0	118
				<1	100 mg/L	98.4	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 3392564)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.9	90.0	115
				<1	1000 mg/L	104	90.0	115
ED093F: Dissolved Major Cations (QCLot: 3390964)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	106	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	108	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	105	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	96.5	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	93.3	79.0	118
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	96.2	88.0	116

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965) - continued								
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	91.2	81.0	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	94.6	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	90.7	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	93.0	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	93.4	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	90.8	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.9	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	93.3	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	99.8	89.0	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	92.3	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.1	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	97.7	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	93.0	87.0	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	101	81.0	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	96.4	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390966)								
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	93.7	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391102)								
EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	107	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391103)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	98.3	80.0	114
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	111	88.0	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	95.4	81.0	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	102	70.0	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	101	88.0	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	101	89.0	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	105	89.0	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	109	88.0	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	104	89.0	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	104	88.0	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	111	90.0	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	108	88.0	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	106	79.0	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	114	87.0	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	103	84.0	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	105	82.0	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	113	82.0	118
EG035F: Dissolved Mercury by FIMS (QCLot: 3390967)								

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG035F: Dissolved Mercury by FIMS (QCLot: 3390967) - continued								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	101	84.0	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391105)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	100	84.0	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391106)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	97.6	84.0	118
EK040P: Fluoride by PC Titrator (QCLot: 3394839)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	94.0	80.0	117
EK040P: Fluoride by PC Titrator (QCLot: 3394843)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	98.6	80.0	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3392563)							
EB2031418-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	85.3	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3392564)							
EB2031418-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	114	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965)							
EB2031461-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	98.2	70.0	130
		EG020A-F: Beryllium	7440-41-7	1 mg/L	89.7	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	93.5	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	92.5	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	92.0	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	90.3	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	88.0	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	94.0	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	93.9	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	90.4	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	96.0	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	93.3	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391103)							
EB2031461-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	112	70.0	130
		EG020A-T: Beryllium	7440-41-7	1 mg/L	110	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EG020T: Total Metals by ICP-MS (QCLot: 3391103) - continued							
EB2031461-002	Anonymous	EG020A-T: Barium	7440-39-3	1 mg/L	101	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	104	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	107	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	109	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	106	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	109	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	114	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	106	70.0	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	124	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	102	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 3390967)							
EB2031461-004	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	94.0	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391105)							
EB2031336-024	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	93.1	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 3394839)							
EB2031425-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	80.4	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 3394843)							
EB2031461-016	RB04	EK040P: Fluoride	16984-48-8	5 mg/L	76.6	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2031461**	Page	: 1 of 11
Amendment	: **3**		
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KATY STEELE	Telephone	: +61-7-3243 7222
Project	: HPE BAP	Date Samples Received	: 27-Nov-2020
Site	: ----	Issue Date	: 18-Dec-2020
Sampler	: DUNCAN DAWSON / SLR	No. of samples received	: 16
Order number	: 4510264491	No. of samples analysed	: 16

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **<u>NO</u> Method Blank value outliers occur.**
- **<u>NO</u> Duplicate outliers occur.**
- **<u>NO</u> Laboratory Control outliers occur.**
- **<u>NO</u> Matrix Spike outliers occur.**
- **For all regular sample matrices, <u>NO</u> surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	**Days overdue**	Date analysed	Due for analysis	**Days overdue**
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural CD01, QA01, GD01, QA02, FB01, RB01	----	----	----	01-Dec-2020	24-Nov-2020	**7**
Clear Plastic Bottle - Natural FB02, RB02	----	----	----	01-Dec-2020	26-Nov-2020	**5**
Clear Plastic Bottle - Natural Pownall 01, QA03, FB03, RB03	----	----	----	01-Dec-2020	26-Nov-2020	**5**
Clear Plastic Bottle - Natural WD05, QA04, FB04, RB04	----	----	----	01-Dec-2020	27-Nov-2020	**4**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Total Mercury by FIMS	1	21	4.76	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	**Sample Date**	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		**Date extracted**	Due for extraction	Evaluation	**Date analysed**	Due for analysis	Evaluation

Matrix: **WATER**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	----	----	----	**01-Dec-2020**	24-Nov-2020	✘
Clear Plastic Bottle - Natural (EA005-P) FB02, RB02	**25-Nov-2020**	----	----	----	**01-Dec-2020**	26-Nov-2020	✘
Clear Plastic Bottle - Natural (EA005-P) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	----	----	----	**01-Dec-2020**	26-Nov-2020	✘
Clear Plastic Bottle - Natural (EA005-P) WD05, QA04, FB04, RB04	**27-Nov-2020**	----	----	----	**01-Dec-2020**	27-Nov-2020	✘
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	----	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) FB02, RB02	**25-Nov-2020**	----	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	----	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) WD05, QA04, FB04, RB04	**27-Nov-2020**	----	----	----	**01-Dec-2020**	25-Dec-2020	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	----	----	----	**01-Dec-2020**	01-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) FB02, RB02	**25-Nov-2020**	----	----	----	**01-Dec-2020**	02-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	----	----	----	**01-Dec-2020**	03-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) WD05, QA04, FB04, RB04	**27-Nov-2020**	----	----	----	**01-Dec-2020**	04-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	08-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	09-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	10-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	11-Dec-2020	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**30-Nov-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) FB02, RB02	**25-Nov-2020**	**----**	----	----	**30-Nov-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**30-Nov-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**30-Nov-2020**	25-Dec-2020	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**30-Nov-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) FB02, RB02	**25-Nov-2020**	**----**	----	----	**30-Nov-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**30-Nov-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**30-Nov-2020**	25-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method **Container** / Client Sample ID(s)	**Sample Date**	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	**Date analysed**	Due for analysis	Evaluation
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	26-May-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**01-Dec-2020**	23-May-2021	✓	**01-Dec-2020**	23-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) FB02, RB02	**25-Nov-2020**	**01-Dec-2020**	24-May-2021	✓	**01-Dec-2020**	24-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**01-Dec-2020**	25-May-2021	✓	**01-Dec-2020**	25-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) WD05, QA04, FB04, RB04	**27-Nov-2020**	**01-Dec-2020**	26-May-2021	✓	**01-Dec-2020**	26-May-2021	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*		*Sample Date*	*Extraction / Preparation*			*Analysis*		
			Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P) CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P) FB02,	RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P) Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P) WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		*Count*		*Rate (%)*			*Quality Control Specification*
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	4	34	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	3	21	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	6	33	**18.18**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	21	**4.76**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

WINCHESTER DOWNS 06

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder			
Surname		Given name(s)	
Company name (if applicable) EXXARO AUSTRALIA PTY LTD		ABN/ACN (if applicable) 26 063 427 369	
Principal contact			
Surname Wooley		Given name(s) Dale	
Phone		Mobile 0499114085	
Tenure type ☐ PL ☐ ATP ☒ MDL ☐ ML		Tenure number 277	
Bore information			
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 06			
Bore registration number (RN)[4] 162824		Bore RN comments Bore location matches DNRME bore location. Casing matches information in DNRME bore report.	
Local bore name			
Property name Winchester Downs			
Lot 8		Plan SP2777384	
Date of site assessment 27/11/2020			
Bore geographic location (GDA94)			
Latitude 22.12470		Longitude 148.18262	
Location method ☒ GPS	☐ GPS – Differential	☐ Surveyed	
Facility type ☒ Sub-Artesian	☐ Artesian – controlled flow	☐ Artesian – uncontrolled flow	☐ Artesian – ceased to flow
Additional comments None			

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) <01/01/1950
Type of casing Steel	Casing diameter (mm) 155
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☐ Yes →	Name of source aquifer Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
☒ No →	Reasons source aquifer unknown No strata log available
Is a strata log available for the bore?	
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No
Additional comments Bore depth - 21.41m btoc	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore					
☐ Operational			☒ Decommissioned		
Is the bore equipped with a pump?					
☐ Yes			☒ No → go to Part D.		
Pump type			Pump make and model		
Pump setting depth (m) (depth from ground)					
Is the bore equipped with a meter?					
☐ Yes → description:			☒ No		
Power source					
☐ Electric motor	☒ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill
Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)					
0.29m Steel stick up.					
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance					
Unknown					

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)				
☒ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply
☐ Other → description: Previously used for stock and domestic				

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A
Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)? N/A	
Describe the operational capacity, including seasonal variation N/A	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore. N/A	
Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

- a. A datum for standing water level (SWL);
- b. The unique identification number of the bore and the groundwater database registered number (if available);
- c. The bore owner's name;
- d. Property name; and
- e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 10.54
	Current conditions relevant to the water level measurement Bore not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.29	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.2%	H_2S (ppm$_v$) 0	CH_4 (%LEL) 0.3%
☒ No →	Reason not measured N/A		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.	☐ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Winchester Downs 06

Report Date: 03/11/2020 16:25

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162824	Sub-Artesian Facility	Abandoned but Still Usable		Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-07-29	**Basin**	1304
Longitude	148-10-57	**Sub-area**	
GIS Latitude	-22.12472938	**Lot**	8
GIS Longitude	148.18263701	**Plan**	SP277384
Easting	621972		
Northing	7552893	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

1 *records for RN* 162824

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1900	1			Steel Casing			152

Strata Logs

0 *records for RN* 162824

Stratigraphies

0 *records for RN* 162824

From Year:

Aquifers

0 ***records for RN*** **162824**

Pump Tests Part 1

0 ***records for RN*** **162824**

Pump Tests Part 2

0 ***records for RN*** **162824**

Bore Conditions

0 ***records for RN*** **162824**

Elevations

1 ***records for RN*** **162824**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	14/02/2006	212.30	GPS	Global Positioning System	AHD - Aust. Height Datum	R	Reference Point	ISAAC PLAINS BORE CENSUS

Water Analysis Part 1

0 ***records for RN*** **162824**

Water Analysis Part 2

0 ***records for RN*** **162824**

Water Levels

2 ***records for RN*** **162824**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	01/10/2004		-10.00	R	Reference Point		ACT	Actual	XX	XX	Unknown		130	Data is of unknown quality
A	14/02/2006		-11.42	R	Reference Point		ACT	Actual	NR	XX	Unknown		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **162824**

Field Measurements

0 ***records for RN*** **162824**

Special Water Analysis

0 ***records for RN*** **162824**

From Year:

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Disclaimer

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WINCHESTER DOWNS 07

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) SOUTH32 EAGLE DOWNS PTY LTD	ABN/ACN (if applicable) 55 624 045 067
Principal contact	
Surname Wooley	Given name(s) Dale
Phone	Mobile 0499114085
Tenure type ☐ PL ☐ ATP ☐ MDL ☒ ML	Tenure number 70389
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 07	
Bore registration number (RN)[4] 141385	Bore RN comments Bore location matches DNRME bore location. Casing matches information in DNRME bore report.
Local bore name MB1	
Property name Winchester Downs	
Lot 8	Plan SP271144
Date of site assessment 27/11/2020	
Bore geographic location (GDA94)	
Latitude 22.13683	Longitude 148.19518
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.
[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Robert Wayne Mclean - IESA	Date of bore construction (drilled date) 09/04/2008
Type of casing PVC	Casing diameter (mm) 50
Details of perforated intervals and/or screens that have been installed 47.50 to 50.50	
Details of any seals and cement grouting installed in the bore annulus Grout 0 to 35.5, Bentonite 35.5 to 36.0	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 0.01 L/s reported on bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Shale - Unknown
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Based on DNRME bore report - low confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Bore depth - 51.02m btom	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore ☒ Operational	☐ Decommissioned
Is the bore equipped with a pump? ☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
Pump setting depth (m) (depth from ground)	
Is the bore equipped with a meter? ☐ Yes → description:	☒ No
Power source ☐ Electric motor ☒ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill	
Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter) 0.47m stick up monument with internal PVC casing	
Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance	

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner) ☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply ☒ Other → description: Monitoring	
Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A - monitoring bore
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A - monitoring bore
Bore utilisation	
How often is the bore utilised (estimated hours pumped per day)? N/A - monitoring Bore	
Describe the operational capacity, including seasonal variation N/A - monitoring Bore	
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore. N/A - monitoring Bore	
Are there any historical water use records available for this bore? ☐ Yes → attach them to this form.	☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 37.30
	Current conditions relevant to the water level measurement Bore not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Monument	
Height of datum above ground level (m) 0.47	
Are water level and/or pressure records available for this bore?	
☐ Yes → attach them to this form.	☐ No

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A - monitoring bore sample not taken	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A -	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☐ No →	Provide details of the pumping history including when the bore was last used
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.3%	H_2S (ppm$_v$) 0	CH_4 (%LEL) 0.1%
☒ No →	Reason not measured N/A - monitoring bore		
Are historical water quality field records available for this bore?			
☒ Yes		☐ No	

Laboratory water quality		
Were water quality samples taken for submission to a laboratory?		
☐ Yes		
☒ No →	Reason not samples not taken N/A - monitoring bore	
Were dissolved gas samples taken for submission to a laboratory?		
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method
	Reason method chosen	
☒ No →	Reason not measured N/A - monitoring bore	
Are the laboratory results for the samples indicated above supplied with this baseline assessment?		
☐ Yes		
☒ No →	Reason not supplied N/A - monitoring bore	
Are historical water quality laboratory records available for this bore?		
☒ Yes → attach them to this form.	☐ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Winchester Downs 07

Report Date: 03/11/2020 16:19

Queensland Government
Groundwater Information

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
141385	Sub-Artesian Facility	Existing	09/04/2008	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	5065 - WINCHESTER		
Original Name	MB1		
Driller Name	MCLEAN, WAYNE ROBERT		
Drill Company	IESA		
Const Method	ROTARY AIR - HAMMER		
Bore Line			
D/O File No	520/000/0072	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	28/04/2008	**Data Owner**	DNR
Roles	Sub-Artesian Monitoring		

Location

Latitude	22-08-13	**Basin**	1304
Longitude	148-11-43	**Sub-area**	
GIS Latitude	-22.13685985	**Lot**	8
GIS Longitude	148.19515858	**Plan**	SP271144
Easting	623253		
Northing	7551540	**Map Scale**	254 - 1: 250 000
Zone	55	**Map Series**	
Accuracy		**Map No**	SF55-11
GPS Accuracy		**Map Name**	CLERMONT
Checked	Yes	**Prog Section**	

Casing

6 ***records for RN*** **141385**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	09/04/2008	1	0.00	47.50	Polyvinyl Chloride	5.500	WT - Wall Thickness	60
A	09/04/2008	2	3.00	48.00	Centraliser			
A	09/04/2008	3	47.50	50.50	Screen	0.500	AP - Aperture Size	60
A	09/04/2008	4	36.00	51.40	Gravel Pack	7.000	GR - Gravel Size	164
A	09/04/2008	5	35.50	36.00	Bentonite Seal			164

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	09/04/2008	6	0.00	35.50	Grout			164

Strata Logs

9 ***records for RN*** **141385**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	"TOP SOIL SILTY CALY LT/BROWN"
2	1.00	16.40	"SHALE SILCRETE BANDS LAMINATED LT/ORANGE, TAN, GREY"
3	16.40	25.60	"CARBONACEOUS MATERIAL SOME OXIDISATION LAMINAR GREY/BLACK"
4	25.60	27.20	"LAMINATED CLAY & LT/GREY"
5	27.20	33.60	"CARBONACEOUS MATERIAL SOME OXIDISATION LAMINATED SHALE LENSES GREY/BLACK"
6	33.60	35.70	""SILTY CLAY LT/GREY"
7	35.70	36.80	"SHALE HARD/SOFT BANDS GREY"
8	36.80	44.70	"SHALE GREY/LT GREY"
9	44.70	51.40	"SHALE SILTY SILCRETE BANDS LT GREY"

Stratigraphies

0 ***records for RN*** **141385**

Aquifers

1 ***records for RN*** **141385**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	42.20		SHLE - Shale	09/04/2008	-30.53	N		0.01	Y	PS	

Pump Tests Part 1

0 ***records for RN*** **141385**

Pump Tests Part 2

0 ***records for RN*** **141385**

Bore Conditions

0 ***records for RN*** **141385**

Bore Report

From Year:

Elevations

2 *records for RN* **141385**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	09/04/2008	221.37	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	
X	09/04/2008	220.87	SVY	Surveyed	AHD - Aust. Height Datum	N	Natural Surface	

Water Analysis Part 1

0 *records for RN* **141385**

Water Analysis Part 2

0 *records for RN* **141385**

Water Levels

30 *records for RN* **141385**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	19/04/2008		-33.59	R	Reference Point		ACT	Actual	XX	MA	Manual/Hand	XX	130	Data is of unknown quality
A	11/06/2008		-33.38	R	Reference Point		ACT	Actual	XX	MA	Manual/Hand	XX	130	Data is of unknown quality
A	12/10/2011		-32.89	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	09/11/2011		-33.04	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	13/12/2011		-33.03	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	11/01/2012		-33.18	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	07/02/2012		-33.04	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	13/03/2012		-33.03	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	12/04/2012		-32.66	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	14/05/2012		-32.32	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	12/06/2012		-32.03	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	09/07/2012		-32.19	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	08/08/2012		-32.02	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	11/09/2012		-31.67	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	10/10/2012		-32.62	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	05/11/2012		-31.59	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	05/12/2012		-31.64	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/01/2013		-31.28	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	11/02/2013		-31.45	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	18/03/2013		-31.18	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/04/2013		-29.90	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/05/2013		-31.07	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	11/06/2013		-31.00	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/07/2013		-31.00	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	06/08/2013		-30.79	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	10/09/2013		-30.79	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/10/2013		-31.11	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	06/11/2013		-32.22	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	04/12/2013		-31.19	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	07/01/2014		-32.34	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality

Wire Line Logs

0 *records for RN* **141385**

Field Measurements

29 *records for RN* **141385**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	09/04/2008		2250	8.1						PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	12/10/2011		1684	6.4						PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	09/11/2011		1673	6.7						PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	13/12/2011		1930	6.5			0.33			PU	Pump - Other or	GB	Groundwater - from

Bore Report

From Year:

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
											Flowing Bore		Bore
A	11/01/2012		2186	7.2	29.8		1.14			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	07/02/2012		1849	6.5	29.5		0.84			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	13/03/2012		1934	6.7	28.4		0.60			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	12/04/2012		2087	7.7	27.4		1.17			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	14/05/2012		2052	7.1	26.4		2.91			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	12/06/2012		2088	6.7	26.4		0.50			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	09/07/2012		2164	6.4	27.3		1.25			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/08/2012		2070	7.7	27.6		0.71			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	11/09/2012		2116	7.0	27.6		4.47			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	10/10/2012		2222	7.6	29.6		0.10			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	05/11/2012		2212	6.8	25.5		11.20			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	05/12/2012		2058	7.0	28.8		0.38			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/01/2013		2060	7.0	28.6		5.02			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	11/02/2013		1789	7.1	28.6		2.66			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	18/03/2013		2038	7.4	27.4		0.39			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/04/2013		2343	7.4	26.9		2.20			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/05/2013		2003	7.2	24.6		2.60			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	11/06/2013		2083	7.5	26.5		1.40			PU	Pump - Other or	GB	Groundwater - from

From Year:

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
											Flowing Bore		Bore
A	08/07/2013			7.1	26.1		2.50			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	06/08/2013		2017	7.1	26.0		19.80			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	10/09/2013		2358	7.5	26.3		2.80			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/10/2013		2278	8.1	27.8		2.20			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	06/11/2013		2400	6.5	27.3		0.60			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	04/12/2013		2409	6.9	28.4		1.96			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	07/01/2014		2074	7.3	27.2					PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore

Special Water Analysis

0 ***records for RN*** **141385**

Bore Report

From Year:

User Licence and Conditions

WINCHESTER DOWNS 08

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) SOUTH32 EAGLE DOWNS PTY LTD	ABN/ACN (if applicable) 55 624 045 067
Principal contact	
Surname Wooley	Given name(s) Dale
Phone	Mobile 0499114085
Tenure type ☐ PL ☐ ATP ☐ MDL ☒ ML	Tenure number 70389
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 08	
Bore registration number (RN)[4] 162829	Bore RN comments Bore location matches DNRME bore location. Casing matches information in DNRME bore report.
Local bore name	
Property name Winchester Downs	
Lot 8	Plan SP2777384
Date of site assessment 27/11/2020	
Bore geographic location (GDA94)	
Latitude 22.15540	Longitude 148.19932
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) <01/01/1950
Type of casing Steel	Casing diameter (mm) 150
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☐ Yes →	Name of source aquifer
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
☒ No →	Reasons source aquifer unknown no strata log available
Is a strata log available for the bore?	
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No
Additional comments Blockage @ 1.36m unable to take any further measurements	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore

☐ Operational ☒ Decommissioned

Is the bore equipped with a pump?

☐ Yes ☒ No → go to Part D.

Pump type	Pump make and model

Pump setting depth (m) (depth from ground)

Is the bore equipped with a meter?

☐ Yes → description: ☒ No

Power source

☐ Electric motor	☒ Generator	☐ Direct drive engine	☐ Mains supply	☐ Tractor	☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)

0.56m Steel stick up - stick up bent.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)

☐ Stock	☐ Domestic supply	☐ Intensive livestock	☐ Irrigation	☐ Town water supply

☐ Other → description: Previously used for stock and domestic

Is the water use from this bore metered?

☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?

N/A

Describe the operational capacity, including seasonal variation

N/A

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.

N/A

Are there any historical water use records available for this bore?

☐ Yes → attach them to this form. ☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☐ Yes →	Standing water level (m) (depth from ground)
	Current conditions relevant to the water level measurement
☒ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL) Blocakge at 1.36m
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing)	
Height of datum above ground level (m)	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.4%	H_2S (ppm$_v$) 0	CH_4 (%LEL) 0.2%
☒ No →	Reason not measured N/A		
Are historical water quality field records available for this bore?			
☐ Yes	☒ No		
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.	☐ No		

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner?	
☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Winchester Downs 08

Report Date: 17/03/2021 22:06

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
162829	Sub-Artesian Facility	Abandoned and Destroyed		Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-09-20	**Basin**	1304
Longitude	148-11-58	**Sub-area**	
GIS Latitude	-22.15541884	**Lot**	8
GIS Longitude	148.19936863	**Plan**	SP277384
Easting	623671		
Northing	7549482	**Map Scale**	
Zone	55	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

1 *records for RN* 162829

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	01/01/1900	1			Steel Casing			152

Strata Logs

0 *records for RN* 162829

Stratigraphies

0 *records for RN* 162829

From Year:

Aquifers
0 ***records for RN*** **162829**

Pump Tests Part 1
0 ***records for RN*** **162829**

Pump Tests Part 2
0 ***records for RN*** **162829**

Bore Conditions
0 ***records for RN*** **162829**

Elevations
1 ***records for RN*** **162829**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	09/02/2006	213.50	GPS	Global Positioning System	AHD - Aust. Height Datum	R	Reference Point	ISAAC PLAINS BORE CENSUS

Water Analysis Part 1
0 ***records for RN*** **162829**

Water Analysis Part 2
0 ***records for RN*** **162829**

Water Levels
1 ***records for RN*** **162829**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	09/02/2006		-15.79	R	Reference Point		ACT	Actual	NR	XX	Unknown	130	Data is of unknown quality

Wire Line Logs
0 ***records for RN*** **162829**

Field Measurements
0 ***records for RN*** **162829**

Special Water Analysis
0 ***records for RN*** **162829**

Bore Report

From Year:

User Licence and Conditions

WINCHESTER DOWNS 09

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable) SOUTH32 EAGLE DOWNS PTY LTD	ABN/ACN (if applicable) 55 624 045 067
Principal contact	
Surname Wooley	Given name(s) Dale
Phone	Mobile 0499114085
Tenure type ☐ PL ☐ ATP ☐ MDL ☐ ML	Tenure number
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Winchester Downs 09	
Bore registration number (RN)[4] 141384	Bore RN comments Bore location 100m W of DNRME bore location. Casing matches information in DNRME bore report.
Local bore name MB2	
Property name Winchester Downs	
Lot 8	Plan SP271144
Date of site assessment 27/11/2020	
Bore geographic location (GDA94)	
Latitude 22.15624	Longitude 148.19951
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using “groundwater database” as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Robert Wayne Mclean - IESA	Date of bore construction (drilled date) 09/04/2008
Type of casing PVC	Casing diameter (mm) 50
Details of perforated intervals and/or screens that have been installed 47.50 to 50.50	
Details of any seals and cement grouting installed in the bore annulus Grout 0 to 21.5, Bentonite 21.5 to 22.0	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) 0.03 L/s reported on bore report	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Shale - Unknown
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Based on DNRME bore report - low confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore? ☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments Bore depth - 51.15m btom	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore ☒ Operational	☐ Decommissioned
Is the bore equipped with a pump? ☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
Pump setting depth (m) (depth from ground)	
Is the bore equipped with a meter? ☐ Yes → description:	☒ No

Power source
☐ Electric motor ☒ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)
0.56m stick up PVC encased in lockable steel monument

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)
☐ Stock ☐ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply
☒ Other → description: Monitoring

Is the water use from this bore metered?

☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A - monitoring bore
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A - monitoring bore

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?
N/A - monitoring Bore

Describe the operational capacity, including seasonal variation
N/A - monitoring Bore

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.
N/A - monitoring Bore

Are there any historical water use records available for this bore?
☐ Yes → attach them to this form. ☒ No

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 16.47
	Current conditions relevant to the water level measurement Bore not purged at least 24hrs prior to assessment
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of bore casing	
Height of datum above ground level (m) 0.56	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A - monitoring bore sample not taken	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A -	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☐ No →	Provide details of the pumping history including when the bore was last used
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.2%	H_2S (ppm$_v$) 0	CH_4 (%LEL) 0%
☒ No →	Reason not measured N/A - monitoring bore		
Are historical water quality field records available for this bore?			
☒ Yes		☐ No	
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - monitoring bore		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method	
	Reason method chosen		
☒ No →	Reason not measured N/A - monitoring bore		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - monitoring bore		
Are historical water quality laboratory records available for this bore?			
☒ Yes → attach them to this form.		☐ No	

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for “sign-off” on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore’s condition for the baseline assessment.

Bore owner	
Surname Wooley	Given name(s) Dale
Phone 0499114085	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Winchester Downs 09

Report Date: 03/11/2020 16:19

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
141384	Sub-Artesian Facility	Existing	09/04/2008	Mackay	3980 - ISAAC REGIONAL

Details

Description			
Parish	5065 - WINCHESTER		
Original Name	MB2		
Driller Name	MCLEAN, WAYNE ROBERT		
Drill Company	IESA		
Const Method	ROTARY AIR - HAMMER		
Bore Line			
D/O File No	520/000/0072	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	28/04/2008	**Data Owner**	DNR
Roles	Sub-Artesian Monitoring		

Location

Latitude	22-09-22	**Basin**	1304
Longitude	148-12-02	**Sub-area**	
GIS Latitude	-22.15623272	**Lot**	8
GIS Longitude	148.2004713	**Plan**	SP271144
Easting	623784		
Northing	7549391	**Map Scale**	254 - 1: 250 000
Zone	55	**Map Series**	
Accuracy		**Map No**	SF55-11
GPS Accuracy		**Map Name**	CLERMONT
Checked	Yes	**Prog Section**	

Casing

6 ***records for RN*** **141384**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	09/04/2008	1	0.00	47.50	Polyvinyl Chloride	5.500	WT - Wall Thickness	60
A	09/04/2008	2	3.00	48.00	Centraliser			
A	09/04/2008	3	47.50	50.50	Screen	0.500	AP - Aperture Size	60
A	09/04/2008	4	22.00	51.00	Gravel Pack	7.000	GR - Gravel Size	164
A	09/04/2008	5	21.50	22.00	Bentonite Seal			164

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	09/04/2008	6	0.00	21.50	Grout			164

Strata Logs

7 *records for RN* 141384

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	"TOP SOIL/BLACK SOIL CLAY BROWN"
2	1.00	16.00	"SILTSTONE LAMINATED SHALE GREY SOME LENSES IRON STAINING"
3	16.00	31.00	"SHALE GREY/LT GREY HARD/SOFT BANDS"
4	31.00	43.40	"SHALE GREY/LIGHT GREY"
5	43.40	45.20	"CARBONACEOUS MATERIAL LAMINATED BLACK/GREY"
6	45.20	47.00	SHALE GREY
7	47.00	51.00	"SHALE GREY LAMINATED CARBONACEOUS MATERIAL"

Stratigraphies

0 *records for RN* 141384

Aquifers

1 *records for RN* 141384

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	42.20		SHLE - Shale	09/04/2008	-23.87	N		0.03	Y	PS	

Pump Tests Part 1

0 *records for RN* 141384

Pump Tests Part 2

0 *records for RN* 141384

Bore Conditions

0 *records for RN* 141384

Elevations

2 *records for RN* 141384

From Year:

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	09/04/2008	210.67	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	
X	09/04/2008	210.17	SVY	Surveyed	AHD - Aust. Height Datum	N	Natural Surface	

Water Analysis Part 1

0 ***records for RN*** **141384**

Water Analysis Part 2

0 ***records for RN*** **141384**

Water Levels

29 ***records for RN*** **141384**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality	
A	19/04/2008		-16.39	R	Reference Point		ACT	Actual	XX	MA	Manual/Hand	XX	130	Data is of unknown quality
A	11/06/2008		-16.38	R	Reference Point		ACT	Actual	XX	MA	Manual/Hand	XX	130	Data is of unknown quality
A	13/10/2011		-16.73	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	10/11/2011		-16.75	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	12/01/2012		-16.76	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	07/02/2012		-16.80	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	13/03/2012		-16.75	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	11/04/2012		-16.71	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	14/05/2012		-16.72	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	12/06/2012		-16.72	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	09/07/2012		-15.79	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	08/08/2012		-15.79	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	11/09/2012		-16.72	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	10/10/2012		-17.71	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	05/11/2012		-16.14	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	05/12/2012		-16.67	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality
A	08/01/2013		-16.14	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand		130	Data is of unknown quality

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	11/02/2013		-16.84	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	18/03/2013		-16.13	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/04/2013		-16.12	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/05/2013		-16.08	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	11/06/2013		-15.79	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/07/2013		-16.42	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	06/08/2013		-16.13	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	09/09/2013		-16.13	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	08/10/2013		-15.98	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	06/11/2013		-16.09	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	04/12/2013		-16.08	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality
A	07/01/2014		-16.07	R	Reference Point		ACT	Actual	NR	MA	Manual/Hand	130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **141384**

Field Measurements

27 ***records for RN*** **141384**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	09/04/2008		5040	8.1						PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	13/10/2011		4228	7.0						PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	12/01/2012		3252	7.3	28.0		1.15			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	07/02/2012		3780	7.1	27.3					PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	13/03/2012		3967	7.2	26.9					PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	11/04/2012		4245	8.0	26.5		0.09			PU	Pump - Other or	GB	Groundwater - from

Bore Report

From Year:

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
											Flowing Bore		Bore
A	14/05/2012		4197	7.5	26.2		0.63			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	12/06/2012		4275	7.2	26.2					PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	09/07/2012		4400	7.1	25.6		0.91			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/08/2012		4159	8.3	27.8		1.56			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	11/09/2012		4293	7.7	31.1		6.41			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	10/10/2012		4491	7.7	27.5		0.30			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	05/11/2012		4279	7.3	27.8		0.22			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	05/12/2012		4044	7.6	27.1		0.34			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/01/2013		4126	7.5	27.6		4.14			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	11/02/2013		3708	7.7	26.9		0.23			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	18/03/2013		4069	8.0	26.6		0.75			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/04/2013		4591	7.8	25.7		1.92			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/05/2013		4036	7.7	25.6		0.43			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	11/06/2013		4330	8.0	25.5		2.37			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/07/2013		4172	7.5	25.2		2.00			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	06/08/2013		4151	7.6	26.6		1.23			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	09/09/2013		4588	8.0	26.2		1.06			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/10/2013		4430	8.0	27.6		1.66			PU	Pump - Other or	GB	Groundwater - from

Bore Report

From Year:

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
											Flowing Bore		Bore
A	06/11/2013		4815	7.0	26.3		0.60			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	04/12/2013		4885	7.3	27.7		1.47			PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	07/01/2014		4423	7.9	26.1					PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore

Special Water Analysis

0 ***records for RN*** **141384**

Bore Report

From Year:

User Licence and Conditions

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ATTACHMENT D

POWNALL BORE BASELINE ASSESSMENT

POWNALL 01

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable)	ABN/ACN (if applicable)
Principal contact	
Surname Pownall	Given name(s) Vicki
Phone	Mobile 0417736485
Tenure type ☐ PL ☐ ATP ☐ MDL ☐ ML	Tenure number No tenure types applicable
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Pownall 01	
Bore registration number (RN)[4] 85499	Bore RN comments DNRME bore report location ~1km NE of GPS measured bore location. Information on bore report matches landholder anecdotal bore details.
Local bore name House Bore	
Property name	
Lot 3	Plan RP617628
Date of site assessment 26/11/2020	
Bore geographic location (GDA94)	
Latitude 22.18875	Longitude 148.02789
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☐ Sub-Artesian ☒ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☒ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☐ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) E Parrott	Date of bore construction (drilled date) 30/05/1992
Type of casing PVC	Casing diameter (mm) 170
Details of perforated intervals and/or screens that have been installed Open hole 12.2m to 53.6m.	
Details of any seals and cement grouting installed in the bore annulus Cement from 0 to ~12m	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Landholder says originally 3.15L/s. Bore report states measured supply on construction of 4.5 L/s	
Is the source aquifer of the bore known?	
☒ Yes →	Name of source aquifer Blenheim Formation
	Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty) Information based on DNRME bore report only - moderate confidence
☐ No →	Reasons source aquifer unknown
Is a strata log available for the bore?	
☒ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☐ No
Additional comments	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore	
☒ Operational	☐ Decommissioned
Is the bore equipped with a pump?	
☐ Yes	☒ No → go to Part D.
Pump type	Pump make and model
Pump setting depth (m) (depth from ground)	
Is the bore equipped with a meter?	
☐ Yes → description:	☒ No

Power source

☐ Electric motor ☐ Generator ☐ Direct drive engine ☒ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)

Concrete plinth with sealed bore plate. Steel T-piece from bore head to 1) poly T-piece and 2) steel ball valve.
1) Poly T-piece connected to steel ball valve and poly ball valve. Steel ball valve connected to 40mm flexihose that connects to petrol pump that pumps bore water to tank located at homestead. Poly ball valve connected to 90 degree poly elbow, connecting 40mm polypipe that runs to troughconncects to 40mm polypipe 40mm polypipe 40mm flexi hose fitted to petrol pump and to ball valve.
2) Steel ball valve Ball valve connected to poly ball valve connected to 60mm poly elbow. Elbow connected to steel ball valve connected to poly T-piece. Poly T-piece connected to 60mm polypipe (that runs to tank at homestead 500m south) and 40mm polypipe that runs to trough.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Bore capped in 2014/2015. Repair works included installing and cementing in PVC casing around original 127mm steel casing (casing believed to have rusted). Bore used to flow directly into stoage tank located next to homestead. Reduction in pressure has resulted in need to pump water once at surface to tank.

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)

☒ Stock ☒ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply

☐ Other → description:

Is the water use from this bore metered?	
☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) 10
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) General daily usage plus max head of cattle over 6month period.

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Bore utilisation
How often is the bore utilised (estimated hours pumped per day)? Daily - as required
Describe the operational capacity, including seasonal variation Peak use in summer for cattle
Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore. Peak usage to water 400hd of cattle
Are there any historical water use records available for this bore? ☐ Yes → attach them to this form. ☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☐ Yes →	Standing water level (m) (depth from ground)
	Current conditions relevant to the water level measurement
☒ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL) Artesian - pressure unknown
	Duration of pumping and rest periods Continuous
	Maximum pumping rate (L/s) Unknown
Datum point description (e.g. top of bore casing) N/A	
Height of datum above ground level (m) N/A	
Are water level and/or pressure records available for this bore? ☐ Yes → attach them to this form. ☐ No	

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) At bore head	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) Bore flowing continously in 24hrs prior to sampling	
Was the sample taken after full purging of the bore casing and discharge piping?	
☒ Yes	
☐ No →	Provide details of the pumping history including when the bore was last used
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up N/A

Field parameters			
Were water quality field measurements taken?			
☒ Yes →	**Physical parameters**		
	pH 7.23	Temperature (°C) 27.91	Electrical conductivity (µS/cm) 2122
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$)	H_2S (ppm$_v$)	CH_4 (%LEL)
☐ No →	Reason not measured		
Are historical water quality field records available for this bore?			
☒ Yes	☐ No		

Laboratory water quality		
Were water quality samples taken for submission to a laboratory?		
☒ Yes		
☐ No →	Reason not samples not taken	
Were dissolved gas samples taken for submission to a laboratory?		
☐ Yes →	Method ☐ Flow through	☐ Geosciences Australia method
	Reason method chosen	
☒ No →	Reason not measured Gas not identified as present by bore holder and not detected at significant levels in bore head	

Are the laboratory results for the samples indicated above supplied with this baseline assessment?	
☒ Yes	
☐ No →	Reason not supplied
Are historical water quality laboratory records available for this bore? ☒ Yes → attach them to this form.	☐ No

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Pownall	Given name(s) Vicki
Phone 0417736485	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner? ☐ Yes	☒ No
Other information provider	
Surname Hoare	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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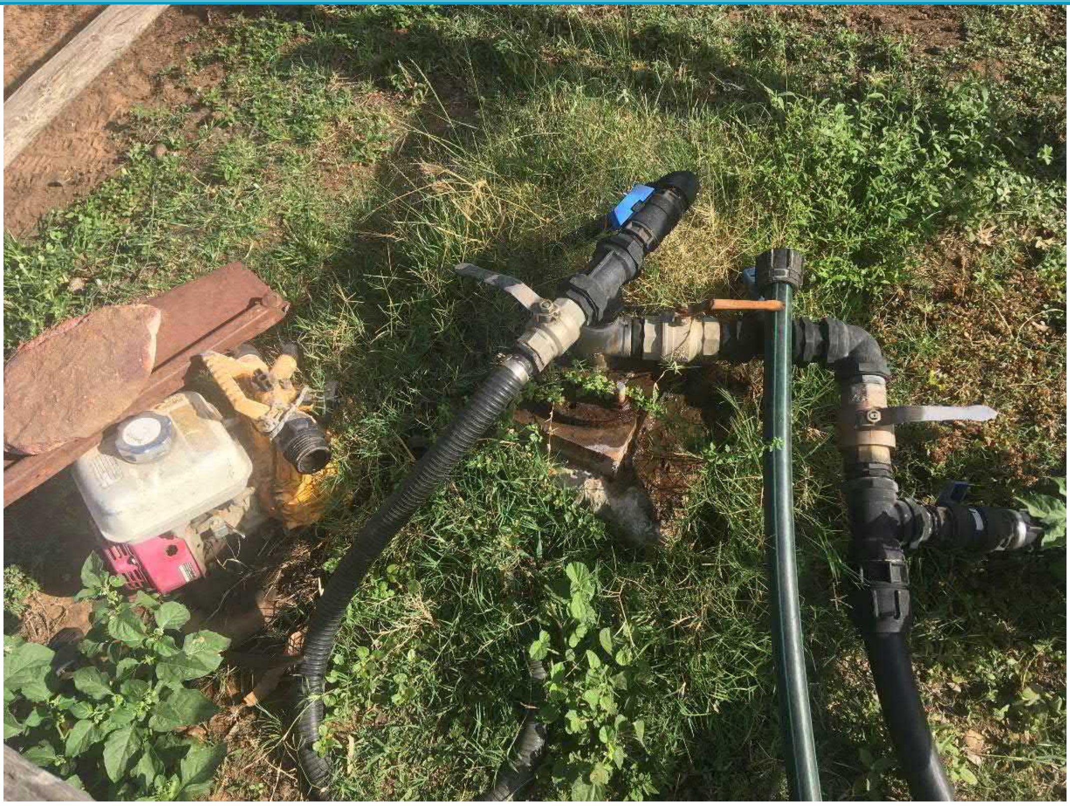
[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Pownall (Skyville) 01



Queensland Government

Groundwater Information

Report Date: 17/03/2021 22:11

GWDB8250

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
85499	Artesian - Controlled Flow	Existing	30/05/1992	Mackay	3980 - ISAAC REGIONAL

Details

Description	L3 RP617628		
Parish	2318 - HEYFORD		
Original Name	SHELLYS BORE		
Driller Name			
Drill Company			
Const Method	ROTARY RIG / E PARROTT		
Bore Line			
D/O File No	MA3029	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	22-10-48	**Basin**	1304
Longitude	148-01-54	**Sub-area**	
GIS Latitude	-22.180051	**Lot**	3
GIS Longitude	148.0316708	**Plan**	RP617628
Easting	606359		
Northing	7546888	**Map Scale**	
Zone	55	**Map Series**	
Accuracy	SKET	**Map No**	
GPS Accuracy		**Map Name**	
Checked	No	**Prog Section**	

Casing

2 *records for RN* **85499**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	30/05/1992	1	0.00	12.20	Steel Casing		WT - Wall Thickness	127
A	30/05/1992	2	12.20	53.60	Open Hole	6.250	AP - Aperture Size	

Strata Logs

6 *records for RN* **85499**

Rec	Top (m)	Bottom (m)	Strata Description

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	0.40	SAND
2	0.40	23.10	QUARTZ & SANDSTONE
3	23.10	32.90	SANDSTONE WITH MINOR CARB BANDS
4	32.90	47.20	SANDSTONE
5	47.20	53.60	CARB M/STONE WITH MINOR COAL BANDS
902			SUPPLY = 4.53LPS 9/6/92

Stratigraphies

1 ***records for RN*** **85499**

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1			BLENHEIM FORMATION

Aquifers

1 ***records for RN*** **85499**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	47.00	53.60	COAL - Coal MDST - Mudstone							SC	BLENHEIM FORMATION

Pump Tests Part 1

2 ***records for RN*** **85499**

Pipe	Date	Rec	RN of Pumped Bore	Top (m)	Bottom (m)	Dist (m)	Meth	Test Types	Pump Type	Suction Set (m)	Q Prior to Test (l/s)	Dur of Q PR (mins)	Pres on Arriv (m)	Q on Arriv (l/s/)
A	10/06/1992	1	85499	0.00	0.00	1.30	ART	ST FR					94.00	
A	08/10/1997	1	85499			1.30	ART	ST FR					80.00	

Pump Tests Part 2

2 ***records for RN*** **85499**

Pipe	Date	Rec	Test	SWL(m)	Recov	Resid	Max DD	Q at	Time to	Max Q	Calc	Design	Design	Suct.	Tmsy	Stor

			Dur (mins)		Time (mins)	DD (m)	or P RED (m)	Max DD (l/s)	Max DD (mins)	(l/s)	Stat HD (m)	Yield (l/s)	BP (m)	Set (m)	(m2/Day)
A	10/06/1992	1	1440	0.00				4.54	1020						
A	08/10/1997	1	240	86.00			80.00	3.85	120	8.20					

Bore Conditions

2 *records for RN* 85499

	Drain Details			*Headworks*									
Date	Tot Len (km)	Max Run (km)	Cond	Ret Len (km)	Cond	Ctrl	Leak	Flow Irreg	Precip	Est Use (ML/yr)	Num of Cattle	Num of Sheep	Comments
10/06/1992					Good	F		HCB					STOCK&DOMESTIC USE
08/10/1997				2.00	Fair	F		HCB	I		500		

Elevations

0 *records for RN* 85499

Water Analysis Part 1

2 *records for RN* 85499

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	09/06/1992	1	GCL	140229	51.00	PU	GB	1887	8.7	21	1208.00	1109.44	269	210	0.4	7.9	0.00
A	08/10/1997	1	GCL	187309	53.60	PU	GB	2220	7.1	18	1425.48	1320.03	325	199	0.4	8.2	0.00

Water Analysis Part 2

2 *records for RN* 85499

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	09/06/1992	1	296.3	17.7	52.5	33.5	0.01	235.0	0.01	10.0	323.5	0.11	1.2	238.1				
A	08/10/1997	1	338.8	17.5	66.1	39.0	0.02	241.9	0.00	0.3	408.7	0.13	0.0	313.1	0.00	0.01	0.30	0.02

Water Levels

0 *records for RN* 85499

From Year:

Wire Line Logs

0 ***records for RN*** **85499**

Field Measurements

2 ***records for RN*** **85499**

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	10/06/1992		1900	8.7	28.0					PU	Pump - Other or Flowing Bore	GB	Groundwater - from Bore
A	08/10/1997		1740		27.0					PU	Pump - Other or Flowing Bore		

Special Water Analysis

0 ***records for RN*** **85499**

From Year:

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7/12

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com
☑BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: ALSEnviro.Gladstone@alsglobal.com
☐MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740 Ph: 07 4952 5795 E: ALSEnviro.Mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 13 Carlton Street, Kirwan QLD 4812 ...
...ng NSW 2500

Environmental Division
Brisbane
Work Order Reference
EB2031461

Telephone : + 61-7-3243 7222

CLIENT: BHP
OFFICE: BRISBANE
PROJECT: HPC BAP PROJECT NO.:
ORDER NUMBER: PURCHASE ORDER NO.: 4510264491
PROJECT MANAGER: KATY STEELE CONTACT PH: 0448888893
SAMPLER: DUNCAN DAWSON /SLR SAMPLER MOBILE: 0419987617
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed): PM + ddawson@slrconsulting.com
Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☑ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.:
COUNTRY OF ORIGIN: AUSTRALIA
COC SEQUENCE NUMBER (Circle)
COC: [✓ 1] 2 3 4 5 6 7
OF: 1 [✓ 2] 3 4 5 6 7

RELINQUISHED BY: Duncan Dawson
DATE/TIME: 27/11/2020

RECEIVED BY: Martin
DATE/TIME: 27/11/2020 18:45

RELINQUISHED BY:
DATE/TIME:

FOR LABORATORY
Custody Seal Intact? No N/A
Free ice / frozen ice bric No N/A
Random Sample Tempe °C
Other comment:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).											Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	pH	EC	TDS	Major ions: Ca, K Cl, Na, F, SO4	Alkalinity – HCO3, CO3, hydroxide as	CaCO3	Total hardness as CaCO3	Total + Dissolved Al, As, Ba, Be, B, Pb, Mg, Ni, Se Mn, Hg, Mo, U, V Cd, Cr, Co, Fe, Zn				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	GD01	24/11/2020 10:20	W	1xP 2xAP	3	X	X	X	X	X	X	X	X	X	X	X	~~Can you please~~
2	QA01	24/11/2020			3												~~[illegible]~~
3	GD01	24/11/2020 16:40			3												
4	QA02	24/11/2020			3												PTO for More Samples
5	FB01	24/11/2020 11:50			3												
6	RB01	24/11/2020 11:59			3												
7	Pownall01	26/11/2020 07:33			3												
8	QA03	26/11/2020			3												
9	FB03	26/11/2020			3												
10	RB03	26/11/2020	↓	↓	3												
11	FB02	25/11/2020 18:50			3												
12	RB02	25/11/2020 18:57	↓	↓		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
16 Samples Total (PTO for continuation of COC)				TOTAL													

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CoC 2/2

SAMPLER Duncan Dawson

Relinquished 27/11/2020

					ANALYSIS						DISS + To
SAMPLE ID	DATE / TIME	MATRIX	TYPE + PRESERVATIVE	Bottles	PH	EC	TDS	MAJOR IONS	ALKALINITY	Total hardness as CaCO3	[illegible], Al, As, B B, Cd, Cr, Co, Fe, Ni, Se, [illegible], Zn
13 WD05	27/11/2020 10:50	W	1 x P 2 x AP	3	x	x	x	x	x	x	x
14 QA04	27/11/2020	W	↓	3	x	x	x	x	x	x	x
15 FB04	27/11/2020 13:00	↓		3	x	x	x	x	x	x	x
16 RB04	27/11/2020 13:00			3	x	x	x	x	x	x	x

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB2031461**
Amendment : **3**

Client : **BM ALLIANCE LTD**
Contact : MS KATY STEELE
Address : L11 480 QUEEN STREET
BRISBANE QLD 4000

E-mail : katy.steele@bhp.com
Telephone : ----
Facsimile : ----

Project : HPE BAP
Order number : 4510264491
C-O-C number : ----
Site : ----
Sampler : DUNCAN DAWSON / SLR

Laboratory : Environmental Division Brisbane
Contact : Nidhi Bhimani
Address : 2 Byth Street Stafford QLD Australia
4053

E-mail : nidhi.bhimani@alsglobal.com
Telephone : +61-7-3243 7222
Facsimile : +61-7-3243 7218

Page : 1 of 4
Quote number : EB2015BMALLI0386 (BN/448/15 V24)
QC Level : NEPM 2013 B3 & ALS QC Standard

Dates

Date Samples Received : 27-Nov-2020 18:45
Client Requested Due Date : 21-Dec-2020

Issue Date : 18-Dec-2020
Scheduled Reporting Date : **21-Dec-2020**

Delivery Details

Mode of Delivery : Client Drop Off
No. of coolers/boxes : 1
Receipt Detail : MED ESKY

Security Seal : Not Available
Temperature : 8.5°C - Ice present
No. of samples received / analysed : 16 / 16

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- ***SRN Reissued 18/12/2020: Please be advised that Total and Dissovled Copper have now been assigned for reporting. The COA has also been split, as per the email from Duncan Dawson 17/12/2020.***
- ***SRN Reissued 18/12/2020 (#2): As per the email from Duncan Dawson, the samples have been split again into separate COA reports.***
- **17.12.2020: SRN has been resent to acknowledge the change of quote from EN/222 to BN/448/15 v24 as requested by client. For any further information regarding these adjustments please contact client services at ALSEnviro.Brisbane@alsglobal.com.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	WATER - EA005P pH (PCT)	WATER - EA010P Electrical Conductivity (PCT)	WATER - EA015H Total Dissolved Solids - Standard Level	WATER - EG020F Dissolved Metals by ICP/MS	WATER - EG035F Dissolved Mercury	WATER - EG035T Total Mercury	WATER - NT-01D & 02A Major Cations & Anions (Ca, Mg, Na, K, Cl, SO4,
EB2031461-001	24-Nov-2020 10:20	CD01	✓	✓	✓	✓	✓	✓	✓
EB2031461-002	24-Nov-2020 00:00	QA01	✓	✓	✓	✓	✓	✓	✓
EB2031461-003	24-Nov-2020 16:40	GD01	✓	✓	✓	✓	✓	✓	✓
EB2031461-004	24-Nov-2020 00:00	QA02	✓	✓	✓	✓	✓	✓	✓
EB2031461-005	24-Nov-2020 11:50	FB01	✓	✓	✓	✓	✓	✓	✓
EB2031461-006	24-Nov-2020 11:59	RB01	✓	✓	✓	✓	✓	✓	✓
EB2031461-007	26-Nov-2020 07:33	Pownall 01	✓	✓	✓	✓	✓	✓	✓
EB2031461-008	26-Nov-2020 00:00	QA03	✓	✓	✓	✓	✓	✓	✓
EB2031461-009	26-Nov-2020 00:00	FB03	✓	✓	✓	✓	✓	✓	✓
EB2031461-010	26-Nov-2020 00:00	RB03	✓	✓	✓	✓	✓	✓	✓
EB2031461-011	25-Nov-2020 18:50	FB02	✓	✓	✓	✓	✓	✓	✓
EB2031461-012	25-Nov-2020 18:57	RB02	✓	✓	✓	✓	✓	✓	✓
EB2031461-013	27-Nov-2020 10:50	WD05	✓	✓	✓	✓	✓	✓	✓
EB2031461-014	27-Nov-2020 00:00	QA04	✓	✓	✓	✓	✓	✓	✓
EB2031461-015	27-Nov-2020 13:00	FB04	✓	✓	✓	✓	✓	✓	✓
EB2031461-016	27-Nov-2020 13:00	RB04	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	WATER - EG020T Total Metals by ICP/MS (including digestion)
EB2031461-001	24-Nov-2020 10:20	CD01	✓
EB2031461-002	24-Nov-2020 00:00	QA01	✓
EB2031461-003	24-Nov-2020 16:40	GD01	✓
EB2031461-004	24-Nov-2020 00:00	QA02	✓
EB2031461-005	24-Nov-2020 11:50	FB01	✓
EB2031461-006	24-Nov-2020 11:59	RB01	✓
EB2031461-007	26-Nov-2020 07:33	Pownall 01	✓
EB2031461-008	26-Nov-2020 00:00	QA03	✓

			WATER - EG020T Total Metals by ICP/MS (including digestion)
EB2031461-009	26-Nov-2020 00:00	FB03	✓
EB2031461-010	26-Nov-2020 00:00	RB03	✓
EB2031461-011	25-Nov-2020 18:50	FB02	✓
EB2031461-012	25-Nov-2020 18:57	RB02	✓
EB2031461-013	27-Nov-2020 10:50	WD05	✓
EB2031461-014	27-Nov-2020 00:00	QA04	✓
EB2031461-015	27-Nov-2020 13:00	FB04	✓
EB2031461-016	27-Nov-2020 13:00	RB04	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method **Client Sample ID(s)**	**Container**	**Due for extraction**	**Due for analysis**	**Samples Received**		**Instructions Received**	
				Date	**Evaluation**	**Date**	**Evaluation**
EA005-P: pH by PC Titrator							
CD01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
FB01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
FB02	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
FB03	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
GD01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
Pownall 01	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
QA01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
QA02	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
QA03	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
RB01	Clear Plastic Bottle - Natural	----	24-Nov-2020	27-Nov-2020	✘	----	----
RB02	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----
RB03	Clear Plastic Bottle - Natural	----	26-Nov-2020	27-Nov-2020	✘	----	----

Requested Deliverables

ACCOUNTS PAYABLE (ALS)

- A4 - AU Tax Invoice (INV)	Email	envirocosting.brisbane@alsglobal.com

BMA ENVIROSYS_DATA

- EDI Format - BMA (BMA)	Email	BMA_Envirosys_Data@bhpbilliton.com

BMA SUPPORT

- EDI Format - BMA (BMA)	Email	bma_support@sra.com.au

Cindy Meyers

- Chain of Custody (CoC) (COC)	Email	cindy.myers@bhp.com
- EDI Format - BMA (BMA)	Email	cindy.myers@bhp.com

KATY STEELE

- *AU Certificate of Analysis - NATA (COA)	Email	katy.steele@bhp.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	katy.steele@bhp.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	katy.steele@bhp.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	katy.steele@bhp.com
- Chain of Custody (CoC) (COC)	Email	katy.steele@bhp.com
- EDI Format - BMA (BMA)	Email	katy.steele@bhp.com
- EDI Format - ESDAT (ESDAT)	Email	katy.steele@bhp.com
- EDI Format - XTab (XTAB)	Email	katy.steele@bhp.com

RESULTS BWM ENVIRONMENT

- *AU Certificate of Analysis - NATA (COA)	Email	bwmenvironment@bhpbilliton.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	bwmenvironment@bhpbilliton.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	bwmenvironment@bhpbilliton.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	bwmenvironment@bhpbilliton.com
- Chain of Custody (CoC) (COC)	Email	bwmenvironment@bhpbilliton.com
- EDI Format - BMA (BMA)	Email	bwmenvironment@bhpbilliton.com
- EDI Format - ESDAT (ESDAT)	Email	bwmenvironment@bhpbilliton.com
- EDI Format - XTab (XTAB)	Email	bwmenvironment@bhpbilliton.com

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **EB2031461-AH**
Amendment : **3**
Client : **BM ALLIANCE LTD**
Contact : MS KATY STEELE
Address : L11 480 QUEEN STREET
BRISBANE QLD 4000
Telephone : ----
Project : HPE BAP
Order number : 4510264491
C-O-C number : ----
Sampler : DUNCAN DAWSON / SLR
Site : ----
Quote number : BN/448/15 V24
No. of samples received : 4
No. of samples analysed : 4

Page : 1 of 5
Laboratory : Environmental Division Brisbane
Contact : Nidhi Bhimani
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 27-Nov-2020 18:45
Date Analysis Commenced : 30-Nov-2020
Issue Date : 18-Dec-2020 11:10

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Amendment (18/12/2020): This report has been amended and re-released to allow the reporting of additional analytical data. Total and Dissolved Copper results are now included.
- Amendment (17.12.2020): This report has been amended as a result of the change of quote from EN/222 to BN/448/15 v24 as requested by client. All analysis results are as per the previous report
- Amendment (18/12/2020): This report has been amended as a result of a request to split samples #1-2, #3-6, #7-10, #11-12 and #13-16 into separate COA reports. All analysis results are as per the previous report
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**Pownall 01**	**QA03**	**FB03**	**RB03**	**----**
			Sampling date / time	26-Nov-2020 07:33	26-Nov-2020 00:00	26-Nov-2020 00:00	26-Nov-2020 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031461-007**	**EB2031461-008**	**EB2031461-009**	**EB2031461-010**	**--------**
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**6.91**	**6.88**	**6.17**	**5.72**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2110**	**2100**	<1	<1	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**1240**	**1300**	<10	<10	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**213**	**212**	<1	<1	----
Total Alkalinity as CaCO3	----	1	mg/L	**213**	**212**	<1	<1	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**287**	**287**	<1	<1	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**434**	**433**	<1	<1	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**64**	**66**	<1	<1	----
Magnesium	7439-95-4	1	mg/L	**40**	**40**	<1	<1	----
Sodium	7440-23-5	1	mg/L	**346**	**354**	<1	<1	----
Potassium	7440-09-7	1	mg/L	**16**	**16**	<1	<1	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**324**	**330**	<1	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Barium	7440-39-3	0.001	mg/L	**0.034**	**0.034**	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.016**	**0.017**	<0.001	<0.001	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**Pownall 01**	**QA03**	**FB03**	**RB03**	**----**
			Sampling date / time	26-Nov-2020 07:33	26-Nov-2020 00:00	26-Nov-2020 00:00	26-Nov-2020 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031461-007**	**EB2031461-008**	**EB2031461-009**	**EB2031461-010**	**--------**
				Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Boron	7440-42-8	0.05	mg/L	**0.36**	**0.37**	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	**2.26**	**2.33**	<0.05	<0.05	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Barium	7440-39-3	0.001	mg/L	**0.035**	**0.034**	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	**0.004**	**0.004**	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	**0.018**	**0.018**	<0.001	<0.001	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Boron	7440-42-8	0.05	mg/L	**0.41**	**0.42**	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	**2.54**	**2.44**	<0.05	<0.05	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.1**	**0.1**	<0.1	<0.1	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**22.5**	**22.4**	<0.01	<0.01	----
ø **Total Cations**	----	0.01	meq/L	**21.9**	**22.4**	<0.01	<0.01	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Sample ID	**Pownall 01**	**QA03**	**FB03**	**RB03**	**----**
			Sampling date / time	26-Nov-2020 07:33	26-Nov-2020 00:00	26-Nov-2020 00:00	26-Nov-2020 00:00	----
Compound	CAS Number	LOR	Unit	**EB2031461-007**	**EB2031461-008**	**EB2031461-009**	**EB2031461-010**	**--------**
				Result	Result	Result	Result	----
EN055: Ionic Balance - Continued								
ø **Ionic Balance**	----	0.01	%	**1.19**	**0.07**	**----**	**----**	**----**

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB2031461-AH**	Page	: 1 of 9
Amendment	: **3**		
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KATY STEELE	Contact	: Nidhi Bhimani
Address	: L11 480 QUEEN STREET BRISBANE QLD 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: HPE BAP	Date Samples Received	: 27-Nov-2020
Order number	: 4510264491	Date Analysis Commenced	: 30-Nov-2020
C-O-C number	: ----	Issue Date	: 18-Dec-2020
Sampler	: DUNCAN DAWSON / SLR		
Site	: ----		
Quote number	: BN/448/15 V24		
No. of samples received	: 4		
No. of samples analysed	: 4		

ilac-MRA NATA

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
\# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 3394837)									
EB2031425-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.99	7.02	0.428	0% - 20%
EB2031461-005	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	5.67	5.64	0.530	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 3394838)									
EB2031425-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	4030	4030	0.00	0% - 20%
EB2031461-005	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1	0.00	No Limit
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 3391123)									
EB2031461-003	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1400	1430	2.12	0% - 20%
EB2031461-012	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	<10	0.00	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 3394840)									
EB2031425-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	481	476	1.09	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	481	476	1.09	0% - 20%
EB2031461-005	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	1	<1	0.00	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3392563)									
EB2031418-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	9	8	0.00	No Limit
EB2031461-008	QA03	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	287	298	3.76	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3392564)									
EB2031418-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	29	29	0.00	0% - 20%
EB2031461-008	QA03	ED045G: Chloride	16887-00-6	1	mg/L	433	437	0.872	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 3390964)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED093F: Dissolved Major Cations (QC Lot: 3390964) - continued									
EB2031461-003	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	103	106	2.98	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	153	154	0.00	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	214	217	1.47	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.00	No Limit
EB2031461-013	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	214	238	10.6	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	187	212	12.9	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	658	720	9.02	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	7	7	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390965)									
EB2031461-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.067	0.067	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.163	0.164	0.00	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.01	0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.22	0.23	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.10	0.10	0.00	No Limit
EB2031461-013	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.269	0.308	13.7	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.115	0.132	13.8	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390965) - continued									
EB2031461-013	Anonymous	EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.32	0.34	5.42	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	1.06	1.22	14.1	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3390966)									
EB2031461-003	Anonymous	EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.002	0.002	0.00	No Limit
EB2031461-013	Anonymous	EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3391102)									
EB2031461-001	Anonymous	EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EB2031461-010	RB03	EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3391103)									
EB2031461-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.801	0.804	0.339	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.012	0.011	0.00	0% - 50%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.054	0.052	2.45	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.006	0.006	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.04	0.02	61.3	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.39	0.42	7.40	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.06	0.06	0.00	No Limit
EB2031461-010	RB03	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 3391103) - continued									
EB2031461-010	RB03	EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 3390967)									
EB2031461-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2031461-013	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3391105)									
EB2031336-023	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB2031461-006	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3394839)									
EB2031425-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EB2031461-005	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 3394837)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.0	102
				----	7 pH Unit	100	98.0	102
EA010P: Conductivity by PC Titrator (QCLot: 3394838)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	220 µS/cm	102	91.0	107
				<1	12890 µS/cm	99.4	91.0	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 3391123)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2460 mg/L	105	88.0	112
				<10	293 mg/L	105	88.0	112
				<10	2000 mg/L	100	80.9	118
ED037P: Alkalinity by PC Titrator (QCLot: 3394840)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	103	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3392563)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	101	85.0	118
				<1	100 mg/L	98.4	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 3392564)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.9	90.0	115
				<1	1000 mg/L	104	90.0	115
ED093F: Dissolved Major Cations (QCLot: 3390964)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	106	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	108	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	105	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	96.5	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	93.3	79.0	118
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	96.2	88.0	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	91.2	81.0	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	94.6	70.0	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	90.7	88.0	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	93.0	87.0	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	93.4	86.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	90.8	88.0	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.9	89.0	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	93.3	89.0	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	99.8	89.0	112

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965) - continued								
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	92.3	89.0	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.1	83.0	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	97.7	88.0	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	93.0	87.0	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	101	81.0	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	96.4	82.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390966)								
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	93.7	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391102)								
EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	0.1 mg/L	107	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391103)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	98.3	80.0	114
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	111	88.0	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	95.4	81.0	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	102	70.0	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	101	88.0	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	101	89.0	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	105	89.0	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	109	88.0	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	104	89.0	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	104	88.0	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	111	90.0	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	108	88.0	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	106	79.0	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	114	87.0	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	103	84.0	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	105	82.0	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	113	82.0	118
EG035F: Dissolved Mercury by FIMS (QCLot: 3390967)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	101	84.0	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391105)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	100	84.0	118
EK040P: Fluoride by PC Titrator (QCLot: 3394839)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	94.0	80.0	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3392563)							
EB2031418-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	85.3	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3392564)							
EB2031418-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	114	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3390965)							
EB2031461-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	98.2	70.0	130
		EG020A-F: Beryllium	7440-41-7	1 mg/L	89.7	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	93.5	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	92.5	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	92.0	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	90.3	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	88.0	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	94.0	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	93.9	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	90.4	70.0	130
		EG020A-F: Vanadium	7440-62-2	1 mg/L	96.0	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	93.3	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3391103)							
EB2031461-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	112	70.0	130
		EG020A-T: Beryllium	7440-41-7	1 mg/L	110	70.0	130
		EG020A-T: Barium	7440-39-3	1 mg/L	101	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	104	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	107	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	109	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	106	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	109	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	114	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	106	70.0	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	124	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	102	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 3390967)							
EB2031461-004	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	94.0	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3391105)							
EB2031336-024	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	93.1	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 3394839)							
EB2031425-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	80.4	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2031461**	Page	: 1 of 11
Amendment	: **3**		
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KATY STEELE	Telephone	: +61-7-3243 7222
Project	: HPE BAP	Date Samples Received	: 27-Nov-2020
Site	: ----	Issue Date	: 18-Dec-2020
Sampler	: DUNCAN DAWSON / SLR	No. of samples received	: 16
Order number	: 4510264491	No. of samples analysed	: 16

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)	*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
CD01, QA01, GD01, QA02, FB01, RB01	----	----	----	01-Dec-2020	24-Nov-2020	**7**
Clear Plastic Bottle - Natural						
FB02, RB02	----	----	----	01-Dec-2020	26-Nov-2020	**5**
Clear Plastic Bottle - Natural						
Pownall 01, QA03, FB03, RB03	----	----	----	01-Dec-2020	26-Nov-2020	**5**
Clear Plastic Bottle - Natural						
WD05, QA04, FB04, RB04	----	----	----	01-Dec-2020	27-Nov-2020	**4**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Total Mercury by FIMS	1	21	4.76	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method ***Container** / Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation* ***Date extracted***	 *Due for extraction*	 *Evaluation*	*Analysis* ***Date analysed***	 *Due for analysis*	 *Evaluation*
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P) CD01, GD01, FB01, QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Nov-2020	✗
Clear Plastic Bottle - Natural (EA005-P) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	26-Nov-2020	✗
Clear Plastic Bottle - Natural (EA005-P) Pownall 01, FB03, QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	26-Nov-2020	✗
Clear Plastic Bottle - Natural (EA005-P) WD05, FB04, QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	27-Nov-2020	✗
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) CD01, GD01, FB01, QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) Pownall 01, FB03, QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (EA010-P) WD05, FB04, QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H) CD01, GD01, FB01, QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	01-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	02-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) Pownall 01, FB03, QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	03-Dec-2020	✓
Clear Plastic Bottle - Natural (EA015H) WD05, FB04, QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	04-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container** / Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	----	----	----	**01-Dec-2020**	08-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) FB02, RB02	**25-Nov-2020**	----	----	----	**01-Dec-2020**	09-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	----	----	----	**01-Dec-2020**	10-Dec-2020	✓
Clear Plastic Bottle - Natural (ED037-P) WD05, QA04, FB04, RB04	**27-Nov-2020**	----	----	----	**01-Dec-2020**	11-Dec-2020	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	----	----	----	**30-Nov-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) FB02, RB02	**25-Nov-2020**	----	----	----	**30-Nov-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	----	----	----	**30-Nov-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (ED041G) WD05, QA04, FB04, RB04	**27-Nov-2020**	----	----	----	**30-Nov-2020**	25-Dec-2020	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	----	----	----	**30-Nov-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) FB02, RB02	**25-Nov-2020**	----	----	----	**30-Nov-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	----	----	----	**30-Nov-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (ED045G) WD05, QA04, FB04, RB04	**27-Nov-2020**	----	----	----	**30-Nov-2020**	25-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	***Sample Date***	*Extraction / Preparation*			*Analysis*		
***Container** / Client Sample ID(s)*		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-May-2021	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	26-May-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method ***Container*** */ Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**01-Dec-2020**	23-May-2021	✓	**01-Dec-2020**	23-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) FB02, RB02	**25-Nov-2020**	**01-Dec-2020**	24-May-2021	✓	**01-Dec-2020**	24-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**01-Dec-2020**	25-May-2021	✓	**01-Dec-2020**	25-May-2021	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) WD05, QA04, FB04, RB04	**27-Nov-2020**	**01-Dec-2020**	26-May-2021	✓	**01-Dec-2020**	26-May-2021	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**03-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) FB02, RB02	**25-Nov-2020**	**----**	----	----	**03-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**03-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**03-Dec-2020**	25-Dec-2020	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) CD01, QA01, GD01, QA02, FB01, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) FB02, RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) Pownall 01, QA03, FB03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) WD05, QA04, FB04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
CD01, GD01, FB01,	QA01, QA02, RB01	**24-Nov-2020**	**----**	----	----	**01-Dec-2020**	22-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
FB02,	RB02	**25-Nov-2020**	**----**	----	----	**01-Dec-2020**	23-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
Pownall 01, FB03,	QA03, RB03	**26-Nov-2020**	**----**	----	----	**01-Dec-2020**	24-Dec-2020	✓
Clear Plastic Bottle - Natural (EK040P)								
WD05, FB04,	QA04, RB04	**27-Nov-2020**	**----**	----	----	**01-Dec-2020**	25-Dec-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	4	34	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	3	21	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	6	33	**18.18**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	21	**4.76**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the libṙated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

ATTACHMENT E

BIELBY BORE BASELINE ASSESSMENT

BIELBY 01

Appendix 1—Bore baseline assessment information

This **mandatory** supporting information must be provided for each relevant bore (use as many copies of this Appendix as you need). The information must be provided in accordance with the *baseline assessments guideline* ESR/2016/1999[3]

Part A: Document identification and bore site information

Resource tenure holder	
Surname	Given name(s)
Company name (if applicable)	ABN/ACN (if applicable)
Principal contact	
Surname Bielby	Given name(s) Richard J
Phone	Mobile 0498795879
Tenure type ☐ PL ☐ ATP ☐ MDL ☐ ML	Tenure number No tenture types applicable
Bore information	
Unique ID (assign a unique ID to the bore, not the same as the bore RN number) Bielby 01	
Bore registration number (RN)[4]	Bore RN comments No registered bores in vicinity of assessement location
Local bore name Camp Bore	
Property name Unknown	
Lot 9	Plan RP853653
Date of site assessment 27/11/2020	
Bore geographic location (GDA94)	
Latitude 22.04920	Longitude 148.00368
Location method ☒ GPS ☐ GPS – Differential ☐ Surveyed	
Facility type ☒ Sub-Artesian ☐ Artesian – controlled flow ☐ Artesian – uncontrolled flow ☐ Artesian – ceased to flow	
Additional comments None	

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[3] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

[4] This information can be obtained from the Department of Natural Resources, Mines and Energy groundwater database available at www.dnrme.qld.gov.au using "groundwater database" as a search term.

Part B: Bore construction details

Are construction details available?	
☐ Yes → verify details (where possible) and supply in the format provided in OGIA's Bore Baseline Assessment Database—Data File Format Document[5]. If available, a copy of the original log should also be provided.	☒ No → complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank).
Drilling contractor (driller name and company name) Unknown	Date of bore construction (drilled date) ~1950s
Type of casing PVC	Casing diameter (mm) 140
Details of perforated intervals and/or screens that have been installed Unknown	
Details of any seals and cement grouting installed in the bore annulus Unknown	
Details of water bore's capacity (estimate the rate at which water may be produced from the bore) (L/s) Unknown	
Is the source aquifer of the bore known?	
☐ Yes →	Name of source aquifer Details of confidence level of the source aquifer (i.e. if there is uncertainty in the source aquifer, provide the reasons for the uncertainty)
☒ No →	Reasons source aquifer unknown No strata log available.
Is a strata log available for the bore?	
☐ Yes → supply in the format outlined in OGIA's Bore Baseline Assessment Database—Data File Format Document[4]. If available, a copy of the original log should also be provided.	☒ No
Additional comments Old Exploration Hole converted into bore	

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[5] This document is available on the Department of Natural Resources, Mines and Energy website at www.dnrme.qld.gov.au , using "bore baseline assessment database" as a search term.

Part C: Bore equipment and condition details

Attach photos of the bore and equipment which captures the condition of the bore at the time of the baseline assessment—these photos must detail each site individually and include a shot of the headworks.

Condition of bore

☒ Operational ☐ Decommissioned

Is the bore equipped with a pump?

☐ Yes ☒ No → go to Part D.

Pump type	Pump make and model
2" Electro-submersible	Unknown

Pump setting depth (m) (depth from ground)

~25m

Is the bore equipped with a meter?

☐ Yes → description: ☒ No

Power source

☒ Electric motor ☐ Generator ☐ Direct drive engine ☐ Mains supply ☐ Tractor ☐ Windmill

Headworks description—provide details on the size and type of riser pipe e.g. material, diameter, joint type, details of any connection to a reticulated system (e.g. pipe sizes, distances, schematic diagram, headworks size, valves, flow meter)

0.285m PVC stick up encased in concrete with steel bore plate. 90 degree 50mm steel elbow from bore plate to 50mm poly pipe with pressure gauge. Pressure gauge attached to steel gate valve. Gate valve attached to 45mm poly pipe that runs to trough.

Repairs/maintenance history—provide any commentary on repairs/maintenance undertaken on the bore e.g. nature and date of work, who has undertaken the maintenance

Bore not used for 7 years.

Part D: Bore supply information

Authorised use/purpose of the bore (must be identified in consultation with the bore owner)

☒ Stock ☒ Domestic supply ☐ Intensive livestock ☐ Irrigation ☐ Town water supply

☒ Other → description: Bore used to be used for camp water.

Is the water use from this bore metered?

☐ Yes →	Average volume used yearly (ML/year) (in the last five years and attach records (if available))
☒ No →	Estimated volume used yearly (ML/year) N/A - bore not in use
	Estimated volume method description (e.g. no. of hours the bore is pumped, storage of ring tank, no. of properties supplied, area irrigated, using standard usage rates supplied in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) N/A - bore not in use

Bore utilisation

How often is the bore utilised (estimated hours pumped per day)?

N/A - bore not in use

Describe the operational capacity, including seasonal variation

N/A - bore not in use

Peak usage—including maximum volumes extracted and period of peak extraction (where no volumetric usage information is available, use the figures provided in Appendix 1 of the *baseline assessments guideline* (ESR/2016/1999[6]) to estimate volumes supplied by the bore.

N/A - bore not in use

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[6] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Are there any historical water use records available for this bore?	
☐ Yes → attach them to this form.	☒ No

Part E: Water level measurement

Attach a photo of the bore clearly showing the following and attach it to this notice:

a. A datum for standing water level (SWL);
b. The unique identification number of the bore and the groundwater database registered number (if available);
c. The bore owner's name;
d. Property name; and
e. The date of the photograph.

Can the standing water level be recorded?	
☒ Yes →	Standing water level (m) (depth from ground) 17.72
	Current conditions relevant to the water level measurement Bore not pumped for 7yrs.
☐ No →	Reason not measured (i.e. significant modifications—e.g. pulling windmills or removing pumps—or damage to the bore would be required in order to measure the SWL)
	Duration of pumping and rest periods
	Maximum pumping rate (L/s)
Datum point description (e.g. top of bore casing) Top of Bore Casing	
Height of datum above ground level (m) 0.285	
Are water level and/or pressure records available for this bore?	
☐ Yes → attach them to this form.	☐ No

Part F: Water quality assessment

All samples are to be analysed at National Association of Testing (NATA) accredited laboratories.

Obtaining water quality samples	
Location of sampling point (where the location is not within 15m of the bore, **attach photo** and provide location referenced to GDA94) N/A - no sample taken as no power source available for pump	
Volume of stagnant water within the bore casing and discharge piping (upstream of the sampling point) N/A -	
Was the sample taken after full purging of the bore casing and discharge piping?	
☐ Yes	
☒ No →	Provide details of the pumping history including when the bore was last used N/A - no power source available for pump
Is pumping equipment in place at the bore?	
☐ Yes	
☒ No →	**Attach photo** showing the bore and sampling set up

Field parameters			
Were water quality field measurements taken?			
☐ Yes →	**Physical parameters**		
	pH	Temperature (°C)	Electrical conductivity (µS/cm)
	Alkalinity and hardness (mg/L)		
	Alkalinity - HCO_3^- as $CaCO_3$	Alkalinity - CO_3^{2-} as $CaCO_3$	Hydroxide OH^- as $CaCO_3$
	Total hardness as $CaCO_3$		
	Field gas measurements (multi-parameter gas detector)		
	CO_2 (ppm$_v$) 0.4%	H_2S (ppm$_v$) 0	CH_4 (%LEL) 0.3%
☒ No →	Reason not measured N/A - no aample taken as no power source available for pump		
Are historical water quality field records available for this bore? ☐ Yes ☒ No			
Laboratory water quality			
Were water quality samples taken for submission to a laboratory?			
☐ Yes			
☒ No →	Reason not samples not taken N/A - no sample taken as no power source available for pump		
Were dissolved gas samples taken for submission to a laboratory?			
☐ Yes →	Method ☐ Flow through ☐ Geosciences Australia method		
	Reason method chosen		
☒ No →	Reason not measured N/A		
Are the laboratory results for the samples indicated above supplied with this baseline assessment?			
☐ Yes			
☒ No →	Reason not supplied N/A - no sample taken as no power source available for pump		
Are historical water quality laboratory records available for this bore? ☐ Yes → attach them to this form. ☒ No			

Part G: Assessment field officer details

Provide the contact details of the assessment officer responsible for conducting the baseline assessment.

Surname Dawson	Given name(s) Duncan
Company SLR Consulting	
Phone	Alternative phone
Fax	Email

Part H: Declaration

Resource tenure holder declaration Provide the contact details for the officer accountable for "sign-off" on the data collected during baseline assessment.	
Surname	Given name(s)
Position title (if applicable)	Date
Third party certification Provide contact details of the person providing third party certification that the baseline assessment has been undertaken in line with appropriate quality control procedures, in compliance with the *baseline assessments guideline* (ESR/2016/1999[7]).	
Surname Lyons	Given name(s) Derwin
Company SLR Consulting	
Phone	Alternative phone
Email	Date certified 01/12/2020

Part I: Property owner/manager details

Provide the contact details of the bore owner, and any person who has provided information to the resource tenure holder about the bore's condition for the baseline assessment.

Bore owner	
Surname Bielby	Given name(s) Richard J
Phone 0498795879	Alternative phone
Fax	Email
UHF Channel Number	
Has a copy of the information collected for the baseline assessment been retained by the bore owner?	
☐ Yes	☒ No
Other information provider	
Surname	Given name(s)
Phone	Alternative phone
Fax	Email
Detail information provided by the above person about the condition of the bore	

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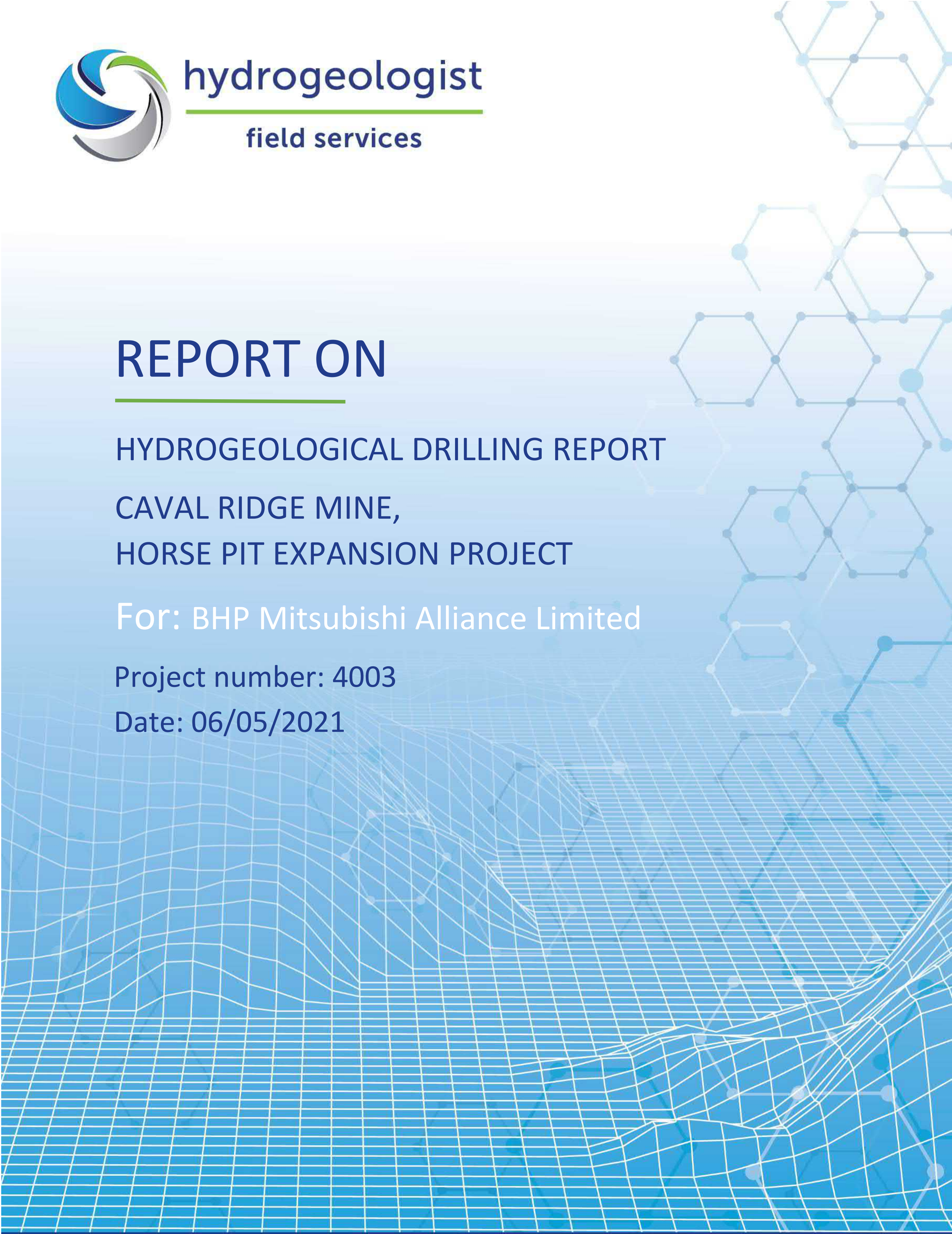
[7] This is the publication number. This document is available on the Queensland Government website at www.qld.gov.au, using the publication number as a search term.

Bielby 01

Appendix A4 – Groundwater Monitoring Bore Drilling Reports



hydrogeologist
field services

REPORT ON

HYDROGEOLOGICAL DRILLING REPORT

CAVAL RIDGE MINE,
HORSE PIT EXPANSION PROJECT

For: BHP Mitsubishi Alliance Limited

Project number: 4003

Date: 06/05/2021

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Appendix A	Bore logs
Appendix B	Downhole geophysics
Appendix C	Bore development records
Appendix D	Laboratory (ALS) Certificate of Analysis

Hydrogeological Drilling Report
Caval Ridge Mine, Horse Pit Expansion Project

Prepared for

BHP Mitsubishi Alliance Limited

1. Introduction

This report describes the hydrogeological drilling program for the Caval Ridge Mine (CVM) Horse Pit Expansion Project, (the Project). The program was conducted for BHP Mitsubishi Alliance Limited (BMA) to provide a monitoring network to assist with future approval requirements for the Project. Hydrogeologist Field Services Pty Ltd (HydroFS) were contracted to supervise the drilling and development of the groundwater monitoring bores and vibrating wire piezometers (VWP) installed as part of this program, and provide a factual field report (this report). The field program commenced on the 5th November 2020 and was completed on the 16th December 2020.

2. Geological setting

The current understanding of the hydrogeological setting of the project site is derived primarily from the Environmental Impact Statement investigations into the CVM which was conducted by URS in 2009. From the surface, the stratigraphic sequence consists of:

- a veneer of unconsolidated Quaternary sediments;
- Tertiary sediments, consisting of lenses of paleochannel gravels and sands separated by sandy silts, sandy clays and clays;
- fresh to highly weathered Tertiary basalt up to 35 m thick; and
- a Late Permian unit (Moranbah Coal Measures) comprising mudstone, siltstone, sandstone and coal.

3. Monitoring bore drilling and construction

Easternwell Pty Ltd conducted the drilling. Four (4) monitoring bores, two (2) production bores and three (3) VWP arrays were installed under the supervision of licensed drillers Conrad Brown (Lic. No. 3495) and Denny Bull (Lic. No. 3445). Table 3.1 and Table 3.2 below summarise the bore and VWP construction details respectively, while Figure 3.1 indicates the bore locations. The bore logs are attached in Appendix A.

Deviations from the original scope of work:

- CVMMB16-01 – The initial drilling target was the Quaternary alluvial sediments; however, none were found on site. It was decided to target the Tertiary sediments, as data from this bore could provide evidence of the seasonal variation and provide details of the extent of the aquifer.
- MB20CVM03P – the original target depth for the bore was 275 m, however BHP provided a new target depth for the P seam at approximately 110 m.
- CVMVWP01_01 – VWP sensor 4 in the alluvial sediments was not installed. The Class 2 driller (Conrad Brown) was concerned that drilling holes in the surface casing would compromise the integrity of

bore construction. As an alternative the sensor was installed in the nearby Tertiary monitoring bore MB20BWM01A.

- CVMVWP07_01 – VWP sensor 1 in the Q seam was not installed. The Class 2 driller (Conrad Brown) was concerned that drilling holes in the surface casing would compromise the integrity of bore construction.

Table 3.1 Caval Ridge bore construction details

Bore ID	Drilling and installation date	Easting	Northing	Ground level (mAHD)*	Drilled depth (mbGL)	Stick-up height (maGL)	Casing depth (mbTOC)	Screen interval (mbGL)	Screened lithology	SWL (mbTOC)	SWL (mAHD)
CVMMB16-01	8/11/2020	611144	7558320	237.3	14.0	0.68	14.58	10.9 – 13.9	Tertiary	Dry	Dry
CVMMB16-02	6-8/11/2020	611135	7558315	237.41	70.0	0.75	70.55	63.8 – 69.8	Permian (H161 seam)	28.29	209.87
MB20CVM02A	24/11/2020	613096	7551038	224.86	20.0	0.58	20.08	16.5 – 19.5	Tertiary basalt	14.17	211.27
MB20CVM03P	21-24/11/2020	613098	7551029	225.15	105.0	0.60	105.60	100.0 – 103.0	Permian (P07 and P08 seam)	15.10	210.65
CVMPB07-01*	15/12/2020	611452	7552345	235.72	28.5	0.76	28.76	22.0 – 28.0	Tertiary basalt	14.18	222.3
CVMPB07-02*	15/12/2020	611452	7552362	236.68	119.4	0.80	117.80	111 - 117	Permian (P07 and P08 seam)	32.21	205.27

***Notes*:**

Coordinates are in AGD66 Zone 55.

**- Co-ordinates provide by BHP, but not finalised.*

mAHD – metres above the Australian height datum

mbGL – metres below ground level

maGL – metres above ground level

mbTOC – metres below the top of the PVC casing

Table 3.2 Caval Ridge VWP construction details

Bore ID	Drilling and installation date	Easting	Northing	Ground level (mAHD)	Drilled depth (mbGL)	Sensor #	Serial #	Sensor depth (mbGL)	Sensor lithology
CVMVWP01-01	9-11/11/2020	609914.9	7560272	217.84	119.7	1		49.5	H01 seam
						2		82	D13 seam
CVMVWP07_01*	12-14/11/2020	Bore abandoned due to rods lost down the hole							
CVMVWP07-R01*	15-22/11/2020	611453.1	7552381	234.06	271.2	1		112	P08 seam
						2		179	H01 seam
						3		256.5	D13 seam
CVMVWP15-01	28/11/2020	614795.9	7548498	227.52	229.2	1		14.5	Tertiary
						2		68	P08 seam
						3		145	H01 seam
						4		210	D13 seam

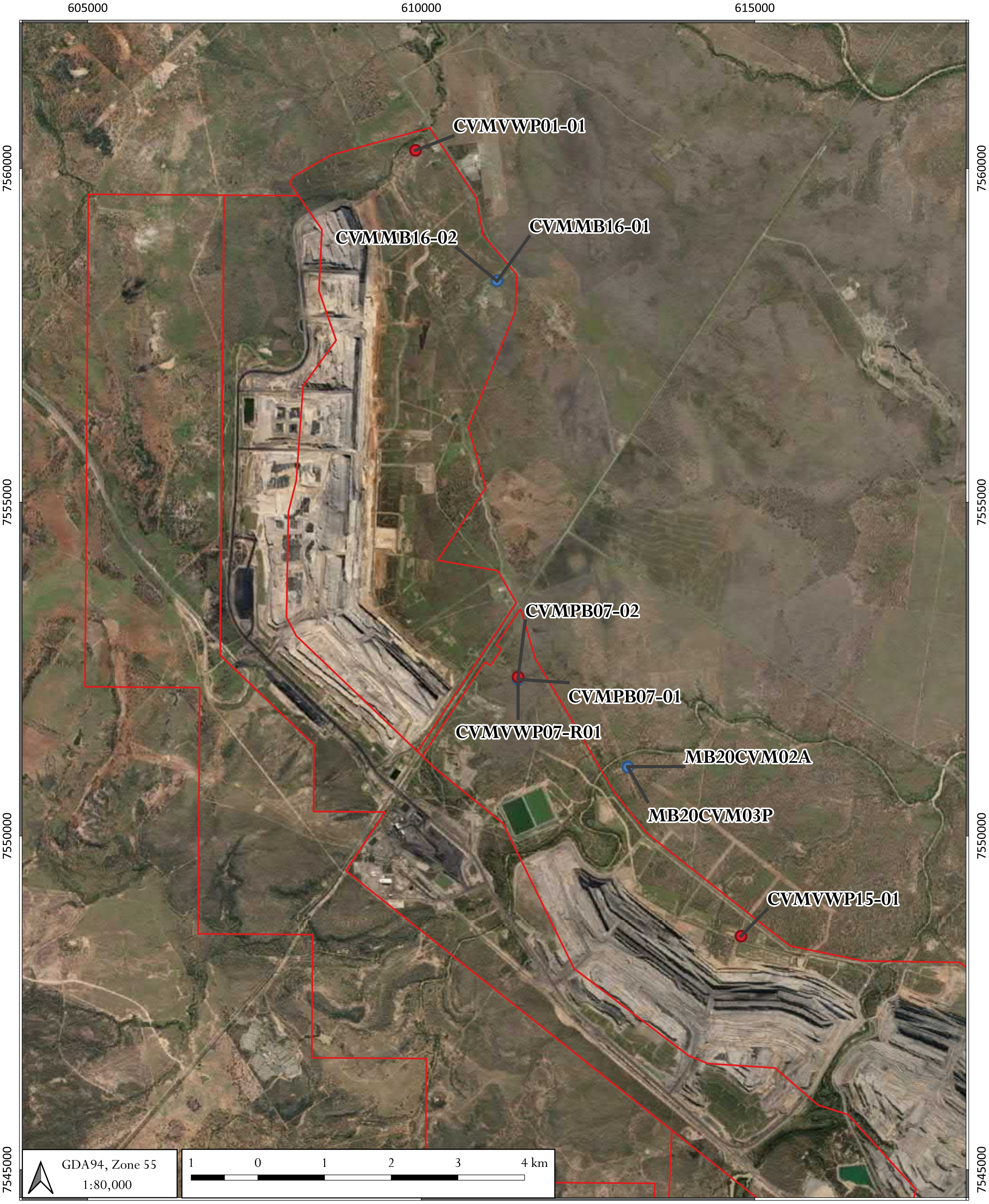
Notes:

Coordinates are in AGD66 Zone 55.

**- Co-ordinates provide by BHP, but not finalised.*

mAHD – metres above the Australian height datum

mbGL – metres below ground level



LEGEND

- ● VWP Locations
- ● Monitoring Bore Locations
- ▭ Mining Lease

DATE
14/04/2021

hydrogeologist field services

Caval Ridge Mine - Horse Pit Expansion (4003)

General Location Plan

FIGURE No.
3.1

Source: ESRI Satellite Imagery - © ESRI Digital Globe

Mining Lease surface areas - Queensland © Commonwealth of Australia (Department of Resources) 2021.

Z:\4000_Projects\4075_HydroFS_Caval Ridge Bore Installation\3_GIS\3_11_Workspaces_QGIS\4075_bore_locations.qgz

5. Geophysical logging

Downhole geophysical logging is required by BHP for all drill holes intersecting the Permian coal measures. Geophysics was completed for CVMVWP01_01, CVMVWP07_01, CVMVWP15_01, CVMMB16_02 and MB20CVM03P. The logs are attached in Appendix B.

6. Bore development

The monitoring bores were developed using the airlifting method once the grout had cured. The purpose of bore development is to remove drilling fines and enhance the hydraulic connectivity with the surrounding hydrostratigraphic unit. A summary of the bore development is provided in Table 6.1 below. Detailed development records are provided in Appendix C.

Bore CVMPB07_02 needs further development as after 3.5 hours of development an orange brown, fine silty sediment was still present. Due to the fact that the drillers were preparing to shut down for the end of year break, the bore could not be developed any further.

Table 6.1 Caval Ridge bores – bore development

Bore ID	Development time (minutes)	Methodology	Flow rate (L/s)	pH	EC (µS/cm)	Comments
CVMMB16-01	Dry					
CVMMB16-02	100	Airlift	0.05	6.81	7640	Clear
MB20CVM02A	100	Airlift	0.005	8.47	1404	Clear
MB20CVM03P	70	Airlift	0.05	8.12	6980	Clear
CVMPB07-01	80	Airlift	0.45	8.38	1311	Opaque
CVMPB07-02	210	Airlift	0.07	8.66	4570	Orange brown with fine silty sediment

7. Water sampling

Water samples for each bore were taken by bailer after bore development. Table 7.1 lists the groundwater quality parameters for each bore as measured at the time of the water sampling. The water samples were sent to ALS for analysis. The results (COA) and associated documentation are attached in Appendix D.

Table 7.1 Caval Ridge bores – groundwater quality after bore development

Bore ID	SWL (mbTOC)	pH	EC (µS/cm)	Temp (°C)
CVMMB16-01	Dry	Dry	Dry	Dry
CVMMB16-02	28.29	6.81	7,640	27.7
MB20CVM02A	14.17	8.47	1,404	28.1
MB20CVM03P	15.10	8.12	6,980	29.9
CVMPB07-01	14.18	8.38	1,311	27.3
CVMPB07-02	32.21	8.66	4,570	31.2

8. Permeability testing

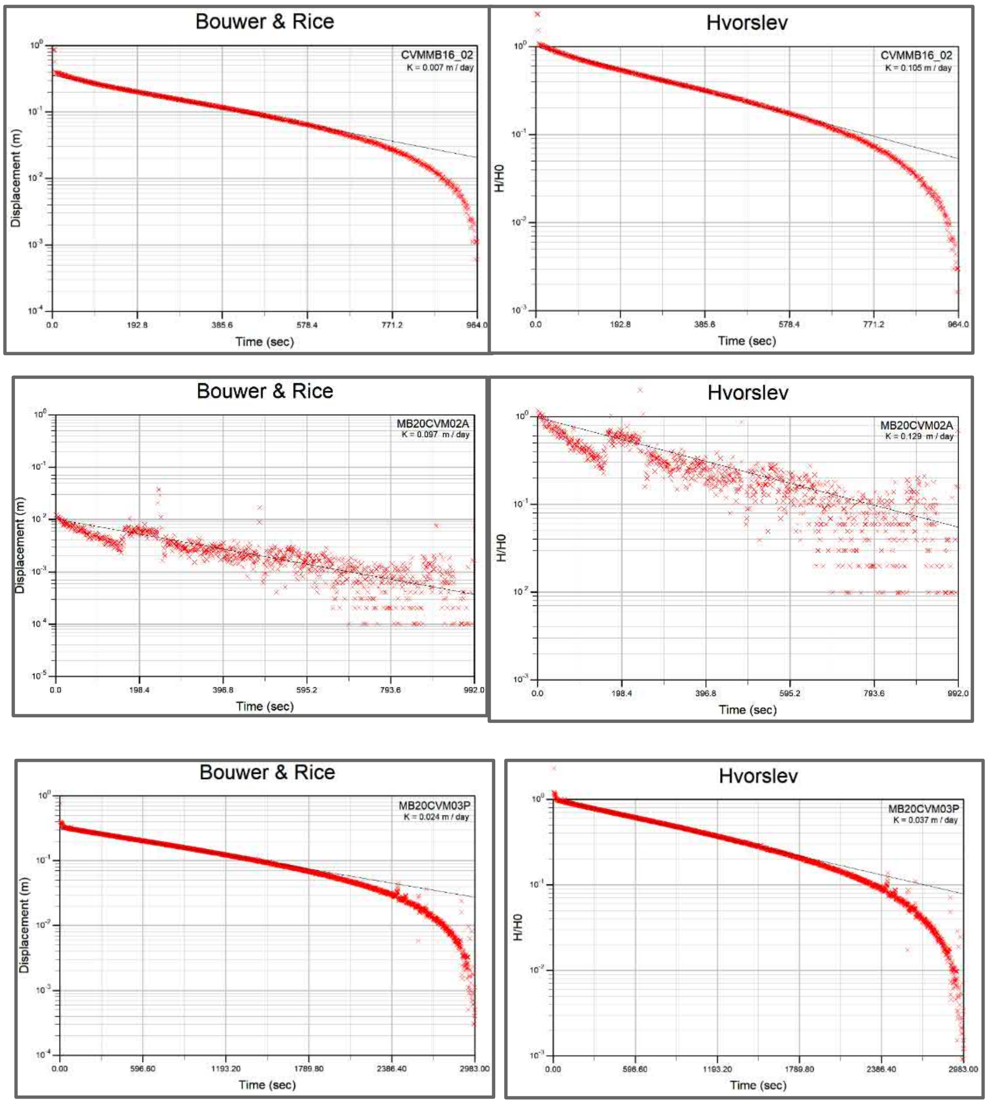
In-situ permeability tests (falling head and rising head tests) were conducted at three of the monitoring bores using the slug testing methodology. The data has been forwarded to BHP for further analysis and interpretation if required. Table 6.1 summarises the interpreted results of the slug tests carried out by HydroFS.

Table 8.1 Hydraulic testing

Bore ID	Date	Hvorslev Estimated K (m/day)	Bouwer & Rice Estimated K (m/day)	Average Estimated K (m/day)
CVMMB16-02	5/12/2020	1.05E-01	7.05E-02	8.78E-02
MB20CVM02A	30/11/2020	1.29E-01	9.67E-02	1.13E-01
MB20CVM03P	30/11/2020	3.68E-02	2.42E-02	3.05E-02

The graphical plots are seen in Figure 8.1 below.

Figure 8.1 Hydraulic testing graphical plots



Appendix A Bore logs

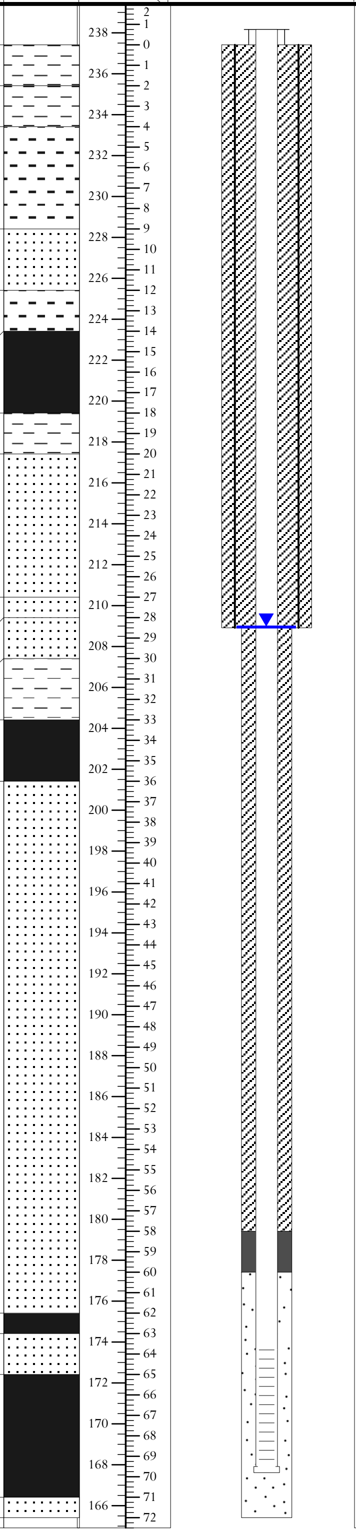
hydrogeologist field services

Project No.: 4003
Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE
CVMMB16-02

Geological Units	Material Description
Q.	CLAY, light to dark brown, stiff, high plasticity, damp
Tertiary	CLAY, yellow brown, stiff, residual siltstone, damp
	SHALE, olive brown, low strength, extremely weathered, very thinly laminated, fractured with iron staining
	SANDSTONE, orange brown, fine grained with fine gravel, low strength, extremely weathered, fractured with iron staining
	SHALE, red brown, low strength, extremely weathered, thinly laminated, contains fine to medium gravel, fractured with iron staining
Permian	COAL, dull black (Q03, Q03)
	SILTSTONE, light grey, low to medium strength, distinctly weathered, very thin carbonaceous laminations
	SANDSTONE, light grey, very fine grained, siliceous, medium to high strength, slightly weathered, very thin carbonaceous laminations
	SANDSTONE, white grey, fine grained, siliceous, medium to high strength, slightly weathered
	SANDSTONE, light grey, very fine grained, medium to high strength, slightly weathered
	SILTSTONE, light grey, with carbonaceous laminae
	COAL, with bands of carbonaceous mudstone, low strength (P08 seam)
	SANDSTONE, light grey, very fine to fine grained, with occasional carbonaceous siltstone laminae
	COAL, with bands of carbonaceous mudstone (H1622 seam)
	SANDSTONE, fine grained, bands of carbonaceous siltstone
	COAL, black, bright, with bands of carbonaceous mudstone (H1621 and H161 seams)
	SANDSTONE, light grey, fine grained, siliceous

Graphic Log | R.L. (mAHD) | Depth (mbGL) | Bore Construction



Bore Description

Protective lockable steel monument
Stick up: +0.75 m
Drilling method:
250 mm Ø PCD (Air Rotary): 0 m to 28.5 m
140 mm Ø PCD (Air Rotary): 28.5 m to 70.0 m
Bentonite grout (5%) : 0 m to 58m
177 mm Ø PN12 uPVC pre-collar casing: 0 m to 28.5 m

50 mm Ø PN18 uPVC blank casing: 0.0 m to 63.8 m

SWL: 28.46 m below top of PVC casing (08/12/2020)

Bentonite seal: 58 m to 60 m

3 mm washed, rounded gravel pack: 60 m to 70 m

50 mm Ø PN18 uPVC machine slotted casing, slot aperture: 1 mm, 63.8 m to 69.8 m

End cap
End of hole: 72 mBGL

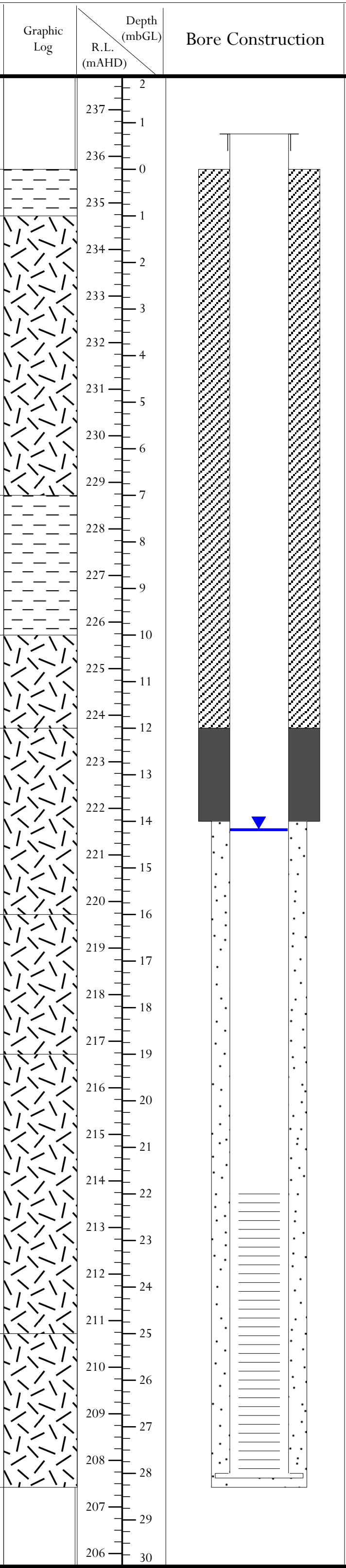
Date Drilled: 6.11.2020	Drilling Company: EWC	Easting: 611135	RL: 237.4
Driller: C. Brown	Drilling Method: Air rotary	Northing: 7558315	TD: 80.0
	Logged By: C. Nelson	Datum: AMG66 (Zone 55)	

hydrogeologist field services

Project No.: 4003
Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE
CVMPB07-01

Geological Units	Material Description
Tertiary	CLAY, dark brown, firm, high plasticity
	BASALT, yellow grey, low strength, extremely to distinctly weathered
	Clay, yellowish brown, soft, medium plasticity
	BASALT, grey, low strength, extremely to distinctly weathered, fractured
	BASALT, brownish grey, medium strength, distinctly weathered, fractured
	BASALT, yellowish grey, medium strength, distinctly weathered, highly fractured
	BASALT, blue grey, high strength, slightly weathered
	BASALT, blue grey, high strength, slightly weathered, fractured with some drill chips >30mm



Bore Description

Locable steel cap
Stick up: +0.76 m

Drilling method (dual rotary drill rig):
347 mm Ø DTH : 0 m to 15.0 m
273 mm Ø DTH : 15.0 m to 28.5 m

168.3 mm Ø HWT blank steel casing: 0 m to 22.0 m

Bentonite grout (5%) : 0 m to 12 m

Bentonite seal: 12 m to 14.0 m

SWL: 14.18 m below top of steel casing (15/12/2020)

Washed, rounded gravel pack: 14 m to 28.3 m

168.3 mm steel HWT machine slotted casing, slot aperture: 1.5 mm, 22 m to 28 m

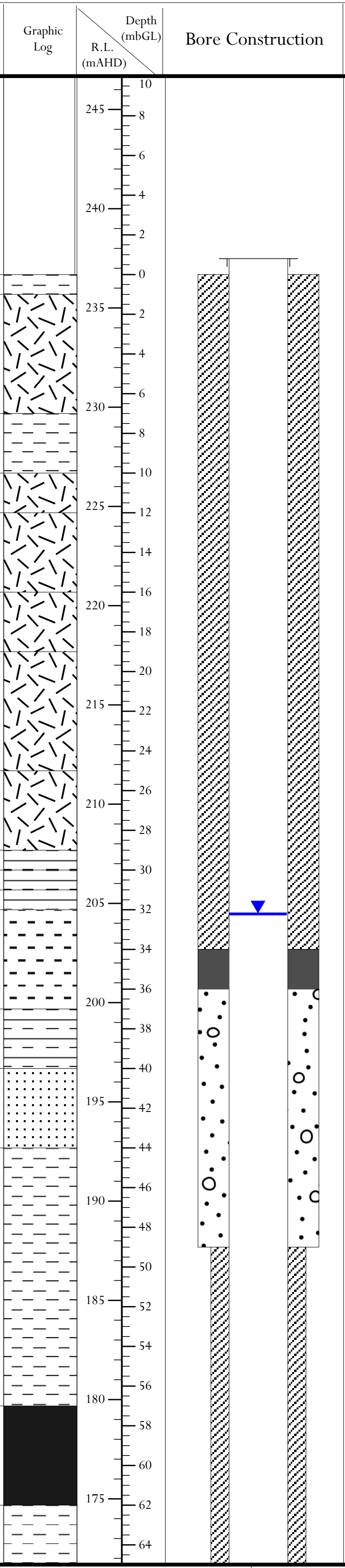
End cap
End of hole: 28.3 mBGL

Date Drilled: 14.12.2020
Driller: D. Bull
Drilling Company: EWC
Drilling Method: Air rotary
Logged By: C. Nelson
Easting: 611452
Northing: 7552345
Datum: AMG84 (Zone 55)
RL: 235.7
TD: 28.3

Project No.: 4003
Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE
CVMPB07-02

Geological Units	Material Description
Tertiary	CLAY, dark brown, firm, high plasticity
	BASALT, yellow grey, low strength, extremely to distinctly weathered
	Clay, yellowish brown, soft, medium plasticity
	BASALT, grey, low strength, extremely to distinctly weathered, fractured
	BASALT, brownish grey, medium strength, distinctly weathered, fractured
	BASALT, yellowish grey, medium strength, distinctly weathered, highly fractured
	BASALT, blue grey, high strength, slightly weathered
	BASALT, blue grey, high strength, slightly weathered, amygdaloidal, fractured with some drill chips >30mm
	MUDSTONE, yellowish green, low strength
	MUDSTONE, orange brown, low strength, extremely weathered
	MUDSTONE, yellowish green, low strength
	CLAYSTONE, yellowish brown, extremely weathered, very low strength
	MUDSTONE, greenish grey, low strength, distinctly weathered
	SANDSTONE, greenish brown, very fine grained, low strength, thinly laminated, distinctly weathered
	SILTSTONE, light grey, medium strength, slightly weathered
	COAL, black, interbedded carbonaceous claystone (Q01 seam)
	SILTSTONE, light grey, medium strength



Bore Description

Lockable steel cap
Stick up: +0.80 m

Drilling method (dual rotary drill rig):
347 mm Ø DTH : 0 m to 49.0 m
273 mm Ø DTH : 49.0 m to 119.4 m

168.3 mm Ø HWT blank steel casing: 0 m to 111.0 m

Bentonite grout (5%) : 0 m to 34.0 m

SWL: 32.21 m below top of steel casing (15/12/2020)

Bentonite seal: 34 m to 36 m

Gravel backfill

Bentonite grout (5%) : 49 m to 105.0 m

Date Drilled: 6.12.2020
Driller: D. Bull

Drilling Company: EWC
Drilling Method: Air rotary
Logged By: C. Nelson

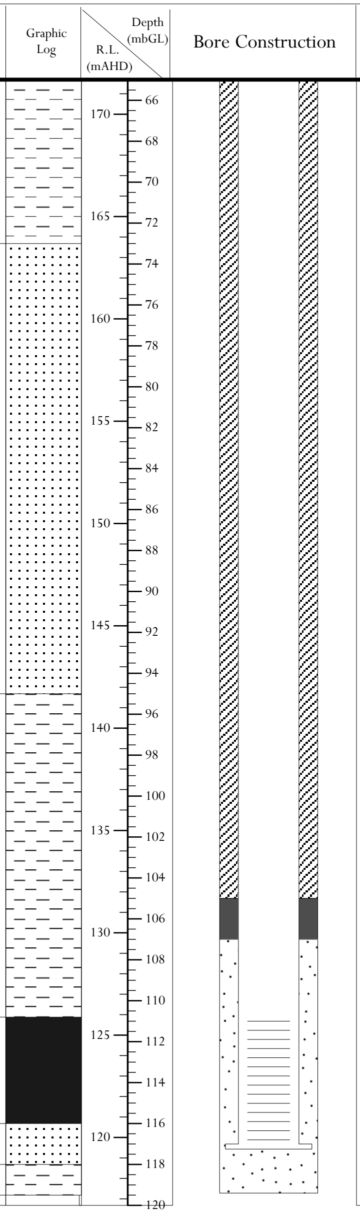
Easting: 611452
Northing: 7552362
Datum: AMG84 (Zone 55)

RL: 236.7
TD: 119.0

Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

CVMPB07-02

Geological Units	Material Description
Permian	SILTSTONE, light grey, medium strength
	SANDSTONE, whitish grey, very fine to fine grained, with interbedded mudstone
	SILTSTONE, dark grey, medium strength, thinly laminated
	COAL, black, bright, with interbedded mudstone (P08 and P07 seams)
	SANDSTONE, whitish grey, fine grained
	SILTSTONE, dark grey



Bore Description

Bentonite seal: 105 m to 107 m

Washed, rounded gravel pack: 107 m to 119.4 m

168.3 mm Ø HWT machine slotted casing, slot aperture: 1.5 mm, 111 m to 117 m

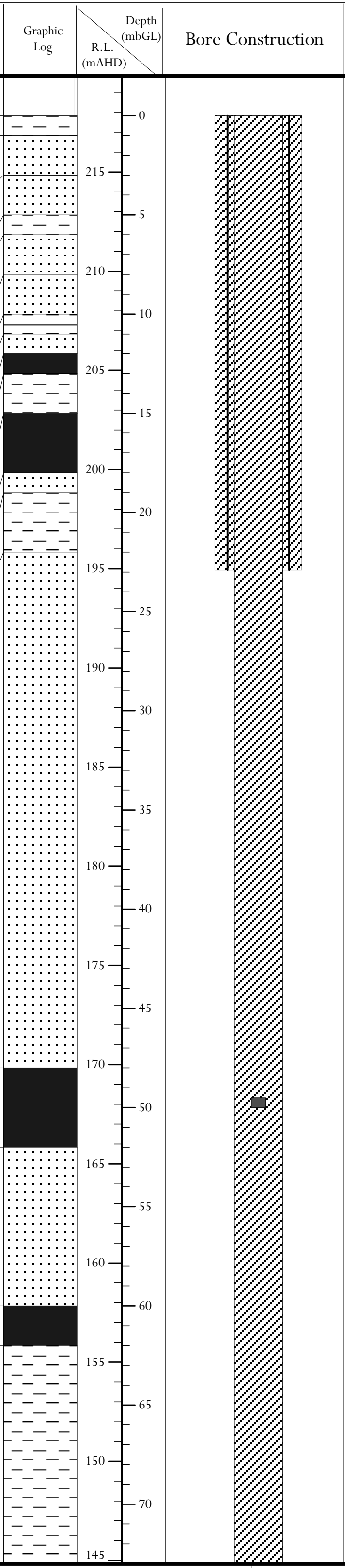
End cap
End of hole: 119.4 mBGL

Date Drilled: 6.12.2020
Driller: D. Bull
Drilling Company: EWC
Drilling Method: Air rotary
Logged By: C. Nelson
Easting: 611452
RL: 236.7
Northing: 7552362
TD: 119.0
Datum: AMG84 (Zone 55)

Project No.: 4003
Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE
CVMVWP01_01

Geological Units	Material Description
Q	CLAY, dark brown, stiff, high plasticity
Tertiary	SANDSTONE, yellowish brown, fine grained, low strength, extremely weathered, thinly laminated, interbedded siltstone laminae, fractured
	SANDSTONE, olive brown, very fine to fine grained, medium strength, distinctly weathered, thinly laminated, interbedded siltstone laminae, fractured
	SILTSTONE, yellowish brown, low strength, extremely weathered
	SANDSTONE, olive brown, very fine to fine grained, medium strength, distinctly weathered, thinly laminated, interbedded siltstone laminae, fractured with iron staining
Permian	SANDSTONE, light-grey, very fine to fine grained, low to medium strength, distinctly weathered
	MUDSTONE, dark grey, medium strength, distinctly weathered
	SANDSTONE, light-grey, very fine to fine grained, medium strength, distinctly weathered
	COAL, dull black, interbedded mudstone, low strength, extremely weathered
	SILTSTONE, light grey, low strength, distinctly weathered, thin carbonaceous laminae
	COAL, dull black, interbedded mudstone, low strength, extremely weathered (H01 seam)
	SANDSTONE, light-grey, very fine to fine grained, quartzose, thinly laminated
	SILTSTONE, dark-grey, carbonaceous, low strength
	SANDSTONE, whitish grey, fine grained, medium strength
	COAL, black, interbedded carbonaceous mudstone (H00 and D43 seams)
	SANDSTONE, light grey, very fine to fine grained, high strength
	COAL, black, interbedded carbonaceous mudstone (D44 seam)
	SILTSTONE, grey, thinly laminated, interbedded sandstone



Bore Description

177 mm Ø PN12 uPVC pre-collar casing: 0 m to 22.9 m

Drilling method:
250 mm Ø PCD (Air Rotary) : 0 m to 22.9 m
140 mm Ø PCD (Air Rotary) : 22.9 m to 119.4 m

VWP : 8.5 m (Tertiary) - installed in nearby groundwater monitoring bore MB20CVM01A

Bentonite grout (30%) : 0 m to 119.4 m

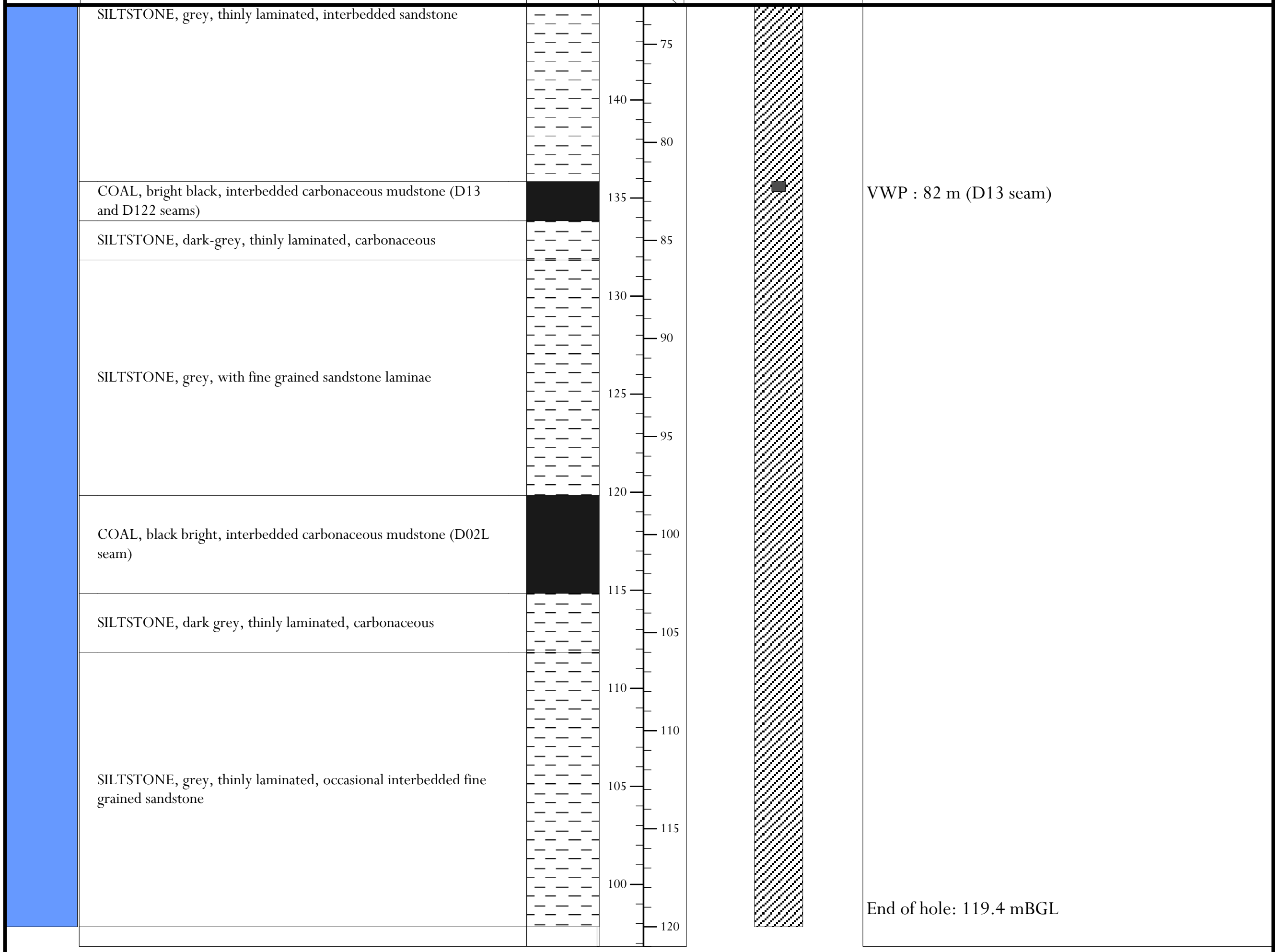
VWP : 49.5 m (H00 seam)

Date Drilled: 15.11.2020	Drilling Company: EWC	Easting: 609915	RL: 217.8
Driller: C. Brown	Drilling Method: Air rotary	Northing: 7560272	TD: 119.7
	Logged By: C. Nelson	Datum: AMG66 (Zone 55)	

Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

CVMVWP01_01

Geological Units	Material Description	Graphic Log	Depth (mbGL) / R.L. (mAHD)	Bore Construction	Bore Description



SILTSTONE, grey, thinly laminated, interbedded sandstone

COAL, bright black, interbedded carbonaceous mudstone (D13 and D122 seams)

SILTSTONE, dark-grey, thinly laminated, carbonaceous

SILTSTONE, grey, with fine grained sandstone laminae

COAL, black bright, interbedded carbonaceous mudstone (D02L seam)

SILTSTONE, dark grey, thinly laminated, carbonaceous

SILTSTONE, grey, thinly laminated, occasional interbedded fine grained sandstone

VWP : 82 m (D13 seam)

End of hole: 119.4 mBGL

Date Drilled: 15.11.2020

Driller: C. Brown

Drilling Company: EWC

Drilling Method: Air rotary

Logged By: C. Nelson

Easting: 609915

Northing: 7560272

Datum: AMG66 (Zone 55)

RL: 217.8

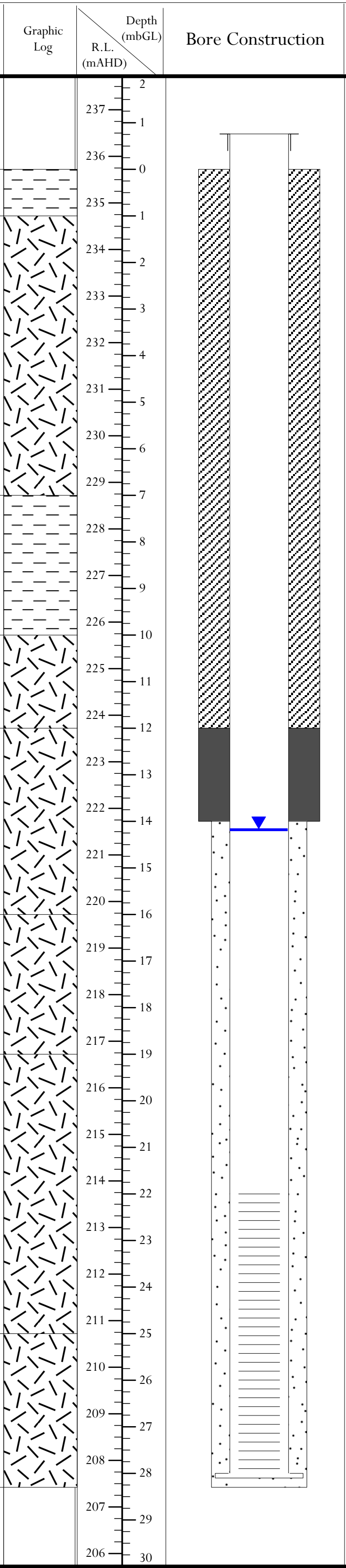
TD: 119.7

hydrogeologist field services

Project No.: 4003
Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE
CVMPB07-01

Geological Units	Material Description
Tertiary	CLAY, dark brown, firm, high plasticity
	BASALT, yellow grey, low strength, extremely to distinctly weathered
	Clay, yellowish brown, soft, medium plasticity
	BASALT, grey, low strength, extremely to distinctly weathered, fractured
	BASALT, brownish grey, medium strength, distinctly weathered, fractured
	BASALT, yellowish grey, medium strength, distinctly weathered, highly fractured
	BASALT, blue grey, high strength, slightly weathered
	BASALT, blue grey, high strength, slightly weathered, fractured with some drill chips >30mm



Bore Description

Locable steel cap
Stick up: +0.76 m

Drilling method (dual rotary drill rig):
347 mm Ø DTH : 0 m to 15.0 m
273 mm Ø DTH : 15.0 m to 28.5 m

168.3 mm Ø HWT blank steel casing: 0 m to 22.0 m

Bentonite grout (5%) : 0 m to 12 m

Bentonite seal: 12 m to 14.0 m

SWL: 14.18 m below top of steel casing (15/12/2020)

Washed, rounded gravel pack: 14 m to 28.3 m

168.3 mm steel HWT machine slotted casing, slot aperture: 1.5 mm, 22 m to 28 m

End cap
End of hole: 28.3 mBGL

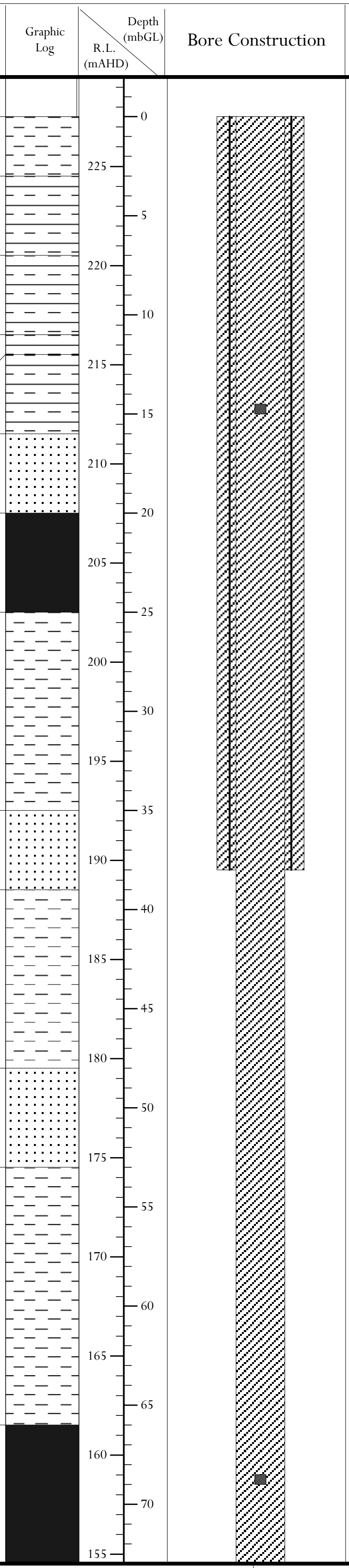
Date Drilled: 14.12.2020	Drilling Company: EWC	Easting: 611452	RL: 235.7
Driller: D. Bull	Drilling Method: Air rotary	Northing: 7552345	TD: 28.3
	Logged By: C. Nelson	Datum: AMG84 (Zone 55)	

Project No.: 4003

Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE
CVMVWP15_01

Geological Units	Material Description
Q.	CLAY, yellow brown, sandy clay with gravel, stiff, high plasticity, dry
Tertiary	MUDSTONE, red-brown, low strength, extremely weathered
	MUDSTONE, light yellow, low strength, extremely weathered
	MUDSTONE, brownish grey, very low strength, extremely weathered
	MUDSTONE, yellowish brown, low strength, extremely weathered
	SANDSTONE, greyish white, medium strength, distinctly weathered
	COAL, black, low strength, distinctly weathered, interbedded carbonaceous siltstone
	SILTSTONE, dark grey, medium strength, slightly weathered, carbonaceous, occasional sandstone laminae
	SANDSTONE, grey, fine grained, medium strength, slightly weathered
	SILTSTONE, dark grey, medium strength, slightly weathered, carbonaceous
	SANDSTONE, grey, fine grained, medium strength, slightly weathered
	SILTSTONE, dark grey, medium strength, slightly weathered, carbonaceous, interbedded sandstone laminae
	COAL, black, low strength, interbedded carbonaceous siltstone (P08 and P07 seams)



Bore Description

Drilling method:
250 mm Ø PCD (Air Rotary) : 0 m to 38.0 m
140 mm Ø PCD (Air Rotary) : 38.0 m to 229.2 m
177 mm Ø PN12 uPVC pre-collar casing: 0 m to 38.0 m

Bentonite grout (30%) : 0 m to 229.2 m

VWP : 14.5 m (Tertiary)

VWP : 68 m (P08 seam)

Date Drilled: 25.11.2020
Driller: C. Brown

Drilling Company: EWC
Drilling Method: Air rotary
Logged By: T. Muehe

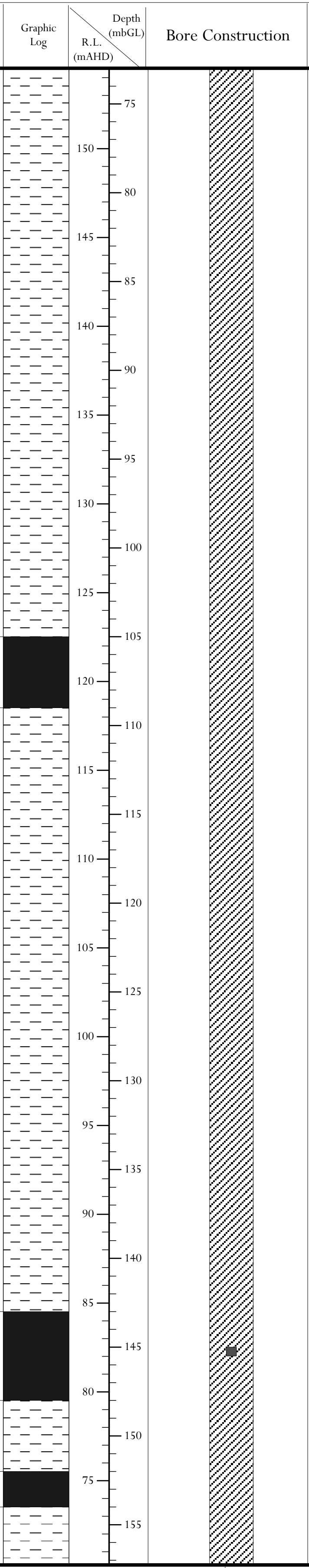
Easting: 614796
Northing: 7548498
Datum: AMG66 (Zone 55)

RL: 227.5
TD: 229.2

Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

CVMVWP15_01

Geological Units	Material Description	Bore Description
Permian	COAL, black, low strength, interbedded carbonaceous siltstone (P08 and P07 seams)	
	SILTSTONE, dark grey, carbonaceous, occasional interbedded sandstone	
	COAL, black, low strength, interbedded carbonaceous siltstone (H161 seam)	
	SILTSTONE, dark grey, carbonaceous	
	COAL, black, low strength, interbedded carbonaceous mudstone (H01 seam)	VWP : 145 m (H01 seam)
	SILTSTONE, dark grey, carbonaceous	
	COAL, black, low strength, interbedded carbonaceous mudstone (H00 seam)	
	SILTSTONE, dark grey, carbonaceous	



Date Drilled: 25.11.2020

Driller: C. Brown

Drilling Company: EWC

Drilling Method: Air rotary

Logged By: T. Muehe

Easting: 614796

Northing: 7548498

Datum: AMG66 (Zone 55)

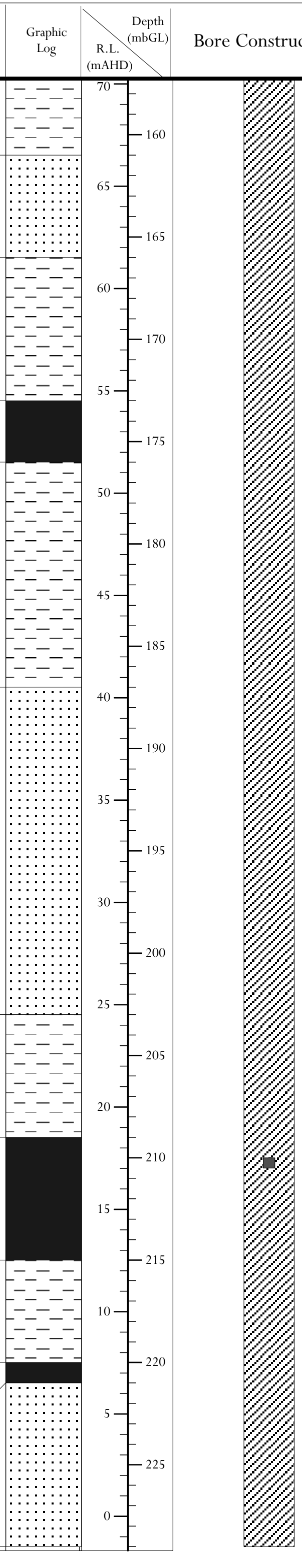
RL: 227.5

TD: 229.2

Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

CVMVWP15_01

Geological Units	Material Description	Bore Description
	SILTSTONE, dark grey, carbonaceous	
	SANDSTONE, grey, fine to medium grained	
	SILTSTONE, dark grey, carbonaceous	
	COAL, black, low strength, interbedded carbonaceous mudstone (D46 seam)	
	SILTSTONE, dark grey, carbonaceous	
	Sandstone, grey, fine to medium grained	
	SILTSTONE, dark grey, carbonaceous	
	COAL, black, low strength, interbedded carbonaceous mudstone (D13 and D12 seams)	VWP : 210 m (D13)
	SILTSTONE, dark grey, carbonaceous	
	COAL, black, low strength, interbedded carbonaceous mudstone (DL)	
	Sandstone, grey, fine to medium grained	End of hole: 229.2 mBGL



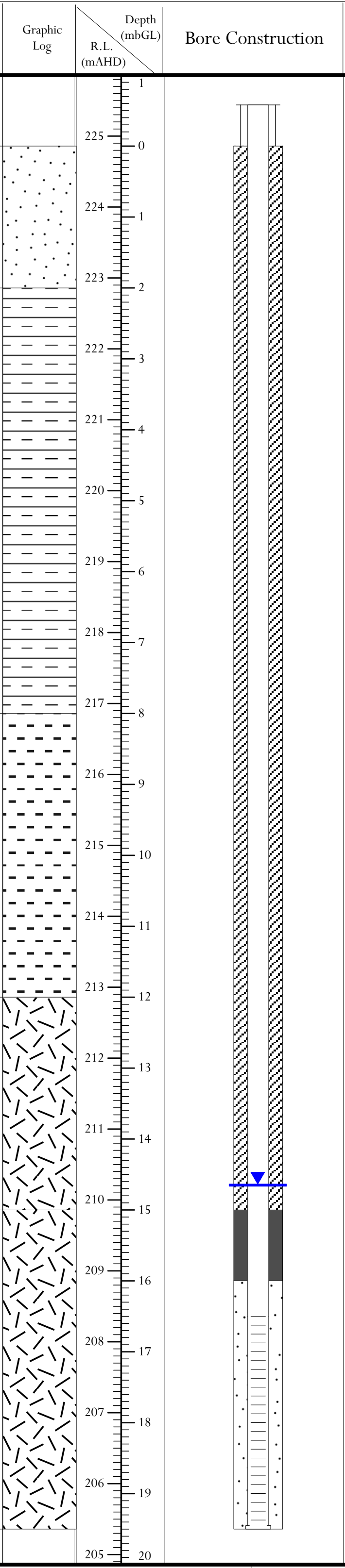
Date Drilled: 25.11.2020	Drilling Company: EWC	Easting: 614796	RL: 227.5
Driller: C. Brown	Drilling Method: Air rotary	Northing: 7548498	TD: 229.2
	Logged By: T. Muehe	Datum: AMG66 (Zone 55)	

Project No.: 4003

Project Name: Hydrogeological Drilling Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE MB20CVM02A

Geological Units	Material Description
Quaternary	SAND, silty sand with gravel, reddish brown, very loose, low plasticity
Tertiary	MUDSTONE, light orange brown, very low to low strength, extremely, fractured, thinly laminated, damp
	SHALE, olive brown, low strength, with sandstone laminae, extremely to distinctly weathered, fractured, damp
	BASALT, dark grey, very fine, mafic, medium strength, with white clay (tuff), distinctly weathered, fractured with iron staining
	BASALT, black, mafic, medium strength, distinctly weathered to slightly weathered, fractured, intersected water at 18m



Bore Description

Protective locable steel monument
Stick up: +0.58 m

Drilling method:
140 mm Ø PCD (Air Rotary) : 0 m to 19.5 m

50 mm Ø PN18 uPVC blank casing: 0 m to 16.5 m

Bentonite grout (5%) : 0 m to 15 m

SWL: 14.65 m below top of PVC casing (07/12/2020)

Bentonite seal: 15 m to 16 m

50 mm Ø PN18 uPVC machine slotted casing, slot aperture: 1 mm, 16.5 m to 19.5 m

3 mm washed, rounded gravel pack: 16 m to 19.5 m

End cap
End of hole: 19.5 mBGL

Date Drilled: 24.11.2020	Drilling Company: EWC	Easting: 613096	RL: 224.9
Driller: C. Brown	Drilling Method: Air rotary	Northing: 7551038	TD: 20.0
	Logged By: C. Nelson	Datum: AMG66 (Zone 55)	

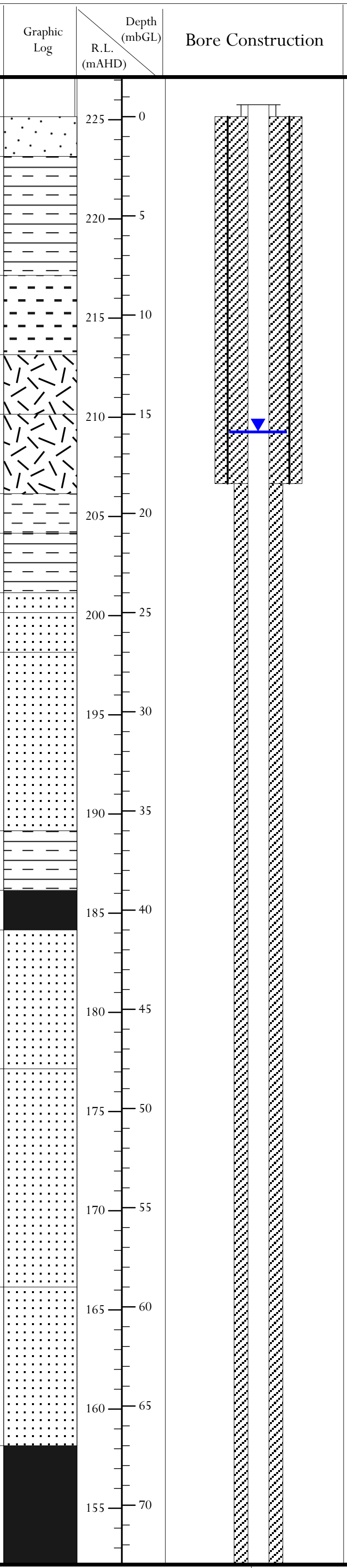
hydrogeologist field services

Project No.: 4003

Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE
MB20CVM03P

Geological Units	Material Description
Q.	SAND, silty sand with gravel, reddish brown, very loose, low plasticity
Tertiary	MUDSTONE, light orange brown, very low to low strength, extremely, fractured, thinly laminated, damp
	SHALE, olive brown, low strength, with sandstone laminae, extremely to distinctly weathered, fractured, damp
	BASALT, dark grey, very fine, mafic, medium strength, with white clay (tuff), distinctly weathered, fractured with iron staining
	BASALT, black, mafic, medium strength, distinctly weathered to slightly weathered, fractured, intersected water at 18m
	CLAY, grey white, high plasticity
Permian	MUDSTONE, dark grey to olive brown, carbonaceous
	SANDSTONE, white, fine grained, siliceous, medium strength
	COAL, interbedded carbonaceous mudstone
	SANDSTONE, grey white, very fine to fine grained, siliceous
	MUDSTONE, dark grey to olive brown, carbonaceous
	COAL, interbedded carbonaceous mudstone
	SANDSTONE, dark grey, very fine to fine grained
	SANDSTONE, light grey, fine grained
	SANDSTONE, dark grey, fine grained
	COAL, interbedded carbonaceous mudstone



Bore Description

Protective lockable steel monument
Stick up: +0.6 m

Drilling method:
250 mm Ø PCD (Air Rotary) : 0 m to 18.5 m
140 mm Ø PCD (Air Rotary) : 18.5 m to 105.0 m

50 mm Ø PN18 uPVC blank casing: 0 m to 100.0 m
177 mm Ø PN12 uPVC pre-collar casing: 0 m to 18.5 m

SWL: 15.89 m below top of PVC casing (07/12/2020)

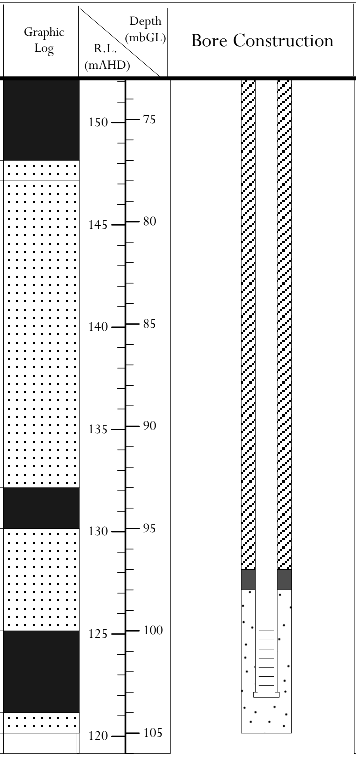
Bentonite grout (5%) : 0 m to 97 m

Date Drilled: 21.11.2020	Drilling Company: EWC	Easting: 613098	RL: 225.2
Driller: C. Brown	Drilling Method: Air rotary	Northing: 7551029	TD: 106.0
	Logged By: C. Nelson	Datum: AMG66 (Zone 55)	

Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MB20CVM03P

Geological Units	Material Description
	COAL, interbedded carbonaceous mudstone
	SANDSTONE, grey white
	SANDSTONE, dark grey, very fine grained
	COAL, interbedded carbonaceous mudstone
	SANDSTONE, light grey, fine grained
	COAL, interbedded carbonaceous mudstone
	SANDSTONE, dark grey, very fine to fine grained



Bore Description

Bentonite seal: 97 m to 98 m

Washed, rounded gravel pack: 98 m to 105 m
50 mm PN18 uPVC machine slotted casing, slot aperture: 1 mm, 100m to 103 m

End cap
End of hole: 105 m BGL

Date Drilled: 21.11.2020

Driller: C. Brown

Drilling Company: EWC

Drilling Method: Air rotary

Logged By: C. Nelson

Easting: 613098

Northing: 7551029

Datum: AMG66 (Zone 55)

RL: 225.2

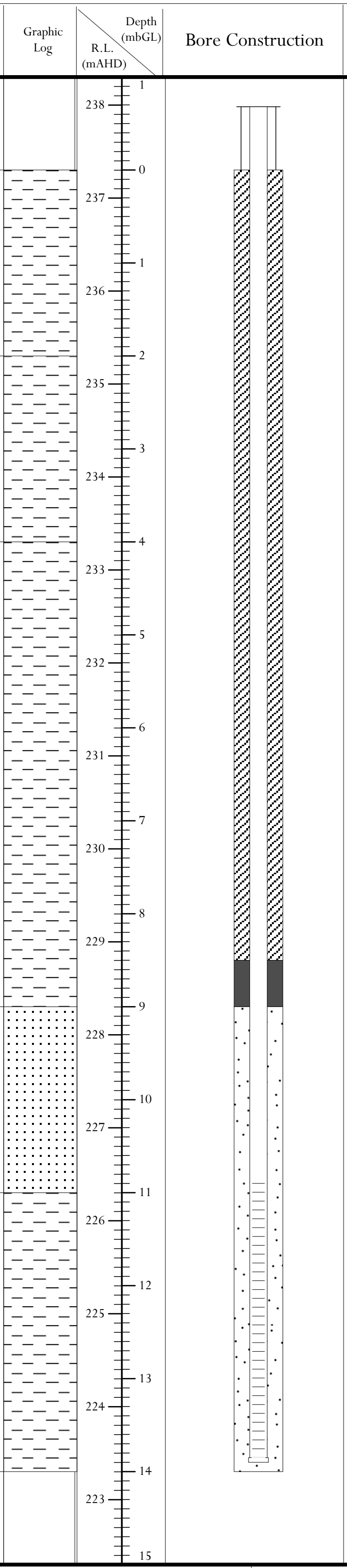
TD: 106.0

hydrogeologist field services

Project No.: 4003
Project Name: Hydrogeological Drilling
Caval Ridge Mine, Horse Pit Expansion Project

MONITORING BORE
CVMMB16-01

Geological Units	Material Description
Quaternary	CLAY, light to dark brown, stiff, high plasticity, damp
Tertiary	CLAY, yellow brown, stiff, residual siltstone, damp
	SHALE, olive brown, low strength, extremely weathered, very thinly laminated, fractured with iron staining
	SANDSTONE, orange brown, fine grained with fine gravel, low strength, extremely weathered, fractured with iron staining, damp
	SHALE, red brown, low strength, extremely to distinctly weathered, thinly laminated, contains fine to medium gravel, fractured with iron staining



Bore Description

Protective lockable steel monument
Stick up: +0.68m

Drilling method:
140 mm Ø PCD (Air Rotary): 0 m to 14 m

50 mm Ø PN18 uPVC blank casing: 0 m to 10.9 m

Bentonite grout (5%): 0 m to 8.5 m

Bentonite seal: 8.5 m to 9 m

3 mm washed, rounded gravel pack: 9 m to 14 m

50 mm Ø PN18 uPVC machine slotted casing, slot aperture: 1 mm, 10.9 m to 13.9 m

End cap
End of hole: 14 mBGL

Date Drilled: 8.11.2020
Driller: C. Brown
Drilling Company: EWC
Drilling Method: Air rotary
Logged By: C. Nelson
Easting: 611144
Northing: 7558320
Datum: AMG66 (Zone 55)
RL: 237.3
TD: 14.0

Appendix B Downhole geophysics

MPC KINETIC

QUICKLOOK LITHOLOGY LOG

201852

COMPANY	BMA	**FIELD**	CVR	**STATE**	QLD
WELL	201852	**LOCATION**	CVMMB16_02_HY	**COUNTRY**	AUSTRALIA

LOCATION: CVMMB16_02_HY
FIELD: CVR
STATE: QLD
WELL: 201852
COMPANY: BMA

LOG MEASURED FROM	GL	ELEVATIONS:	OTHER SERVICES:
DRILLING MEASURED FROM	GL	KB	1. DEN VERT
PERMANENT DATUM		DF	2. RES
PERMANENT DATUM ELEVATION		GL	3.

LICENSE	SECTION	TOWNSHIP	RANGE	MAGNETIC DECLINATION
				8.17deg

DATE	08-11-2020			RECORDED BY	LAP		
TIME	07-38			WITNESSED BY			
RUN NUMBER	1			LOGGING UNIT	V034		
DEPTH-DRILLER	70m			RIG NUMBER	EWC RIG728		
DEPTH-LOGGER	69.62m			TOOL TYPE	9239C		
BIT SIZE	140mm			TOOL SERIAL NO.	2727		
CASING TYPE	PVC			EASTING	611134		
CASING ID	179mm			NORTHING	7558321		
CASING BOTTOM	28.6m			SAMPLE INT.	.01m		
FLUID TYPE	0			LOG DIRECTION	U		
TRUCK CAL NO.	0.09770			FEET OR METER	M		
WATER LEVEL	27m			SOURCE TYPE	CS137	SOURCE ID	CZ3954

QUICKLOOK LITHOLOGY ANALYSIS PARAMETERS

1. HYBRID BOUNDARY PICK ANALYSIS APPLIED.
2. BLOCK AVERAGED GAMMA AND DENSITY USED.
3. GAMMA-DENSITY CROSSPLOT CLUSTER CHART APPLIED - CCC.v.1.13
4. LITHOLOGICAL DICTIONARY APPLIED - COAL.
5. CASING DEPTH SUPPLIED BY LOG
6. THE QUICKLOOK PROCESS HAS BEEN DEVELOPED TO PROCESS DATA RECORDED IN OPENHOLE.
   THE INTERPRETATION PROVIDED FOR DATA RECORDED EITHER IN-ROD OR IN CASING SHOULD BE TREATED WITH CAUTION

LOGGER COMMENTS:

1. DENSITY SPIKES AT 4.8m, 10.8m, 16.8m & 22.8m, DUE TO PVC CASING JOINTS WITH CALIPER JUMPING
2.
3.

LITHOLOGY LEGEND

⬛	**CO - Coal**	🟧	**S2 - Sandstone - fine grained**
▒	**CF - Inferior Coal**	🟨	**S3 - Sandstone - fine to medium grained**
🟦	**ST - SILTSTONE**	⬜	**S4 - Sandstone - medium grained**

🟦	ST - SILTSTONE	🟨	S4 - Sandstone - medium grained
🟫	**S1 - Sandstone - very fine grained**		

MNEMONICS

DEN(LS)	LONG SPACED DENSITY STANDARD UNITS
DEN(SS)	SHORT SPACED DENSITY STANDARD UNITS
RES(SG)	SHORT GUARD RESISTIVITY
DENR(LS)	LONG SPACED DENSITY RESPONSE UNITS
DENR(SS)	SHORT SPACED DENSITY RESPONSE UNITS
DEN(CDL)	COMPENSATED DENSITY
POR(DEN)	SANDSTONE DENSITY POROSITY
CALIPER	MECHANICAL CALIPER FROM DENSITY
GAM(NAT)	NATURAL GAMMA FROM DENSITY
DEN(COD)	COMPENSATED DENSITY FORMULA
DEN(ER)	VECTAR PROCESSED DENSITY
SANGB	SAMPLE ANGLE BEARING
SANG	SAMPLE SLANT ANGLE (0 DEG = VERTICAL DOWN)
TVD	TRUE VERTICAL DEPTH
EAST	BOREHOLE EAST DEVIATION
NORTH	BOREHOLE NORTH DEVIATION
CDIST	DEVIATED CLOSURE DISTANCE
CANGB	DEVIATED CLOSURE ANGLE BEARING

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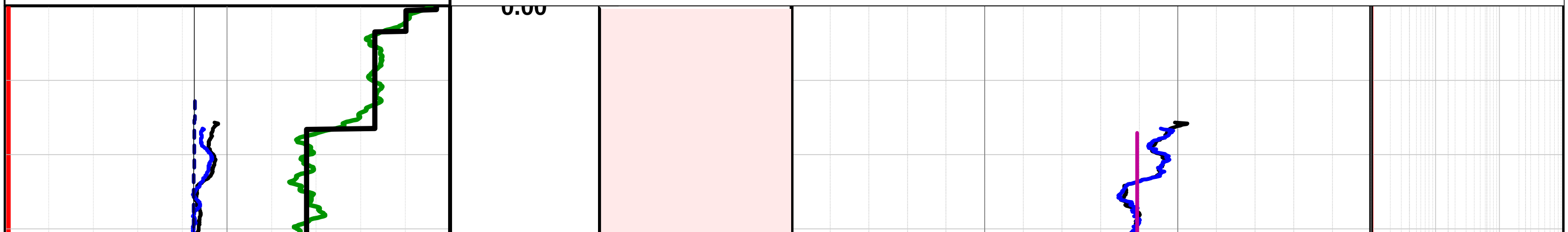
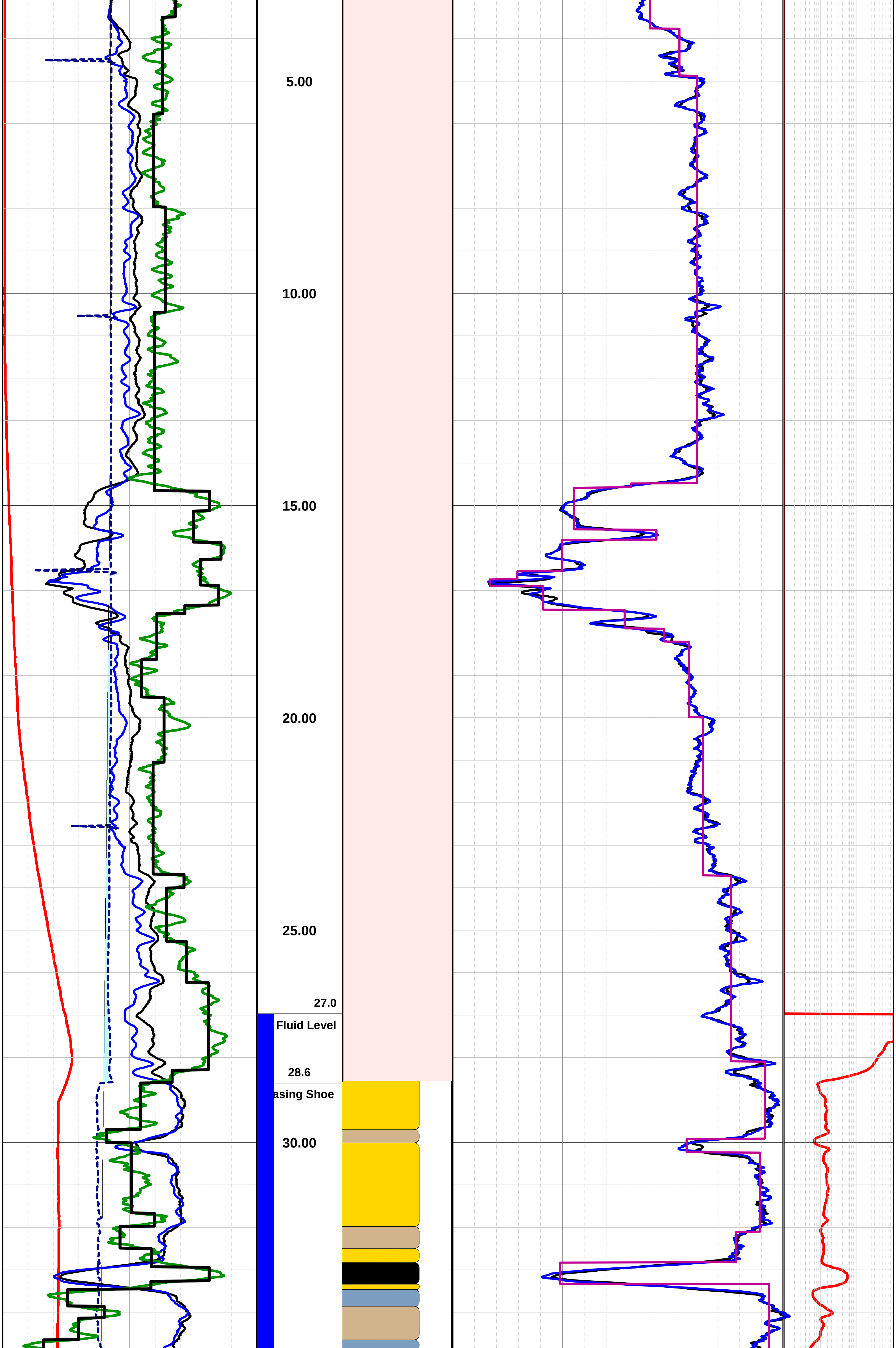
DEPTH SCALE 1:100

DEN(LS) 1 g/cc 3	**Depth** 1m:100m	**COKED_COAL**		**RES(SG)** 1 OHM-M 1000
DEN(SS) 1 g/cc 3	**DATA_FLAG**	**LITHOLOGY**	**DEN(COD)** 1 g/cc 3	
SANG 0 DEG 20	**WT_FLAG**	**CASING**	**DEN(ER)** 1 g/cc 3	
CALIPER 50 mm 300				
GAM(NAT) 200 API 0				
NOM_BIT 50 mm 300				

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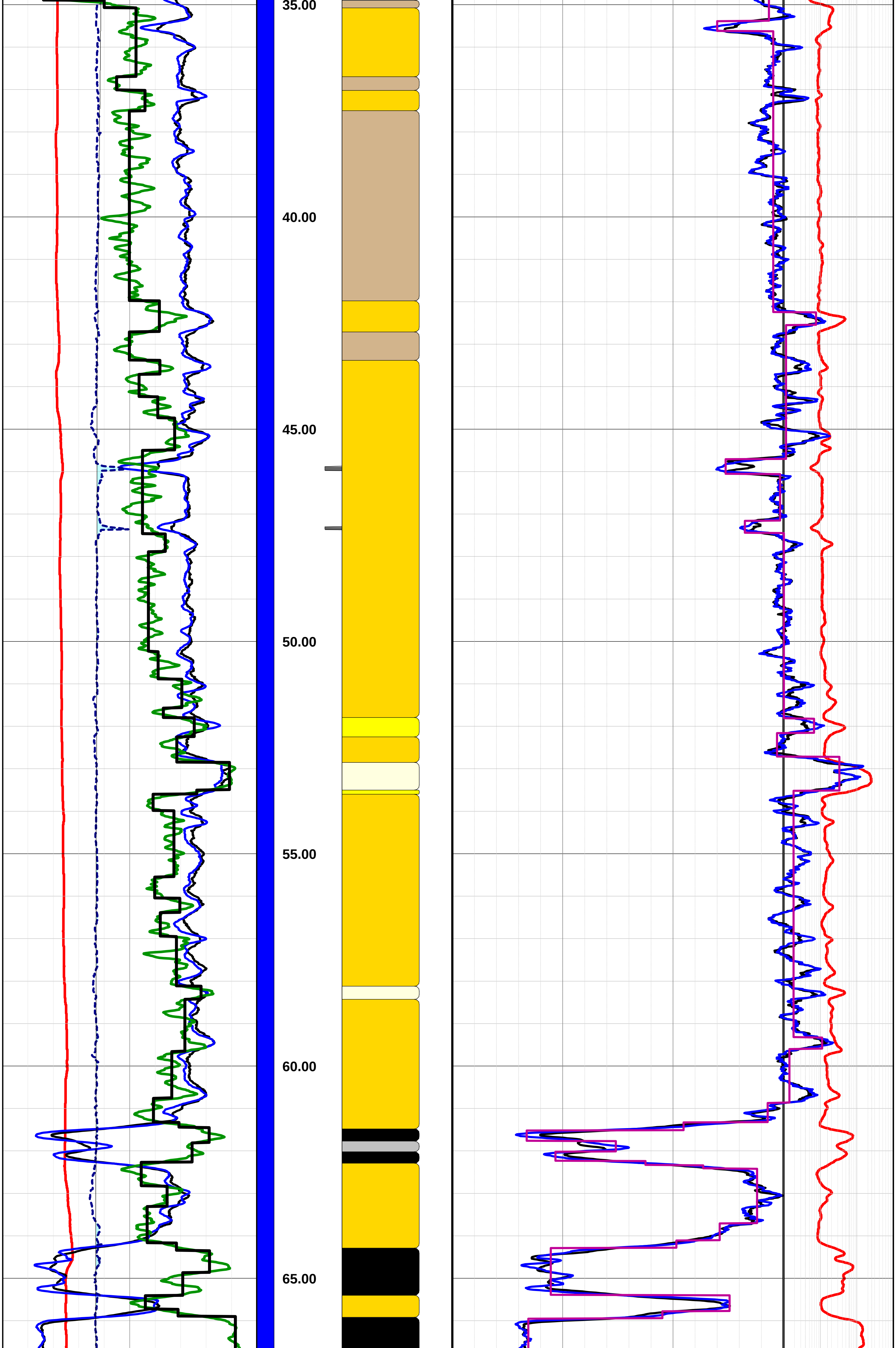
20.00
25.00
27.0
Fluid Level
28.6
asing Shoe
30.00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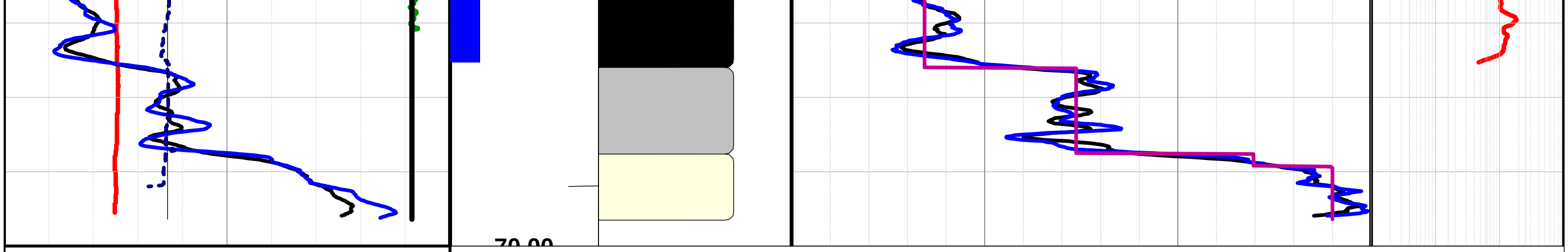
55.00
60.00
65.00



50	mm	300	NOM_BIT
200	API	0	GAM(NAT)
50	mm	300	CALIPER
0	DEG	20	SANG
1	g/cc	3	DEN(SS)
1	g/cc	3	DEN(LS)
			WT_FLAG
			DATA_FLAG
	1m:100m		Depth
			CASING
			LITHOLOGY
			COKED_COAL
1	g/cc	3	DEN(ER)
1	g/cc	3	DEN(COD)
1	OHM-M	1000	RES(SG)

DEPTH SCALE 1:100

MPC KINETIC

QUICKLOOK LITHOLOGY LOG

201858

COMPANY	BMA	**FIELD**	CVR	**STATE**	QLD
WELL	201858	**LOCATION**	MB20CRM03P_HY	**COUNTRY**	AUSTRALIA

LOCATION: MB20CRM03P_HY
FIELD: CVR
STATE: QLD
WELL: 201858
COMPANY: BMA

LOG MEASURED FROM	GL	ELEVATIONS:	OTHER SERVICES:
DRILLING MEASURED FROM	GL	KB	1.
PERMANENT DATUM		DF	2.
PERMANENT DATUM ELEVATION		GL	3.

LICENSE	SECTION	TOWNSHIP	RANGE	MAGNETIC DECLINATION
				8.17deg

DATE	23-11-2020			RECORDED BY	LAP		
TIME	15-55			WITNESSED BY			
RUN NUMBER	1			LOGGING UNIT	V034		
DEPTH-DRILLER	105m			RIG NUMBER	EWC RIG728		
DEPTH-LOGGER	104.99m			TOOL TYPE	9239C		
BIT SIZE	140mm			TOOL SERIAL NO.	2727		
CASING TYPE	PVC			EASTING	613101		
CASING ID	179mm			NORTHING	7551018		
CASING BOTTOM	18m			SAMPLE INT.	.01m		
FLUID TYPE	0			LOG DIRECTION	U		
TRUCK CAL NO.	0.09770			FEET OR METER	M		
WATER LEVEL	18.1m			SOURCE TYPE	CS137	SOURCE ID	CZ3954

QUICKLOOK LITHOLOGY ANALYSIS PARAMETERS

1. HYBRID BOUNDARY PICK ANALYSIS APPLIED.
2. BLOCK AVERAGED GAMMA AND DENSITY USED.
3. GAMMA-DENSITY CROSSPLOT CLUSTER CHART APPLIED - CCC.v.1.13
4. LITHOLOGICAL DICTIONARY APPLIED - COAL.
5. CASING DEPTH SUPPLIED BY LOG
6. THE QUICKLOOK PROCESS HAS BEEN DEVELOPED TO PROCESS DATA RECORDED IN OPENHOLE.
   THE INTERPRETATION PROVIDED FOR DATA RECORDED EITHER IN-ROD OR IN CASING SHOULD BE TREATED WITH CAUTION

LOGGER COMMENTS:

1. REQUESTED TO LOG DENSITY, VERT & FWS
2. DENSITY LOG DATA SPIKES 6.4m & 12.4m, DUE TO PVC CASING JOINTS WITH CALIPER JUMPING
3.

LITHOLOGY LEGEND

⬛	**CO - Coal**	🟨	**S3 - Sandstone - fine to medium grained**
▨	**CF - Inferior Coal**	⬜	**S4 - Sandstone - medium grained**
🟦	**ST - SILTSTONE**	🟪	**TF - TUFF**

🟦	ST - SILTSTONE	🟪	TF - TUFF
🟫	**S1 - Sandstone - very fine grained**	🟩	**CY - Claystone**
🟨	**S2 - Sandstone - fine grained**		

MNEMONICS

DEN(LS)	LONG SPACED DENSITY STANDARD UNITS
DEN(SS)	SHORT SPACED DENSITY STANDARD UNITS
RES(SG)	SHORT GUARD RESISTIVITY
DENR(LS)	LONG SPACED DENSITY RESPONSE UNITS
DENR(SS)	SHORT SPACED DENSITY RESPONSE UNITS
DEN(CDL)	COMPENSATED DENSITY
POR(DEN)	SANDSTONE DENSITY POROSITY
CALIPER	MECHANICAL CALIPER FROM DENSITY
GAM(NAT)	NATURAL GAMMA FROM DENSITY
DEN(COD)	COMPENSATED DENSITY FORMULA
DEN(ER)	VECTAR PROCESSED DENSITY
SANGB	SAMPLE ANGLE BEARING
SANG	SAMPLE SLANT ANGLE (0 DEG = VERTICAL DOWN)
TVD	TRUE VERTICAL DEPTH
EAST	BOREHOLE EAST DEVIATION
NORTH	BOREHOLE NORTH DEVIATION
CDIST	DEVIATED CLOSURE DISTANCE
CANGB	DEVIATED CLOSURE ANGLE BEARING

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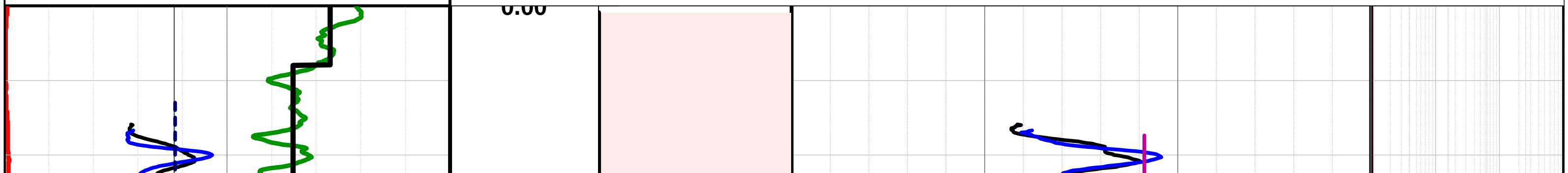
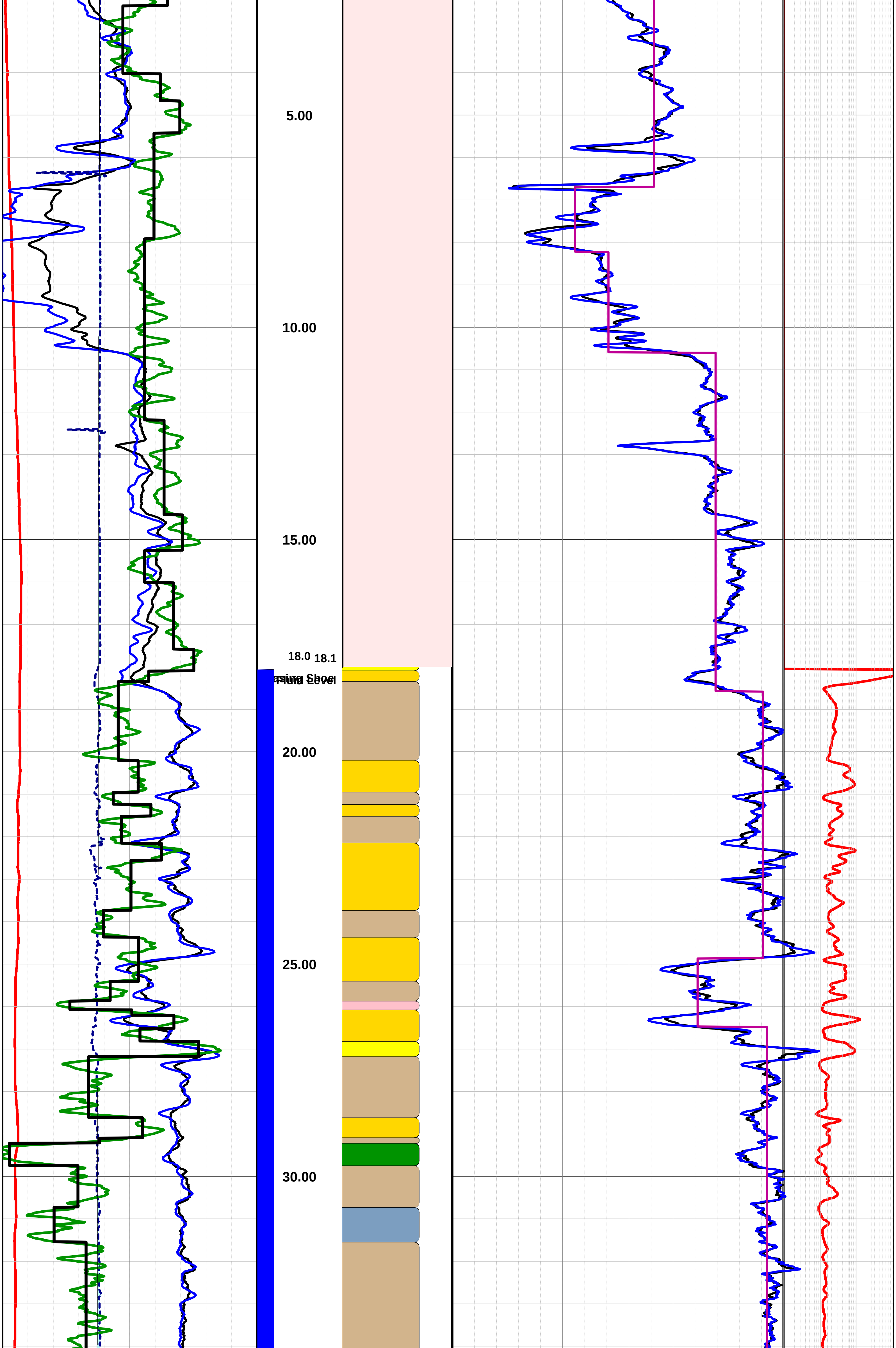
DEPTH SCALE 1:100

DEN(LS) 1 g/cc 3	**Depth** 1m:100m	**COKED_COAL**		**RES(SG)** 1 OHM-M 1000
DEN(SS) 1 g/cc 3	**DATA_FLAG**	**LITHOLOGY**	**DEN(COD)** 1 g/cc 3	
SANG 0 DEG 20	**WT_FLAG**	**CASING**	**DEN(ER)** 1 g/cc 3	
CALIPER 50 mm 300				
GAM(NAT) 200 API 0				
NOM_BIT 50 mm 300				

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18.1
Casing Shoe
Fluid Level
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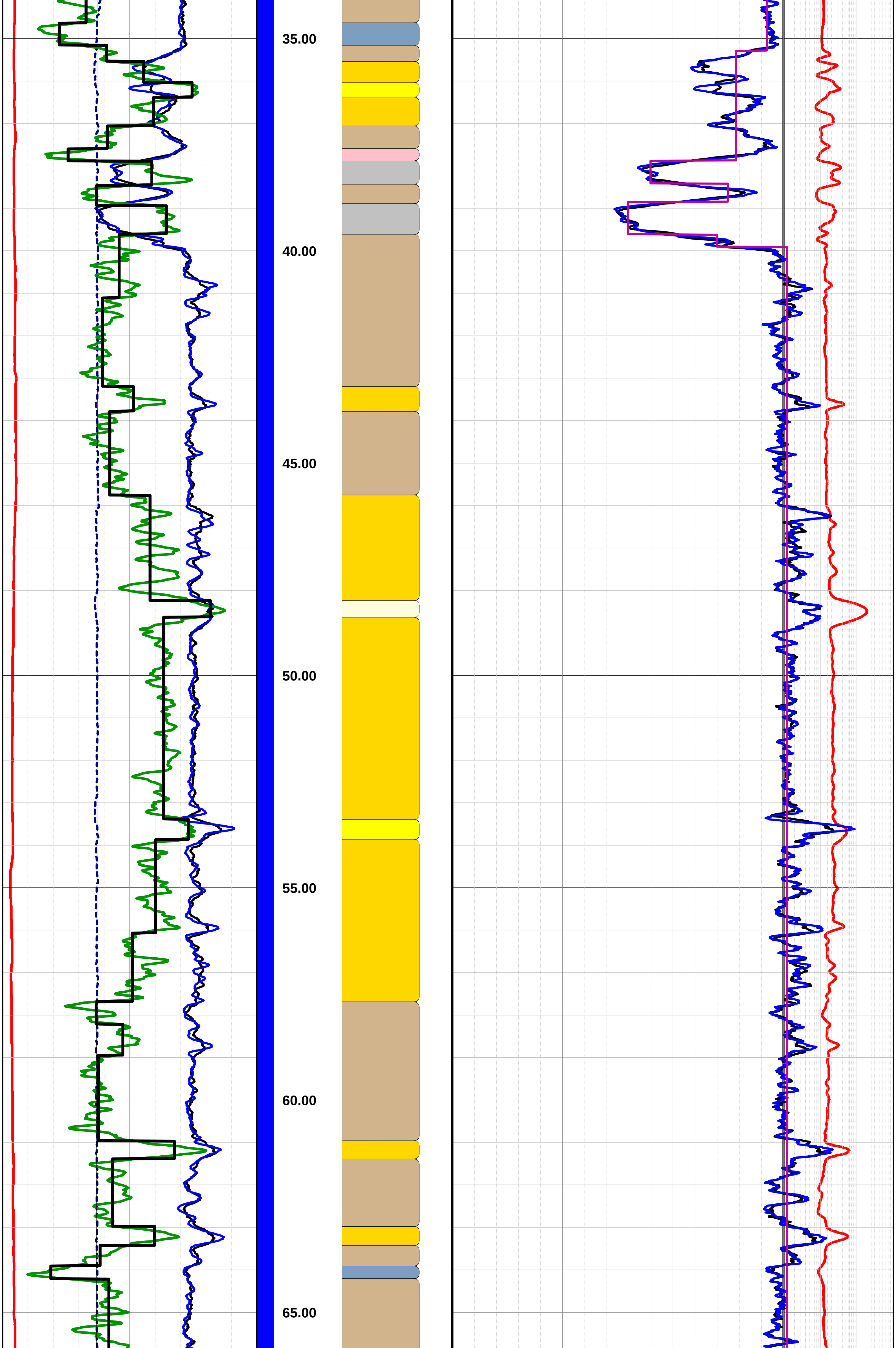
30.00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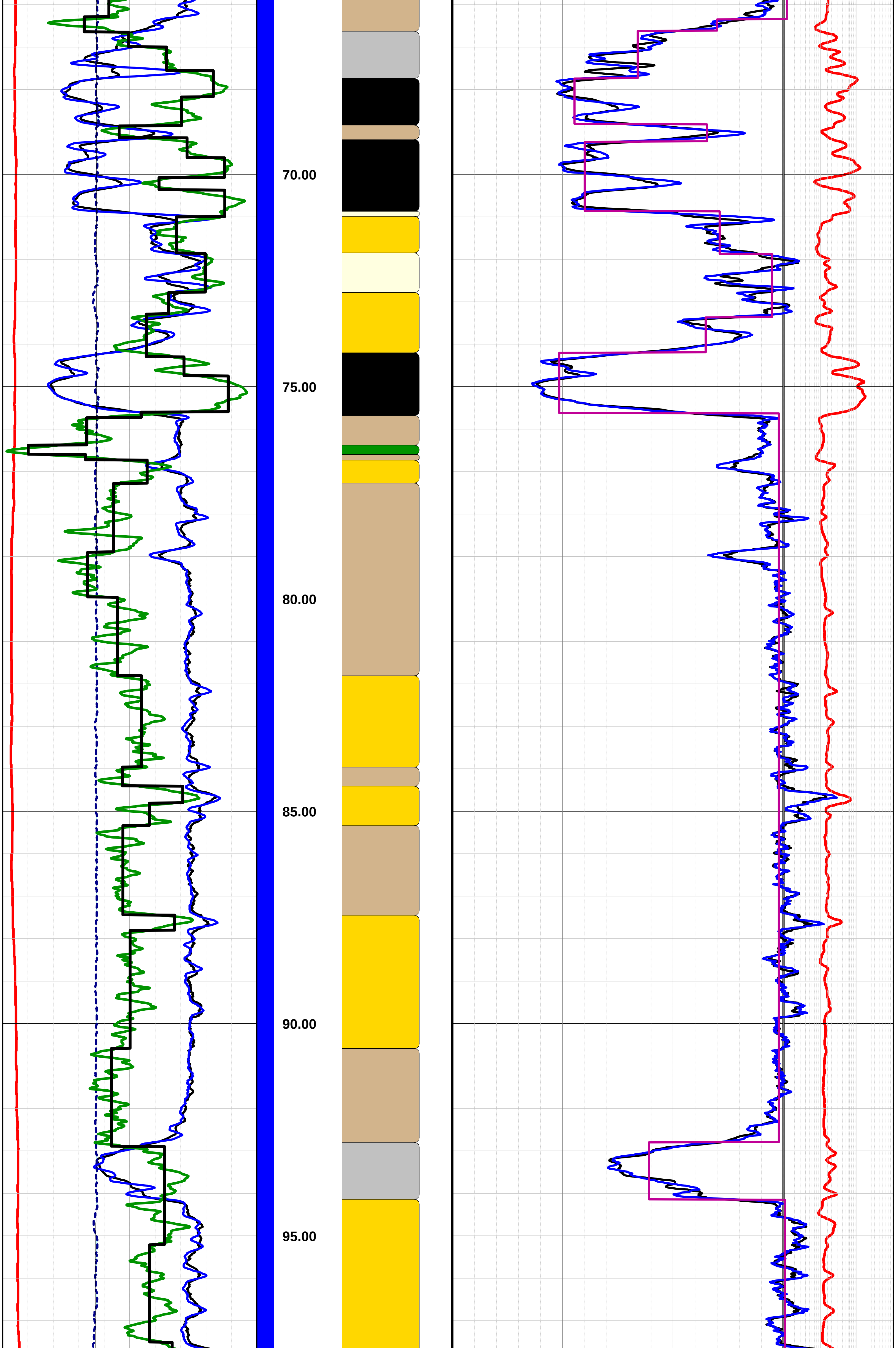
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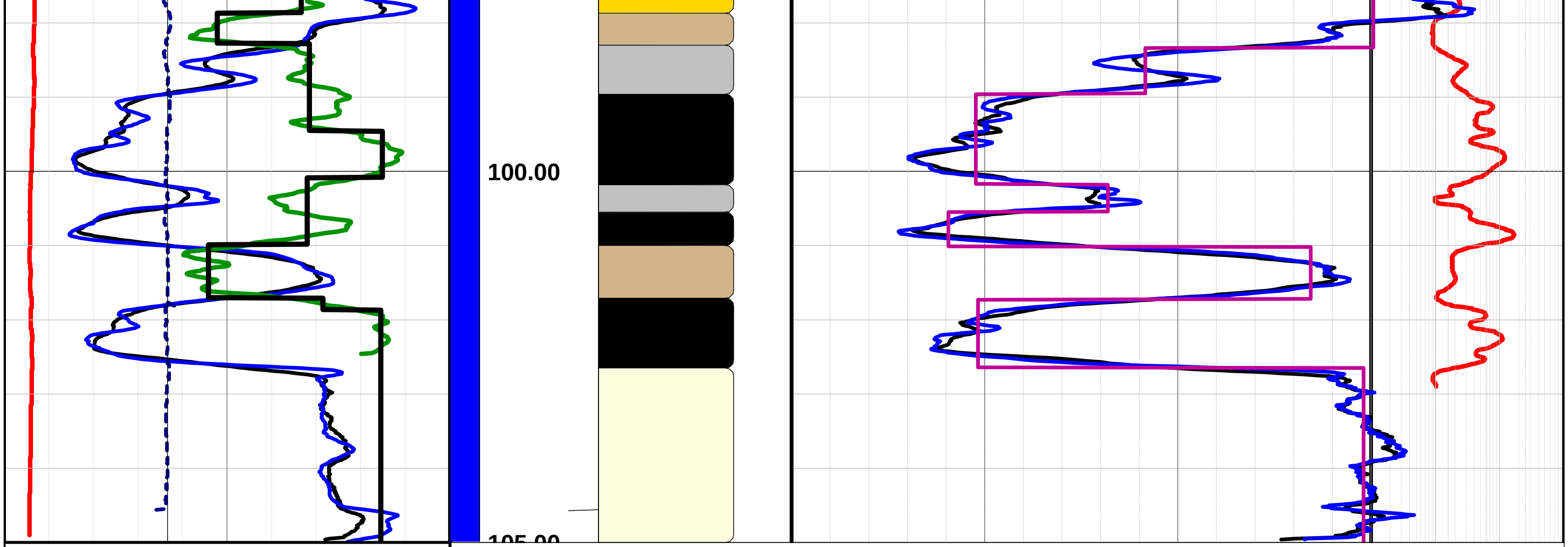


50 mm 300 NOM_BIT				
200 API 0 GAM(NAT)				
50 mm 300 CALIPER				
0 DEG 20 SANG	WT_FLAG	CASING	1 g/cc 3 DEN(ER)	
1 g/cc 3 DEN(SS)	DATA_FLAG	LITHOLOGY	1 g/cc 3 DEN(COD)	
1 g/cc 3 DEN(LS)	1m:100m Depth	COKED_COAL		1 OHM-M 1000 RES(SG)

DEPTH SCALE 1:100

MPC KINETIC

QUICKLOOK LITHOLOGY LOG

201853

COMPANY	BMA	**FIELD**	CVR	**STATE**	QLD
WELL	201853	**LOCATION**	CVMVWP_01_HY	**COUNTRY**	AUSTRALIA

LOCATION: CVMVWP_01_HY
FIELD: CVR
STATE: QLD
WELL: 201853
COMPANY: BMA

LOG MEASURED FROM	GL	ELEVATIONS:	OTHER SERVICES:
DRILLING MEASURED FROM	GL	KB	1.
PERMANENT DATUM		DF	2.
PERMANENT DATUM ELEVATION		GL	3.

LICENSE	SECTION	TOWNSHIP	RANGE	MAGNETIC DECLINATION
				8.17deg

DATE	10-11-2020			RECORDED BY	JOT		
TIME	13-46			WITNESSED BY			
RUN NUMBER				LOGGING UNIT	V032		
DEPTH-DRILLER	119.7m			RIG NUMBER			
DEPTH-LOGGER	119.24m			TOOL TYPE	9239C		
BIT SIZE	139mm			TOOL SERIAL NO.	2745		
CASING TYPE	PVC			EASTING	610042		
CASING ID	170mm			NORTHING	7560433		
CASING BOTTOM	22.9m			SAMPLE INT.	.01m		
FLUID TYPE	0			LOG DIRECTION	U		
TRUCK CAL NO.	0.0978			FEET OR METER	M		
WATER LEVEL	16.2 m			SOURCE TYPE	CS137	SOURCE ID	CZ3952

QUICKLOOK LITHOLOGY ANALYSIS PARAMETERS

1. HYBRID BOUNDARY PICK ANALYSIS APPLIED.
2. BLOCK AVERAGED GAMMA AND DENSITY USED.
3. GAMMA-DENSITY CROSSPLOT CLUSTER CHART APPLIED - CCC.v.1.13
4. LITHOLOGICAL DICTIONARY APPLIED - COAL.
5. CASING DEPTH SUPPLIED BY LOG
6. THE QUICKLOOK PROCESS HAS BEEN DEVELOPED TO PROCESS DATA RECORDED IN OPENHOLE.
   THE INTERPRETATION PROVIDED FOR DATA RECORDED EITHER IN-ROD OR IN CASING SHOULD BE TREATED WITH CAUTION

LOGGER COMMENTS:

1.

2.

3.

LITHOLOGY LEGEND

⬛	**CO - Coal**	🟧	**S2 - Sandstone - fine grained**
▒	**CF - Inferior Coal**	🟨	**S3 - Sandstone - fine to medium grained**
🟦	**ST - SILTSTONE**	🟪	**TF - TUFF**

🟦	ST - SILTSTONE	🟥	TF - TUFF
🟫	**S1 - Sandstone - very fine grained**	⬜	**XT - Carbonaceous Siltstone**

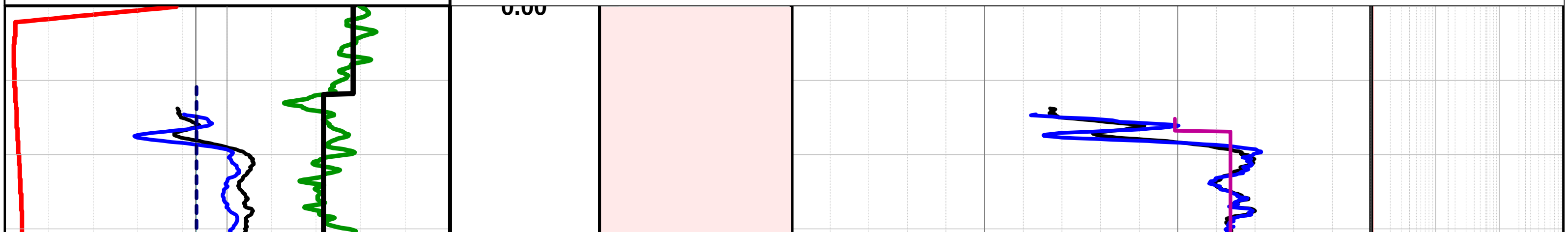
MNEMONICS

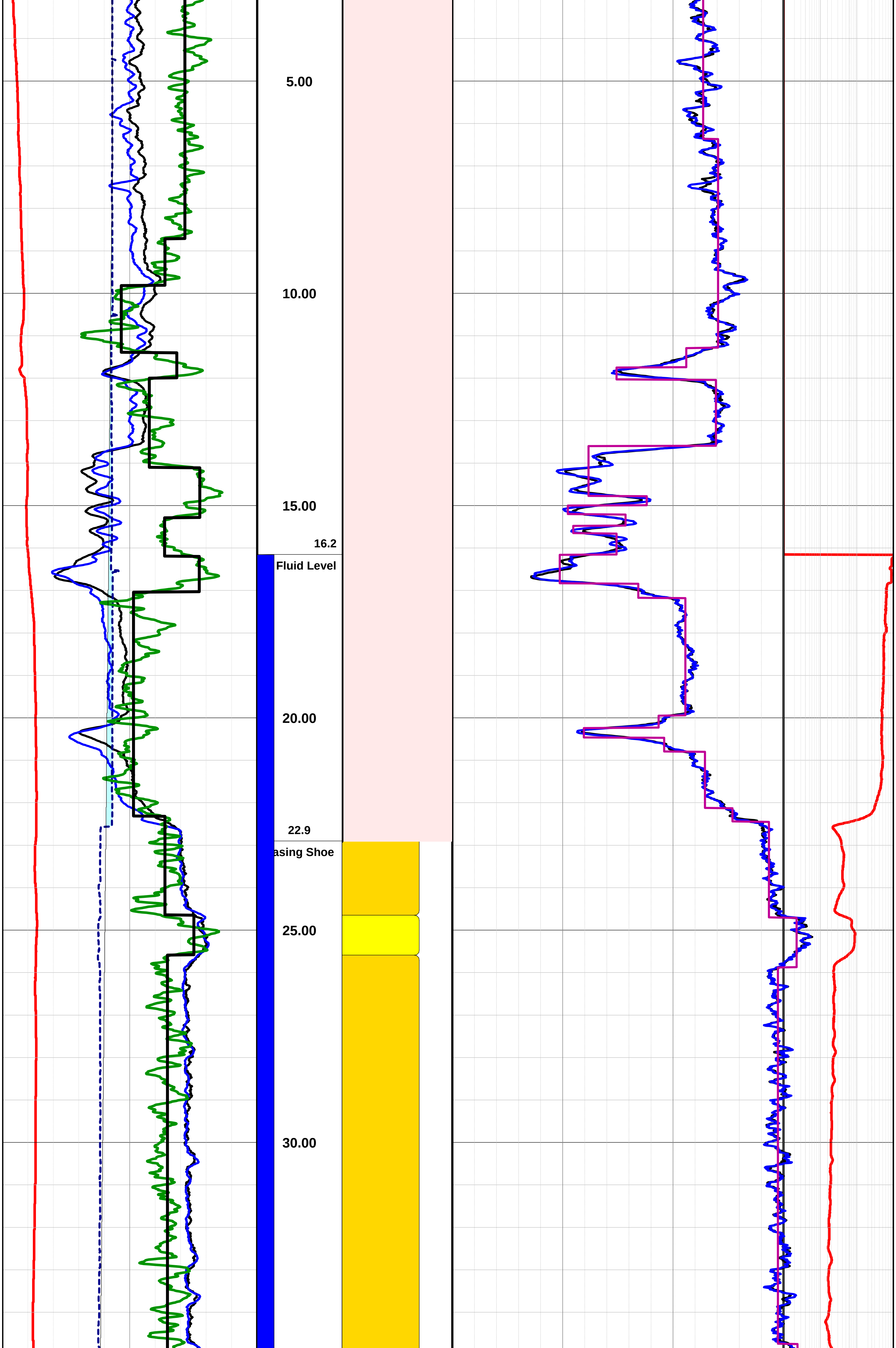
DEN(LS)	LONG SPACED DENSITY STANDARD UNITS
DEN(SS)	SHORT SPACED DENSITY STANDARD UNITS
RES(SG)	SHORT GUARD RESISTIVITY
DENR(LS)	LONG SPACED DENSITY RESPONSE UNITS
DENR(SS)	SHORT SPACED DENSITY RESPONSE UNITS
DEN(CDL)	COMPENSATED DENSITY
POR(DEN)	SANDSTONE DENSITY POROSITY
CALIPER	MECHANICAL CALIPER FROM DENSITY
GAM(NAT)	NATURAL GAMMA FROM DENSITY
DEN(COD)	COMPENSATED DENSITY FORMULA
DEN(ER)	VECTAR PROCESSED DENSITY
SANGB	SAMPLE ANGLE BEARING
SANG	SAMPLE SLANT ANGLE (0 DEG = VERTICAL DOWN)
TVD	TRUE VERTICAL DEPTH
EAST	BOREHOLE EAST DEVIATION
NORTH	BOREHOLE NORTH DEVIATION
CDIST	DEVIATED CLOSURE DISTANCE
CANGB	DEVIATED CLOSURE ANGLE BEARING

IMPORTANT NOTE	The following interpretations are opinions based upon inferences from borehole logs, Kinetic Logging Services Pty Ltd cannot and does not guarantee the correctness or accuracy of any interpretations. Therefore Kinetic Logging Services Pty Ltd shall not be liable or responsible for any loss, damage, cost or expense incurred or sustained by anyone resulting from any interpretations.

DEPTH SCALE 1:100

DEN(LS) 1 g/cc 3	**Depth** 1m:100m	**COKED_COAL**		**RES(SG)** 1 OHM-M 1000
DEN(SS) 1 g/cc 3	**DATA_FLAG**	**LITHOLOGY**	**DEN(COD)** 1 g/cc 3	
SANG 0 DEG 20	**WT_FLAG**	**CASING**	**DEN(ER)** 1 g/cc 3	
CALIPER 50 mm 300				
GAM(NAT) 200 API 0				
NOM_BIT 50 mm 300				

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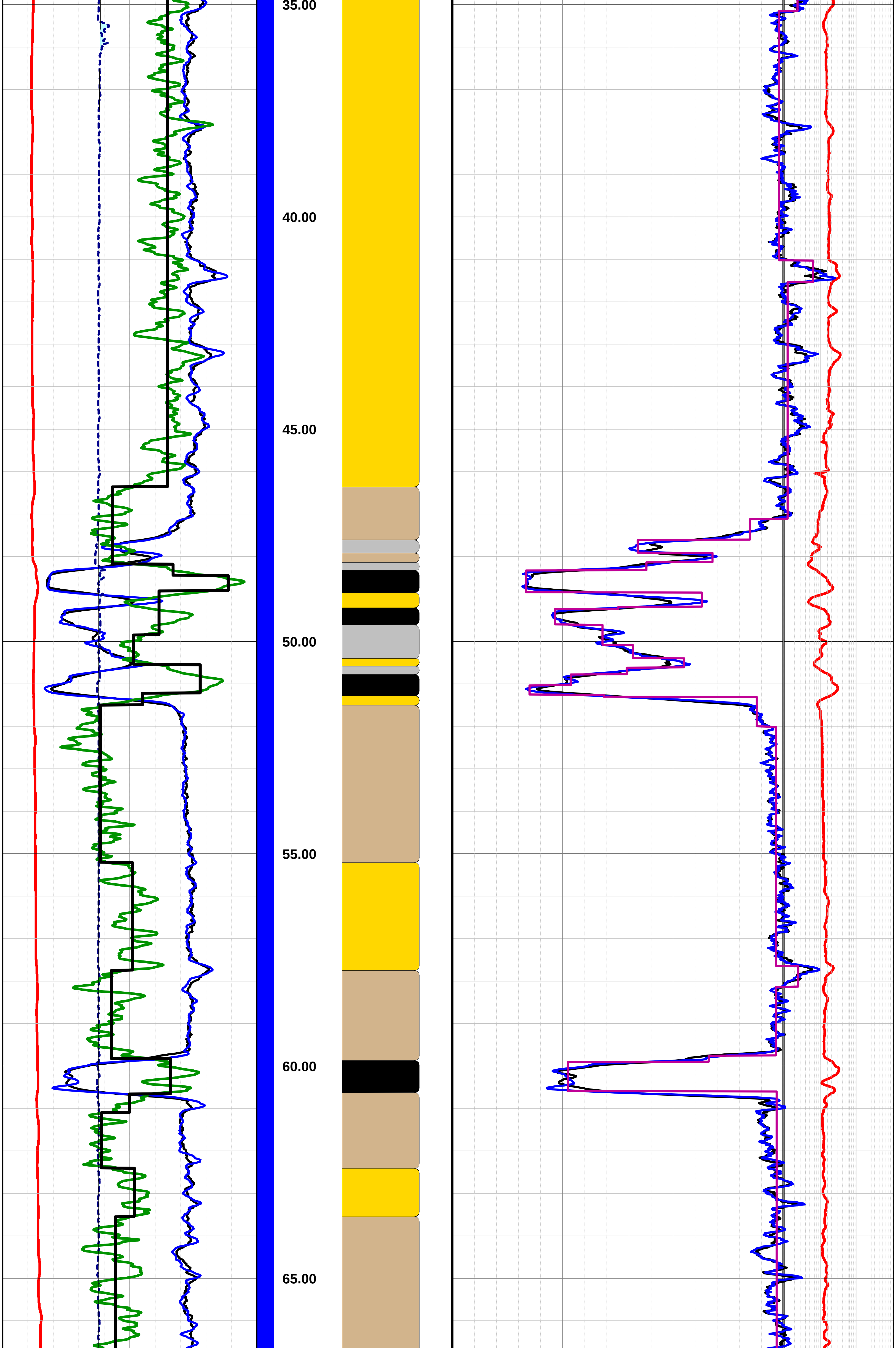
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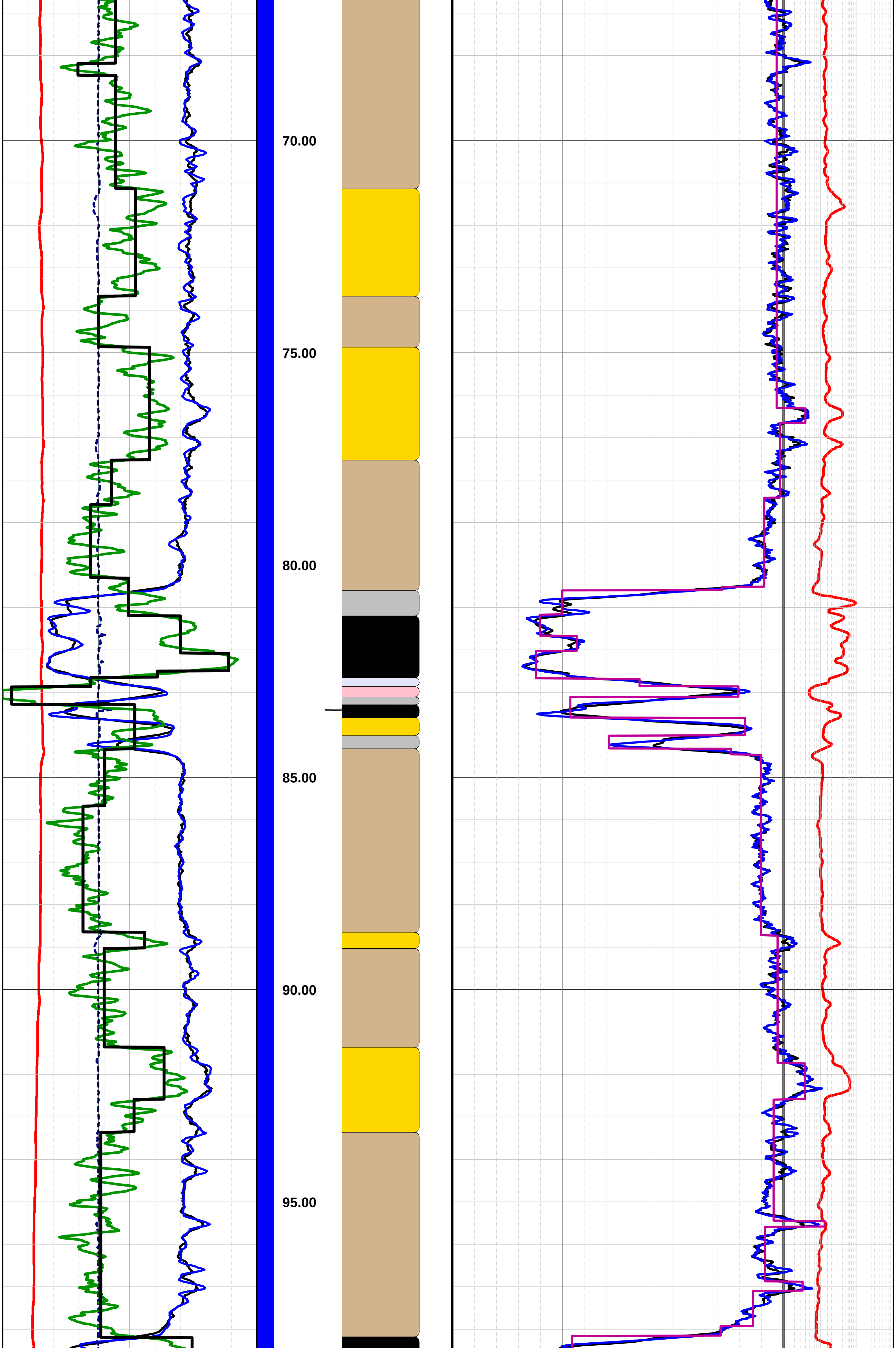
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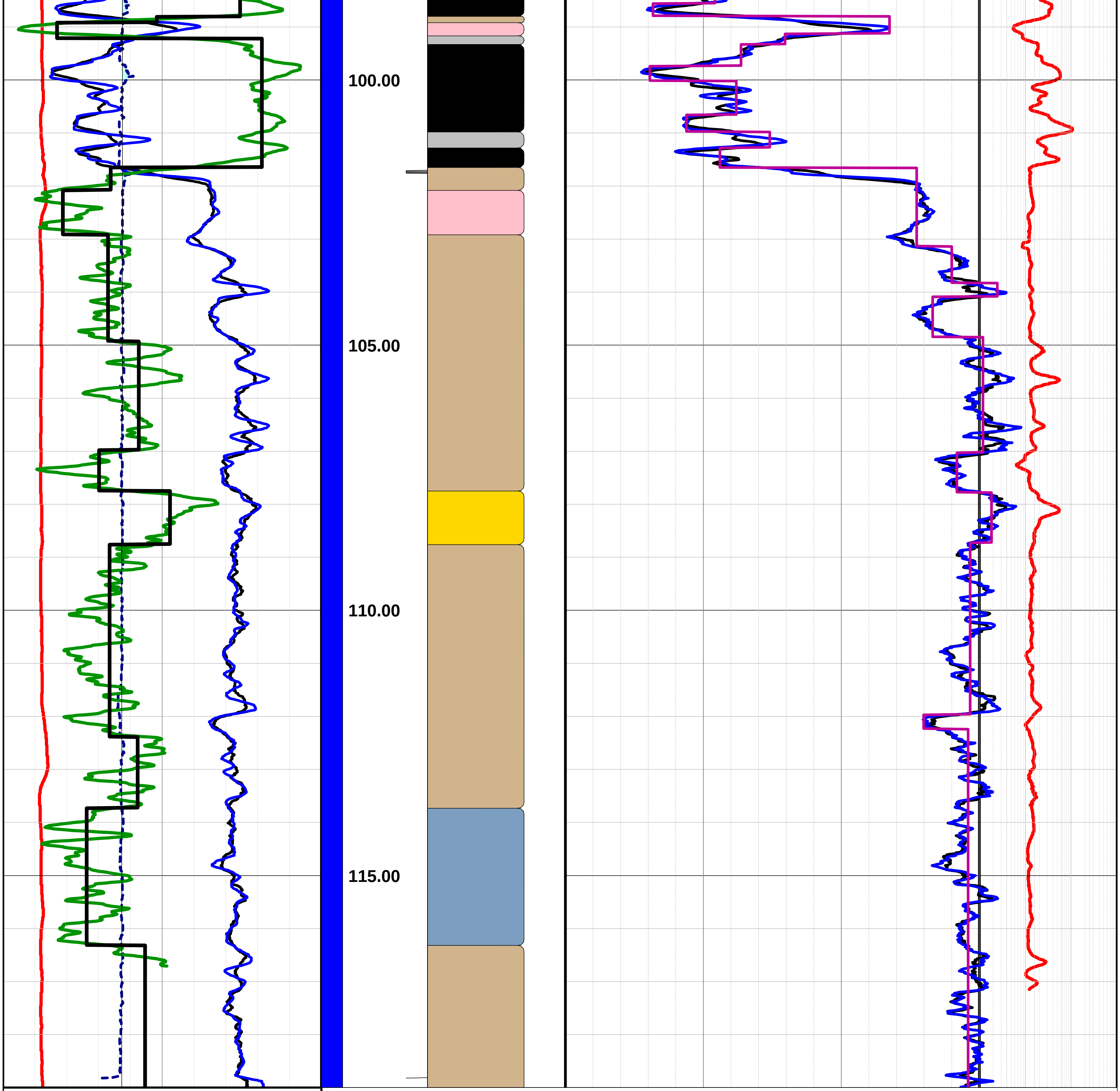

50	mm	300	NOM_BIT
200	API	0	GAM(NAT)
50	mm	300	CALIPER
0	DEG	20	SANG
1	g/cc	3	DEN(SS)
1	g/cc	3	DEN(LS)
			WT_FLAG
			DATA_FLAG
	1m:100m		Depth
			CASING
			LITHOLOGY
			COKED_COAL
1	g/cc	3	DEN(ER)
1	g/cc	3	DEN(COD)
1	OHM-M	1000	RES(SG)

DEPTH SCALE 1:100

QUICKLOOK LITHOLOGY LOG

201856_R01

COMPANY	BMA	**FIELD**	CVR	**STATE**	QLD
WELL	201856_R01	**LOCATION**	CVMVWP07_01_HY_R01	**COUNTRY**	AUSTRALIA

LOCATION: CVMVWP07_01_HY_R01
FIELD: CVR
STATE: QLD
WELL: 201856_R01
COMPANY: BMA

LOG MEASURED FROM	GL	ELEVATIONS:	OTHER SERVICES:
DRILLING MEASURED FROM	GL	KB	1.
PERMANENT DATUM		DF	2.
PERMANENT DATUM ELEVATION		GL	3.

LICENSE	SECTION	TOWNSHIP	RANGE	MAGNETIC DECLINATION
				8.17deg

DATE	20-11-2020			RECORDED BY	LAP		
TIME	13-51			WITNESSED BY			
RUN NUMBER	1			LOGGING UNIT	V034		
DEPTH-DRILLER	271.2m			RIG NUMBER	EWC RIG728		
DEPTH-LOGGER	271.17m			TOOL TYPE	9239C		
BIT SIZE	140mm			TOOL SERIAL NO.	2727		
CASING TYPE	PVC			EASTING	611449		
CASING ID	179mm			NORTHING	7552345		
CASING BOTTOM	76m			SAMPLE INT.	.01m		
FLUID TYPE	0			LOG DIRECTION	U		
TRUCK CAL NO.	0.09770			FEET OR METER	M		
WATER LEVEL	25.5m			SOURCE TYPE	CS137	SOURCE ID	CZ3954

QUICKLOOK LITHOLOGY ANALYSIS PARAMETERS

1. HYBRID BOUNDARY PICK ANALYSIS APPLIED.
2. BLOCK AVERAGED GAMMA AND DENSITY USED.
3. GAMMA-DENSITY CROSSPLOT CLUSTER CHART APPLIED - CCC.v.1.13
4. LITHOLOGICAL DICTIONARY APPLIED - COAL.
5. CASING DEPTH SUPPLIED BY LOG
6. THE QUICKLOOK PROCESS HAS BEEN DEVELOPED TO PROCESS DATA RECORDED IN OPENHOLE.
   THE INTERPRETATION PROVIDED FOR DATA RECORDED EITHER IN-ROD OR IN CASING SHOULD BE TREATED WITH CAUTION

LOGGER COMMENTS:

1. REQUESTED TO LOG DENSITY, VERT & FWS
2.
3.

LITHOLOGY LEGEND

⬛	**CO - Coal**	🟨	**S3 - Sandstone - fine to medium grained**
▨	**CF - Inferior Coal**	⬜	**S4 - Sandstone - medium grained**
🟦	**ST - SILTSTONE**	🟥	**TF - TUFF**

🟦	ST - SILTSTONE	🟪	TF - TUFF
🟫	**S1 - Sandstone - very fine grained**	⬜	**XT - Carbonaceous Siltstone**
🟨	**S2 - Sandstone - fine grained**	🟩	**CY - Claystone**

MNEMONICS

DEN(LS)	LONG SPACED DENSITY STANDARD UNITS
DEN(SS)	SHORT SPACED DENSITY STANDARD UNITS
RES(SG)	SHORT GUARD RESISTIVITY
DENR(LS)	LONG SPACED DENSITY RESPONSE UNITS
DENR(SS)	SHORT SPACED DENSITY RESPONSE UNITS
DEN(CDL)	COMPENSATED DENSITY
POR(DEN)	SANDSTONE DENSITY POROSITY
CALIPER	MECHANICAL CALIPER FROM DENSITY
GAM(NAT)	NATURAL GAMMA FROM DENSITY
DEN(COD)	COMPENSATED DENSITY FORMULA
DEN(ER)	VECTAR PROCESSED DENSITY
SANGB	SAMPLE ANGLE BEARING
SANG	SAMPLE SLANT ANGLE (0 DEG = VERTICAL DOWN)
TVD	TRUE VERTICAL DEPTH
EAST	BOREHOLE EAST DEVIATION
NORTH	BOREHOLE NORTH DEVIATION
CDIST	DEVIATED CLOSURE DISTANCE
CANGB	DEVIATED CLOSURE ANGLE BEARING

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DEPTH SCALE 1:100

DEN(LS)
1 g/cc 3

DEN(SS)
1 g/cc 3

SANG
0 DEG 20

CALIPER
50 mm 300

GAM(NAT)
200 API 0

NOM_BIT
50 mm 300

Depth
1m:100m

DATA_FLAG

WT_FLAG

COKED_COAL

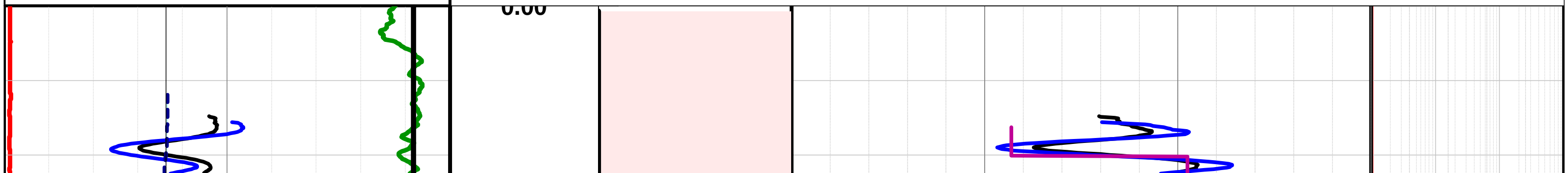
LITHOLOGY

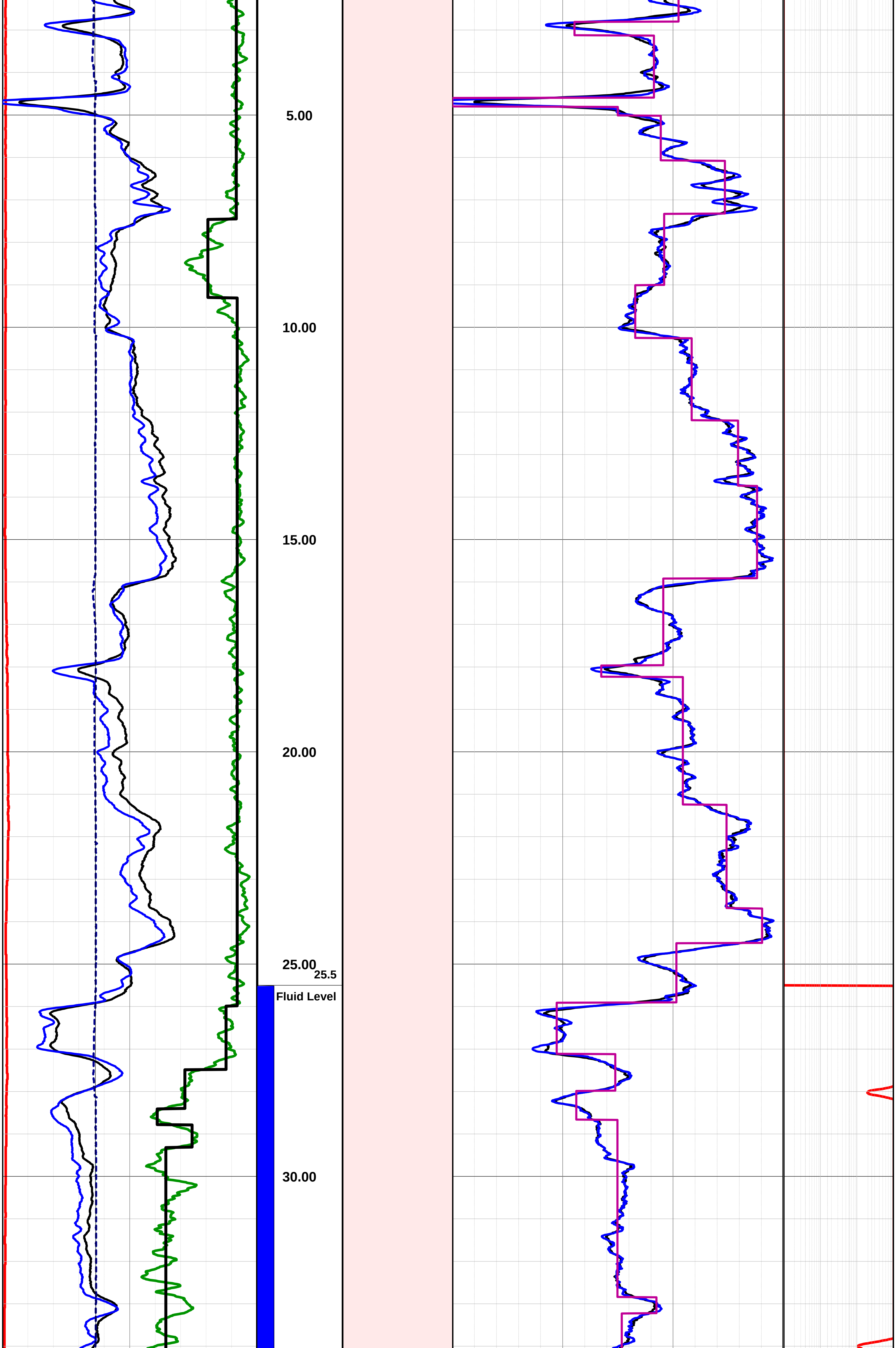
CASING

RES(SG)
1 OHM-M 1000

DEN(COD)
1 g/cc 3

DEN(ER)
1 g/cc 3

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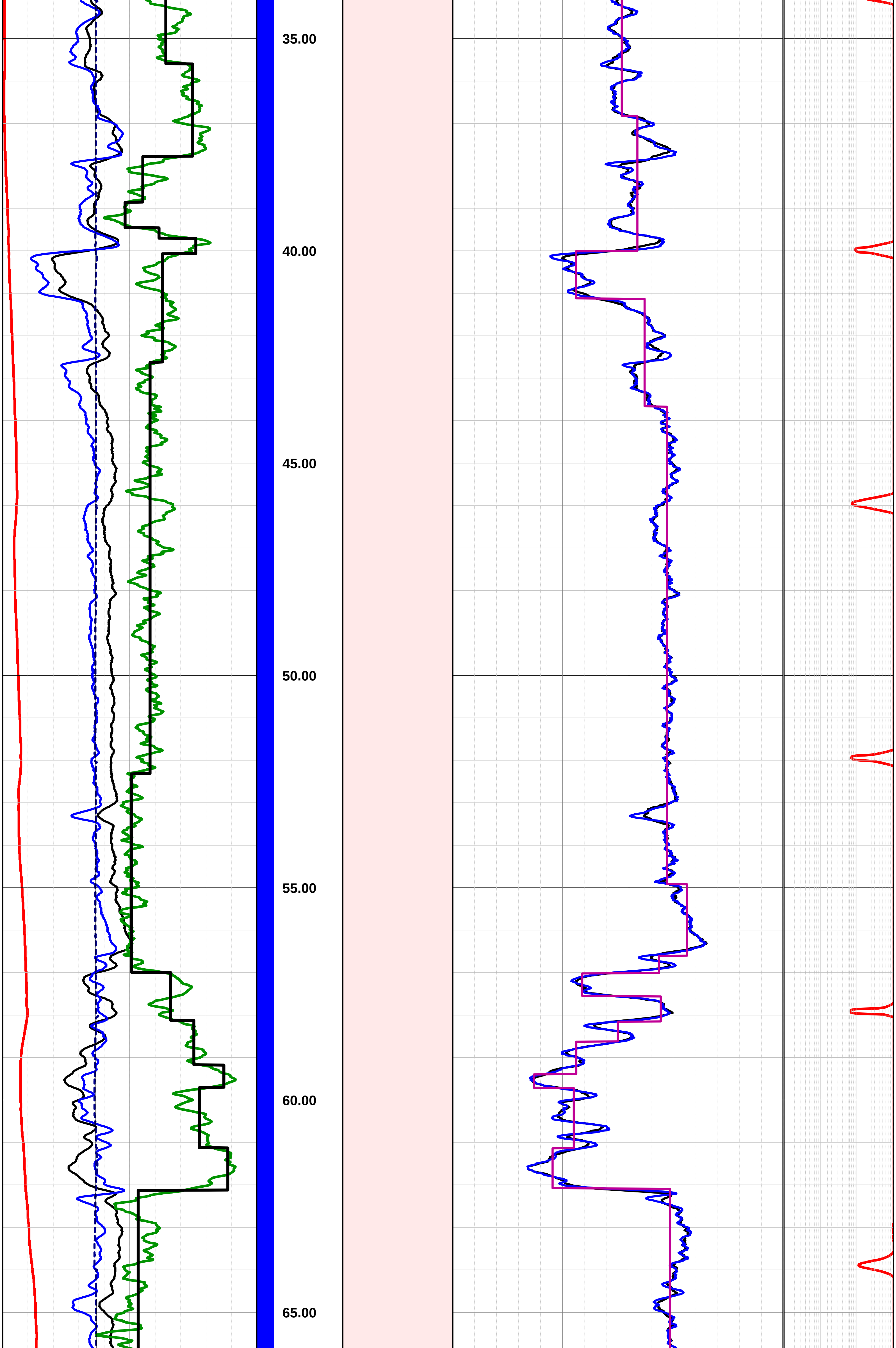
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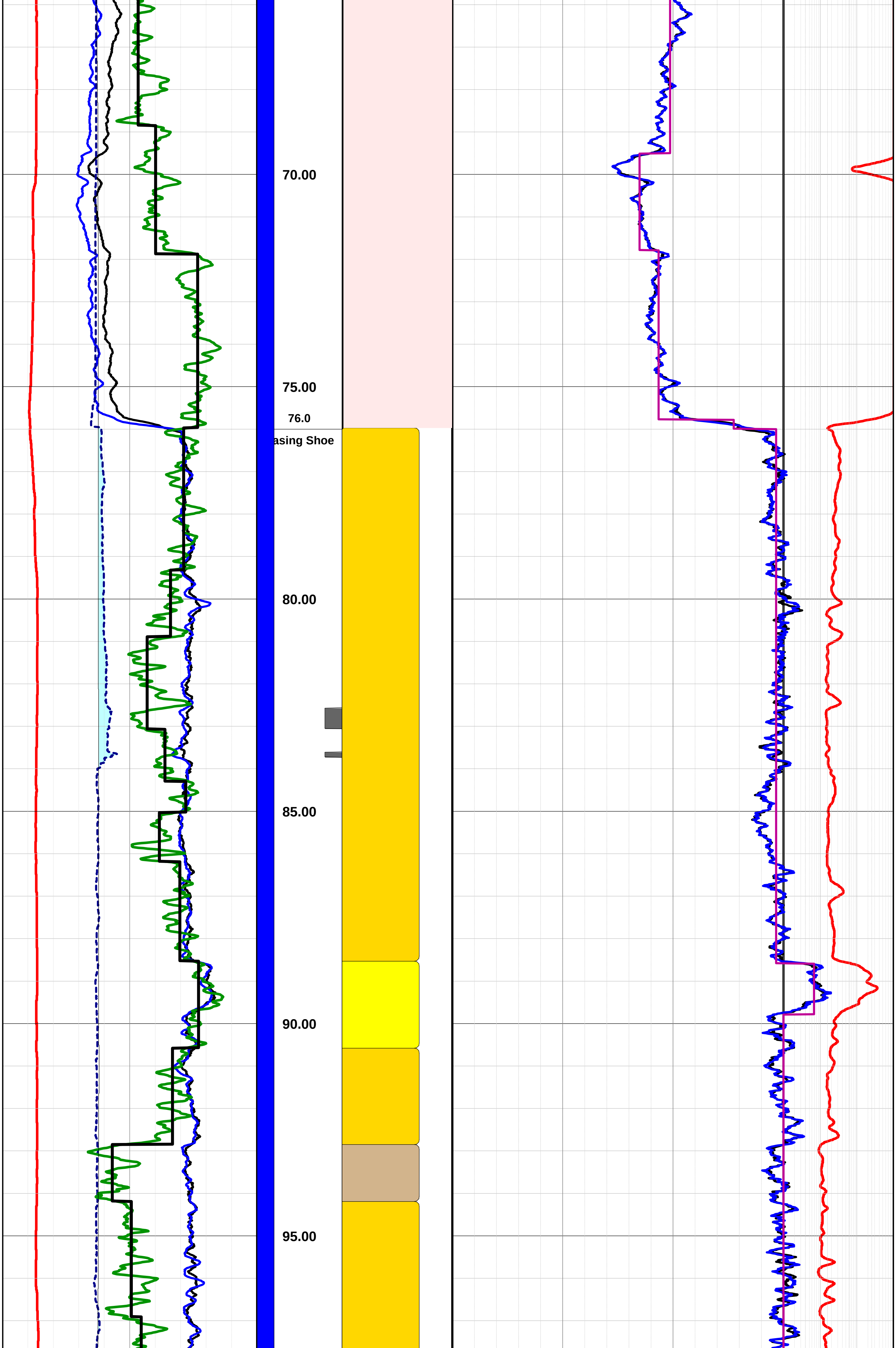
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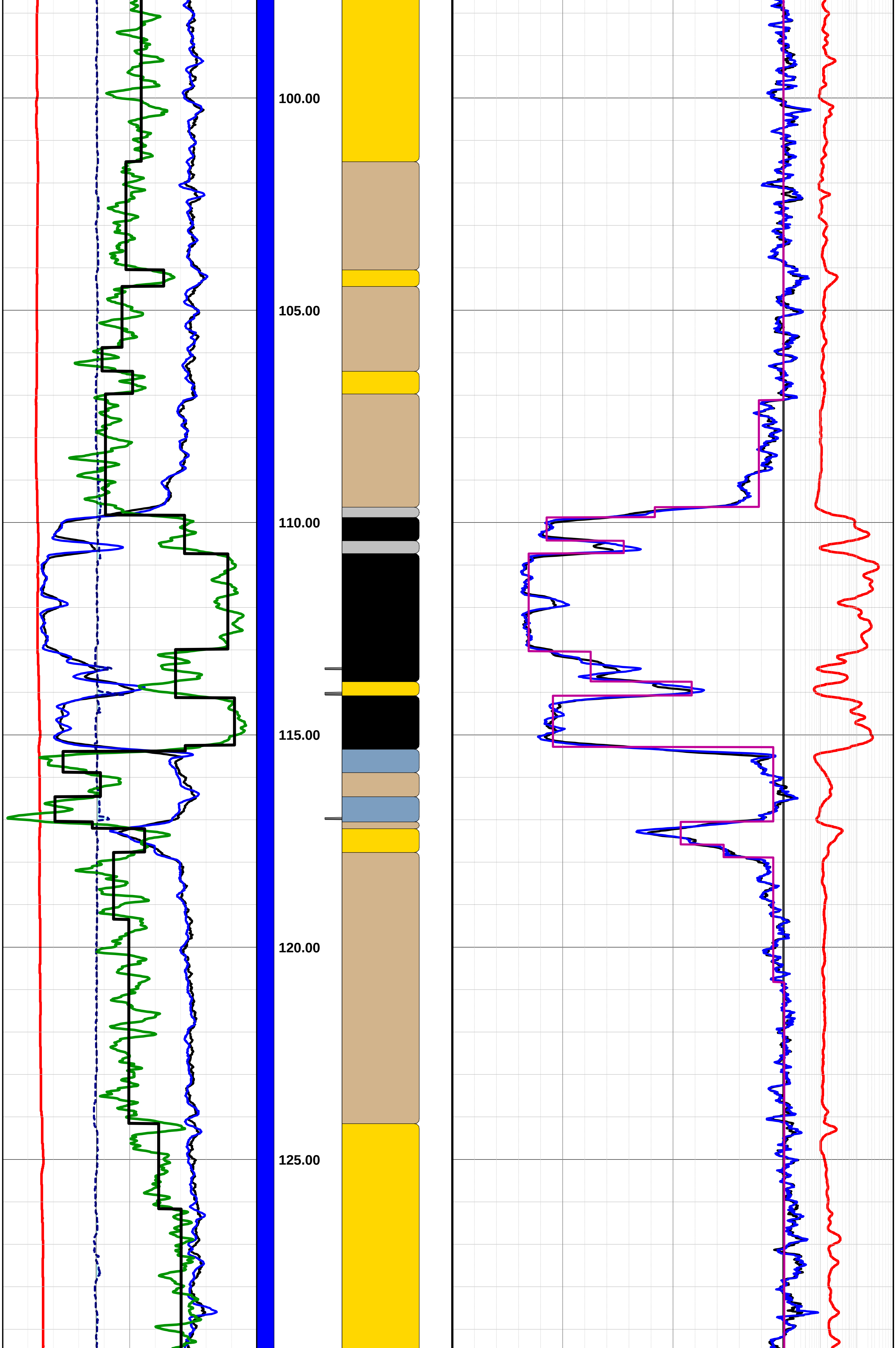
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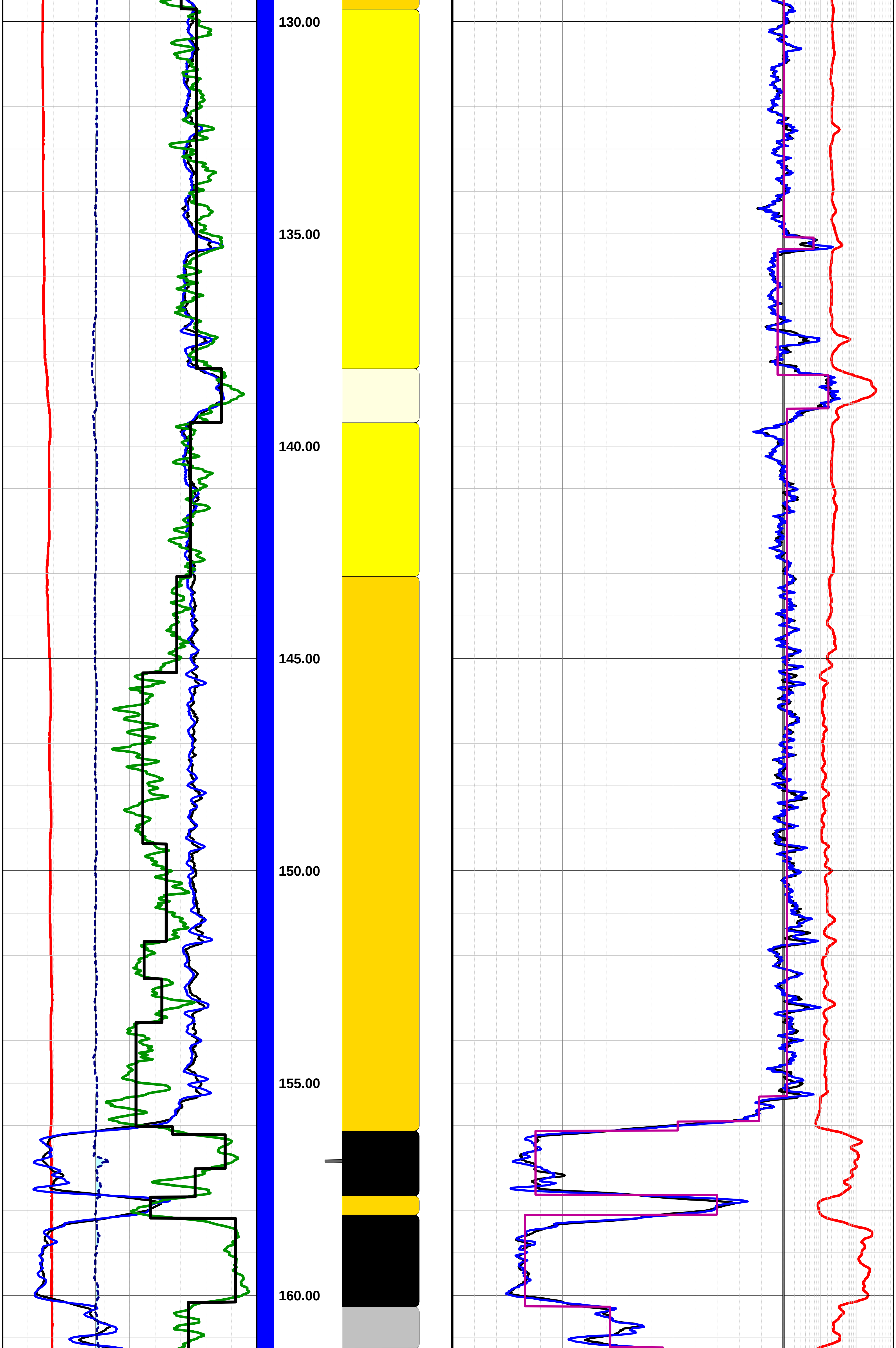
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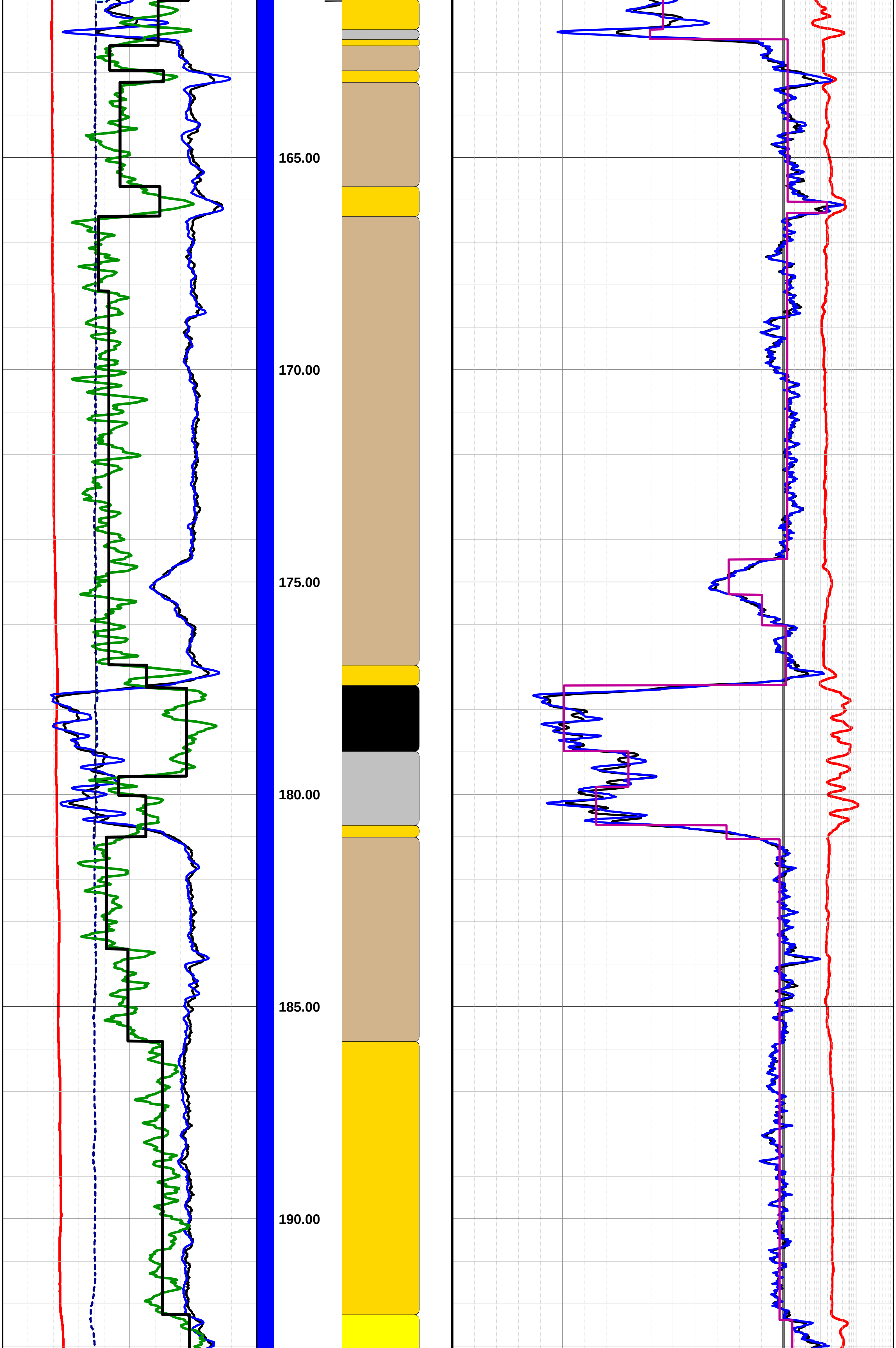
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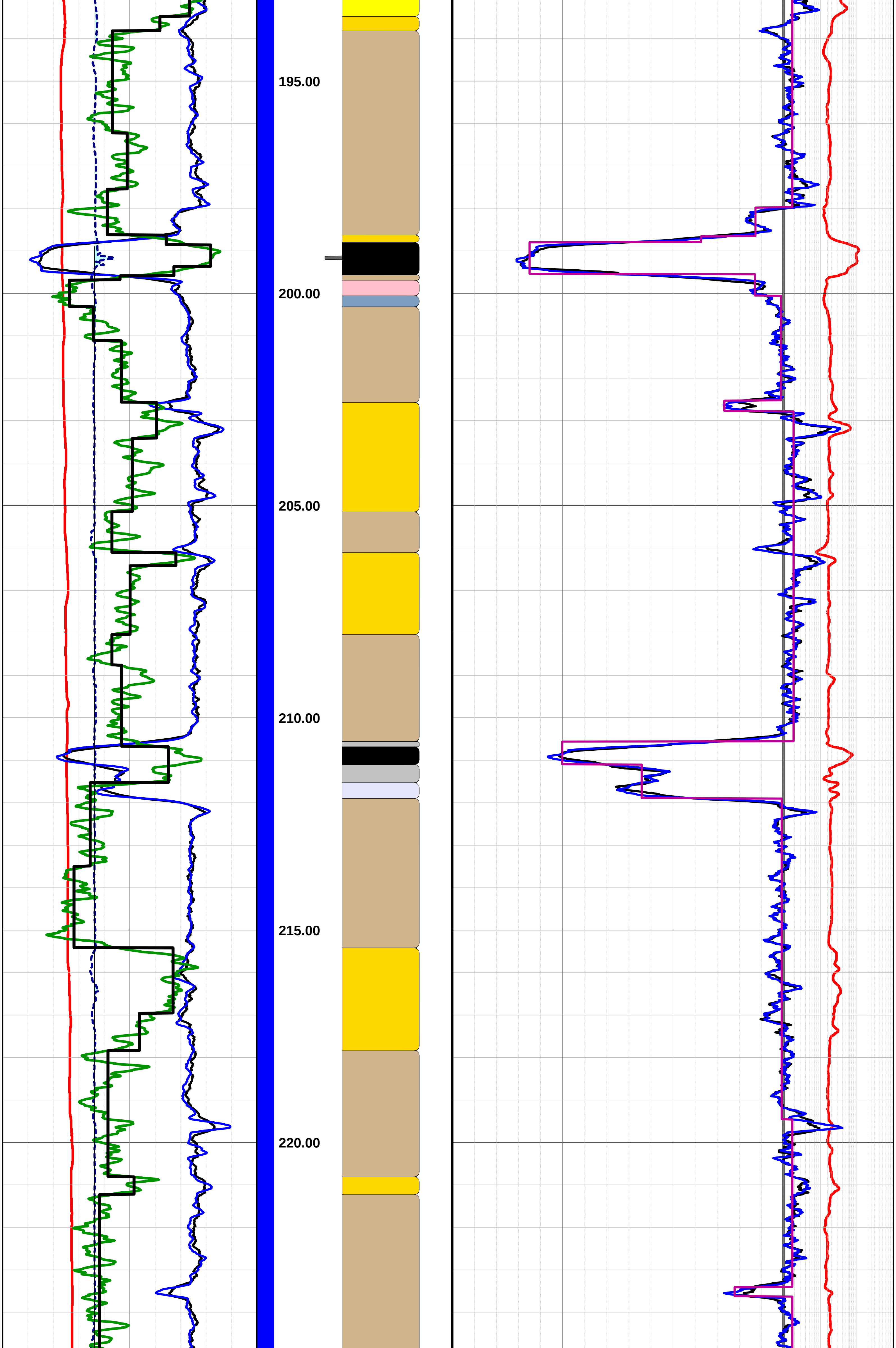
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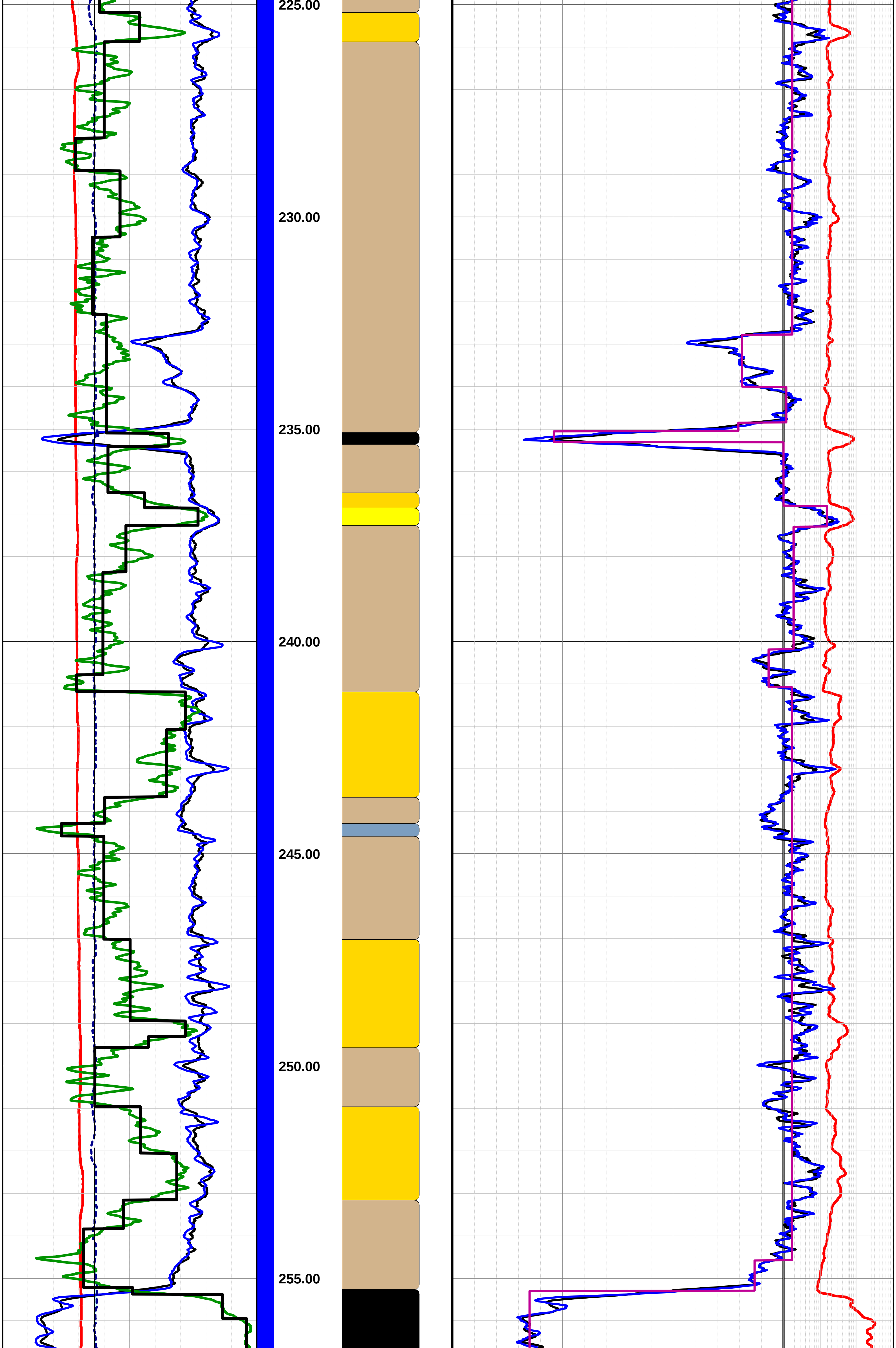
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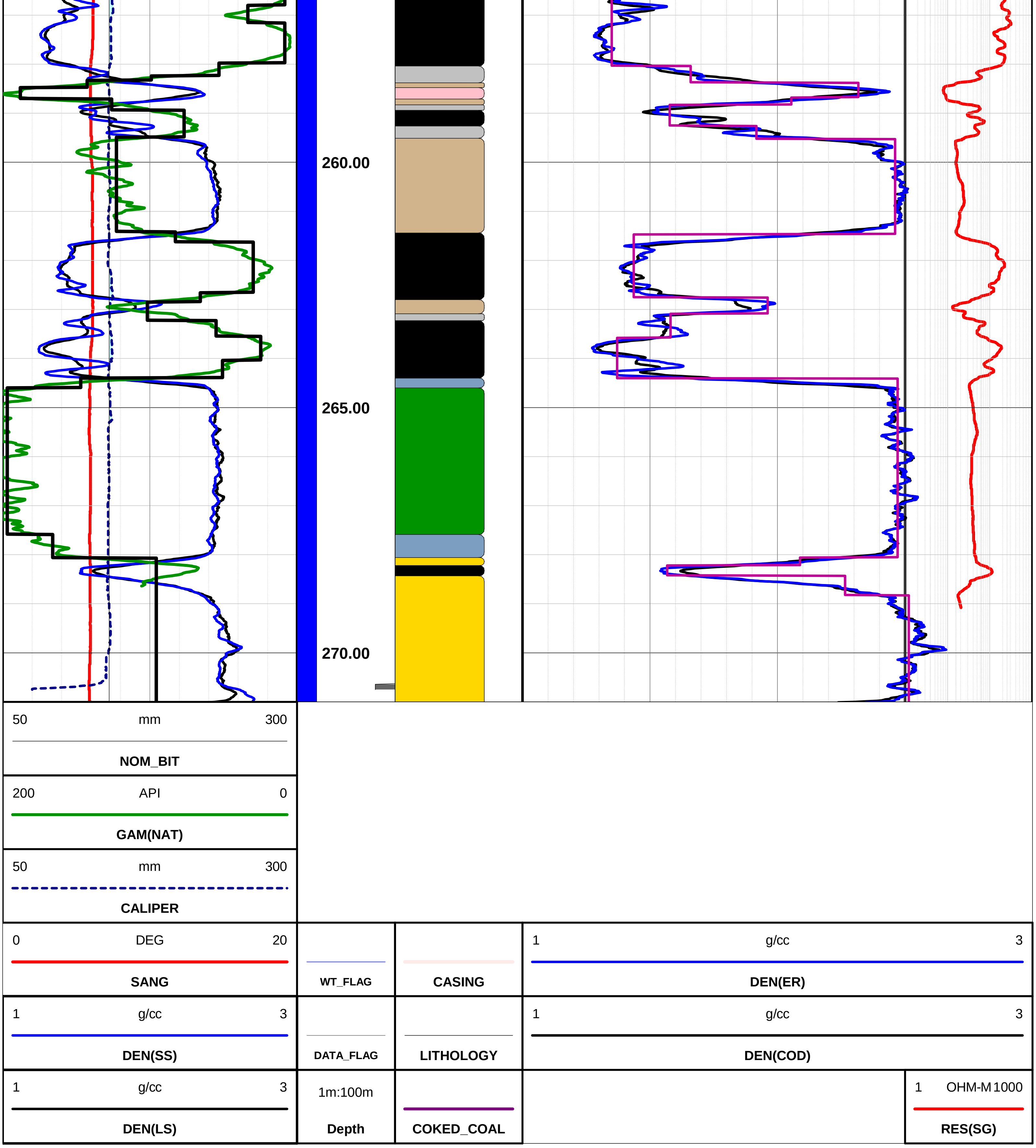

DEPTH SCALE 1:100

QUICKLOOK LITHOLOGY LOG

201859

COMPANY	BMA	**FIELD**	CVR	**STATE**	QLD
WELL	201859	**LOCATION**	CVMVWP15_01_HY	**COUNTRY**	AUSTRALIA

LOCATION: CVMVWP15_01_HY
FIELD: CVR
STATE: QLD
WELL: 201859
COMPANY: BMA

LOG MEASURED FROM	GL	ELEVATIONS:	OTHER SERVICES:
DRILLING MEASURED FROM	GL	KB	1.
PERMANENT DATUM		DF	2.
PERMANENT DATUM ELEVATION		GL	3.

LICENSE	SECTION	TOWNSHIP	RANGE	MAGNETIC DECLINATION
				8.17deg

DATE	28-11-2020			RECORDED BY	GRM		
TIME	15-10			WITNESSED BY			
RUN NUMBER	1			LOGGING UNIT	V031		
DEPTH-DRILLER	229.2m			RIG NUMBER			
DEPTH-LOGGER	228.93m			TOOL TYPE	9239C		
BIT SIZE	138mm			TOOL SERIAL NO.	2720		
CASING TYPE	PVC			EASTING	614797		
CASING ID	150mm			NORTHING	7548501		
CASING BOTTOM	38m			SAMPLE INT.	.01m		
FLUID TYPE	0			LOG DIRECTION	U		
TRUCK CAL NO.	0.09773			FEET OR METER	M		
WATER LEVEL	67.7 m			SOURCE TYPE	CS137	SOURCE ID	CZ3499

QUICKLOOK LITHOLOGY ANALYSIS PARAMETERS

1. HYBRID BOUNDARY PICK ANALYSIS APPLIED.
2. BLOCK AVERAGED GAMMA AND DENSITY USED.
3. GAMMA-DENSITY CROSSPLOT CLUSTER CHART APPLIED - CCC.v.1.13
4. LITHOLOGICAL DICTIONARY APPLIED - COAL.
5. CASING DEPTH SUPPLIED BY LOG
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   THE INTERPRETATION PROVIDED FOR DATA RECORDED EITHER IN-ROD OR IN CASING SHOULD BE TREATED WITH CAUTION

LOGGER COMMENTS:

1.

2.

3.

LITHOLOGY LEGEND

⬛	**CO - Coal**	🟨	**S3 - Sandstone - fine to medium grained**
▒	**CF - Inferior Coal**	⬜	**S4 - Sandstone - medium grained**
🟦	**ST - SILTSTONE**	🟪	**TF - TUFF**

🟦	**ST - SILTSTONE**	🟥	**TF - TUFF**
🟫	**S1 - Sandstone - very fine grained**	⬜	**XT - Carbonaceous Siltstone**
🟨	**S2 - Sandstone - fine grained**	🟩	**CY - Claystone**

MNEMONICS

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DEN(SS)	SHORT SPACED DENSITY STANDARD UNITS
RES(SG)	SHORT GUARD RESISTIVITY
DENR(LS)	LONG SPACED DENSITY RESPONSE UNITS
DENR(SS)	SHORT SPACED DENSITY RESPONSE UNITS
DEN(CDL)	COMPENSATED DENSITY
POR(DEN)	SANDSTONE DENSITY POROSITY
CALIPER	MECHANICAL CALIPER FROM DENSITY
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DEN(ER)	VECTAR PROCESSED DENSITY
SANGB	SAMPLE ANGLE BEARING
SANG	SAMPLE SLANT ANGLE (0 DEG = VERTICAL DOWN)
TVD	TRUE VERTICAL DEPTH
EAST	BOREHOLE EAST DEVIATION
NORTH	BOREHOLE NORTH DEVIATION
CDIST	DEVIATED CLOSURE DISTANCE
CANGB	DEVIATED CLOSURE ANGLE BEARING

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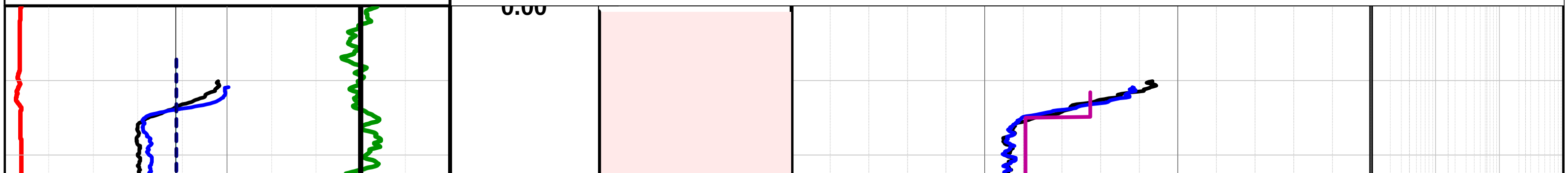
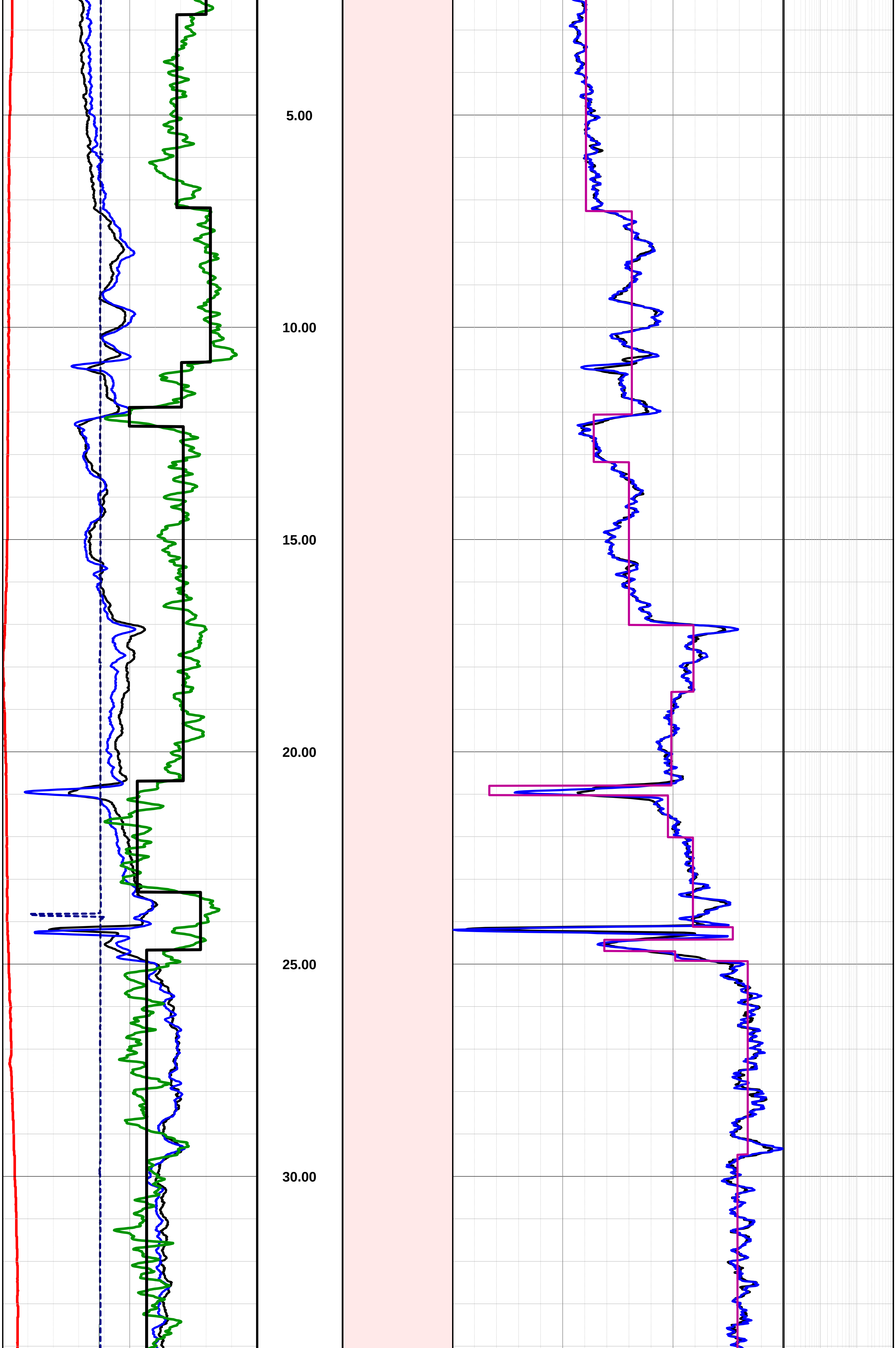
DEPTH SCALE 1:100

DEN(LS) 1 g/cc 3	**Depth** 1m:100m	**COKED_COAL**		**RES(SG)** 1 OHM-M 1000
DEN(SS) 1 g/cc 3	**DATA_FLAG**	**LITHOLOGY**	**DEN(COD)** 1 g/cc 3	
SANG 0 DEG 20	**WT_FLAG**	**CASING**	**DEN(ER)** 1 g/cc 3	
CALIPER 50 mm 300				
GAM(NAT) 200 API 0				
NOM_BIT 50 mm 300				

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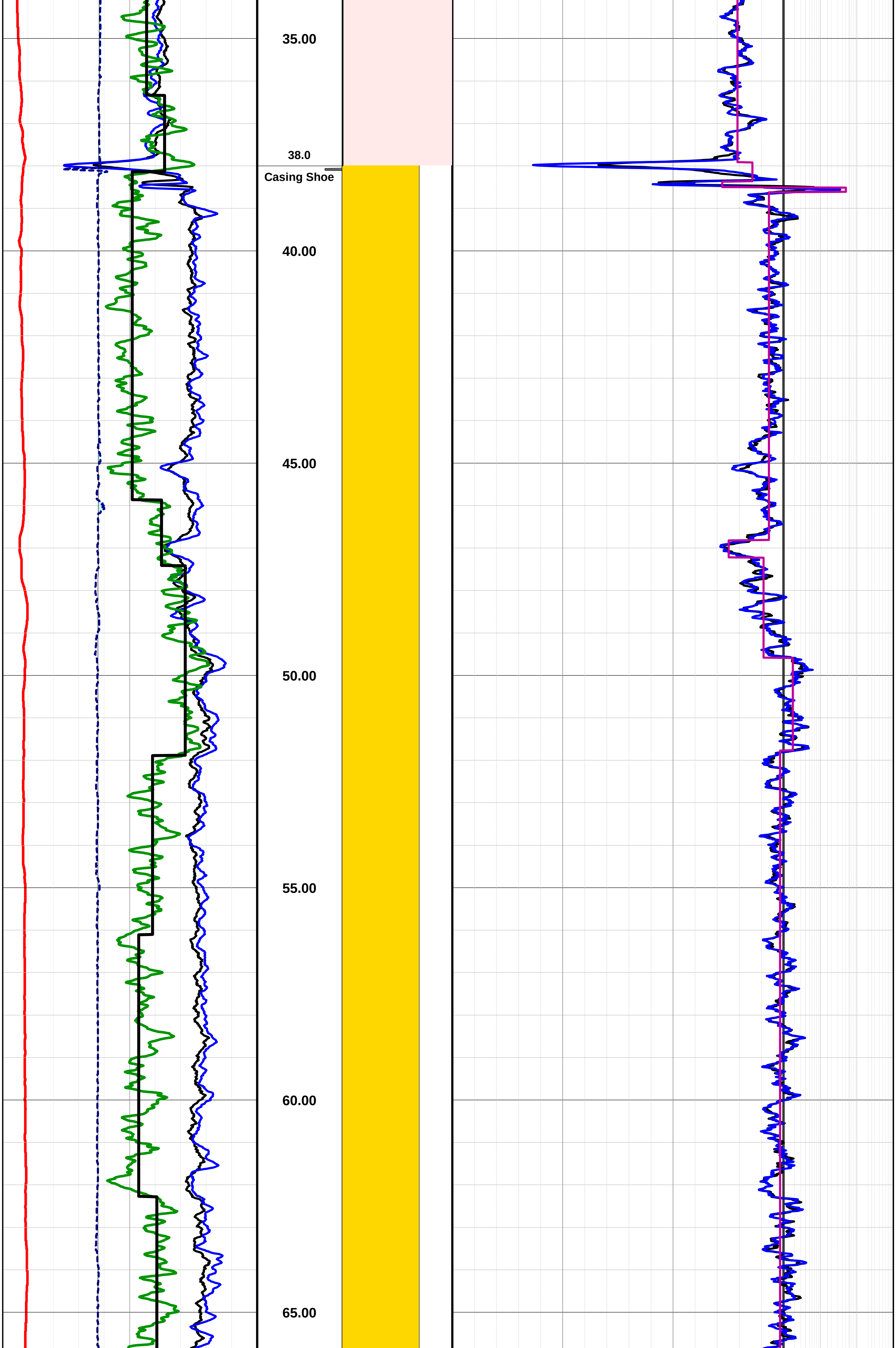
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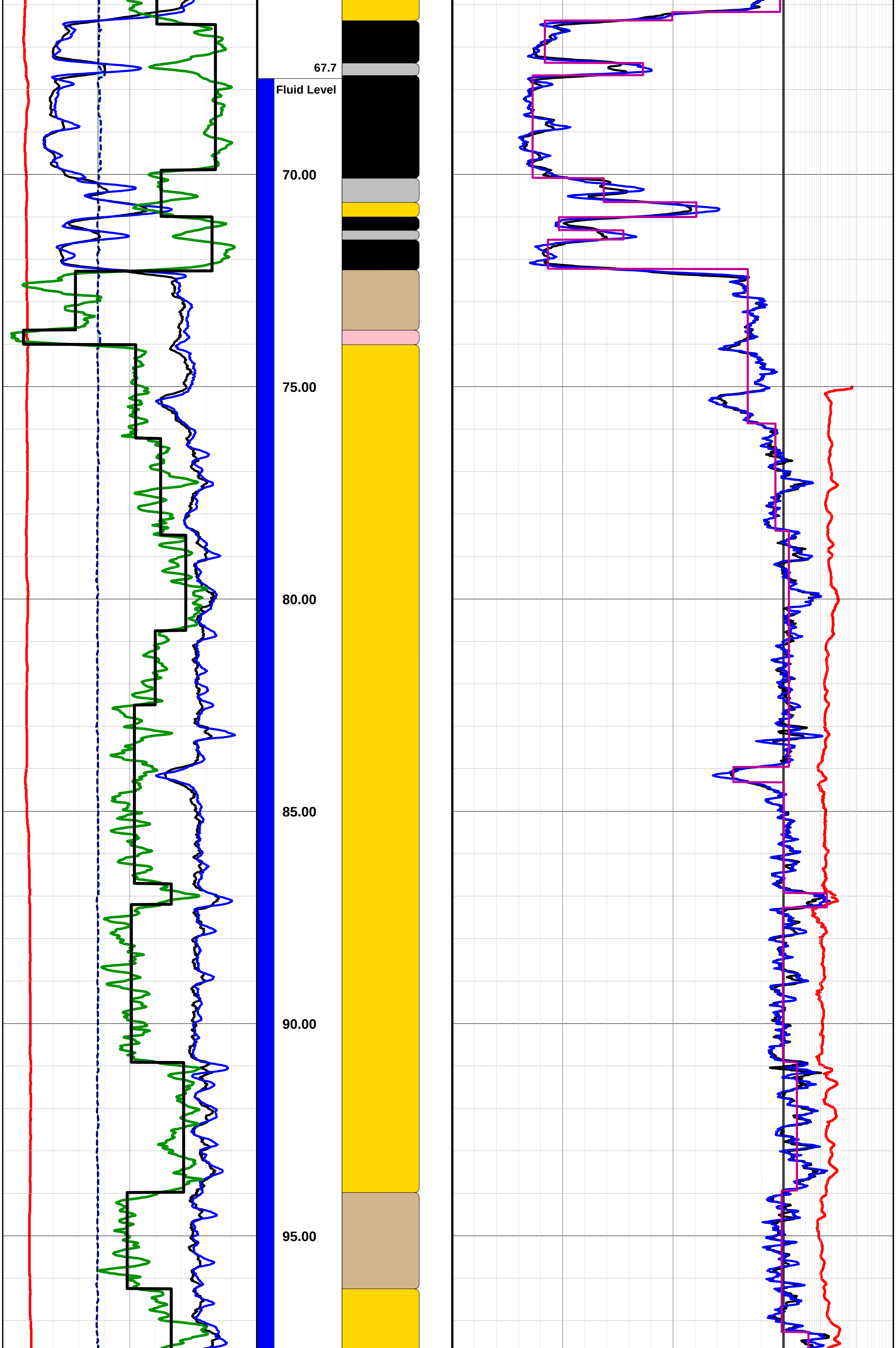
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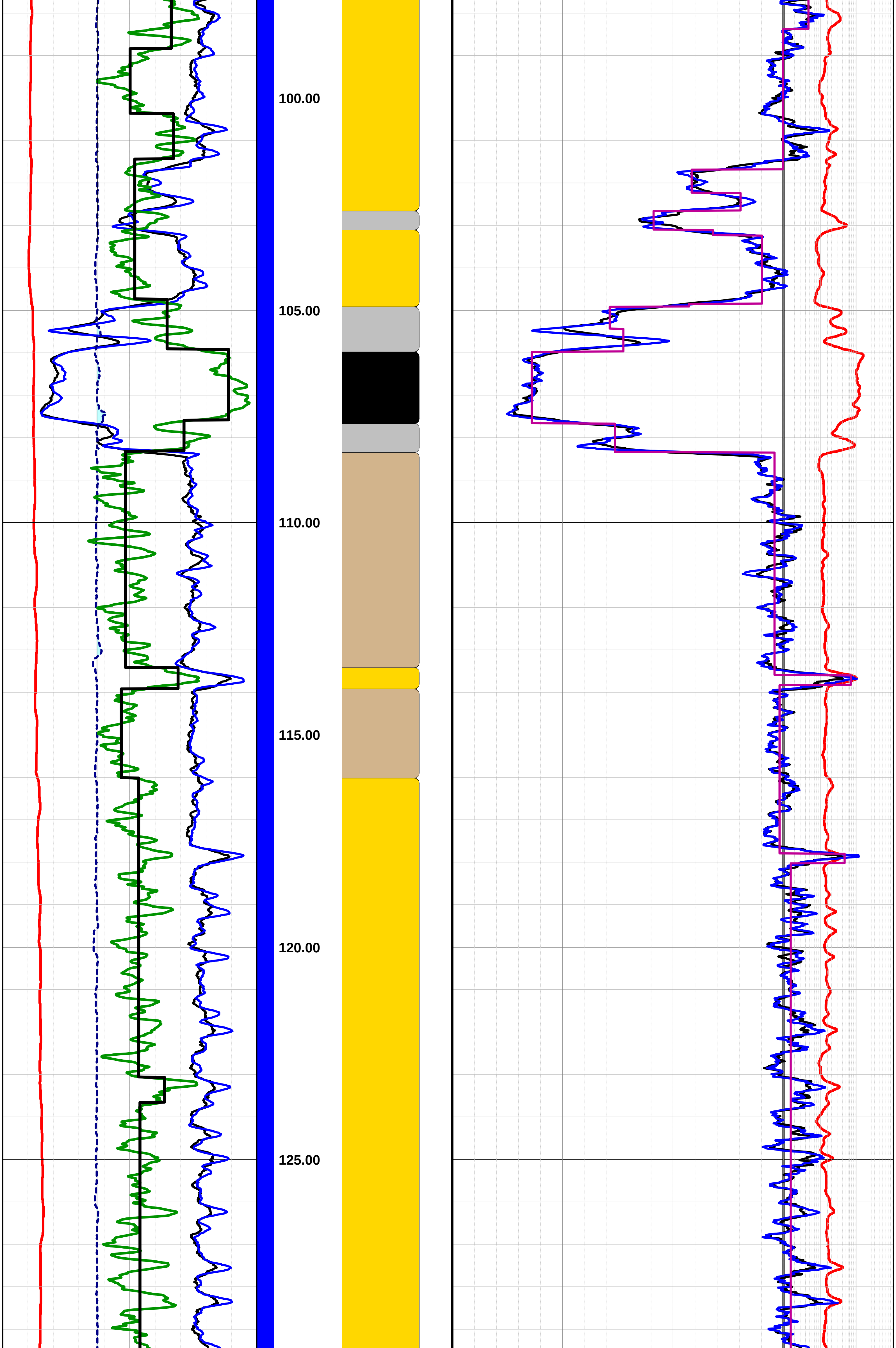
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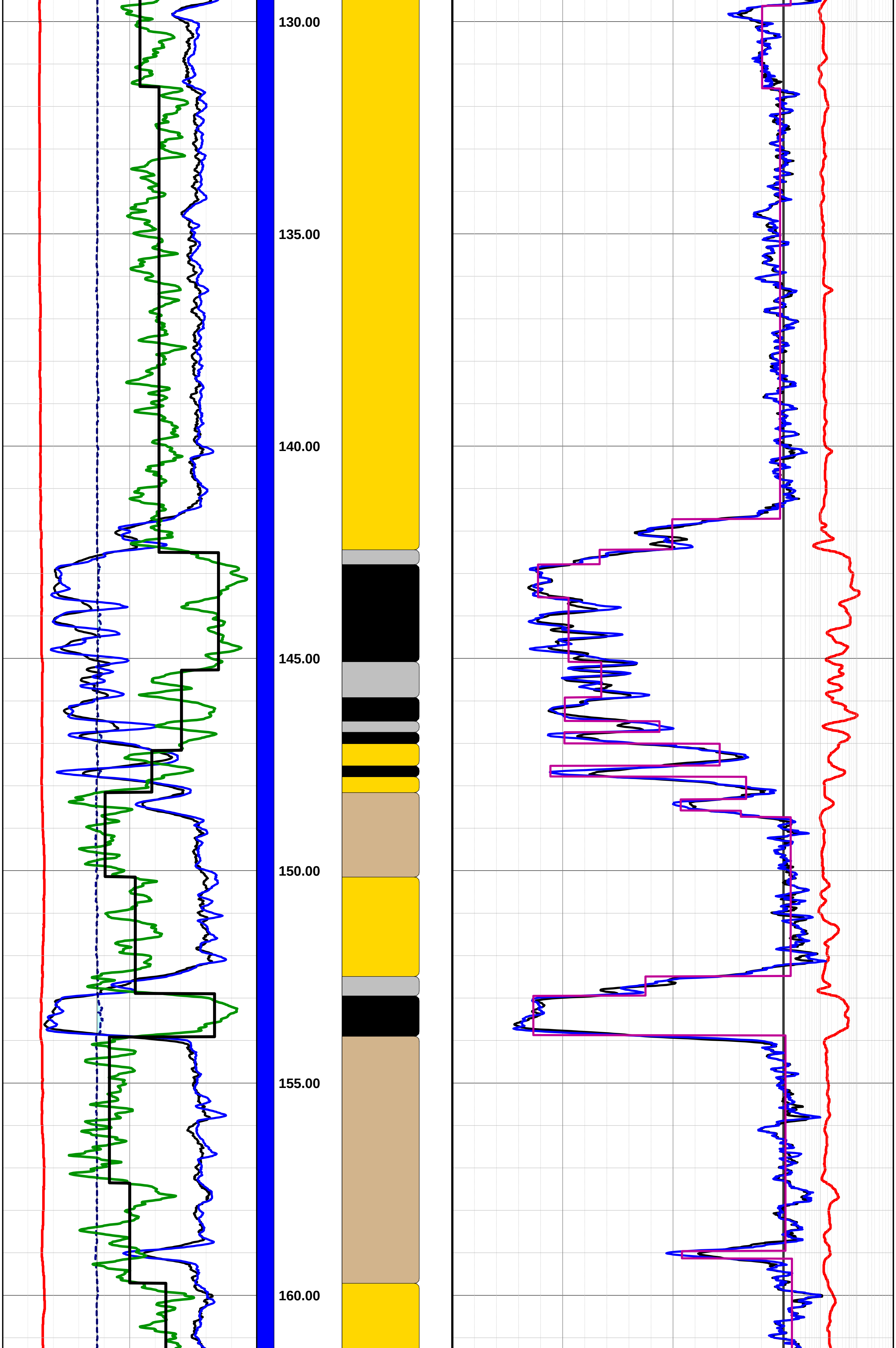
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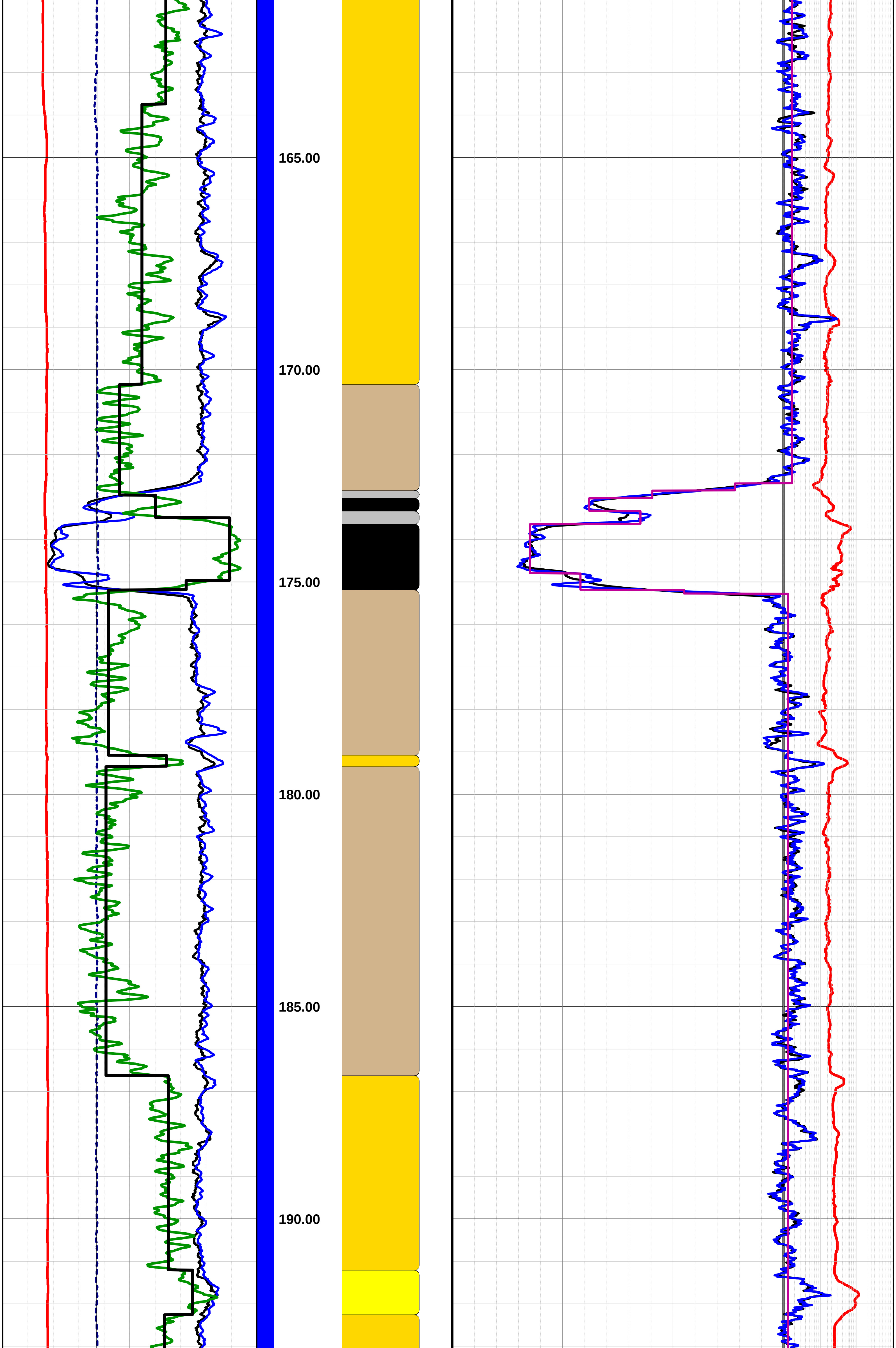
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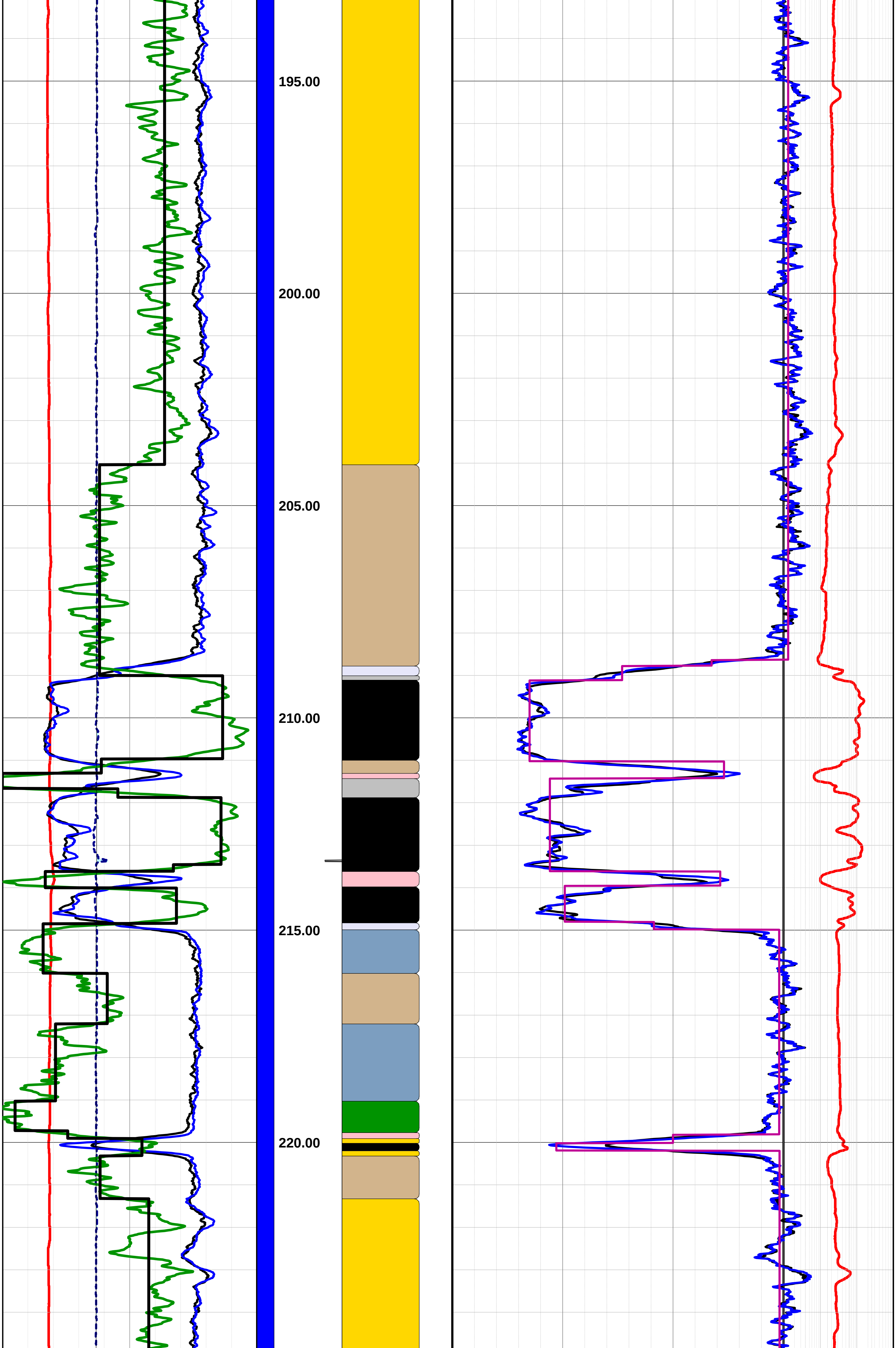
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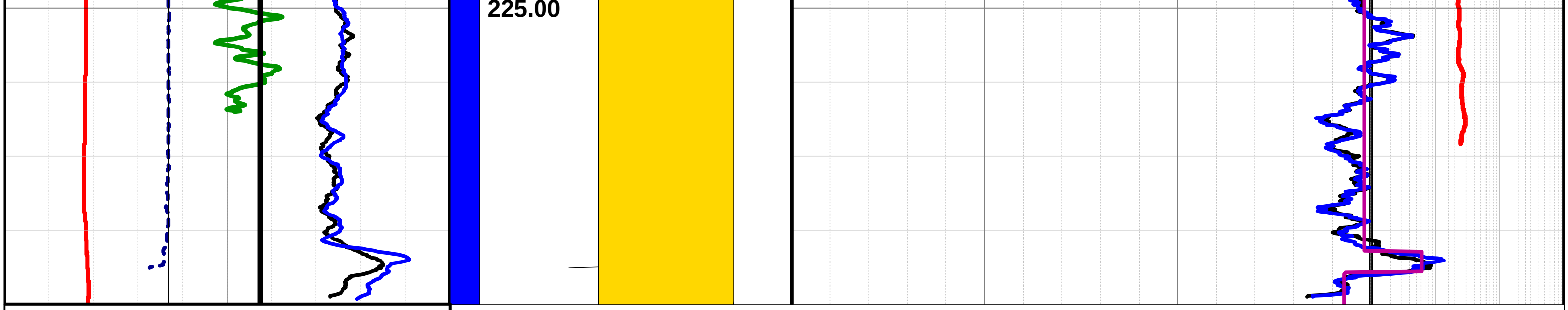

50 mm 300 NOM_BIT				
200 API 0 GAM(NAT)				
50 mm 300 CALIPER				
0 DEG 20 SANG	WT_FLAG	CASING	1 g/cc 3 DEN(ER)	
1 g/cc 3 DEN(SS)	DATA_FLAG	LITHOLOGY	1 g/cc 3 DEN(COD)	
1 g/cc 3 DEN(LS)	1m:100m Depth	COKED_COAL		1 OHM-M 1000 RES(SG)

DEPTH SCALE 1:100

Appendix C Bore development records

Bore Sampling/Development Record

hydrogeologist field services

Client:	***BHP***	***Site:***	***CVM***	***Job No.:***	***4003***		
Bore No.	CVMMB16_02	Reference point (REF)	Top of PVC casing	Target Aquifer	H161 Coal seam		
Date	27/11/2020	REF height (magl)	0.75	Screen location (mbgl)	63.8-69.8	Logger No.	
Time	13:40	Ground level (mAHD)		Sampling method	Air lifting	Mem:	Bat:
Co-ords (Datum/Zone)	AMG66 (Z55)	Water level (mbREF)	28.29	Pump type	N/A	Page #:	1 of 1
Eastings/Lats	611135.167	TD (mbREF)/Measured (Y/N)	70.36 Y	Pump intake (mbREF)	70	Sampled by	T. Muehe
Northings/Longs	7558314.897	Casing Ø (mm) / Material	50 mm / PVC	Hydrasleeve depth (mbREF)	N/A		

Start (hh:mm)	**End** (hh:mm)	**Volume** (L)	**Rate** (L/min)	**SWL** (mbREF)	**pH**	**EC** (µS/cm)	**Temp** (oC)	**ORP** (mV)	**DO** (mg/L)	**Turbidity** (NTU)	**Colour**	**Odour**	**Sediment**	**Notes**
13:50	13:55		5.28		8.34	7740	29.6				Grey brown		Yes	
13:55	14:00		3.90		8.40	7730	28.1				Grey brown		Yes	
14:00	14:10		3.90		8.40	7840	27.8				Cloudy	Nil	Nil	
14:10	14:20		3.60		8.40	7790	28.1				Clear	Nil	Nil	
14:20	14:30		3.30		8.39	7760	27.8				Clear	Nil	Nil	
14:30	14:40		3.30		7.3	7750	27.5				Clear	Nil	Nil	
14:40	14:50		3.08		7.23	7750	27.7				Clear	Nil	Nil	
14:50	15:00		3.00		7.23	760	27.6				Clear	Nil	Nil	
15:00	15:10		2.85		6.96	7640	28.0				Clear	Nil	Nil	
15:10	15:20		2.85		6.81	7640	27.7				Clear	Nil	Nil	
15:20	15:30		2.85		6.82	7640	27.3				Clear	Nil	Nil	

Water sample	
Sample number:	**CVMMB16_02**
Sample time:	**15:40**
Despatched date:	**28/11/2020**

Additional comments:

Bore Sampling/Development Record

Client:	***BHP***	***Site:***	***CVM***		***Job No.:***	***4003***		
Bore No.	MB20CVM02A	Reference point (REF)	Top of steel casing		Target Aquifer	Basalt		
Date	26/11/2020	REF height (magl)	0.58		Screen location (mbgl)	16.5-19.5	Logger No.	
Time	11:50	Ground level (mAHD)			Sampling method	Air lifting	Mem:	Bat:
Co-ords (Datum/Zone)	AMG66 (Z55)	Water level (mbREF)	14.17		Pump type	N/A	Page #:	1 of 1
Eastings/Lats	613096.373	TD (mbREF)/Measured (Y/N)	117.5	Y	Pump intake (mbREF)	19.5	Sampled by	T Muehe
Northings/Longs	7551038.196	Casing Ø (mm) / Material	50 / PVC		Hydrasleeve depth (mbREF)	N/A		

Start (hh:mm)	**End** (hh:mm)	**Volume** (L)	**Rate** (L/min)	**SWL** (mbREF)	**pH**	**EC** (µS/cm)	**Temp** (oC)	**ORP** (mV)	**DO** (mg/L)	**Turbidity** (NTU)	**Colour**	**Odour**	**Sediment**	**Notes**
13:50	14:01		0.11		8.33	1980	36.8				Light brown	Nil	Yes	
14:01	14:12		0.21		8.42	1790	30.7				Light brown	Nil	Yes	
14:12	14:22		0.27		7.55	1470	29.5				Cloudy	Nil	Cloudy	
14:22	14:32		0.28		8.46	1440	28.7				Cloudy	Nil	Cloudy	
14:32	14:42		0.30		8.47	1430	29.0				Clear	Nil	Nil	
14:42	14:52		0.24		8.48	1410	29.6				Clear	Nil	Nil	
14:52	15:02		0.25		8.48	1400	29.1				Clear	Nil	Nil	
15:02	15:12		0.28		8.47	1415	28.6				Clear	Nil	Nil	
15:12	15:22		0.29		8.47	1400	28.6				Clear	Nil	Nil	
15:22	15:32		0.30		8.47	1404	28.1				Clear	Nil	Nil	

Water sample		**Additional comments:**
Sample number:	**MB20BWM02A**	
Sample time:	**15:35**	
Despatched date:	**27/11/2020**	

Bore Sampling/Development Record

hydrogeologist field services

Client:	***BHP***	***Site:***	***CVM***		***Job No.:***	***4003***		
Bore No.	MB20CVM03P	Reference point (REF)	Top of PVC casing		Target Aquifer	Permian Coal seam		
Date	26/11/2020	REF height (magl)	0.6		Screen location (mbgl)	100-103	Logger No.	
Time	11:50	Ground level (mAHD)			Sampling method	Air lifting	Mem:	Bat:
Co-ords (Datum/Zone)	AMG66 (Zone 55)	Water level (mbREF)	15.10		Pump type	N/A	Page #:	1 of 1
Eastings/Lats	613097.694	TD (mbREF)/Measured (Y/N)	103.6	Y	Pump intake (mbREF)	103	Sampled by	T. Muehe
Northings/Longs	7551029.097	Casing Ø (mm) / Material	50 / PVC		Hydrasleeve depth (mbREF)	N/A		

Start (hh:mm)	**End** (hh:mm)	**Volume** (L)	**Rate** (L/min)	**SWL** (mbREF)	**pH**	**EC** (µS/cm)	**Temp** (oC)	**ORP** (mV)	**DO** (mg/L)	**Turbidity** (NTU)	**Colour**	**Odour**	**Sediment**	**Notes**
12:17	12:24		4		8.20	4950	32.1				Clear	Nil	Nil	
12:24	12:36		4		8.10	6300	32.5				Clear	Nil	Nil	
12:36	12:45		3.6		8.10	6350	33.8				Clear	Nil	Nil	
12:45	12:55		3.2		8.10	6660	32.4				Clear	Nil	Nil	
12:55	13:05		3.2		8.11	6720	32.2				Clear	Nil	Nil	
13:05	13:15		3.2		8.11	6960	30.9				Clear	Nil	Nil	
13:15	13:25		3.2		8.13	6970	30.1				Clear	Nil	Nil	
13:25	13:35		2.8		8.12	6980	29.9				Clear	Nil	Nil	

Water sample		**Additional comments:**
Sample number:	**MB20CVM03P**	
Sample time:	**13:35**	
Despatched date:	**27/11/2020**	

Bore Sampling/Development Record

Client:	***BHP***	***Site:***	***CVM***		***Job No.:***	***4003***		
Bore No.	CVMBP07_01	Reference point (REF)	Top of steel casing		Target Aquifer	Basalt		
Date	15/12/2020	REF height (magl)	0.76		Screen location (mbgl)	22-28	Logger No.	
Time	9:20	Ground level (mAHD)			Sampling method	Air lifting	Mem:	Bat:
Co-ords (Datum/Zone)		Water level (mbREF)	14.18		Pump type	N/A	Page #:	1 of 1
Eastings/Lats		TD (mbREF)/Measured (Y/N)	28.6	Y	Pump intake (mbREF)	28	Sampled by	C Nelson
Northings/Longs		Casing Ø (mm) / Material	168.3 (OD) / Steel		Hydrasleeve depth (mbREF)	N/A		

Start (hh:mm)	**End** (hh:mm)	**Volume** (L)	**Rate** (L/min)	**SWL** (mbREF)	**pH**	**EC** (µS/cm)	**Temp** (oC)	**ORP** (mV)	**DO** (mg/L)	**Turbidity** (NTU)	**Colour**	**Odour**	**Sediment**	**Notes**
9:15	9:25		0.5		8.27	1267	28.6				Brown	Nil	Yes	Bown silty sand
9:25	9:35		0.5		8.31	1197	30.1				Brown	Nil	Yes	
9:35	9:45		0.5		8.34	1250	28.5				Brown	Nil	Yes	
9:45	9:55		0.5		8.49	1283	27.7				Clearing	Nil	Yes	
9:55	10:05		0.5		8.37	1310	27.0				O opaque	Nil	Decreased	O = opaque
10:05	10:15		0.5		8.38	1285	28.1				O opaque	Nil	Decreased	
10:15	10:25		0.5		8.42	1327	26.4				O opaque	Nil	Decreased	
10:25	10:35		0.5		8.37	1339	26.2				O opaque	Nil	Nil	
10:35	10:45		0.5		8.38	1311	27.3				O opaque	Nil	Nil	

Water sample	
Sample number:	**CVMPB07-01**
Sample time:	**10:45**
Despatched date:	**15/12/2020**

Additional comments:

Bore Sampling/Development Record

hydrogeologist
field services

Client:	***BHP***	***Site:***	***CVM***		***Job No.:***	***4003***		
Bore No.	CVMBP07_02	Reference point (REF)	Top of steel casing		Target Aquifer	P7/8 Coal seam		
Date	15/12/2020	REF height (magl)	0.8		Screen location (mbgl)	111-117	Logger No.	
Time	11:50	Ground level (mAHD)			Sampling method	Air lifting	Mem:	Bat:
Co-ords (Datum/Zone)		Water level (mbREF)	32.21		Pump type	N/A	Page #:	1 of 1
Eastings/Lats		TD (mbREF)/Measured (Y/N)	117.5	Y	Pump intake (mbREF)	116	Sampled by	C Nelson
Northings/Longs		Casing Ø (mm) / Material	168.3 (OD) /. Steel		Hydrasleeve depth (mbREF)	N/A		

Start (hh:mm)	**End** (hh:mm)	**Volume** (L)	**Rate** (L/min)	**SWL** (mbREF)	**pH**	**EC** (µS/cm)	**Temp** (oC)	**ORP** (mV)	**DO** (mg/L)	**Turbidity** (NTU)	**Colour**	**Odour**	**Sediment**	**Notes**
11:05	12:05		0.1		8.07	4520					Brown	Nil	Y	Brown silty sand
12:05	12:15		0.1		8.27	4450					Brown	Nil	Y	
12:15	12:30		0.1		8.40	4520					O Brown	Nil	Y	O = Orange
12:30	12:45		0.1		8.44	4260					O Brown	Nil	Y	
12:45		Turn-off and allow to recover												
13:55	14:05		0.1		8.3	4250					O Brown	Nil	Y	Fine silty sand
14:05	14:30		0.1		8.45	4440					O Brown	Nil	Y	Fine silty sand
14:30	14:45		0.1		8.62	4530					O Brown	Nil	Y	Fine silty sand
14:45	15:00		0.1		8.55	4430					O Brown	Nil	Y	Fine silty sand
15:00	15:15		0.1		8.55	4440					O Brown	Nil	Y	Fine silty sand
15:15	15:45		0.1		8.66	4570					O Brown	Nil	Y	Fine silty sand

Water sample		**Additional comments:**
Sample number:	**CVMPB07-02**	The bore needs further development
Sample time:	**16:00**	
Despatched date:	**15/12/2020**	

Appendix D Laboratory (ALS) Certificate of Analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2031602**	Page	: 1 of 7
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: ELIZABETH SARTO	Contact	: Nidhi Bhimani
Address	: L11 480 QUEEN STREET BRISBANE QLD 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: BWM Horse Pit Hydro Drilling	Date Samples Received	: 01-Dec-2020 07:00
Order number	: 4509904980	Date Analysis Commenced	: 01-Dec-2020
C-O-C number	: ----	Issue Date	: 09-Dec-2020 12:47
Sampler	: CEDRIC NELSON, THOMAS MUEHE		
Site	: ----		
Quote number	: TV/109/19		
No. of samples received	: 3		
No. of samples analysed	: 3		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Morgan Lennox	2IC Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MB20_03P	MB20_02A	MB16_2	----	----
			Sampling date / time	26-Nov-2020 13:35	26-Nov-2020 15:35	27-Nov-2020 15:40	----	----
Compound	CAS Number	LOR	Unit	EB2031602-001	EB2031602-002	EB2031602-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.91	8.35	8.22	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	7070	1280	7430	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	4340	731	4210	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	----	----
EA030: Total Solids dried at 104 ± 2°C								
Total Solids	----	10	mg/L	4610	780	4280	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	10	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	200	402	350	----	----
Total Alkalinity as CaCO3	----	1	mg/L	200	412	350	----	----
ED040T: Total Major Anions								
Silicon	7440-21-3	0.05	mg/L	8.44	13.8	8.51	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	238	60	170	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	2150	169	2270	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	165	45	93	----	----
Magnesium	7439-95-4	1	mg/L	91	35	90	----	----
Sodium	7440-23-5	1	mg/L	1210	223	1420	----	----
Potassium	7440-09-7	1	mg/L	7	6	6	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	787	256	603	----	----
^ Sodium Adsorption Ratio	----	0.01	-	18.8	6.06	25.2	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.002	0.002	----	----
Barium	7440-39-3	0.001	mg/L	0.066	0.078	0.090	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**MB20_03P**	**MB20_02A**	**MB16_2**	**----**	**----**
			Sampling date / time	26-Nov-2020 13:35	26-Nov-2020 15:35	27-Nov-2020 15:40	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031602-001**	**EB2031602-002**	**EB2031602-003**	**--------**	**--------**
				Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.013**	**0.307**	**0.021**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.001**	<0.001	**0.002**	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	**0.001**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Strontium	7440-24-6	0.001	mg/L	**21.7**	**0.847**	**8.23**	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	----	----
Boron	7440-42-8	0.05	mg/L	**0.26**	**0.26**	**0.80**	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	**0.07**	**0.04**	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	**0.002**	**0.002**	----	----
Barium	7440-39-3	0.001	mg/L	**0.064**	**0.082**	**0.088**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.017**	**0.346**	**0.025**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	**0.001**	**0.004**	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Strontium	7440-24-6	0.001	mg/L	**23.0**	**0.934**	**8.52**	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	MB20_03P	MB20_02A	MB16_2	----	----
			Sampling date / time	26-Nov-2020 13:35	26-Nov-2020 15:35	27-Nov-2020 15:40	----	----
				EB2031602-001	**EB2031602-002**	**EB2031602-003**	--------	--------
				Result	Result	Result	----	----
EG020T: Total Metals by ICP-MS - Continued								
Boron	7440-42-8	0.05	mg/L	**0.36**	**0.25**	**0.63**	----	----
Iron	7439-89-6	0.05	mg/L	**0.20**	**0.09**	**0.07**	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	<0.05	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	**0.5**	<0.1	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**1.99**	**0.05**	**1.50**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.02**	**0.02**	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.02**	**0.02**	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**2.3**	**0.2**	**1.8**	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**2.3**	**0.2**	**1.8**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	**0.02**	**0.01**	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**69.6**	**14.2**	**74.6**	----	----
ø **Total Cations**	----	0.01	meq/L	**68.5**	**15.0**	**74.0**	----	----
ø **Ionic Balance**	----	0.01	%	**0.77**	**2.50**	**0.40**	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**MB20_03P**	**MB20_02A**	**MB16_2**	----	----
			Sampling date / time	26-Nov-2020 13:35	26-Nov-2020 15:35	27-Nov-2020 15:40	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2031602-001**	**EB2031602-002**	**EB2031602-003**	--------	--------
				Result	Result	Result	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued								
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	<50	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ **Total Xylenes**	----	2	µg/L	<2	<2	<2	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
ED009: Anions								
Bromide	24959-67-9	0.010	mg/L	**4.05**	**0.350**	**4.60**	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**108**	**110**	**106**	----	----
Toluene-D8	2037-26-5	2	%	**95.4**	**94.7**	**94.2**	----	----
4-Bromofluorobenzene	460-00-4	2	%	**96.7**	**92.3**	**95.5**	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	*CAS Number*	***Recovery Limits (%)*** Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

to ALS Environmental

Qld 4053

BMA

BHP Billiton Mitsubishi Alliance

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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☐BRISBANE 2 Byth Street Stafford QLD 4053
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☐GLADSTONE
Ph: 07 747

CKAY 78 Harb
4944 0177 E:
BOURNE 2-4 W
8549 9600 E: samples

ALS

CLIENT: BM Alliance Coal Operations Pty. Ltd. (BMALLI)		**TURNAROUND REQUIREMENTS :** ☐ **Standard 3 DAY TAT**	FOR LABORATORY USE ONLY (Circle)
OFFICE: Caval Ridge Mine	**Envirosys Site code:** BWM	(Standard TAT may be longer for some tests eg. Ultra Trace Organics) ☐ Non Standard TAT (**List due date**):	Custody Seal Intact? Yes No N/A
PROJECT: Horse Pit Hydro Drilling		**ALS QUOTE NO.:** TV/109/19	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER 4509904980		**ALS Project Manager:** Joy Morgan (07) 4796 0605	Random Sample Temperature on Receipt:
PROJECT MANAGER: Elisabeth Sarto	**CONTACT PH:** 0499 994 790		Other comment:

COC SEQUENCE NUMBER (Circle)

COC: [✓ 1] 2 3 4 5 6 7

OF: [✓ 1] 2 3 4 5 6 7

SAMPLER: Cedric Nelson / Thomas Muehe	**SAMPLER MOBILE:** 0403 975 903 / 0477 447 040	**RELINQUISHED BY:**	**RECEIVED BY:**	**RELINQUISHED BY:**	**RECEIVED BY:**
COC emailed to ALS? No	**EDD FORMAT (or default):** BMA Envirosys	*Thomas Muehe*	GRS		
Email Reports: bma_envirosys_data@bmacoal.com, bma.support@sra.com.au, bwmenvironment@bhpbilliton.com, tina.girard@bhp.com; elizabeth.sarto@bhp.com, cedric@hydrofs.com		**DATE/TIME:**	**DATE/TIME:**	**DATE/TIME:**	**DATE/TIME:**
Email Invoice: bwmenvironment@bhpbilliton.com, elizabeth.sarto@bhp.com		*30/11/2020* 07:30h	1/12/20 7:00		

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS					ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) *Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).*								Additional Information
LAB ID	**SAMPLE ID**	**DATE / TIME**	**MATRIX** Solid(S) Water(W)	**CONTAINER TYPE & PRESERVATIVE** *(refer to codes below)*	**TOTAL NO. CONTAINERS**	**BMA FY20 Water Analysis Suite**								- Comments on likely contamination, dilutions samples for QC analysis etc.
1	MB20_03P	26/11/2020 1:35:00 PM	W		8	X								
2	MB20_02A	26/11/2020 3:35:00 PM	W		8	X								
3	MB16_2	27/11/2020 3:40:00 PM	W		8	X								
					TOTAL									

HT

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulphuric Preserved; AV = Airfrieght Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Environmental Division
Brisbane
Work Order Reference
EB2031602

Telephone : + 61-7-3243 7222

CERTIFICATE OF ANALYSIS

Work Order	: **EB2034124**	Page	: 1 of 7
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: ELISABETH SARTO	Contact	: Nidhi Bhimani
Address	: BLACKWATER MINE PRIVATE MAIL BAG BLACKWATER QLD, AUSTRALIA 4717	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Blackwater Hydro Drilling	Date Samples Received	: 22-Dec-2020 10:40
Order number	: 4509904980	Date Analysis Commenced	: 22-Dec-2020
C-O-C number	: ----	Issue Date	: 05-Jan-2021 17:48
Sampler	: CEDRIC NELSON		
Site	: BWM		
Quote number	: TV/109/19		
No. of samples received	: 2		
No. of samples analysed	: 2		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Diana Mesa	Senior Organic Chemist	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**CVMPB07_01**	**CVMPB07_02**	**----**	**----**	**----**
			Sampling date / time	15-Dec-2020 10:45	15-Dec-2020 16:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2034124-001**	**EB2034124-002**	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.21**	**8.77**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1190**	**4340**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**694**	**2580**	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**91**	**239**	----	----	----
EA030: Total Solids dried at 104 ± 2°C								
Total Solids	----	10	mg/L	**770**	**2830**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	**45**	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**362**	**285**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**362**	**330**	----	----	----
ED040T: Total Major Anions								
Silicon	7440-21-3	0.05	mg/L	**16.1**	**4.02**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**46**	**153**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**166**	**1250**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**46**	**14**	----	----	----
Magnesium	7439-95-4	1	mg/L	**40**	**59**	----	----	----
Sodium	7440-23-5	1	mg/L	**200**	**896**	----	----	----
Potassium	7440-09-7	1	mg/L	**5**	**7**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**280**	**278**	----	----	----
^ **Sodium Adsorption Ratio**	----	0.01	-	**5.20**	**23.4**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.109**	**0.006**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Sample ID	**CVMPB07_01**	**CVMPB07_02**	**----**	**----**	**----**
			Sampling date / time	15-Dec-2020 10:45	15-Dec-2020 16:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2034124-001**	**EB2034124-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.136**	**0.151**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.005**	**0.002**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**2.06**	**0.943**	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.13**	**0.28**	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**1.68**	**0.12**	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.001**	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.184**	**0.080**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.005**	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.002**	**0.008**	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.002**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	**0.002**	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.229**	**2.85**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.006**	**0.002**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.007**	**0.018**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**3.14**	**2.37**	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.007**	**0.007**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**CVMPB07_01**	**CVMPB07_02**	**----**	**----**	**----**
			Sampling date / time	15-Dec-2020 10:45	15-Dec-2020 16:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2034124-001**	**EB2034124-002**	--------	--------	--------
				Result	Result	----	----	----
EG020T: Total Metals by ICP-MS - Continued								
Boron	7440-42-8	0.05	mg/L	**0.18**	**0.38**	----	----	----
Iron	7439-89-6	0.05	mg/L	**7.24**	**104**	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	**0.1**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.28**	**0.52**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.04**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.04**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.5**	**0.8**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.5**	**0.8**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.02**	----	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**12.9**	**45.0**	----	----	----
ø **Total Cations**	----	0.01	meq/L	**14.4**	**44.7**	----	----	----
ø **Ionic Balance**	----	0.01	%	**5.65**	**0.37**	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	**70**	----	----	----
C15 - C28 Fraction	----	100	µg/L	**450**	**150**	----	----	----
C29 - C36 Fraction	----	50	µg/L	**700**	**110**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**CVMPB07_01**	**CVMPB07_02**	----	----	----
			Sampling date / time	15-Dec-2020 10:45	15-Dec-2020 16:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2034124-001**	**EB2034124-002**	--------	--------	--------
				Result	Result	----	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued								
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**1150**	**330**	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L	**930**	**220**	----	----	----
>C34 - C40 Fraction	----	100	µg/L	**650**	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**1580**	**220**	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----
Toluene	108-88-3	2	µg/L	<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
^ **Total Xylenes**	----	2	µg/L	<2	<2	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	----	----	----
ED009: Anions								
Bromide	24959-67-9	0.010	mg/L	**0.340**	**3.08**	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**93.4**	**95.9**	----	----	----
Toluene-D8	2037-26-5	2	%	**103**	**105**	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**112**	**113**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

5|1

BMA
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CHAIN OF CUSTODY

ALS Laboratory: *please tick →*

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☐WOLLON[illegible]

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Brisbane
Work Order Reference
EB2034124

Telephone : + 61-7-3243 7222

CLIENT: BM Alliance Coal Operations Pty. Ltd. (BMALLI)		**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests eg. Ultra Trace Organics)	☐ Standard 3 DAY TAT ☐ Non Standard TAT (List due date):
OFFICE: Blackwater Mine	**Envirosys Site code:** BWM		
PROJECT: Blackwater Hydro Drilling		**ALS QUOTE NO.:** TV/109/19	**COC SEQUENCE NUMBER (Circle)** COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7
ORDER NUMBER 4509904980		**ALS Project Manager:** Joy Morgan (07) 4796 0605	
PROJECT MANAGER: Elisabeth Sarto	**CONTACT PH:** 0499 994 790		
SAMPLER: Cedric Nelson	**SAMPLER MOBILE:** 0403 975 903	**RELINQUISHED BY:** Cedric Nelson **DATE/TIME:** 16/12/20 13:45	**RECEIVED BY:** T Dicky **DATE/TIME:** 22/12/2020 1040
COC emailed to ALS? No	**EDD FORMAT (or default):** BMA Envirosys		**RELINQUISH** **DATE/TIME:**
Email Reports: bma_envirosys_data@bmacoal.com, bma.support@sra.com.au, bwmenvironment@bhpbilliton.com, tina.girhard@bhp.com; elizabeth.sarto@bhp.com, cedric@hydrofs.com			
Email Invoice: bwmenvironment@bhpbilliton.com, elizabeth.sarto@bhp.com			
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:			

FOR LA[illegible] Custody [illegible] Random [illegible]

ALS USE ONLY	SAMPLE DETAILS					ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) *Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).*								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX Solid(S) Water(W)	CONTAINER TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL NO. CONTAINERS	BMA FY20 Water Analysis Suite								- Comments on likely contamination, dilutions samples for QC analysis etc.
	CVMPB07_01	15/12/2020 10:45:00 AM	W		8	X								
	CVMPB07_02	15/12/2020 4:00:00 PM	W		8	X								
				TOTAL	16									

HT

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulphuric Preserved; AV = Airfrieght Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

BHP Pty Ltd

BHP Caval Ridge Mine Groundwater Well Installation

June 2020

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Appendices

1. Introduction

1.1 Background

Caval Ridge Mine (CVM) is a BHP and Mitsubishi Alliance (BMA) owned and operated coal asset, located in the Bowen Basin approximately 15 kilometres (km) south of Moranbah.

GHD Pty Ltd (GHD) was engaged by BHP to supervise the installation of five groundwater monitoring boreholes and one pilot hole for their 2020 financial year program (FY20SOW). The FY20SOW boreholes are designed to monitor various aquifers within the alluvium, tertiary, and coal seams. FY20SOW borehole details are presented in Table 3-1, the pilot hole MB20CVN03P and alluvial bore MB20CVN02A were moved to the FY21SOW before site works commenced which reduced the FY20SOW to four monitoring bores.

The aim of the program is to:

- Maintain compliance with Environmental Authority (EA) EPML00562013 – 16 June 2017
- Implement recommendations from "Annual Groundwater Monitoring Data Reviews"
- Financial year 20 mine interactions
- Support new approval requirements and future approvals

1.2 Purpose of this report

This report documents the bore logs and results of the FY20SOW hydrogeological drilling program.

1.3 Scope and limitations

This report: has been prepared by GHD for BHP Pty Ltd and *may only be used and relied on by BHP Pty Ltd for the purpose agreed between GHD and the BHP Pty Ltd as set out in section 2 of this report.*

GHD otherwise disclaims responsibility to any person other than BHP Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) Section 2 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by BHP Pty Ltd and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Scope of work and methodology

Scope of work documentation (BHP, *Resource Engineering, Caval Ridge FY20 Hydro Drilling Scope of Work,* Undated) included monitoring bore designs, details of target aquifers, and a breakdown of tasks to be undertaken by the hydrogeological consultant.

The specific scope of works included the following tasks:

- Attend a planning meeting prior to the field program and a project closure meeting at completion of field work, where results, feedback and learnings from the field program can be communicated with the Brisbane based BHP Water Planning Team
- Oversee monitoring bore installation in accordance with the FY20SOW (BHP, 2019)
- Geological logging of cuttings produced during drilling
- Supervise and interpret geophysical logging of drill holes where bores are to be constructed over Permian coal seams (MB20CVM5P)
- Develop the newly installed bores to establish hydraulic conductivity with surrounding aquifer and clear bore of drilling fluids.
- Sample and record groundwater quality field parameters
- Complete a bore installation report

A site-specific online induction and work area familiarisation were also completed prior to site works.

BHP contracted hydrogeologist Cedric Nelson provided onsite supervision and GHD provided the technical reporting.

3. Monitoring bore installation

3.1 Construction details

BHP engaged Ausdrill as drilling contractor who drilled, installed and developed each monitoring bore. Kaine Fowler an independent contractor was engaged as a class 2 water bore driller to supervise and direct the instillation and development of the bores. FY20SOW monitoring bores have been identified using “MB20” designation. Field work was completed from the 7 to the 14 April 2020 with technical guidance and collection of groundwater data provided by BHP hydrogeologists. Four groundwater monitoring bores were installed at five sites (Figure 3-1 and Figure 3-2).

BHP pre-determined target screened intervals from their geological database and extrapolation of exploration borehole logs. Targeted zones included the below potential aquifer bearing lithologies:

- Alluvial sediments (denoted by “A” suffix in bore name nomenclature)
- Tertiary strata (denoted by “T” suffix in bore name nomenclature)
- Permian interburden strata and coal seams (denoted by “P” suffix in bore name nomenclature)

MB20CVM01A planned as an alluvium bore was screened in tertiary strata when field observations during drilling indicated the alluvium was too shallow to install a bore at the planned location. The bore will be referenced throughout the report as MB20CVM01A as delegated in the FY20SOW, while being described as screening Tertiary sediments in Table 4-1 and Figure 3-2.

The construction details are provided in Table 3-1 and bore logs are provided in Appendix A. All FY20SOW monitoring bores were drilled with a borehole gauge of 139 millimetre (mm) and completed using PN18 PVC-U pressure pipe with nominal inside diameter of 50 mm.

The construction of the bores included the following materials and methods:

- Screened intervals comprised of casing with 1 mm aperture slots.
- The screened zone was positioned at or within 2 meters of the base of the bore.
- A gravel (3 mm diameter) filter pack was installed to at least 1 m above the top of the slotted casing except where the targeted production zone was within 10 m below ground level (bgl), and grout to surface would be less than 6 mbgl. Then to comply with minimum borehole construction standards, 0.5 m of gravel and 0.5 m of bentonite were installed above the screen.
- The bores were sealed from overlying formations by bentonite and grout (cement) seals.

Table 3-1 FY20SOW borehole details

Local Bore Identification (ID)	Easting– AMG66 Zone 55$^{\%}$	Northing– AMG66 Zone 55$^{\%}$	Top of Casing (mAHD)	Stick-up (m)	Total bore depth (mbgl)	Screened interval (mbgl)	Screened lithology	Targeted Lithology	Top of filter pack (mbgl)	Date drilling commenced
MB20CVM01A	609915	7560288	TBC	TBC	9.5	5.0 – 8.0	Sandy clay and moderately weathered sandstone	Alluvium	4.5	12/04/2020
MB20CVM04T	608194	7559651	TBC	TBC	28.5	22 – 28	Slightly weathered basalt	Tertiary aged basalt	20	9/04/2020
MB20CVM06T	610808	7548889	TBC	TBC	18.0	11.75 – 17.75	Sand and moderately weathered sandstone	Tertiary / base of weathering	10.75	8/04/2020
MB20CVM05P	608199	7559646	TBC	TBC	45.5	39 – 45	Coal and carbonaceous mudstone	First water bearing Coal seam	26.0	11/04/2020

Table notes:

mAHD = metres Australian height datum,

mbtoc = metres below top of casing,

$^{\%}$Locations surveyed with x and y coordinates only

3.2 Groundwater strikes

Groundwater strikes and estimated yields where measured are recorded in Table 3.2 below and reported in the comments section of the bore logs in Appendix A.

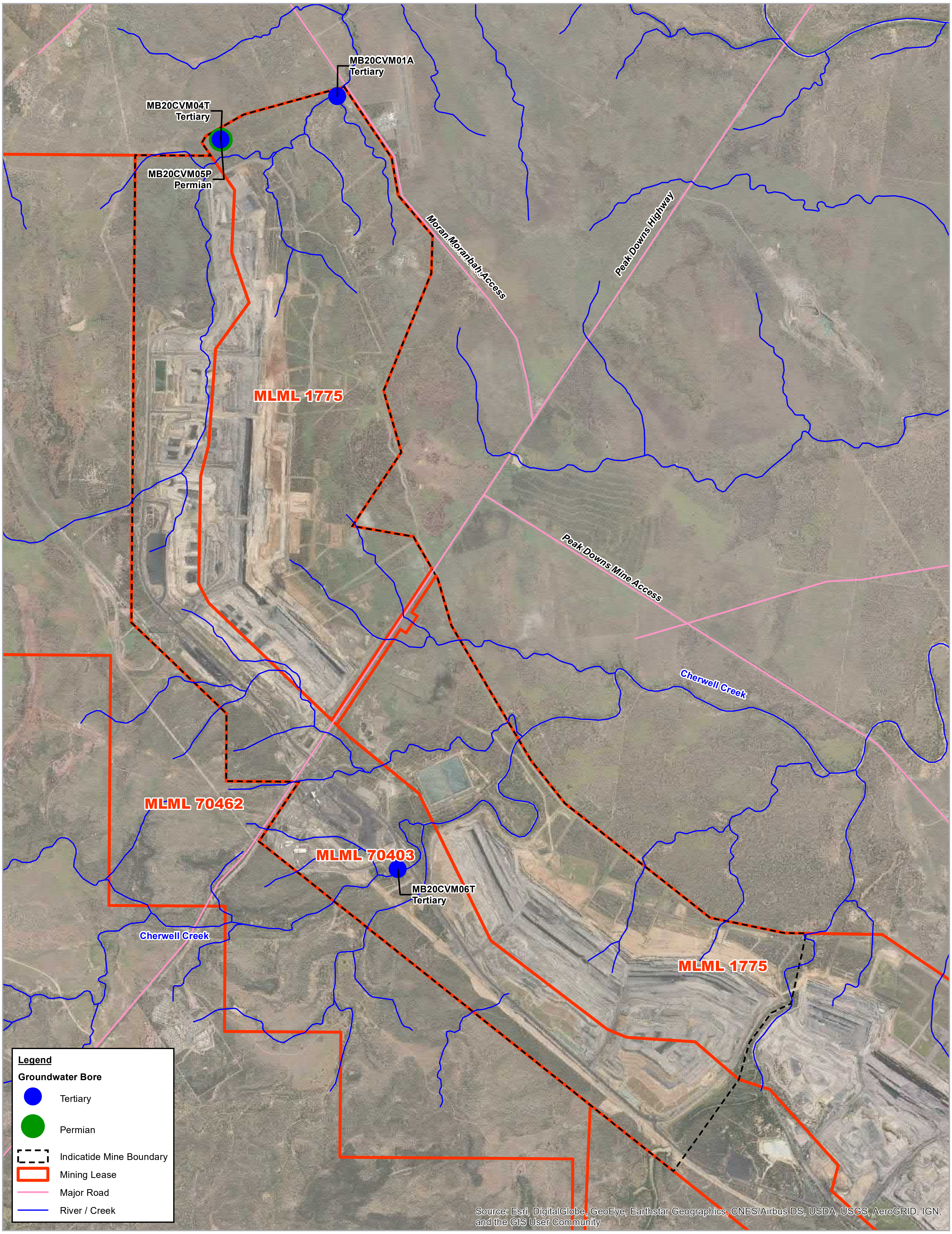
Table 3-2 Record of water strikes during drilling

Bore ID	Depth of GW strike mbgl	Lithology	Yield L/s
MB20CVM04T	19 to 20	Basalt	NR
MB20CVM05P	18 to 19	Basalt	0.5
	19 to 26	Basalt	1.3

Table notes:

mbtoc = metres below top of casing

NR = Not recorded



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:50,000 Paper Size A3

0 500 1,000 1,500 2,000

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

BHP
Caval Ridge Mine

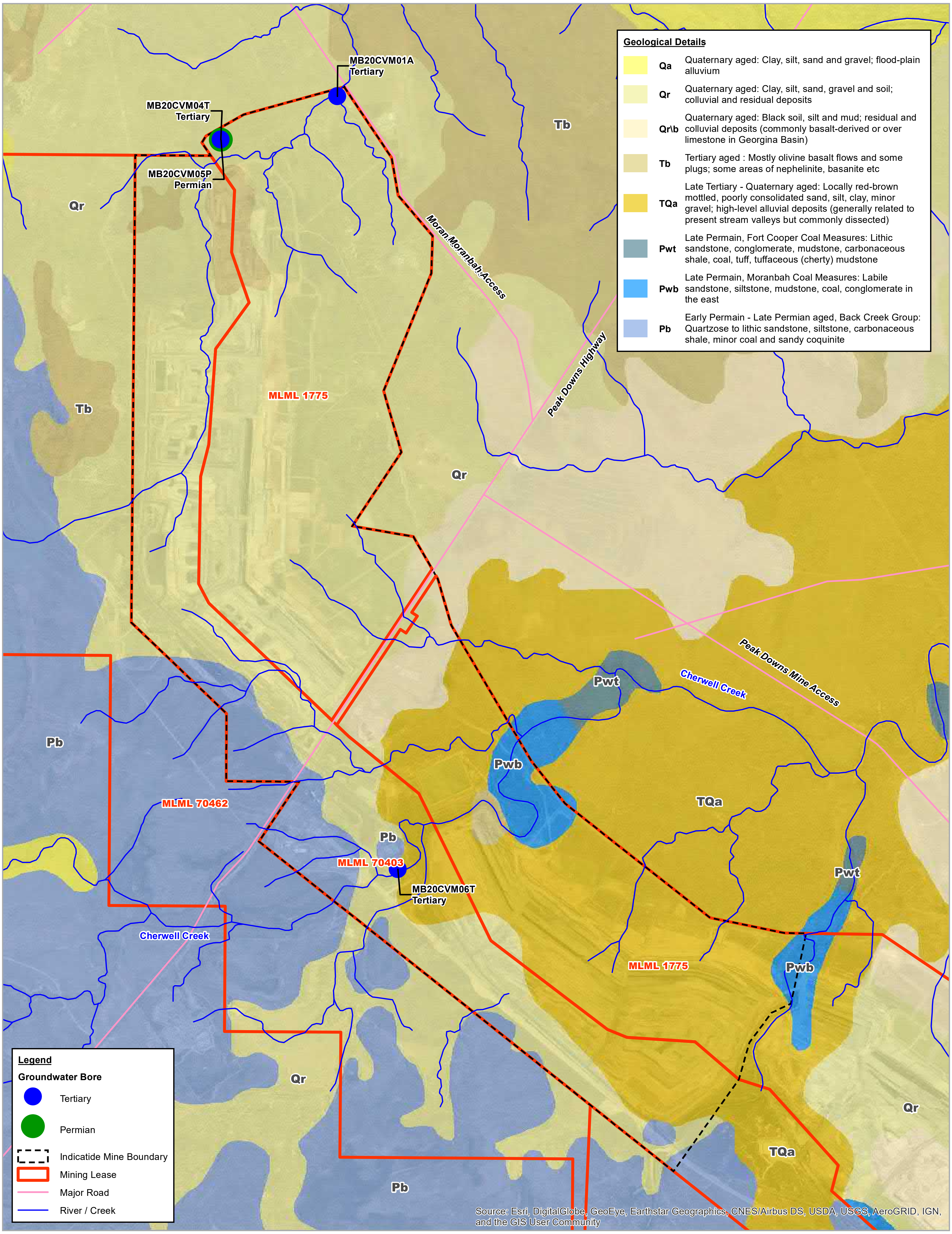
Project No.	**12525920**
Revision No.	**A**
Date	**05/06/2020**

BHP Caval Ridge Mine

FIGURE 3-1

G:\41\12525920\GIS\Maps\MXD\41-12525920-01_cavelRidgeSiteLayout_revA.mxd
Print date: 05 Jun 2020

Data source: GHD:??????. Created by: JVanCooten



Geological Details

🟨	Qa	Quaternary aged: Clay, silt, sand and gravel; flood-plain alluvium
🟨	Qr	Quaternary aged: Clay, silt, sand, gravel and soil; colluvial and residual deposits
🟨	Qr\b	Quaternary aged: Black soil, silt and mud; residual and colluvial deposits (commonly basalt-derived or over limestone in Georgina Basin)
🟫	Tb	Tertiary aged : Mostly olivine basalt flows and some plugs; some areas of nephelinite, basanite etc
🟨	TQa	Late Tertiary - Quaternary aged: Locally red-brown mottled, poorly consolidated sand, silt, clay, minor gravel; high-level alluvial deposits (generally related to present stream valleys but commonly dissected)
▨	Pwt	Late Permian, Fort Cooper Coal Measures: Lithic sandstone, conglomerate, mudstone, carbonaceous shale, coal, tuff, tuffaceous (cherty) mudstone
🟦	Pwb	Late Permian, Moranbah Coal Measures: Labile sandstone, siltstone, mudstone, coal, conglomerate in the east
🟦	Pb	Early Permian - Late Permian aged, Back Creek Group: Quartzose to lithic sandstone, siltstone, carbonaceous shale, minor coal and sandy coquinite

Legend

Groundwater Bore

●	Tertiary
●	Permian
▭	Indicatide Mine Boundary
▭	Mining Lease
—	Major Road
—	River / Creek

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:50,000 Paper Size A3

0 500 1,000 1,500 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

BHP
Caval Ridge Mine

BHP Caval Ridge Mine Surface Geology

Project No. 12525920
Revision No. A
Date 05/06/2020

FIGURE 3-2

G:\41\12525920\GIS\Maps\MXD\41-12525920-02_cavelRidgeGeology_revA.mxd
Print date: 05 Jun 2020

Data source: GHD:??????. Created by: JVanCooten

3.3 Bore development

Following installation, each bore was developed by airlifting after the grout had been allowed to cure. The purpose of development was to remove drilling fines, foreign materials and to enhance hydraulic connectivity with the surrounding aquifer. Bore development was continued until monitored field parameters Specific Conductance (SPC), pH, and water clarity had stabilised (within 10%) for 3 consecutive readings within practicable time constraints, the final Field parameters recoded at the completion of development are detailed in Table 3-3. Groundwater quality samples were collected from each bore after development had concluded.

Table 3-3 below details the bore development at each bore. Digitised field bore development logs are presented in Appendix B.

Table 3-3 Bore development summary table

Bore ID	Pre-development SWL (mbgl)	Duration (mins)	Flow rate (L/s)	SPC (µS/cm)	pH	End of development water observations
MB20CVM01A	6.25	60	0.01	58629	8.48	Clear no odour or sediment
MB20CVM04T	15.0	50	1.10	12474	7.91	Clear no odour
MB20CVM06T	13.82	390	N/A	1912	7.80	opaque no odour or sediment
MB20CVM05P	35.1	210	0.05	14207	8.28	Grey / black with some sediment

Table notes:
mbtgl = metres below ground level

4. Groundwater levels

It must be noted that representative standing water levels (SWLs) for each borehole may not be established for some time post development depending on the depth and recharge rate of the bore. Future monitoring will be required to establish representative borehole SWLs.

As such, the borehole SWLs taken during this project may not be a true representation of the aquifers that have been screened.

Recorded groundwater levels are provided in Table 3-3 (pre-development) and Table 4-1 (post-development) where more than one SWL was recorded post development the most recent record is reported.

Table 4-1 Borehole groundwater levels

Bore ID	Screened interval (mbgl)	Screened lithology	Geological age	SWL (mbtoc)	SWL record date
MB20CVM01A	5.0 – 8.0	Sandy clay and moderately weathered sandstone	Tertiary	6.5	14/04/2020
MB20CVM04T	22 – 28	Slightly weathered basalt	Tertiary	15.0	13/04/2020
MB20CVM06T	11.75 – 17.75	Sand and moderately weathered sandstone	Tertiary	13.82	14/04/2020
MB20CVM05P	39 – 45	Coal and carbonaceous mudstone	Permian	35.1	14/04/2020

Table notes:

mbtoc = metres below top of casing

mbgl = metres below ground level

5. Groundwater sampling and quality

5.1 Groundwater sampling

The following bores were sampled by BHP hydrogeologist upon completion of development:

- MB20CVM01A
  - Sampling was collected by airlifting through the a 32 mm blue line poly pipe at the completion of development
- MB20CVM04T
  - Sampling was collected by airlifting through the a 32 mm blue line poly pipe at the completion of development
- MB20CVM06T
  - Sampling was conducted using a dedicated bailer 15.5 hours after completion of development, which was conducted over three days as detailed in Appendix B Sampling through the tremie line was not practicable due to low flow and high air pressure used during lifting.
- MB20CVM05P
  - Sampling was collected by airlifting through the tremie line at the completion of development

The samples were sent for “BMA FY20 Water Analysis Suite” an analysis suite provided to ALS by BMA. A trip blank sample was dispatched with the samples. Samples were recorded and dispatched using chain of custody (COC) documentation to the agreed laboratory [Australian Laboratory Services (ALS)]. ALS is a National Association of Testing Authorities (NATA) accredited laboratory, laboratory results are included in Appendix C.

A summary of the results of the sampling are presented in Table 5-1.

Table 5-1 Summary of groundwater sampling results

			Sample ID:	MB20CVM01A	MB20CVM04T	MB20CVM05P	MB20CVM06T
			ALS Sample number:	EB2010311-003	EB2010311-001	EB2010311-002	EB2010311-004
			Sample date:	14-Apr-2020 09:46	13-Apr-2020 09:30	13-Apr-2020 17:30	14-Apr-2020 11:00
Analyte grouping	**Analyte**	**Units**	**LOR**	**Result**	**Result**	**Result**	**Result**
EA005P: pH by PC Titrator	pH Value	pH Unit	0.01	7.82	8.19	8.11	7.67
EA010P: Conductivity by PC Titrator	Electrical Conductivity @ 25°C	µS/cm	1	5710	11500	13400	1900
EA015: Total Dissolved Solids dried at 180 ± 5 °C	Total Dissolved Solids @180°C	mg/L	10	3500	7150	8520	1110
EA025: Total Suspended Solids dried at 104 ± 2°C	Suspended Solids (SS)	mg/L	5	210	17	1300	179
EA030: Total Solids dried at 104 ± 2°C	Total Solids	mg/L	10	3640	7790	9530	1300
ED009: Anions	Bromide	mg/L	0.01	2.85	7.8	9.35	1.69
ED037P: Alkalinity by PC Titrator	Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1
	Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1
	Bicarbonate Alkalinity as CaCO3	mg/L	1	1150	605	404	84
	Total Alkalinity as CaCO3	mg/L	1	1150	605	404	84
ED040T: Total Major Anions	Silicon	mg/L	0.05	9.32	26.9	8.98	5.56
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	Sulfate as SO4 - Turbidimetric	mg/L	1	133	470	679	151
ED045G: Chloride by Discrete Analyser	Chloride	mg/L	1	1200	3920	4490	493
ED093F: Dissolved Major Cations	Calcium	mg/L	1	43	149	203	52
	Magnesium	mg/L	1	72	362	354	41
	Sodium	mg/L	1	1160	1770	2280	273
	Potassium	mg/L	1	2	15	21	10
ED093F: SAR and Hardness Calculations	Total Hardness as CaCO3	mg/L	1	404	1860	1960	299
	^ Sodium Adsorption Ratio	-	0.01	25.1	17.8	22.4	6.87

Table 5-1 Summary of groundwater sampling results

			Sample ID:	MB20CVM01A	MB20CVM04T	MB20CVM05P	MB20CVM06T
			ALS Sample number:	EB2010311-003	EB2010311-001	EB2010311-002	EB2010311-004
			Sample date:	14-Apr-2020 09:46	13-Apr-2020 09:30	13-Apr-2020 17:30	14-Apr-2020 11:00
Analyte grouping	**Analyte**	**Units**	**LOR**	**Result**	**Result**	**Result**	**Result**
EG020F: Dissolved Metals by ICP-MS	Aluminium	mg/L	0.01	<0.01	<0.01	<0.01	0.02
	Antimony	mg/L	0.001	0.003	<0.001	0.004	0.001
	Arsenic	mg/L	0.001	0.013	<0.001	0.026	0.004
	Barium	mg/L	0.001	0.101	0.063	0.044	0.061
	Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
	Cobalt	mg/L	0.001	0.003	<0.001	0.006	0.008
	Copper	mg/L	0.001	<0.001	<0.001	<0.001	0.001
	Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
	Manganese	mg/L	0.001	0.074	0.042	0.038	0.085
	Molybdenum	mg/L	0.001	0.004	<0.001	0.005	0.007
	Nickel	mg/L	0.001	0.007	<0.001	0.015	0.009
	Selenium	mg/L	0.01	0.03	<0.01	<0.01	<0.01
	Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
	Strontium	mg/L	0.001	1.48	4.2	5.34	0.629
	Uranium	mg/L	0.001	0.014	<0.001	<0.001	0.001
	Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
	Zinc	mg/L	0.005	0.016	<0.005	<0.005	0.073
	Boron	mg/L	0.05	0.7	0.84	1.35	0.13
	Iron	mg/L	0.05	<0.05	0.13	<0.05	<0.05
EG020T: Total Metals by ICP-MS	Aluminium	mg/L	0.01	0.99	0.18	5.37	0.72
	Antimony	mg/L	0.001	0.004	<0.001	0.003	0.002
	Arsenic	mg/L	0.001	0.013	<0.001	0.031	0.004
	Barium	mg/L	0.001	0.11	0.068	0.19	0.068
	Cadmium	mg/L	0.0001	<0.0001	<0.0001	0.0002	<0.0001
	Chromium	mg/L	0.001	0.002	<0.001	0.007	0.003
	Cobalt	mg/L	0.001	0.003	<0.001	0.039	0.008
	Copper	mg/L	0.001	<0.001	<0.001	0.036	0.003
	Lead	mg/L	0.001	<0.001	<0.001	0.023	0.004
	Manganese	mg/L	0.001	0.096	0.052	0.115	0.122
	Molybdenum	mg/L	0.001	0.006	<0.001	0.004	0.01
	Nickel	mg/L	0.001	0.008	<0.001	0.085	0.01
	Selenium	mg/L	0.01	0.02	<0.01	<0.01	<0.01
	Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
	Strontium	mg/L	0.001	1.63	4.63	5.8	0.631
	Uranium	mg/L	0.001	0.02	<0.001	0.002	0.002
	Vanadium	mg/L	0.01	<0.01	<0.01	0.02	<0.01
	Zinc	mg/L	0.005	0.028	0.008	0.538	0.172
	Boron	mg/L	0.05	0.71	0.95	1.37	0.1
	Iron	mg/L	0.05	0.78	1.03	4.38	1.16

Table 5-1 Summary of groundwater sampling results

			Sample ID:	MB20CVM01A	MB20CVM04T	MB20CVM05P	MB20CVM06T
			ALS Sample number:	EB2010311-003	EB2010311-001	EB2010311-002	EB2010311-004
			Sample date:	14-Apr-2020 09:46	13-Apr-2020 09:30	13-Apr-2020 17:30	14-Apr-2020 11:00
Analyte grouping	**Analyte**	**Units**	**LOR**	**Result**	**Result**	**Result**	**Result**
EG035F: Dissolved Mercury by FIMS	Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS	Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator	Fluoride	mg/L	0.1	0.8	1.2	0.7	0.2
EK055G: Ammonia as N by Discrete Analyser	Ammonia as N	mg/L	0.01	0.03	0.26	0.75	<0.01
EK057G: Nitrite as N by Discrete Analyser	Nitrite as N	mg/L	0.01	0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser	Nitrate as N	mg/L	0.01	0.09	0.02	0.03	0.03
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser	Nitrite + Nitrate as N	mg/L	0.01	0.1	0.02	0.03	0.03
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	Total Kjeldahl Nitrogen as N	mg/L	0.1	0.3	0.9	2.8	0.7
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser	^ Total Nitrogen as N	mg/L	0.1	0.4	0.9	2.8	0.7
EK067G: Total Phosphorus as P by Discrete Analyser	Total Phosphorus as P	mg/L	0.01	0.04	0.08	0.26	0.04
EN055: Ionic Balance	ø Total Anions	meq/L	0.01	59.6	132	149	18.7
	ø Total Cations	meq/L	0.01	58.6	115	139	18.1
	ø Ionic Balance	%	0.01	0.86	7.22	3.44	1.71
EP080/071: Total Petroleum Hydrocarbons	C6 - C9 Fraction	µg/L	20	<20	<20	<20	<20
	C10 - C14 Fraction	µg/L	50	<50	<50	<50	80
	C15 - C28 Fraction	µg/L	100	<100	<100	<100	150
	C29 - C36 Fraction	µg/L	50	<50	<50	<50	<50
	^ C10 - C36 Fraction (sum)	µg/L	50	<50	<50	<50	230
	C6 - C10 Fraction	µg/L	20	<20	<20	<20	<20
	^ C6 - C10 Fraction minus BTEX(F1)	µg/L	20	<20	<20	<20	<20
	>C10 - C16 Fraction	µg/L	100	<100	<100	<100	140
	>C16 - C34 Fraction	µg/L	100	100	<100	<100	<100
	>C34 - C40 Fraction	µg/L	100	<100	<100	<100	<100
	^ >C10 - C40 Fraction (sum)	µg/L	100	100	<100	<100	140
	^ >C10 - C16 Fraction minus Naphthalene(F2)	µg/L	100	<100	<100	<100	140
EP080: BTEXN	Benzene	µg/L	1	<1	<1	<1	<1
	Toluene	µg/L	2	<2	<2	<2	<2
	Ethylbenzene	µg/L	2	<2	<2	<2	<2
	meta- & para-Xylene	µg/L	2	<2	<2	<2	<2
	ortho-Xylene	µg/L	2	<2	<2	<2	<2
	^ Total Xylenes	µg/L	2	<2	<2	<2	<2
	^ Sum of BTEX	µg/L	1	<1	<1	<1	<1
	Naphthalene	µg/L	5	<5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates	1.2-Dichloroethane-D4	%	2	99.8	99.6	100	97.3
	Toluene-D8	%	2	97	97.9	96.7	98.8
	4-Bromofluorobenzene	%	2	114	115	112	113

Table 5-1 Summary of groundwater sampling results

			Sample ID:	MB19CVM08P	MB19CVM09A	MB19CVM10P
			ALS Sample number:	EB2010311-007	EB2010311-006	EB2010311-005
			Sample date:	14-Apr-2020 16:05	14-Apr-2020 15:30	14-Apr-2020 13:30
Analyte grouping	**Analyte**	**Units**	**LOR**	**Result**	**Result**	**Result**
EA005P: pH by PC Titrator	pH Value	pH Unit	0.01	8.41	7.9	8.73
EA010P: Conductivity by PC Titrator	Electrical Conductivity @ 25°C	µS/cm	1	3300	1250	1840
EA015: Total Dissolved Solids dried at 180 ± 5 °C	Total Dissolved Solids @180°C	mg/L	10	1830	782	1100
EA025: Total Suspended Solids dried at 104 ± 2°C	Suspended Solids (SS)	mg/L	5	14	44	1520
EA030: Total Solids dried at 104 ± 2°C	Total Solids	mg/L	10	1890	800	3620
ED009: Anions	Bromide	mg/L	0.01	1.76	0.95	0.82
ED037P: Alkalinity by PC Titrator	Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1
	Carbonate Alkalinity as CaCO3	mg/L	1	20	<1	47
	Bicarbonate Alkalinity as CaCO3	mg/L	1	343	232	302
	Total Alkalinity as CaCO3	mg/L	1	363	232	349
ED040T: Total Major Anions	Silicon	mg/L	0.05	8.06	19.9	22.5
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	Sulfate as SO4 - Turbidimetric	mg/L	1	142	80	139
ED045G: Chloride by Discrete Analyser	Chloride	mg/L	1	816	233	318
ED093F: Dissolved Major Cations	Calcium	mg/L	1	46	46	15
	Magnesium	mg/L	1	46	32	10
	Sodium	mg/L	1	583	176	385
	Potassium	mg/L	1	8	8	5
ED093F: SAR and Hardness Calculations	Total Hardness as CaCO3	mg/L	1	304	247	79
	^ Sodium Adsorption Ratio	-	0.01	14.5	4.88	18.9

Table 5-1 Summary of groundwater sampling results

			Sample ID:	MB19CVM08P	MB19CVM09A	MB19CVM10P
			ALS Sample number:	EB2010311-007	EB2010311-006	EB2010311-005
			Sample date:	14-Apr-2020 16:05	14-Apr-2020 15:30	14-Apr-2020 13:30
Analyte grouping	**Analyte**	**Units**	**LOR**	**Result**	**Result**	**Result**
EG020F: Dissolved Metals by ICP-MS	Aluminium	mg/L	0.01	<0.01	<0.01	<0.01
	Antimony	mg/L	0.001	<0.001	0.002	0.001
	Arsenic	mg/L	0.001	<0.001	0.006	0.006
	Barium	mg/L	0.001	0.085	0.083	0.062
	Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001
	Chromium	mg/L	0.001	<0.001	<0.001	<0.001
	Cobalt	mg/L	0.001	<0.001	0.016	<0.001
	Copper	mg/L	0.001	<0.001	0.002	<0.001
	Lead	mg/L	0.001	<0.001	<0.001	<0.001
	Manganese	mg/L	0.001	0.001	0.267	0.006
	Molybdenum	mg/L	0.001	0.004	0.003	0.001
	Nickel	mg/L	0.001	<0.001	0.012	0.002
	Selenium	mg/L	0.01	<0.01	<0.01	<0.01
	Silver	mg/L	0.001	<0.001	<0.001	<0.001
	Strontium	mg/L	0.001	8.09	0.462	1.63
	Uranium	mg/L	0.001	<0.001	0.002	<0.001
	Vanadium	mg/L	0.01	<0.01	<0.01	<0.01
	Zinc	mg/L	0.005	<0.005	0.098	<0.005
	Boron	mg/L	0.05	0.22	0.11	0.28
	Iron	mg/L	0.05	<0.05	<0.05	<0.05
EG020T: Total Metals by ICP-MS	Aluminium	mg/L	0.01	0.02	1.47	12.3
	Antimony	mg/L	0.001	<0.001	0.004	0.001
	Arsenic	mg/L	0.001	<0.001	0.007	0.011
	Barium	mg/L	0.001	0.087	0.105	0.507
	Cadmium	mg/L	0.0001	<0.0001	0.0001	0.0001
	Chromium	mg/L	0.001	0.001	0.003	0.013
	Cobalt	mg/L	0.001	<0.001	0.019	0.012
	Copper	mg/L	0.001	<0.001	0.012	0.039
	Lead	mg/L	0.001	<0.001	0.006	0.019
	Manganese	mg/L	0.001	0.002	0.304	0.358
	Molybdenum	mg/L	0.001	0.005	0.007	0.003
	Nickel	mg/L	0.001	<0.001	0.017	0.032
	Selenium	mg/L	0.01	<0.01	<0.01	<0.01
	Silver	mg/L	0.001	<0.001	<0.001	<0.001
	Strontium	mg/L	0.001	9.4	0.49	2.38
	Uranium	mg/L	0.001	<0.001	0.004	<0.001
	Vanadium	mg/L	0.01	<0.01	<0.01	0.03
	Zinc	mg/L	0.005	<0.005	0.187	0.054
	Boron	mg/L	0.05	0.17	0.06	0.18
	Iron	mg/L	0.05	0.12	1.8	26.1

Table 5-1 Summary of groundwater sampling results

			Sample ID:	MB19CVM08P	MB19CVM09A	MB19CVM10P
			ALS Sample number:	EB2010311-007	EB2010311-006	EB2010311-005
			Sample date:	14-Apr-2020 16:05	14-Apr-2020 15:30	14-Apr-2020 13:30
Analyte grouping	**Analyte**	**Units**	**LOR**	**Result**	**Result**	**Result**
EG035F: Dissolved Mercury by FIMS	Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS	Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator	Fluoride	mg/L	0.1	<0.1	0.2	0.1
EK055G: Ammonia as N by Discrete Analyser	Ammonia as N	mg/L	0.01	1.06	0.12	0.41
EK057G: Nitrite as N by Discrete Analyser	Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser	Nitrate as N	mg/L	0.01	<0.01	0.02	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser	Nitrite + Nitrate as N	mg/L	0.01	<0.01	0.02	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	Total Kjeldahl Nitrogen as N	mg/L	0.1	1.5	2.5	3.6
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser	^ Total Nitrogen as N	mg/L	0.1	1.5	2.5	3.6
EK067G: Total Phosphorus as P by Discrete Analyser	Total Phosphorus as P	mg/L	0.01	0.01	0.08	0.96
EN055: Ionic Balance	ø Total Anions	meq/L	0.01	33.2	12.9	18.8
	ø Total Cations	meq/L	0.01	31.6	12.8	18.4
	ø Ionic Balance	%	0.01	2.44	0.33	1.05
EP080/071: Total Petroleum Hydrocarbons	C6 - C9 Fraction	µg/L	20	<20	<20	<20
	C10 - C14 Fraction	µg/L	50	<50	310	<50
	C15 - C28 Fraction	µg/L	100	<100	990	100
	C29 - C36 Fraction	µg/L	50	<50	<50	50
	^ C10 - C36 Fraction (sum)	µg/L	50	<50	1300	150
	C6 - C10 Fraction	µg/L	20	<20	<20	<20
	^ C6 - C10 Fraction minus BTEX(F1)	µg/L	20	<20	<20	<20
	>C10 - C16 Fraction	µg/L	100	<100	670	<100
	>C16 - C34 Fraction	µg/L	100	<100	630	140
	>C34 - C40 Fraction	µg/L	100	<100	<100	<100
	^ >C10 - C40 Fraction (sum)	µg/L	100	<100	1300	140
	^ >C10 - C16 Fraction minus Naphthalene(F2)	µg/L	100	<100	670	<100
EP080: BTEXN	Benzene	µg/L	1	<1	<1	<1
	Toluene	µg/L	2	<2	<2	<2
	Ethylbenzene	µg/L	2	<2	<2	<2
	meta- & para-Xylene	µg/L	2	<2	<2	<2
	ortho-Xylene	µg/L	2	<2	<2	<2
	^ Total Xylenes	µg/L	2	<2	<2	<2
	^ Sum of BTEX	µg/L	1	<1	<1	<1
	Naphthalene	µg/L	5	<5	<5	<5
EP080S: TPH(V)/BTEX Surrogates	1.2-Dichloroethane-D4	%	2	101	101	99.1
	Toluene-D8	%	2	98.4	96.6	95.9
	4-Bromofluorobenzene	%	2	114	114	112

5.2 Groundwater field measurements

BHP personnel measured in-situ groundwater quality parameters for the following during sampling:

- Specific conductance (SPC)
- pH
- Reduced Oxygen (Redox)
- Temperature - although measured, due to airlifting is not representative of aquifer and only taken for the purposes of referencing EC

The groundwater parameters recorded in the field during sampling are detailed in Table 5-2.

Table 5-2 Measured field parameters of groundwater samples

Bore ID	SPC (µS/cm)	pH	Redox (mV)	Temp. (ºC)
MB20CVM01A	6077	8.48	135	21.3
MB20CVM04T	12474	7.91	37.2	27.8
MB20CVM06T	1912	7.80	82.0	26.5
MB20CVM05P	14207	8.28	31.2	25.9

6. References

BHP, Scope of Work - Simple Off-Contract Scope of Work Template, *FY20 Hydro Drilling – Hydrogeological Services*, 02 July 2019

BHP, *Resource Engineering, Caval Ridge FY20 Hydro Drilling Scope of Work,* Undated

BHP, *Caval Ridge FY20 Groundwater bores map*, 27 September 2019

National Uniform Drillers Licencing Committee, *Minimum Construction Requirements For Water Bores in Australia: 3rd edition*, February 2012

Appendices

Appendix A - Bore construction logs and drillers logs

BOREHOLE LOG SHEET WITH WELL PIEZOMETER

Client : BMA
Project : Caval Ridge Mine Groundwater Monitoring Well Installation
Location : MB20CVM01A, Caval Ridge Mine

HOLE No. MB20CVM01A

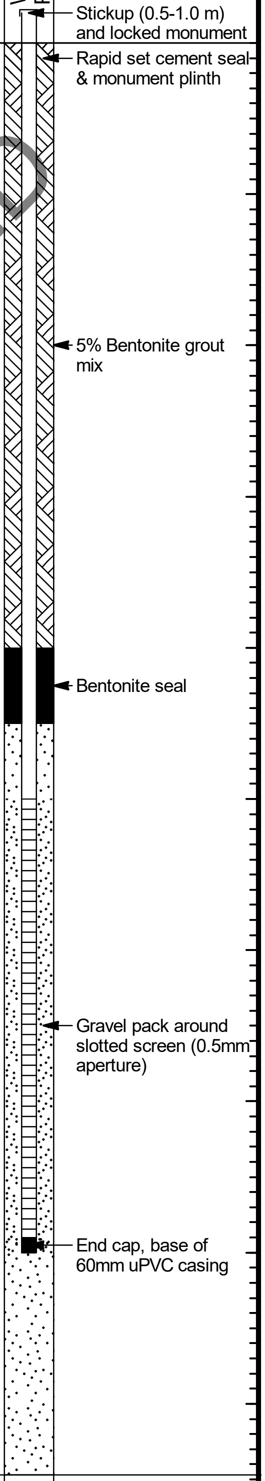
SHEET 1 OF 1

Position : 609915.00 E 7560288.00 N AMG66 55	**Surface RL:** AHD	**Angle from Horiz. :** 90°	**Processed :** D Rider
Rig Type : DRA-RC600 **Mounting:** Truck-mounted	**Contractor :** Ausdrill	**Driller :** Kaine Fowles	**Checked :** V Dear
Date Started : 12/4/2020	**Date Completed :** 14/4/2020	**Logged by :** C Nelson	**Date:** 12/05/20

Note: * indicates signatures on original issue of log or last revision of log

SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations
0	Rotary Air (139mm)					▨		CLAY, dark brown, high plasticity index, alluvia	D	F	
1					1.00			Sandy CLAY, yellow brown, with gravel, medium plasticity index, tertiary			
2					2.00			Sandy CLAY, yellow brown, with gravel with interbedded sandstone and cemented sands, Tertiary			
6					6.00			SANDSTONE, yellow brown, fine grained, moderately weathered, low strenth, brown staining along joint planes planes, Tertiary			
7					7.00			SANDSTONE, dark grey, fine grained, moderately weathered, low strength, Permian			
9					9.47			End of borehole at 9.47 metres.			

WELL PIEZOMETER



See standard sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET WITH WELL PIEZOMETER

Client : BMA
Project : Caval Ridge Mine Groundwater Monitoring Well Installation
Location : MB20CVM04T, Caval Ridge Mine

HOLE No. MB20CVM04T

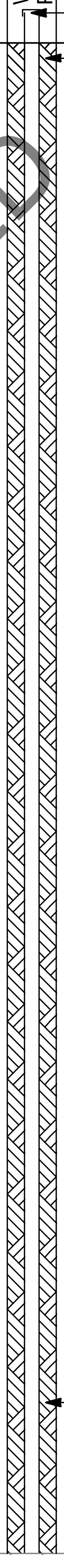
SHEET 1 OF 3

Position : 608194.00 E 7559651.00 N AMG66 55	**Surface RL:** AHD	**Angle from Horiz. :** 90°	**Processed :** D Rider
Rig Type : DRA-RC600 **Mounting:** Truck-mounted	**Contractor :** Ausdrill	**Driller :** Kaine Fowles	**Checked :** V Dear
Date Started : 9/4/2020	**Date Completed :** 12/4/2020	**Logged by :** C Nelson	**Date:** 12/05/20

Note: * indicates signatures on original issue of log or last revision of log

SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations
0–10	Rotary Air (139mm)							Sandy CLAY, red brown, with gravel, high plasticity, colluvium and residual basalt	D	H	
					2.00			BASALT, pale yellow brown, extremely weathered, very low strength, sand and gravel matrix, Tertiary			
					3.00			BASALT, pale grey, distinctly weathered, low strength, jointed with discoloration and infilling, Tertiary			
					10.00						

WELL PIEZOMETER



See standard sheets for details of abbreviations & basis of descriptions

Job No.
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BOREHOLE LOG SHEET WITH WELL PIEZOMETER

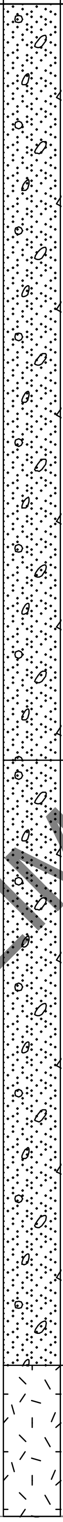
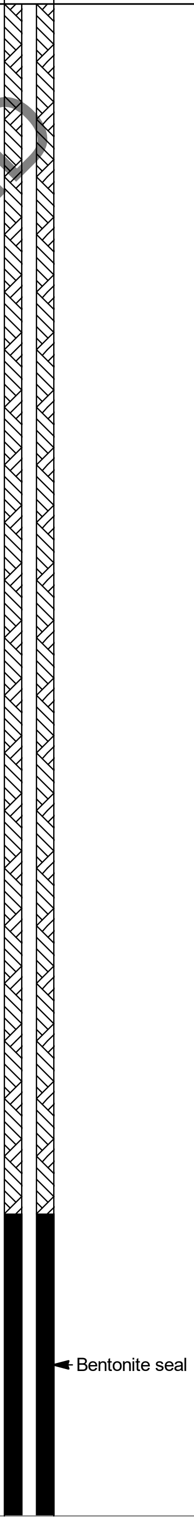
Client : BMA
Project : Caval Ridge Mine Groundwater Monitoring Well Installation
Location : MB20CVM04T, Caval Ridge Mine

HOLE No. MB20CVM04T

SHEET 2 OF 3

Position : 608194.00 E 7559651.00 N AMG66 55	**Surface RL:** AHD		**Angle from Horiz. :** 90°		**Processed :** D Rider
Rig Type : DRA-RC600	**Mounting:** Truck-mounted	**Contractor :** Ausdrill	**Driller :** Kaine Fowles		**Checked :** V Dear
Date Started : 9/4/2020	**Date Completed :** 12/4/2020		**Logged by :** C Nelson		**Date:** 12/05/20

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL							WELL PIEZOMETER	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	**Comments/ Observations**	WELL PIEZOMETER Log	**Components**
11 12 13 14	Rotary Air (139mm)							Gravely SAND, brown, with clay, medium sized gravel and sub-angular, Tertiary					
15 16 17 18					15.00			Gravely SAND, brown, medium to course gravel, sub angular, Tertiary					
19 20					19.00 20.00			BASALT, pale yellow brown, distinctly weathered, low strength, jointed with discoloration and infilling, Tertiary			From 19 m, bore started making water		Bentonite seal

See standard sheets for details of abbreviations & basis of descriptions

Job No.
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BOREHOLE LOG SHEET WITH WELL PIEZOMETER

Client : BMA
Project : Caval Ridge Mine Groundwater Monitoring Well Installation
Location : MB20CVM04T, Caval Ridge Mine

HOLE No. MB20CVM04T

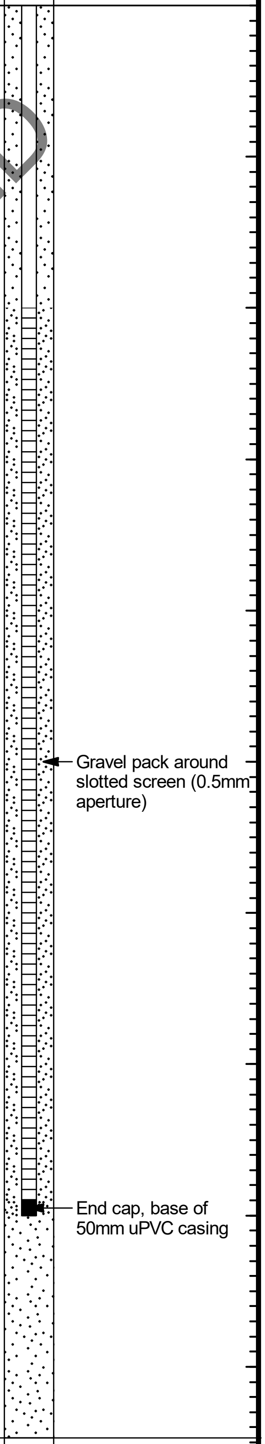
SHEET 3 OF 3

Position : 608194.00 E 7559651.00 N AMG66 55	**Surface RL:** AHD	**Angle from Horiz. :** 90°	**Processed :** D Rider
Rig Type : DRA-RC600	**Mounting:** Truck-mounted **Contractor :** Ausdrill	**Driller :** Kaine Fowles	**Checked :** V Dear
Date Started : 9/4/2020	**Date Completed :** 12/4/2020	**Logged by :** C Nelson	**Date:** 12/05/20

Note: * indicates signatures on original issue of log or last revision of log

SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations
21 22 23 24 25 26	Rotary Air (139mm)							BASALT, blue grey, moderately to slightly weathered, amygdaloidal, some green mineralisation (Serpentine) and pyrite observed, Tertiary			
27					27.00			GRAVEL, blue grey, coarse basalt gravel, sub-angular, Tertiary			
28 29					28.00			CLAY, pale grey, high plasticity			
30					29.47			End of borehole at 29.47 metres.			

WELL PIEZOMETER



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GEO_BOREHOLE AS1726 2017 CVM.GPJ GHD_GEO_TEMPLATE 2.00.GDT 5/6/20

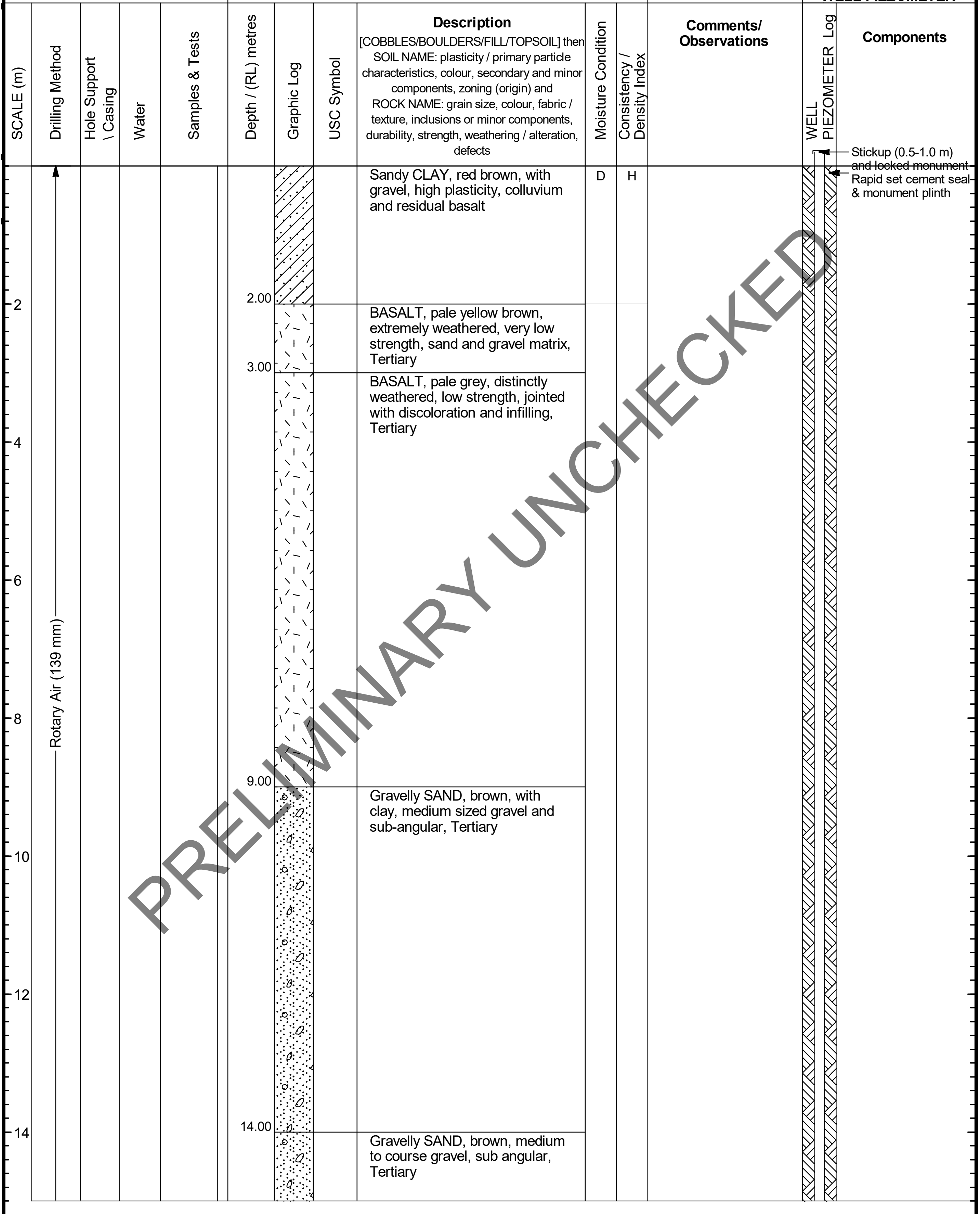
BOREHOLE LOG SHEET WITH WELL PIEZOMETER

HOLE No. MB20CVM05P

SHEET 1 OF 4

Client : BMA			
Project : Caval Ridge Mine Groundwater Monitoring Well Installation			
Location : MB20CVM05P, Caval Ridge Mine			
Position : 608199.00 E 7559646.00 N AMG66 55	**Surface RL:** AHD	**Angle from Horiz. :** 90°	**Processed :** D Rider
Rig Type : DRA-RC600	**Mounting:** Truck-mounted	**Contractor :** Ausdrill	**Driller :** Kaine Fowles
			Checked : V Dear
Date Started : 11/4/2020	**Date Completed :** 13/4/2020	**Logged by :** C Nelson	**Date:** 12/05/20

Note: * indicates signatures on original issue of log or last revision of log



SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	WELL PIEZOMETER Log / Components
	Rotary Air (139 mm)						Sandy CLAY, red brown, with gravel, high plasticity, colluvium and residual basalt	D	H		Stickup (0.5-1.0 m) and locked monument Rapid set cement seal & monument plinth
2					2.00		BASALT, pale yellow brown, extremely weathered, very low strength, sand and gravel matrix, Tertiary				
					3.00		BASALT, pale grey, distinctly weathered, low strength, jointed with discoloration and infilling, Tertiary				
4											
6											
8					9.00		Gravelly SAND, brown, with clay, medium sized gravel and sub-angular, Tertiary				
10											
12											
14					14.00		Gravelly SAND, brown, medium to course gravel, sub angular, Tertiary				

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BOREHOLE LOG SHEET WITH WELL PIEZOMETER

Client : BMA
Project : Caval Ridge Mine Groundwater Monitoring Well Installation
Location : MB20CVM05P, Caval Ridge Mine

HOLE No. MB20CVM05P

SHEET 2 OF 4

Position : 608199.00 E 7559646.00 N AMG66 55	**Surface RL:** AHD	**Angle from Horiz. :** 90°	**Processed :** D Rider
Rig Type : DRA-RC600 **Mounting:** Truck-mounted	**Contractor :** Ausdrill	**Driller :** Kaine Fowles	**Checked :** V Dear
Date Started : 11/4/2020	**Date Completed :** 13/4/2020	**Logged by :** C Nelson	**Date:** 12/05/20

Note: * indicates signatures on original issue of log or last revision of log

SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	WELL PIEZOMETER Log	Components
16	Rotary Air (139 mm)												
18					18.00			BASALT, pale yellow brown, distinctly weathered, low strength, jointed with discoloration and infilling, Tertiary			At 18m water present - 0.5L/s		Bentonite 5% / Cement grout backfill
					19.00			BASALT, blue grey, moderately to slightly weathered, amygdaloidal, some green mineralisation (Serpentine) and pyrite observed, Tertiary			From 19m to 26m bore was flowing water at 1.31L/s		
20													
22													
24													
					25.00			BASALT, blue grey, coarse basalt gravel, sub-angular, Tertiary					
26					26.00			CLAY, pale grey to brown grey, high plasticity					
28													
30													

See standard sheets for details of abbreviations & basis of descriptions

Job No. 12525920

GEO_BOREHOLE AS1726 2017 CVM.GPJ GHD_GEO_TEMPLATE 2.00.GDT 5/6/20

BOREHOLE LOG SHEET WITH WELL PIEZOMETER

Client : BMA
Project : Caval Ridge Mine Groundwater Monitoring Well Installation
Location : MB20CVM05P, Caval Ridge Mine

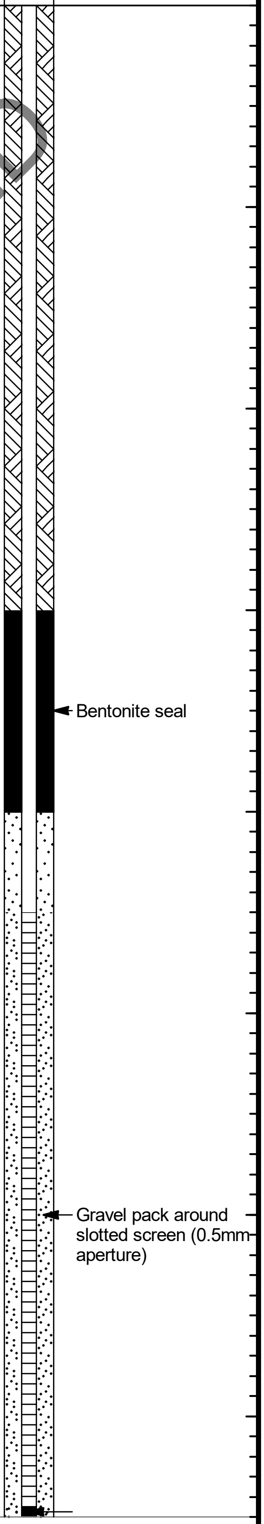
HOLE No. MB20CVM05P

SHEET 3 OF 4

Position : 608199.00 E 7559646.00 N AMG66 55	**Surface RL:** AHD		**Angle from Horiz. :** 90°		**Processed :** D Rider
Rig Type : DRA-RC600	**Mounting:** Truck-mounted	**Contractor :** Ausdrill	**Driller :** Kaine Fowles		**Checked :** V Dear
Date Started : 11/4/2020	**Date Completed :** 13/4/2020		**Logged by :** C Nelson		**Date:** 12/05/20

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL							WELL PIEZOMETER	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Comments/ Observations	WELL PIEZOMETER Log	Components
32 34 36	Rotary Air (139 mm)					▨							
					37.00	▤		MUDSTONE, dark grey, highly weathered, very low strength, Permian					Bentonite seal
38					39.00			CARBONACEOUS MUDSTONE, dark grey, moderately weathered, low strength, thinly laminated, Permian					
40					41.00	■		COAL, black, with some interbedded mudstone					Gravel pack around slotted screen (0.5mm aperture)
42 44					44.00			CARBONACEOUS MUDSTONE, dark grey, moderately weathered, low strength, thinly laminated,					



See standard sheets for details of abbreviations & basis of descriptions

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Job No.
12525920

BOREHOLE LOG SHEET WITH WELL PIEZOMETER

Client :	BMA
Project :	Caval Ridge Mine Groundwater Monitoring Well Installation
Location :	MB20CVM05P, Caval Ridge Mine

HOLE No. MB20CVM05P

SHEET 4 OF 4

Position :	608199.00 E 7559646.00 N AMG66 55	**Surface RL:**	AHD	**Angle from Horiz. :**	90°	**Processed :**	D Rider
Rig Type :	DRA-RC600	**Mounting:**	Truck-mounted	**Contractor :**	Ausdrill	**Driller :**	Kaine Fowles
Date Started :	11/4/2020	**Date Completed :**	13/4/2020	**Logged by :**	C Nelson	**Checked :**	V Dear
						Date:	12/05/20

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL							WELL PIEZOMETER	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	**Comments/ Observations**	WELL PIEZOMETER Log	**Components**
	↓				45.47	▨		Permian				⁙	End cap, base of 50mm uPVC casing
								End of borehole at 45.47 metres.					
46													
48													
50													
52													
54													
56													
58													
60													

GEO_BOREHOLE AS1726 2017 CVM.GPJ GHD_GEO_TEMPLATE 2.00.GDT 5/6/20

BOREHOLE LOG SHEET WITH WELL PIEZOMETER

HOLE No. MB20CVM06T

SHEET 1 OF 2

Client : BMA			
Project : Caval Ridge Mine Groundwater Monitoring Well Installation			
Location : MB20CVM06T, Caval Ridge Mine			
Position : 610808.00 E 7548889.00 N AMG66 55	**Surface RL:** AHD	**Angle from Horiz. :** 90°	**Processed :** D Rider
Rig Type : DRA-RC600 **Mounting:** Truck-mounted	**Contractor :** Ausdrill	**Driller :** Kaine Fowles	**Checked :** V Dear
Date Started : 8/4/2020	**Date Completed :** 9/4/2020	**Logged by :** C Nelson	**Date:** 12/05/20

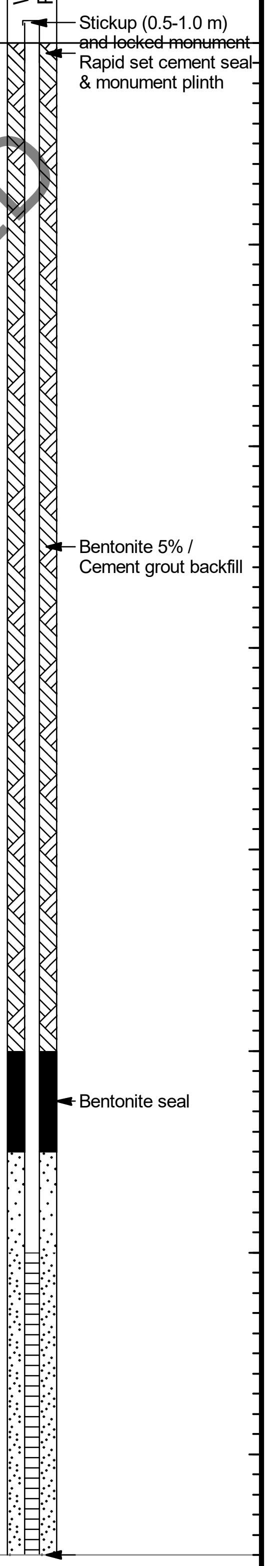
Note: * indicates signatures on original issue of log or last revision of log

Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	USC Symbol	Description	Moisture Condition	Consistency / Density Index	Comments/ Observations
Rotary Air (139 mm)						Gravelly SAND, orange brown, sub rounded, quartz rich sands, alluvial	D	L	Form 0m drilling with water and foam
				2.00		Sandy CLAY, orange brown, medium plasticity, alluvial		L	
				6.00		Clayey SAND, orange brown, with fine gravel, low plasticity, sand is quartz rich, Alluvial		L	
				8.00		Gravelly SAND, orange brown, with clay, low plasticity, fine to medium gravel, quartzose, alluvial		L	
				9.00		SAND, buff brown (khaki), medium to coarse grained sand, grains are sub-rounded, quartzose, cemented, Tertiary		L	

Description: [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects

SCALE (m): 2, 4, 6, 8, 10, 12, 14

WELL PIEZOMETER



See standard sheets for details of abbreviations & basis of descriptions

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Job No. 12525920

GEO_BOREHOLE AS1726 2017 CVM.GPJ GHD_GEO_TEMPLATE 2.00.GDT 5/6/20

BOREHOLE LOG SHEET WITH WELL PIEZOMETER

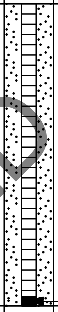
Client : BMA
Project : Caval Ridge Mine Groundwater Monitoring Well Installation
Location : MB20CVM06T, Caval Ridge Mine

HOLE No. MB20CVM06T

SHEET 2 OF 2

Position : 610808.00 E 7548889.00 N AMG66 55	**Surface RL:** AHD		**Angle from Horiz. :** 90°		**Processed :** D Rider
Rig Type : DRA-RC600	**Mounting:** Truck-mounted	**Contractor :** Ausdrill	**Driller :** Kaine Fowles		**Checked :** V Dear
Date Started : 8/4/2020	**Date Completed :** 9/4/2020		**Logged by :** C Nelson		**Date:** 12/05/20

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL							WELL PIEZOMETER	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric / texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	**Comments/ Observations**	WELL PIEZOMETER Log	**Components**
16	Rotary Air (139 mm)				17.00					L			Gravel pack around slotted screen (0.5mm aperture)
					18.00			SANDSTONE, dark grey, medium grained, soft, moderately weathered, Permian		L			End cap, base of 50mm uPVC casing
18								End of borehole at 18.00 metres.					
20													
22													
24													
26													
28													
30													

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
12525920

Water bore drilling log

Queensland Government

2034262

Authorisation details

Registered number ______ Development permit number ______ Works reference number ______

SECTION A—LOCATION DETAILS

Name of landholder BHP Billiton Phone No. ______

Postal address 480 Queen street Brisbane city Postcode 4000

Real property address Caval Ridge Mine Moranbah QLD Postcode 4744

Real property description Lot ______ Plan ______ or Bore location GPS. Latitude ______ Longitude ______ Datum ______

Easting 609916 Northing 7560290 Zone 55

SECTION B—BORE COMPLETION DETAILS

Date commenced 12/4/2020

Date completed 14/4/2020

SECTION C—DRILLING METHOD

☐ Rotary mud ☐ Cable tool

☐ Auger ☒ Rotary air

☐ Other ______

SECTION D—HOLE SIZE

Diameter (mm)	Location (metres) From	To
139	0	9.47

SECTION E—CASING DETAILS

Type (PVC, steel etc)	Size O.D. (mm)	Wall thickness (mm)	Location (metres) From	To
PVC	60	class 18	0	8

SECTION F—CENTRALISERS

Type	Location (metres) From	To
Kwich Zip	0	8

SECTION G—PERFORATIONS/ SLOTS/ SCREENS

Type	Size O.D. (mm)	Aperture (mm)	Location (metres) From	To
PVC slotted	60	1	5	8

SECTION H—CEMENTING/GRAVEL PACK/ANNULAR FILL DETAILS

Type & material size	Hole diameter (mm)	Casing diameter (mm O.D.)	Location (metres) From	To
Grout	139	60	0	4
Bentonite	139	60	4	4.5
Gravel 3mm	139	60	4.5	9.47

SECTION I—BORE PURPOSE

☐ Domestic ☐ Stock ☐ Irrigation ☐ Commercial

☐ Urban ☒ Industrial Other (please specify) ______

SECTION J—PARTICULARS OF STRATA

From (metres)	To (metres)	Strata description (use more than one line if required)	Water bed thus(*)
0	1	Dark Brown clay	
1	2	yellow Brown sandy clay	
2	6	yellow Brown Sandy clay with Sandstone	
6	7	yellow Brown sandstone	
7	9.47	Dark grey Sandstone	
		Bore Constructed as per Mandatory requirement 11.2 page 70 of minimum Construction requirements	
		Dry Bore Constructed for monitoring purposes	

SECTION K—WATER BEARING BEDS

Depth struck (metres)	Water rose to (metres)	Supply (litres/second)	Quality (e.g. potable, brackish, salty)

Conductivity (µS/cm) ______ pH ______

SECTION L—SUB ARTESIAN BORE ON COMPLETION

Depth to standing water level from ground level ______ (metres)

Depth to pump suction or bottom of drill stem ______ (metres)

Type of test used ☐ Air ☐ Bail ☐ Pump

Estimated supply ______ (litres/second) Duration of test ______ (hours) Drawdown level from surface ______ (metres)

SECTION M—ARTESIAN BORE ON COMPLETION

Shut-in pressure ______ (kPa) Free flow ______ (litres/second) Temperature ______ (°C)

SECTION N—REMARKS

Grouted using 5% Bentonite mix

MB20CVMA4

SECTION O—CERTIFICATION

I hereby certify that the bore is drilled and constructed according to the conditions of my driller's licence and the information provided is true and accurate.

Driller Kaine Fowley Driller's licence no. 3503

Trainee driller ______ Driller's licence no. ______

Signature of driller ______ Date 14/4/2020

Contractor Ausdrill

Department of Natural Resources and Mines

White — foward to the Department of Natural Resources and Mines Pink — provide to landholder Blue — Driller to retain

Water bore drilling log

Queensland Government

2034260

Authorisation details

Registered number ______ Development permit number ______ Works reference number ______

SECTION A—LOCATION DETAILS

Name of landholder BHP Billiton Phone No. ______

Postal address 480 Queen street Brisbane City Postcode 4000

Real property address Caval Ridge Mine Moranbah Postcode 4744

Real property description Lot ______ Plan ______ or Bore location GPS. Latitude ______ Longitude ______ Datum ______

Easting 608193 Northing 7559650 Zone 55

SECTION B—BORE COMPLETION DETAILS

Date commenced 9 /4/2020

Date completed 12 /4/2020

SECTION C—DRILLING METHOD

☐ Rotary mud ☐ Cable tool

☐ Auger ☒ Rotary air

☐ Other ______

SECTION D—HOLE SIZE

Diameter (mm)	Location (metres) From	To
139	0	29.47

SECTION E—CASING DETAILS

Type (PVC, steel etc)	Size O.D. (mm)	Wall thickness (mm)	Location (metres) From	To
PVC	60	class 18	0	28

SECTION F—CENTRALISERS

Type	Location (metres) From	To
Kwick Zip	0	28

SECTION G—PERFORATIONS/ SLOTS/ SCREENS

Type	Size O.D. (mm)	Aperture (mm)	Location (metres) From	To
PVC Slotted	60	1	22	28

SECTION H—CEMENTING/GRAVEL PACK/ANNULAR FILL DETAILS

Type & material size	Hole diameter (mm)	Casing diameter (mm O.D.)	Location (metres) From	To
Cement Grout	139	60	0	18
Bentonite	139	60	18	20
Gravel 3mm	139	60	20	29.47

SECTION I—BORE PURPOSE

☐ Domestic ☐ Stock ☐ Irrigation ☐ Commercial

☐ Urban ☒ Industrial Other (please specify) ______

SECTION J—PARTICULARS OF STRATA

From (metres)	To (metres)	Strata description (use more than one line if required)	Water bed thus(*)
0	2	Redish topsoil	
2	10	light yellow Brown weathered Basalt	
10	15	Brown gravely sand with some clay	
15	19	Brown sandy gravel	*
19	28	Fairly fresh Basalt	*
28	29.47	Light grey clay	

SECTION K—WATER BEARING BEDS

Depth struck (metres)	Water rose to (metres)	Supply (litres/second)	Quality (e.g. potable, brackish, salty)
19	28	1.3	Salty
15	19	0.5	Salty

Conductivity (µS/cm) 12474 pH 7.91

SECTION L—SUB ARTESIAN BORE ON COMPLETION

Depth to standing water level from ground level 15 (metres)

Depth to pump suction or bottom of drill stem ______ (metres)

Type of test used ☒ Air ☐ Bail ☐ Pump

Estimated supply 1.3 (litres/second)

Duration of test 2 (hours)

Drawdown level from surface ______ (metres)

SECTION M—ARTESIAN BORE ON COMPLETION

Shut-in pressure ______ (kPa)

Free flow ______ (litres/second)

Temperature ______ (°C)

SECTION N—REMARKS

Grouted with tremmie line 5% Bentonite mix @ 1425G

Bore number MB20CCUM047

SECTION O—CERTIFICATION

I hereby certify that the bore is drilled and constructed according to the conditions of my driller's licence and the information provided is true and accurate.

Driller Kaine Fowles Driller's licence no. 3503

Trainee driller ______ Driller's licence no. ______

Signature of driller ______ Date 12/4/2020

Contractor Ausdrill

Water bore drilling log

Queensland Government

2034259

Authorisation details
Registered number ______ Development permit number ______ Works reference number ______

SECTION A—LOCATION DETAILS

Name of landholder BHP Billiton Phone No. ______
Postal address 480 Queen street Brisbane QLD Postcode 4000
Real property address Caval Ridge Mine Moranbah QLD Postcode 4744
Real property description Lot ______ Plan ______ or Bore location GPS. Latitude ______ Longitude ______ Datum ______
Easting 610805 Northing 7548887 Zone 55

SECTION B—BORE COMPLETION DETAILS

Date commenced 8/4/2020
Date completed 13/4/2020

SECTION C—DRILLING METHOD

☐ Rotary mud ☐ Cable tool
☐ Auger ☒ Rotary air
☐ Other ______

SECTION D—HOLE SIZE

Diameter (mm)	Location (metres) From	To
139	0	18.00

SECTION E—CASING DETAILS

Type (PVC, steel etc)	Size O.D. (mm)	Wall thickness (mm)	Location (metres) From	To
PVC	60	Class 18	0	17.75

SECTION F—CENTRALISERS

Type	Location (metres) From	To
Kwick Zip	0	17.75

SECTION G—PERFORATIONS/ SLOTS/ SCREENS

Type	Size O.D. (mm)	Aperture (mm)	Location (metres) From	To
PVC slotted	60	1	11.75	17.75

SECTION H—CEMENTING/GRAVEL PACK/ANNULAR FILL DETAILS

Type & material size	Hole diameter (mm)	Casing diameter (mm O.D.)	Location (metres) From	To
Cement grout	139	60	0	9.75
Bentonite	139	60	9.75	10.75
Gravel 3mm	139	60	10.75	18.00

SECTION I—BORE PURPOSE

☐ Domestic ☐ Stock ☐ Irrigation ☐ Commercial
☐ Urban ☒ Industrial Other (please specify) monitoring bore

SECTION J—PARTICULARS OF STRATA

From (metres)	To (metres)	Strata description (use more than one line if required)	Water bed thus(*)
0	2	small gravely Sand orange/Brown	
2	6	orange/Brown Sandy clay	
6	8	orange/Brown Clay sand with small gravel	
8	9	Gravely Sand orange Brown	
9	17	Consolidated tertiary medium grain sand yellow Brown	
17	18	Dark grey medium grain permian Sandstone	
		Dry bore Constructed for monitoring purposed	

SECTION K—WATER BEARING BEDS

Depth struck (metres)	Water rose to (metres)	Supply (litres/second)	Quality (e.g. potable, brackish, salty)

Conductivity (µS/cm) pH

SECTION L—SUB ARTESIAN BORE ON COMPLETION

Depth to standing water level from ground level (metres)
Depth to pump suction or bottom of drill stem (metres)
Type of test used ☐ Air ☐ Bail ☐ Pump
Estimated supply (litres/second)
Duration of test (hours)
Drawdown level from surface (metres)

SECTION M—ARTESIAN BORE ON COMPLETION

Shut-in pressure (kPa)
Free flow (litres/second)
Temperature (°C)

SECTION N—REMARKS

Grouted to surface using 5% Bentonite mix @ 1.425G
Bore number MB20CVM06T

SECTION O—CERTIFICATION

I hereby certify that the bore is drilled and constructed according to the conditions of my driller's licence and the information provided is true and accurate.

Driller Kaine Fowles Driller's licence no. 3503
Trainee driller ______ Driller's licence no. ______
Signature of driller ______ Date 13/4/2020
Contractor Ausdrill

Department of Natural Resources and Mines White — forward to the Department of Natural Resources and Mines Pink — provide to landholder Blue — Driller to retain

Water bore drilling log

Queensland Government

2034261

Authorisation details

Registered number ________ Development permit number ________ Works reference number ________

SECTION A—LOCATION DETAILS

Name of landholder BHP Billiton Phone No. ________

Postal address 480 Queen street Brisbane city Postcode 4000

Real property address Caval Ridge Mine Moranbah QLD Postcode 4744

Real property description Lot ________ Plan ________ or Bore location GPS. Latitude ________ Longitude ________ Datum ________

Easting 608193 Northing 7559650 Zone 55

SECTION B—BORE COMPLETION DETAILS

Date commenced 11 / 4 / 2020

Date completed 13 /4 / 2020

SECTION C—DRILLING METHOD

☐ Rotary mud ☐ Cable tool

☐ Auger ☒ Rotary air

☐ Other ________

SECTION D—HOLE SIZE

Diameter (mm)	Location (metres) From	To
139	0	45.47

SECTION E—CASING DETAILS

Type (PVC, steel etc)	Size O.D. (mm)	Wall thickness (mm)	Location (metres) From	To
PVC	60	class 18	0	45

SECTION F—CENTRALISERS

Type	Location (metres) From	To
Kwick Zip	0	45

SECTION G—PERFORATIONS/ SLOTS/ SCREENS

Type	Size O.D. (mm)	Aperture (mm)	Location (metres) From	To
PVC slotted	60	1	39	45

SECTION H—CEMENTING/GRAVEL PACK/ANNULAR FILL DETAILS

Type & material size	Hole diameter (mm)	Casing diameter (mm O.D.)	Location (metres) From	To
Grout	139	60	0	36
Bentonite	139	60	36	38
gravel 3mm	139	60	38	45.47

SECTION I—BORE PURPOSE

☐ Domestic ☐ Stock ☐ Irrigation ☐ Commercial

☐ Urban ☒ Industrial Other (please specify) ________

SECTION J—PARTICULARS OF STRATA

From (metres)	To (metres)	Strata description (use more than one line if required)	Water bed thus(*)
0	2	Redish topsoil	
2	9	Light Brown weathered Basalt	
9	14	Brown medium to carse grain gravely sand	
14	18	Brown sandy gravel medium	
18	25	Blue grey fairly fresh Basalt	*
25	26	Course gravel	
26	37	Brown to light grey clay	
37	39	Dark grey weathered mudstone	
39	41	Carbonacious mudstone	
41	44	Coal	*
44	45.47	Dark grey mudstone	

SECTION K—WATER BEARING BEDS

Depth struck (metres)	Water rose to (metres)	Supply (litres/second)	Quality (e.g. potable, brackish, salty)
18	25	1.3	Salty
41	44	0.05	Salty

Conductivity (µS/cm) 14 207 pH 8.28

SECTION L—SUB ARTESIAN BORE ON COMPLETION

Depth to standing water level from ground level 15 (metres)

Depth to pump suction or bottom of drill stem ________ (metres)

Type of test used ☒ Air ☐ Bail ☐ Pump

Estimated supply 0.05 (litres/second)

Duration of test 3 (hours)

Drawdown level from surface ________ (metres)

SECTION M—ARTESIAN BORE ON COMPLETION

Shut-in pressure ________ (kPa)

Free flow ________ (litres/second)

Temperature ________ (°C)

SECTION N—REMARKS

Grouted using tremmie line

5% Bentonite mix

Bore number MR20CUM05P

SECTION O—CERTIFICATION

I hereby certify that the bore is drilled and constructed according to the conditions of my driller's licence and the information provided is true and accurate.

Driller Kaine Fowlg Driller's licence no. 3503

Trainee driller ________ Driller's licence no. ________

Signature of driller ________ Date 13/4/2020

Contractor Ausdrill

Department of Natural Resources and Mines

White — foward to the Department of Natural Resources and Mines Pink — provide to landholder Blue — Driller to retain

The information being collected in this form will be used by this department for the purpose of processing your drill log form to record your water bore drilling activity under the authority of section 313 of the *Water Act 2000*. Your personal details will be accessed only by authorised officers within this

Appendix B - Bore development records

Bore Sampling Record

Site	**Caval Ridge**	**Project**	**FY20 bores**				
Bore #	MB20CVM01A	Bore reference point (REF)		Hydrostratigraphic unit	Tertiary		
Co-ordinates		Water level (mbgl)	6.25	Date	14/04/2020	Page #:	1
Eastings		Total Depth (mbgl)	8.00	Time	8:30	Developed by	C Nelson
Northings		Casing Ø (mm) / Material	50 mm / uPVC		-		

Time (hh:mm)	**Flow Rate** (L/s)	**SWL** (mbgl)	**pH**	**EC** (uS/cm)	**SPC** (uS/cm)	**Temp** (°C)	**ORP** (mV)	**DO** mg/L	**Colour**	**Odour**	**Comment**
8:35											Start
8:45	0.01		7.24	6045	5871	26.6	78.0		Brown	Nil	
8:55	0.01		8.36		5762	24.5	49.0		White brown	Nil	
9:10	0.01		8.34	6091	6091	25.0	38.9		White brown	Nil	Some sediment
9:20	0.01		8.44	5937	6213	22.6	41.6		Brown opaque	Nil	Some sediment
9:25	0.01		8.42	5883	6285	21.6	121.8		Brown opaque	Nil	No sediment
9:30	0.01		8.37	5763	6131	21.6	135.0		Opaque	Nil	No sediment
9:35	0.01		8.37	5825	6270	21.7	135.0		Opaque	Nil	No sediment
9:45	0.01		8.48	5862	6077	21.3			Clear	Nil	No sediment

Water sample	Sample Number	MB20CVM01A	Sample time	9:46

Comments: SWL after development was 6.5 mbgl

The bore was originally meant to be alluvial, however no signicant material was present.

Bore Sampling Record

Site	**Caval Ridge**	**Project**	**FY20 bores**	

Bore #	MB20CVM04T	Bore reference point (REF)		Hydrostratigraphic unit	Tertiary		
Co-ordinates		Water level (mbgl)	15.0	Date	13/04/2020	Page #:	1
Eastings		Total Depth (mbgl)	28.0	Time	8:30	Developed by	C Nelson
Northings		Casing Ø (mm) / Material	50 mm / uPVC		-		

Time (hh:mm)	**Flow Rate** (L/s)	**SWL** (mbgl)	**pH**	**EC** (uS/cm)	**SPC** (uS/cm)	**Temp** (°C)	**ORP** (mV)	**DO** mg/L	**Colour**	**Odour**	**Comment**
8:40											Start
8:42	1.10		7.40	6327		28.1	183.3		Brown	Nil	
8:50	1.10		7.90	10863	10234	28.0	28.0		Opaque	Nil	
9:00	1.10		7.93	11728	11098	27.9	117.0		Opaque	Nil	
9:10	1.10		7.94	12158	11472	27.8	74.4		Clear	Nil	
9:20	1.10		7.91	12408	11750	27.9	54.9		Clear	Nil	
9:30	1.10		7.91	11828	12474	27.8	37.2		Clear	Nil	

Water sample	Sample Number	MB20CVM04T	Sample time	9:30

Comments:

Bore Sampling Record

Site	**Caval Ridge**	**Project**	**FY20 bores**				
Bore #	MB20CVM05P	Bore reference point (REF)		Hydrostratigraphic unit	Permian Coal		
Co-ordinates		Water level (mbgl)		Date	13/04/2020	Page #:	1
Eastings		Total Depth (mbgl)		Time	12:30	Developed by	C Nelson
Northings		Casing Ø (mm) / Material	50 mm / uPVC				

Time (hh:mm)	**Flow Rate** (L/s)	**SWL** (mbgl)	**pH**	**EC** (uS/cm)	**SPC** (uS/cm)	**Temp** (°C)	**ORP** (mV)	**DO** mg/L	**Colour**	**Odour**	**Comment**
13:00	Flush bore with potable water pH 8.37 and SPC 436 uS/cm										
14:00	Start										Start
14:08			8.25	820	752	29.7	13.6		Muddy brown		Injected water again
14:48			8.36	1280	1206	28.2	23.6		Muddy brown		
15:08	0.04		8.40	3303	3096	28.5	25.7		Blackish grey		Bore is making water
15:28	0.05		8.39	4942	4675	27.9	42.9		Grey		With some sediment
15:48	0.05		8.38	7121	6795	27.5	45.0		Grey		With some sediment
16:08	0.05		8.36	8365	8026	27.2	44.6		Grey black		With some sediment
16:28	0.05		8.28	11617	11189	27.0	46.2		Grey black		With some sediment
16:48	0.05		8.28		13201	26.5	35.5		Grey black		With some sediment
17:08	0.05		8.28		14009	26.4	31.1		Grey black		Reduced sediment
17:18	0.05		8.29		14132	26.1	30.9		Grey black		Reduced sediment
17:28	0.05		8.28		14207	25.9	31.2		Grey black		Reduced sediment

Water sample	Sample Number	MB20CVM05P	Sample time	17:30

Comments: SWL was 35 mbgl on 12/04/2020 at 14: 45

SWL was 35.1 mbgl on 14/04/2020 at 7:05

Bore Sampling Record

Site	**Caval Ridge**	**Project**	**FY20 bores**	

Bore #	MB20CVM06T	Bore reference point (REF)		Hydrostratigraphic unit	Tertiary		
Co-ordinates		Water level (mbgl)	15.0	Date	10/04/2020 - 14/04/2020	Page #:	1
Eastings		Total Depth (mbgl)	18.0	Time	12:00	Developed by	C Nelson
Northings		Casing Ø (mm) / Material	50 mm / uPVC				

Time (hh:mm)	**Flow Rate** (L/s)	**SWL** (mbgl)	**pH**	**EC** (uS/cm)	**SPC** (uS/cm)	**Temp** (°C)	**ORP** (mV)	**DO** mg/L	**Colour**	**Odour**	**Comment**
12:30	Inject potable water (pH 7.83 and SPC 436 uS/cm) and airlift water out										
16:30			8.14		4019						Water is foamy with sediment, need to continue development
16:00	12/04/2020 Inject potable water (pH 7.83 and SPC 436 uS/cm) and airlift the water out										
16:10			8.03		3501	30.5	74.7		Muddy brown	No smell	Foamy with sediment
16:24			8.06		1808	30.7	46.4		Muddy brown	No smell	Foamy with sediment
16:45			8.33		1229	29.9	62.2		Clearing	No smell	Some foam
17:10			8.23		858	29.7	47.8		Opaque	No smell	Some fine quartz sand sediment
17:25			8.19		861	29.2	47.8		Opaque	No smell	Very little sediment, bore considered clean
	13/04/2020 Bailed the bore for an hour										
6:30			7.95		1061	25.2	46.7		Opaque	No smell	
7:30			7.81		1170	24.6	225.0		Opaque	No smell	
	14/04/2020 Bailed the water sample										
11:00			7.80		1912	26.5	82.0		Opaque	No smell	

Water sample	Sample Number	MB20CVM06T	Sample time	11:00
Comments:	SWL - 16.5 mbgl on **09/04/2020** at 9:30; 15.81 mbgl on **12/04/2020** at 15:45; 13.93 mTOC on **13/04/2020** at 06:30; 13.82 mTOC on **14/04/2020** at 06:30			

Appendix C - Laboratory (COA) documentation

Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2010311**	Page	: 1 of 11
Client	: **BM ALLIANCE LTD**	Laboratory	: Environmental Division Brisbane
Contact	: CEDRIC NELSON	Contact	: Joy Morgan
Address	: L11 480 QUEEN STREET BRISBANE QLD 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 4773 0030
Project	: DNM_GROUNDWATER	Date Samples Received	: 15-Apr-2020 14:30
Order number	: 4508436635	Date Analysis Commenced	: 16-Apr-2020
C-O-C number	: ----	Issue Date	: 22-Apr-2020 15:14
Sampler	: VANESSA DEAR		
Site	: ----		
Quote number	: TV/109/19		
No. of samples received	: 7		
No. of samples analysed	: 7		

NATA

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Morgan Lennox		Brisbane Organics, Stafford, QLD
Santusha Pandra	Senior Chemist	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- It is recognised that EG020T (Total Metals) is less than EG020F (Dissolved Metals) for some samples. However, the difference is within experimental variation of the methods.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB20CVM04T**	**MB20CVM05P**	**MB20CVM01A**	**MB20CVM06T**	**MB19CVM10P**
			Client sampling date / time	13-Apr-2020 09:30	13-Apr-2020 17:30	14-Apr-2020 09:46	14-Apr-2020 11:00	14-Apr-2020 13:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB2010311-001**	**EB2010311-002**	**EB2010311-003**	**EB2010311-004**	**EB2010311-005**
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.19**	**8.11**	**7.82**	**7.67**	**8.73**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**11500**	**13400**	**5710**	**1900**	**1840**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**7150**	**8520**	**3500**	**1110**	**1100**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**17**	**1300**	**210**	**179**	**1520**
EA030: Total Solids dried at 104 ± 2°C								
Total Solids	----	10	mg/L	**7790**	**9530**	**3640**	**1300**	**3620**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	**47**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**605**	**404**	**1150**	**84**	**302**
Total Alkalinity as CaCO3	----	1	mg/L	**605**	**404**	**1150**	**84**	**349**
ED040T: Total Major Anions								
Silicon	7440-21-3	0.05	mg/L	**26.9**	**8.98**	**9.32**	**5.56**	**22.5**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**470**	**679**	**133**	**151**	**139**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**3920**	**4490**	**1200**	**493**	**318**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**149**	**203**	**43**	**52**	**15**
Magnesium	7439-95-4	1	mg/L	**362**	**354**	**72**	**41**	**10**
Sodium	7440-23-5	1	mg/L	**1770**	**2280**	**1160**	**273**	**385**
Potassium	7440-09-7	1	mg/L	**15**	**21**	**2**	**10**	**5**
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**1860**	**1960**	**404**	**299**	**79**
^ **Sodium Adsorption Ratio**	----	0.01	-	**17.8**	**22.4**	**25.1**	**6.87**	**18.9**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	**0.02**	<0.01
Antimony	7440-36-0	0.001	mg/L	<0.001	**0.004**	**0.003**	**0.001**	**0.001**
Arsenic	7440-38-2	0.001	mg/L	<0.001	**0.026**	**0.013**	**0.004**	**0.006**
Barium	7440-39-3	0.001	mg/L	**0.063**	**0.044**	**0.101**	**0.061**	**0.062**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB20CVM04T**	**MB20CVM05P**	**MB20CVM01A**	**MB20CVM06T**	**MB19CVM10P**
			Client sampling date / time	13-Apr-2020 09:30	13-Apr-2020 17:30	14-Apr-2020 09:46	14-Apr-2020 11:00	14-Apr-2020 13:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB2010311-001**	**EB2010311-002**	**EB2010311-003**	**EB2010311-004**	**EB2010311-005**
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.006**	**0.003**	**0.008**	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	**0.042**	**0.038**	**0.074**	**0.085**	**0.006**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.005**	**0.004**	**0.007**	**0.001**
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.015**	**0.007**	**0.009**	**0.002**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	**0.03**	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**4.20**	**5.34**	**1.48**	**0.629**	**1.63**
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	**0.014**	**0.001**	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	**0.016**	**0.073**	<0.005
Boron	7440-42-8	0.05	mg/L	**0.84**	**1.35**	**0.70**	**0.13**	**0.28**
Iron	7439-89-6	0.05	mg/L	**0.13**	<0.05	<0.05	<0.05	<0.05
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.18**	**5.37**	**0.99**	**0.72**	**12.3**
Antimony	7440-36-0	0.001	mg/L	<0.001	**0.003**	**0.004**	**0.002**	**0.001**
Arsenic	7440-38-2	0.001	mg/L	<0.001	**0.031**	**0.013**	**0.004**	**0.011**
Barium	7440-39-3	0.001	mg/L	**0.068**	**0.190**	**0.110**	**0.068**	**0.507**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	**0.0002**	<0.0001	<0.0001	**0.0001**
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.007**	**0.002**	**0.003**	**0.013**
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.039**	**0.003**	**0.008**	**0.012**
Copper	7440-50-8	0.001	mg/L	<0.001	**0.036**	<0.001	**0.003**	**0.039**
Lead	7439-92-1	0.001	mg/L	<0.001	**0.023**	<0.001	**0.004**	**0.019**
Manganese	7439-96-5	0.001	mg/L	**0.052**	**0.115**	**0.096**	**0.122**	**0.358**
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.004**	**0.006**	**0.010**	**0.003**
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.085**	**0.008**	**0.010**	**0.032**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	**0.02**	<0.01	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**4.63**	**5.80**	**1.63**	**0.631**	**2.38**
Uranium	7440-61-1	0.001	mg/L	<0.001	**0.002**	**0.020**	**0.002**	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	**0.02**	<0.01	<0.01	**0.03**
Zinc	7440-66-6	0.005	mg/L	**0.008**	**0.538**	**0.028**	**0.172**	**0.054**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB20CVM04T**	**MB20CVM05P**	**MB20CVM01A**	**MB20CVM06T**	**MB19CVM10P**
			Client sampling date / time	13-Apr-2020 09:30	13-Apr-2020 17:30	14-Apr-2020 09:46	14-Apr-2020 11:00	14-Apr-2020 13:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB2010311-001**	**EB2010311-002**	**EB2010311-003**	**EB2010311-004**	**EB2010311-005**
				Result	Result	Result	Result	Result
EG020T: Total Metals by ICP-MS - Continued								
Boron	7440-42-8	0.05	mg/L	**0.95**	**1.37**	**0.71**	**0.10**	**0.18**
Iron	7439-89-6	0.05	mg/L	**1.03**	**4.38**	**0.78**	**1.16**	**26.1**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.2**	**0.7**	**0.8**	**0.2**	**0.1**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.26**	**0.75**	**0.03**	<0.01	**0.41**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	**0.01**	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.02**	**0.03**	**0.09**	**0.03**	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.02**	**0.03**	**0.10**	**0.03**	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.9**	**2.8**	**0.3**	**0.7**	**3.6**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.9**	**2.8**	**0.4**	**0.7**	**3.6**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.26**	**0.04**	**0.04**	**0.96**
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**132**	**149**	**59.6**	**18.7**	**18.8**
ø **Total Cations**	----	0.01	meq/L	**115**	**139**	**58.6**	**18.1**	**18.4**
ø **Ionic Balance**	----	0.01	%	**7.22**	**3.44**	**0.86**	**1.71**	**1.05**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	**80**	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	**150**	**100**
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	**50**
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	<50	<50	<50	**230**	**150**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB20CVM04T**	**MB20CVM05P**	**MB20CVM01A**	**MB20CVM06T**	**MB19CVM10P**
			Client sampling date / time	13-Apr-2020 09:30	13-Apr-2020 17:30	14-Apr-2020 09:46	14-Apr-2020 11:00	14-Apr-2020 13:30
Compound	*CAS Number*	*LOR*	*Unit*	**EB2010311-001**	**EB2010311-002**	**EB2010311-003**	**EB2010311-004**	**EB2010311-005**
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	**140**	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	**100**	<100	**140**
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	<100	**100**	**140**	**140**
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	<100	**140**	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ **Total Xylenes**	----	2	µg/L	<2	<2	<2	<2	<2
^ **Sum of BTEX**	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
ED009: Anions								
Bromide	24959-67-9	0.010	mg/L	**7.80**	**9.35**	**2.85**	**1.69**	**0.820**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**99.6**	**100**	**99.8**	**97.3**	**99.1**
Toluene-D8	2037-26-5	2	%	**97.9**	**96.7**	**97.0**	**98.8**	**95.9**
4-Bromofluorobenzene	460-00-4	2	%	**115**	**112**	**114**	**113**	**112**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB19CVM09A**	**MB19CVM08P**	**----**	**----**	**----**
			Client sampling date / time	14-Apr-2020 15:30	14-Apr-2020 16:05	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2010311-006**	**EB2010311-007**	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.90**	**8.41**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1250**	**3300**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**782**	**1830**	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**44**	**14**	----	----	----
EA030: Total Solids dried at 104 ± 2°C								
Total Solids	----	10	mg/L	**800**	**1890**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	**20**	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**232**	**343**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**232**	**363**	----	----	----
ED040T: Total Major Anions								
Silicon	7440-21-3	0.05	mg/L	**19.9**	**8.06**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**80**	**142**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**233**	**816**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**46**	**46**	----	----	----
Magnesium	7439-95-4	1	mg/L	**32**	**46**	----	----	----
Sodium	7440-23-5	1	mg/L	**176**	**583**	----	----	----
Potassium	7440-09-7	1	mg/L	**8**	**8**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**247**	**304**	----	----	----
^ **Sodium Adsorption Ratio**	----	0.01	-	**4.88**	**14.5**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.002**	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.006**	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.083**	**0.085**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**MB19CVM09A**	**MB19CVM08P**	**----**	**----**	**----**
			Client sampling date / time	14-Apr-2020 15:30	14-Apr-2020 16:05	----	----	----
Compound	CAS Number	LOR	Unit	**EB2010311-006**	**EB2010311-007**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.016**	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.267**	**0.001**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.003**	**0.004**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.012**	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.462**	**8.09**	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.098**	<0.005	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.11**	**0.22**	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**1.47**	**0.02**	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.004**	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.007**	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.105**	**0.087**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.003**	**0.001**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.019**	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.012**	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	**0.006**	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.304**	**0.002**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.007**	**0.005**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.017**	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.490**	**9.40**	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.004**	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.187**	<0.005	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB19CVM09A**	**MB19CVM08P**	**----**	**----**	**----**
			Client sampling date / time	14-Apr-2020 15:30	14-Apr-2020 16:05	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2010311-006**	**EB2010311-007**	--------	--------	--------
				Result	Result	----	----	----
EG020T: Total Metals by ICP-MS - Continued								
Boron	7440-42-8	0.05	mg/L	**0.06**	**0.17**	----	----	----
Iron	7439-89-6	0.05	mg/L	**1.80**	**0.12**	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	<0.1	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.12**	**1.06**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.02**	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.02**	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**2.5**	**1.5**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**2.5**	**1.5**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.01**	----	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**12.9**	**33.2**	----	----	----
ø **Total Cations**	----	0.01	meq/L	**12.8**	**31.6**	----	----	----
ø **Ionic Balance**	----	0.01	%	**0.33**	**2.44**	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	**310**	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L	**990**	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**1300**	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**MB19CVM09A**	**MB19CVM08P**	**----**	**----**	**----**
			Client sampling date / time	14-Apr-2020 15:30	14-Apr-2020 16:05	----	----	----
Compound	CAS Number	LOR	Unit	**EB2010311-006**	**EB2010311-007**	--------	--------	--------
				Result	Result	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	**670**	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L	**630**	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**1300**	<100	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	**670**	<100	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----
Toluene	108-88-3	2	µg/L	<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
^ **Total Xylenes**	----	2	µg/L	<2	<2	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	----	----	----
ED009: Anions								
Bromide	24959-67-9	0.010	mg/L	**0.950**	**1.76**	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**101**	**101**	----	----	----
Toluene-D8	2037-26-5	2	%	**96.6**	**98.4**	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**114**	**114**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	*CAS Number*	***Recovery Limits (%)*** Low	***Recovery Limits (%)*** High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

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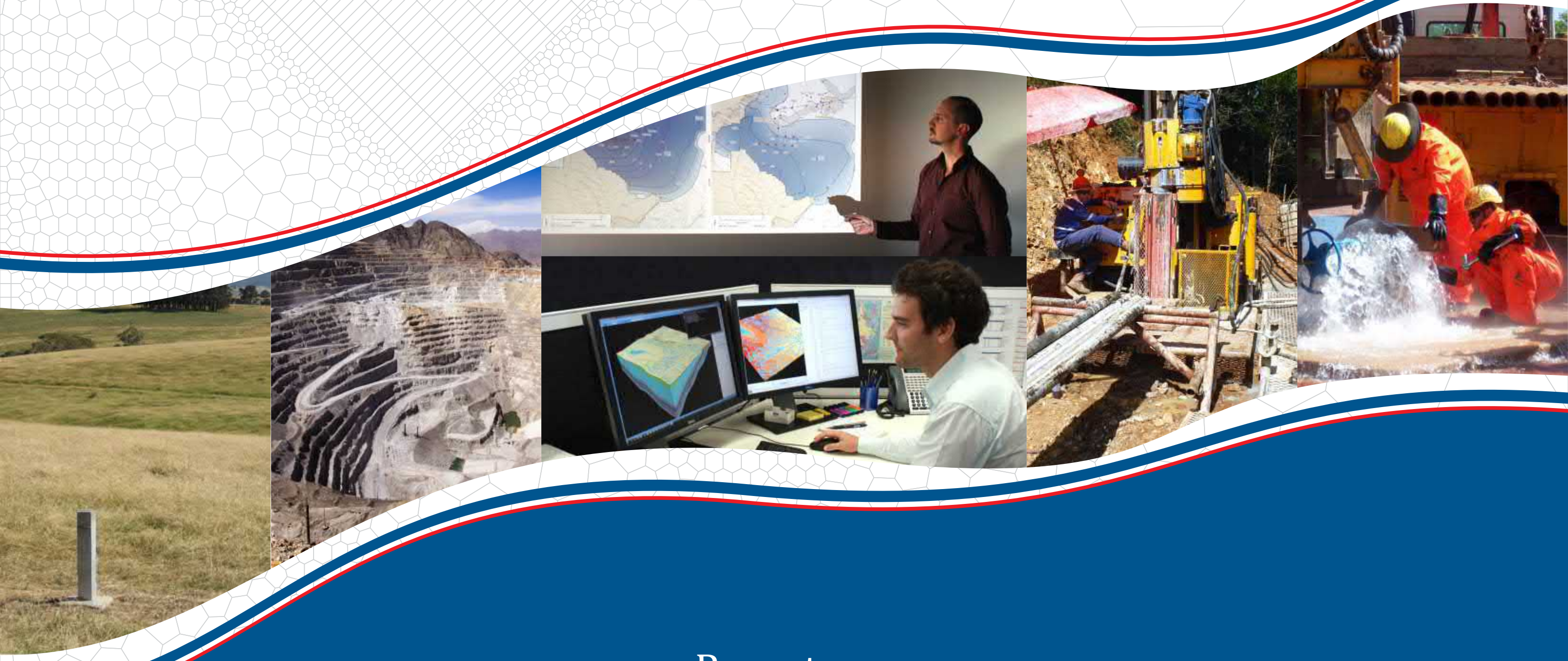

Report on

Caval Ridge Mine Groundwater Investigation Fieldwork Report

Prepared for
BHP Billiton Mitsubishi Alliance Pty Ltd

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Report on

Caval Ridge Mine Groundwater Investigation Fieldwork Report

1 Introduction

Caval Ridge Mine (CVM) is a BHP Billiton Mitsubishi Alliance (BMA) owned and operated coal asset, located in the Bowen Basin, approximately 15 km south of Moranbah off the Peak Downs Highway.

Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) were engaged by BMA to supervise the installation of ten groundwater bores, located on the eastern side of Peak Downs Highway, between R20 Pit and Heyford Pit. The aim of the program is to obtain hydrogeological data to inform on state and federal approval processes for the Cherwell Resource. Specifically, the groundwater monitoring network and associated data will assist in:

- achieving environmental authority compliance;
- improving the understanding of the local groundwater regime;
- identifying environmental values; and
- providing baseline monitoring for the Cherwell Pit approval.

This report provides the results of this field hydrogeological program.

2 Scope of work and methodology

Scope of work documentation (BHP Resource Engineering, 2018) included monitoring bore designs, details of target aquifers, and a breakdown of tasks to be undertaken by the hydrogeological consultant. There were some deviations from the provided scope of works, although these occurred in consultation with BHP, prior to the onset of the fieldwork program. An agreement was reached that AGE would conduct the groundwater sampling, oversee laboratory analysis and install vented water level loggers in each bore (water level loggers sourced by the drilling contractor - J & S Drilling).

The proposed scope of works included the following tasks:

- oversee monitoring bore installation in accordance with the BHP Resource Engineering (2018) scope of works;
- collect groundwater samples for analysis of a comprehensive parameter suite to meet State and Federal approval requirements;
- conduct formation permeability tests by the slug test method;
- install groundwater level loggers within the monitoring bores;
- attend a planning meeting prior to the field program and a project closure meeting at completion of field work, where results, feedback and learnings from the field program can be communicated with the Brisbane based BMA Water Planning Team; and
- complete a bore installation report;

A site-specific online induction and work area familiarisation were also completed prior to site works.

3 Monitoring bore installation

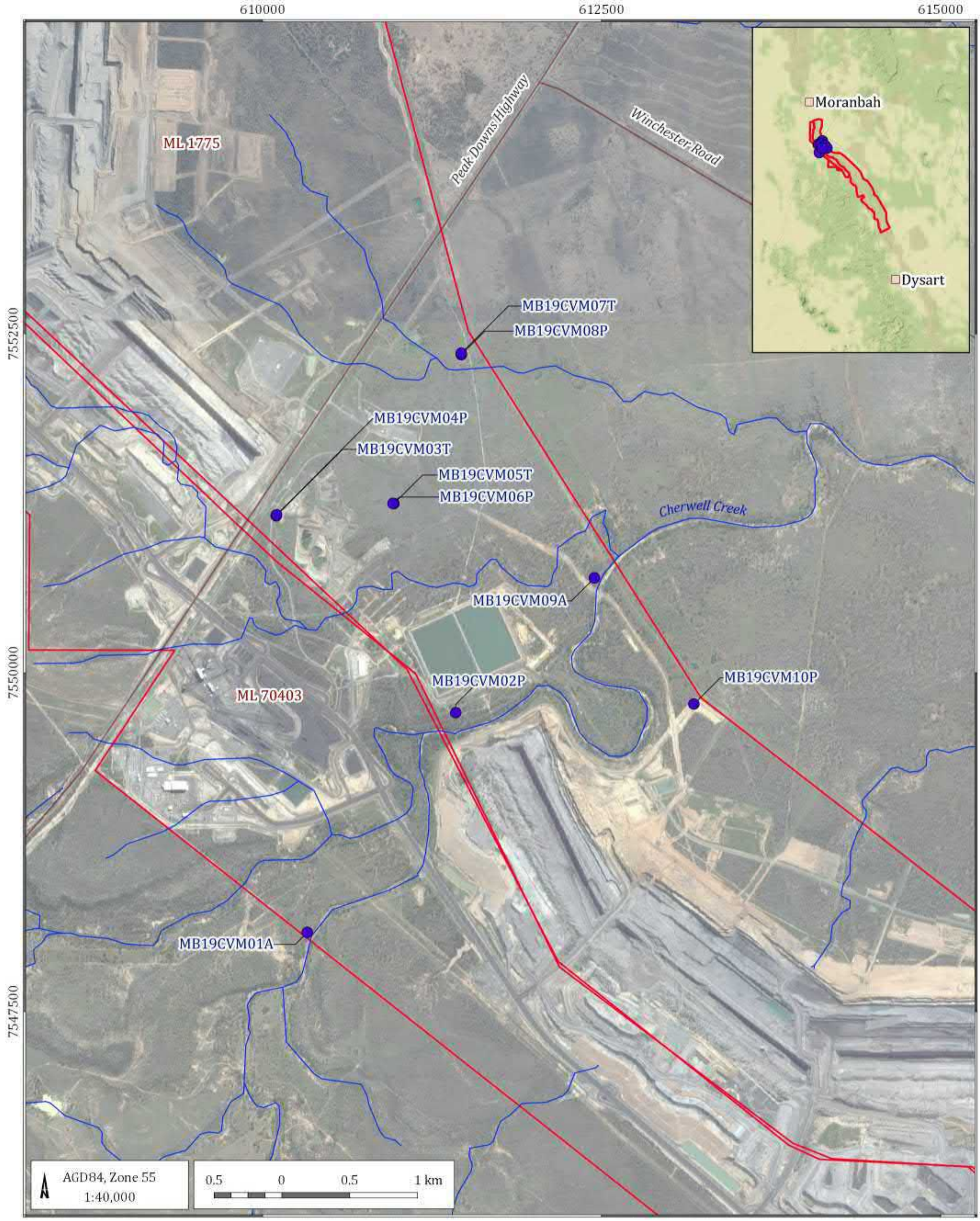
3.1 Construction details

Monitoring bores were installed by J&S Drilling from February to March 2019, with technical guidance and collection of groundwater data provided by AGE hydrogeologists (Dean Newborn and Joel Vos). Ten groundwater monitoring bores were installed at seven sites (Figure 1).

Target screened intervals were pre-determined by BHP from the geological database and extrapolation of exploration borehole logs. Targeted zones included potential aquifer bearing lithologies which include:

- surficial alluvial sediments (denoted by A in bore naming nomenclature);
- shallow Tertiary basalts (denoted by T in bore naming nomenclature); and
- Permian coal seams of the Moranbah Coal Measures (denoted by P in bore naming nomenclature).

The construction details for each bore are provided in Table 3.1, and borelogs presenting detailed construction and geological information are provided in Appendix A. All monitoring bores were constructed using 50 mm internal diameter uPVC threaded casing (PN18), with the screened interval comprising machine slotted casing of 1 mm aperture. The screened zone was positioned at the base of the bore. A sand filter pack consisting of washed quartz sand of 2.6 mm to 3.2 mm diameter was installed to at least 1 m above the top of the slotted casing. The bores were sealed from overlying formations by bentonite and grout (cement) seals.



LEGEND

- ▢ Populated place
- ● Monitoring bore
- — Road
- — Watercourse
- ▭ Mining lease

Caval Ridge Mine groundwater investigation (G1628A)

Monitoring bore locations

AGE

DATE	FIGURE No:
10/04/2019	**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\G1628A.Caval Ridge mon bore install\3_GIS\Workspaces\001_Deliverable1\01.00_G1628A_Monitoring bore locations.qgs

Table 3.1 Monitoring bore details

Bore ID	Installation date	Easting (m)	Northing (m)	Ground level (mAHD)	Screened lithology	Total bore depth (mbgl)	PVC stick-up (m)	Slotted PVC interval (mbgl)	Top of filter pack (mbgl)	Water level date	Water level (mbtoc)
MB19CVM01A	09-03-19	610329	7548084	238.06	Alluvium/weathered sandstone	13	0.69	7 – 13	6	24-03-19	Dry
MB19CVM02P	10-03-19	*611424*	*7549705*	*242*	Coal/siltstone	36	*0.69*	30 – 36	29	24-03-19	Dry
MB19CVM03T	06-03-19	610100	7551158	245.81	Basalt	35	0.85	29 – 35	28	23-03-19	20.27
MB19CVM04P	06-03-19	610101	7551164	245.94	Coal	47	0.74	41 – 47	39.9	23-03-19	Dry
MB19CVM05T	22-03-19	610968	7551248	240.82	Basalt/basal sands	45.5	0.74	39.5– 45.5	38.5	23-03-19	32.65
MB19CVM06P	14-03-19	610961	7551249	240.87	Coal/siltstone	73	0.78	67 – 73	65.5	23-03-19	35.59
MB19CVM07T	05-03-19	611464	7552357	233.87	Basalt	27	0.84	21 – 27	20	24-03-19	13.23
MB19CVM08P	04-03-19	611465	7552346	233.78	Coal/siltstone	163.5	0.79	157.5 – 163.5	155	24-03-19	25.56
MB19CVM09A	19-02-19	612446	7550699	226.94	Alluvium	18.5	0.93	15.5 – 18.5	14	23-03-19	13.34
MB19CVM10P	17-02-19	613180	7549768	230.61	Coal/siltstone	129.5	0.87	123.5 – 129.5	120.5	22-03-19	34.02

Notes: *Coordinates in AGD84 zone 55;*
MB19CVM02P has not been surveyed and location details are italicised;
mAHD – meters Australian height datum;
mbgl – meters below ground level; and
mbtoc – meters below top of casing.

3.2 Bore development

Each monitoring bore was developed via airlifting after the grout had cured. The purpose of bore development was to remove drilling fines and to enhance hydraulic connectivity with the surrounding aquifer. Bore development was continued until most fines were removed, and the EC and pH values had stabilised over consecutive readings. Groundwater quality samples were collected from each bore at the end of development. Dry bores (MB19CVM01A, MB19CVM02P and MB19CVM04P) and bores with insufficient yields for development (MB19CVM09A) were developed with injected water, where at least three bore volumes were injected and airlifted. A summary of development details, including physico-chemical properties measured prior to sampling are provided in Table 3.2.

Table 3.2 Bore development details

Bore ID	Pre-development SWL (mbtoc)	Duration (mins)	Flow rate (L/s)	Electrical Conductivity (µS/cm)	pH	End of development water clarity
MB19CVM01A	Dry	52 mins	*Developed with injected water* [a]			Dark brown
MB19CVM02P	Dry	1 hr 22 mins	*Developed with injected water*			Brown with minor coal float
MB19CVM03T	20.21	1 hr 22 mins	0.04	3,176	11.38	Clear
MB19CVM04P	Dry	1 hr 15 mins	*Developed with injected water*			Clear
MB19CVM05T	32.70	59 mins	0.03	1,504	8.67	Clear
MB19CVM06P	35.20	1 hr 4 mins	0.03	19,910	8.07	Clear
MB19CVM07T	13.21	1 hr 2 mins	0.3	1,192	8.34	Clear
MB19CVM08P	25.43	1 hr 18 mins	0.17	3,963	8.41	Clear
MB19CVM09A	9.01	3 hrs 31 mins	*Developed with injected water* [b]			Clear (sampled following morning)
MB19CVM10P	33.74	1 hr 32 mins	0.09	1,781	8.84	Clear

Notes: *(a) – Losing significant water to formation; and;*
(b) – 1 L of chlorine injected to assist with breakdown of drilling mud.

3.3 Datalogger installation

Automatic vented loggers for recording water level data (In-Situ Level TROLL 500) were deployed into each monitoring bore following development, with details provided in Table 3.3. The Level TROLL 500 is capable of measuring temperature and vented pressure, with a memory capacity of 120,000 readings. Data is transferred manually from the logger using the direct read cable, which was pre-ordered by J&S Drilling according to estimates provided by BHP in the scope of work.

All loggers were set to record readings at six hourly intervals, with each logger synchronised to capture data at 00:00, 06:00, 12:00, and 18:00 hours daily.

Table 3.3 Data logger details

Bore ID	Logger model	PSI range	Serial number	Logger depth (mbtoc)	Water level (mbtoc)	Water level measurement date/time	Recording interval
MB19CVM01A	Level TROLL 500	100	638197	~13m	Dry	24-03-19 / 18:40	6 hrs
MB19CVM02P	Level TROLL 500	30	637141	~35m	Dry	23-03-19 / 16:00	6 hrs
MB19CVM03T	Level TROLL 500	100	611502	~35m	20.27	23-03-19 / 15:00	6 hrs
MB19CVM04P	Level TROLL 500	100	*(a)*	~47 m	Dry	23-03-19 / 15:10	6 hrs
MB19CVM05T	Level TROLL 500	100	*(a)*	~47m	32.65	23-03-19 / 10:00	6 hrs
MB19CVM06P	Level TROLL 500	100	619025	~49m	35.59	22-03-19 / 16:00	6 hrs
MB19CVM07T	Level TROLL 500	100	641388	~27m	13.23	24-03-19 / 11:00	6 hrs
MB19CVM08P	Level TROLL 500	300	642001	~100m	25.56	24-03-19 / 15:00	6 hrs
MB19CVM09A	Level TROLL 500	30	637643	~16m	13.34	23-03-19 / 14:30	6 hrs
MB19CVM10P	Level TROLL 500	300	640680	~100m	34.02	22-03-19 / 16:00	6 hrs

Notes: *mbtoc – metres below top of casing; and*
(a) – serial number either 611665 or 637990.

4 Permeability testing

In-situ permeability tests (falling head and rising head tests) were conducted in each monitoring bore to estimate the hydraulic conductivity of the screened lithology. Testing of bores MB19CVM01A, MB19CVM02P and MB19CVM04P was not possible, due to these bores being dry.

The falling head tests were undertaken using a standard technique, where a solid slug was inserted into the bore, resulting in displacement of the water column and a rise in water level. The recovery of the water level over time was recorded with a water level datalogger. The rising head tests were undertaken using a similar technique, where a solid slug was removed from the bore, resulting in a lowered water level. All tests were completed following bore development.

The test data was analysed by the Cooper et al. (1967), Hvorslev (1951) and Bouwer and Rice (1976) methods, applying the *Aquifer Test (version 9)* analytical software package. Each of these analysis methods are suitable for the conditions encountered (confined aquifer with a partially/fully penetrating screen). The average hydraulic conductivity value was calculated for tests/analyses where good fits were observed (see Appendix B). The results of each test are summarised in Table 4.1 and the detailed analytical reports are provided in Appendix B.

Tests results for bore MB19CVM09A are of limited reliability, likely due to storage mechanisms of the aquifer. The method of analysis was therefore adapted as per Butler (1997), solving for normalised head between the range of 0.15 to 0.25. Variable storage mechanisms may be a relic of mud injection during drilling and associated bore development issues.

Table 4.1 Hydraulic conductivity results

Bore ID	Test type	Hvorslev (m/day)	GoF	Bouwer and Rice (m/day)	GoF	Cooper et al. (m/day)	GoF	Mean hydraulic conductivity [a] (m/day)	Screened lithology
MB19CVM03T	FHT	0.65	G	0.81	M	0.51	G	**0.57**	Basalt
	RHT	0.63	G	1.30	M	0.49	G		
MB19CVM05T	FHT	0.05	G	0.01	M	0.04	G	**0.05**	Basalt/basal sand
	RHT	0.05	G	0.01	M	0.04	G		
MB19CVM06P	FHT	0.13	G	0.21	M	0.10	G	**0.10**	Coal/siltstone
	RHT	0.10	G	0.33 [b]	G	0.07	G		
MB19CVM07T	FHT	2.78	G	2.14	G	2.18	G	**2.37**	Basalt
	RHT	3.19	M	1.07	M	2.50	M		
MB19CVM08P	FHT	0.06	M	0.09	G	0.05	M	**0.08**	Coal/siltstone
	RHT	0.08	G	0.09	G	0.06	G		
MB19CVM09A	FHT	*Test unsuccessful*						**1.05 [c]**	Alluvium
	RHT	1.25	M	0.92	M	0.97	M		
MB19CVM10P	FHT	0.02	P	0.03	G	0.02	P	**0.04**	Coal/siltstone
	RHT	0.05	G	0.22 [b]	G	0.04	G		

Notes: *m/day – metres per day;*
GoF – Goodness of Fit – [G] Good, [M] Moderate and [P] Poor;
(a) – Calculated using 'good' fitting results;
(b) – Result considered erroneously high; and
(c) – Result of limited reliability
Hydraulic conductivity (K) result by Cooper et al. (1967) method derived from transmissivity.

5 Groundwater levels

Manual groundwater level measurements were taken at several stages during bore construction/testing, both pre and post development. Recorded groundwater levels are provided in Table 3.1, Table 3.2 and Table 3.3, as well as in Appendix A.

6 Groundwater quality

Groundwater samples were collected in appropriate laboratory-supplied containers from all bores following development (except for dry bores MB19CVM01A, MB19CVM02P and MB19CVM04P). Samples requiring dissolved metal analysis were field-filtered using a 0.45-micron filter. All samples were itemised and dispatched under full chain of custody (COC) documentation. Ice bricks were used to keep the samples cool during transit.

Groundwater samples were analysed by Australian Laboratory Services (ALS), which is accredited by the National Association of Testing Authorities (NATA). Samples were analysed for the following baseline parameter suite, which meets State and Federal Government approval requirements:

- physical parameters (pH, EC, TDS, total hardness, and sodium adsorption ratio);
- major anions (CO_3, HCO_3, Cl, and SO_4);
- major cations (Ca, Mg, Na, and K);
- bromide, silicon, and fluoride;
- dissolved and total metals (Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe^{2+}, Hg, Mn, Mo, Ni, Pb, Sb, Sr, Se, V, and Zn);
- nutrients (NH_3-N, NO_2, NO_3, NO_x, total Kjeldahl nitrogen [TKN], total N, reactive P and total P);
- total recoverable hydrocarbons (TRH, C6 – C40 fraction);
- total petroleum hydrocarbons (TRH, C6 – C36 fraction); and
- BTEXN (benzene, toluene, ethyl benzene, meta- & para-xylene, ortho-xylene, total xylenes, sum of BTEX, and naphthalene).

Laboratory results are provided in Appendix C, noting that no comparisons with groundwater guidelines are made. It is understood that more appropriate specific EA conditions exist but were not available during compilation of this report. Pertinent findings of the groundwater quality sampling are detailed below.

- pH values range from 7.31 to 11.38, typifying neutral to alkaline conditions.
- Electrical conductivity values range from 1,192 to 19,910 µS/cm, with most samples typifying brackish water.
- Major ion concentrations indicate that groundwater of the Permian coal seams and alluvium is largely Na – Cl dominant, while the major chemistry of basalt bores is more variable.
- Dissolved metal concentrations are variable, but generally low. Exceedances of the ANZECC (2000) ecosystem protection guidelines (fresh water, 95% level of species protection) were recorded in bores MB19CVM03T (chromium and molybdenum) and MB19CVM09A (aluminium, chromium and copper).
- Detectable hydrocarbon concentrations were recorded in bores MB19CVM09A (C6-C40) and MB19CVM05T (C16-C40).

The charge balance error for all samples is less than 5%, indicating results are representative and reliable. The laboratory certificate of analysis, COC documentation, sample receipt notification (SRN) and the quality assurance/quality control (QA/QC) documentation are provided in Appendix D.

7 References

BHP Resource Engineering (2018). *Caval Ridge FY19 hydro drilling scope of work*.

Bouwer and Rice (1976). *A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells*. Water resources research 12.3: 423-428.

Butler (1997). *The design, performance, and analysis of slug tests*. CRC Press.

Cooper, Bredehoeft and Papadopulos (1967). *Response of a finite-diameter well to an instantaneous charge of water*. Water Resources Research 3.1: 263-269.

Hvorslev (1951). *Time lag and soil permeability in ground-water observations.*

Appendix A Monitoring bore construction logs

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Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

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MB19CVM01A

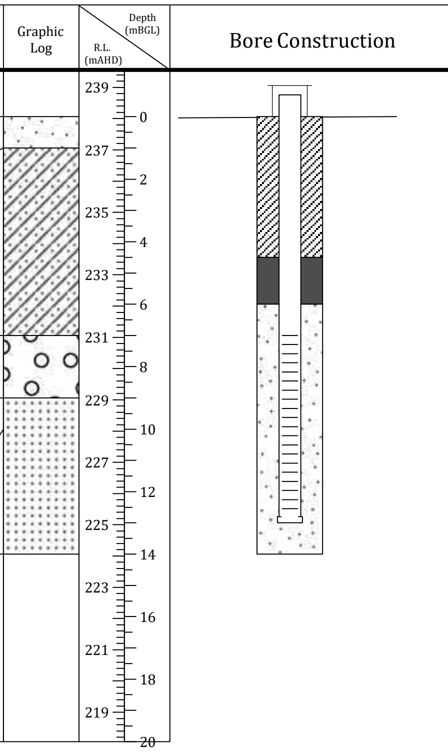
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **09-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **610329 mE**
NORTHING: **7548084 mN**
DATUM: **AGD84 z55**
RL: **238.06 mAHD**
TD: **14 mBGL**

COMMENTS: **Dry. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	SAND: fine sand, sub-rounded, quartzitic/lithic, silty matrix, reddish brown, medium dense.
	SANDY CLAY: medium plasticity, reddish brown, firm.
	GRAVEL: medium gravel (lithic) to coarse sand (quartzitic), sub-angular to sub-rounded, silty matrix, grey / brown / orange, loose.
Permian	SANDSTONE: fine sand, sub-rounded, quartzitic/lithic, light grey, low strength, extremely weathered.
	SANDSTONE: fine sand, sub-rounded, quartzitic/lithic, light grey / brown, low strength, distinctly weathered.



Bore Description

Protective lockable steel collar
Stick up: +0.69 m
Drilling method:
140 mm ø PCD: 0 m to 14 m (Air rotary)
Bentonite grout (5 %): 0 m to 4.5 m
50 mm ø uPVC Class 18 blank casing: 0 m to 7 m
Bentonite seal: 4.5 m to 6 m
3 mm ø washed, rounded, quartz gravel pack: 6 m to 14 m
50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm, 7 m to 13 m
End cap
End of hole: 14 m BGL
Developed with injected water

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BOREHOLE LOG

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MB19CVM02P

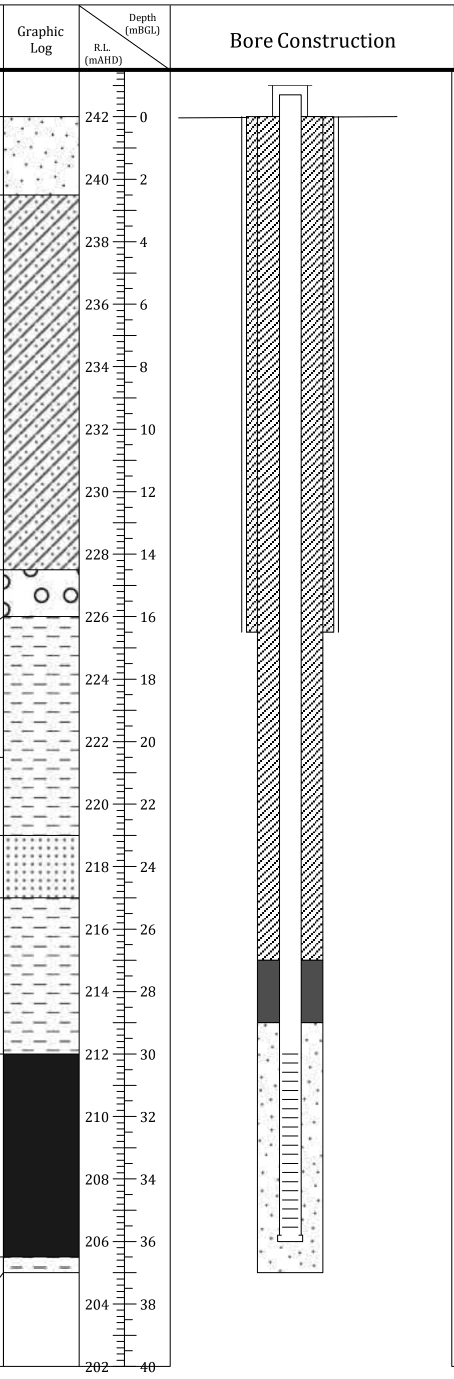
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **10-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **611424 mE**
NORTHING: **7549705 mN**
DATUM: **AGD84 z55**
RL: **242 mAHD**
TD: **36.5 mBGL**

COMMENTS: **Dry. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	SAND: fine sand, sub-rounded, quartzitic/lithic, silty matrix, reddish brown, medium dense.
	SANDY CLAY: medium plasticity, orangey brown, firm.
	GRAVEL: coarse gravel (lithic) to coarse sand (quartzitic), sub-angular to sub-rounded, silty matrix, reddish brown / white, loose.
Permian	SILTSTONE: light grey, low strength, extremely weathered.
	SILTSTONE: grey, medium strength, distinctly weathered.
	SANDSTONE: medium sand to fine sand, sub-rounded, lithic, light grey, medium strength, slightly weathered.
	SILTSTONE: grey, medium strength, fresh.
	COAL: black, bright, interbedded siltstone throughout (10%).
	SILTSTONE: brownish grey, medium strength, fresh, carbonaceous.



Bore Description

Protective lockable steel collar
Stick up: +0.69 m

Bentonite grout (5 %): 0 m to 27 m

50 mm øuPVC Class 18 blank casing: 0 m to 30 m

Drilling method:
203 mm ø PCD: 0 m to 21 m (Air rotary)
140 mm ø PCD: 0 m to 37 m (Air rotary)

150 mm ø uPVC Class 9 surface casing: 0 m to 16.5 m

Bentonite seal: 27 m to 29 m

3 mm ø washed, rounded, quartz gravel pack: 29 m to 37 m

50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm, 30 m to 36 m

End cap

End of hole: 37 m BGL

Developed with injected water

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BOREHOLE LOG

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MB19CVM03T

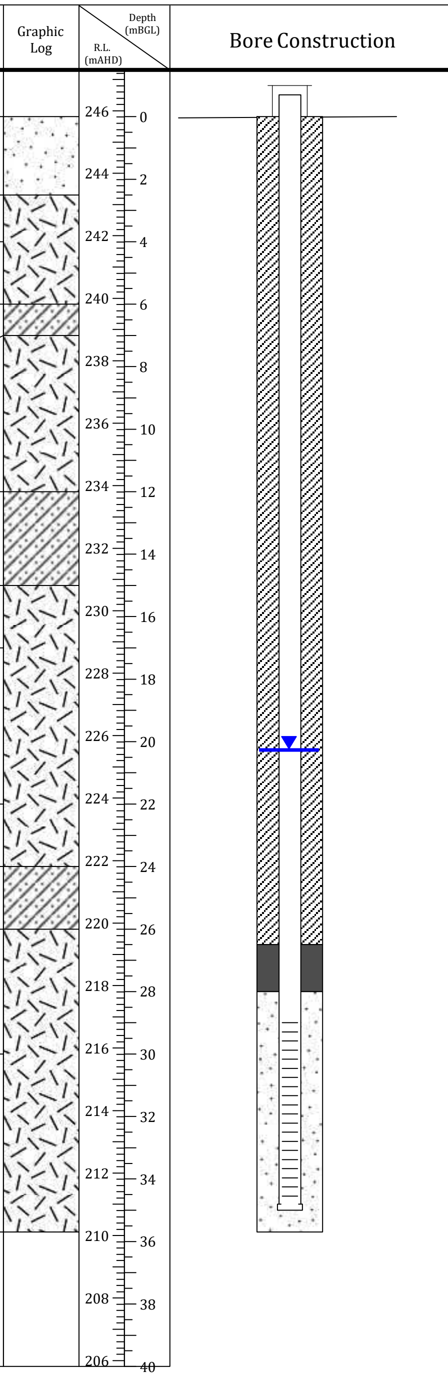
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **06-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **610100 mE**
NORTHING: **7551158 mN**
DATUM: **AGD84 z55**
RL: **245.81 mAHD**
TD: **35.7 mBGL**

COMMENTS: **End of hole airlift = 0.1 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	SAND: coarse sand, sub-angular, lithic, clay matrix, greyish brown, inferred weathered basalt clasts.
	BASALT: greyish brown / black, high strength, distinctly weathered.
	BASALT: dark bluish brown, high strength, distinctly weathered, limonitic (10%).
	SANDY CLAY: medium sand, sub-angular, yellowish brown, soft.
	BASALT: clay matrix, reddish brown, high strength, distinctly weathered, limonitic (10%).
	SANDY CLAY: medium sand, sub-angular, greyish yellow, soft.
	BASALT: clay matrix, greyish brown, high strength, distinctly weathered, limonitic (20%).
	BASALT: clay matrix, brown, high strength, distinctly weathered, limonitic (20%), trace quartz.
	BASALT: bluish grey, high strength, slightly weathered.
	SANDY CLAY: medium sand, sub-angular, dark brown, firm.
	BASALT: bluish grey, high strength, fresh, making water, amygdaloidal, chlorite/calcite/limonite mineralisation.
	BASALT: clay matrix, bluish grey, medium strength, fresh, making water, amygdaloidal.



Bore Description

Protective lockable steel collar
Stick up: +0.85 m

Bentonite grout (5 %): 0 m to 26.5 m

50 mm ø uPVC Class 18 blank casing: 0 m to 29 m

Drilling method:
140 mm ø Hammer: 0 m to 35.7 m (Air rotary)

Bentonite seal: 26.5 m to 28 m

3 mm ø washed, rounded, quartz gravel pack: 28 m to 35.7 m

50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm, 29 m to 35 m

End cap
End of hole: 35.7 m BGL

Bore development: 1 hr 22 mins; EC: 3176 µS/cm; pH: 11.38
Airlift flow rate: 0.04 L/s
Clear

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BOREHOLE LOG

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MB19CVM04P

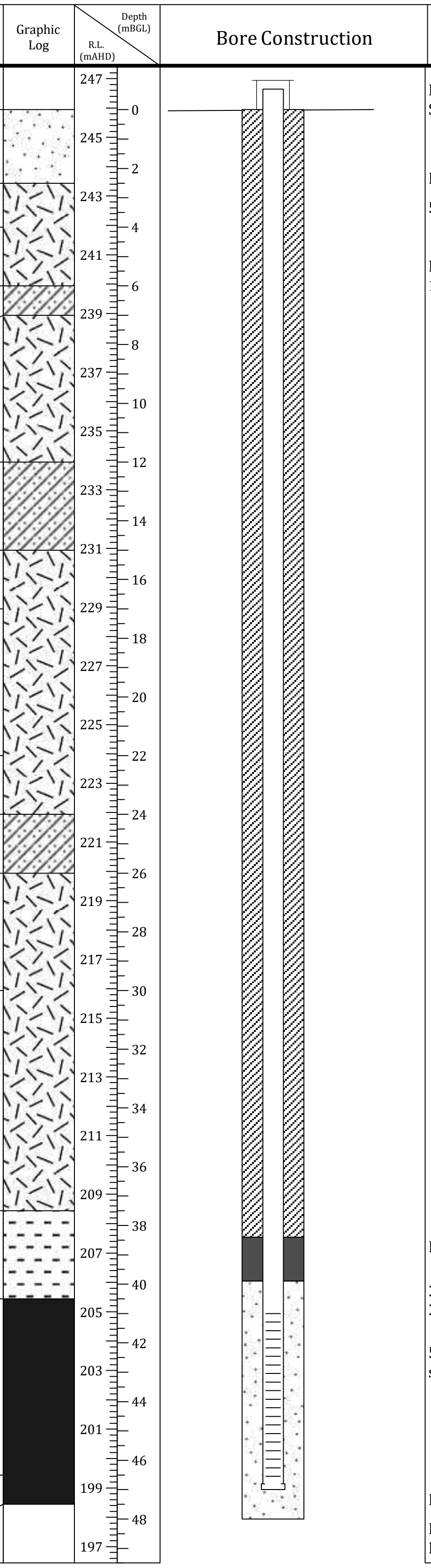
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **06-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **610101 mE**
NORTHING: **7551164 mN**
DATUM: **AGD84 z55**
RL: **245.94 mAHD**
TD: **47.5 mBGL**

COMMENTS: **End of hole airlift = 0.3 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	SAND: coarse sand, sub-angular, lithic, clay matrix, greyish brown, inferred weathered basalt clasts.
	BASALT: greyish brown / black, high strength, distinctly weathered.
	BASALT: dark bluish brown, high strength, distinctly weathered, limonitic (10%).
	SANDY CLAY: medium sand, sub-angular, yellowish brown, soft.
	BASALT: clay matrix, reddish brown, high strength, distinctly weathered, limonitic (10%).
	SANDY CLAY: medium sand, sub-angular, greyish yellow, soft.
	BASALT: clay matrix, greyish brown, high strength, distinctly weathered, limonitic (20%).
	BASALT: clay matrix, brown, high strength, distinctly weathered, limonitic (20%), trace quartz.
	BASALT: bluish grey, high strength, slightly weathered.
	SANDY CLAY: medium sand, sub-angular, dark brown, firm.
	BASALT: bluish grey, high strength, fresh, making water, amygdaloidal, chlorite/calcite/limonite mineralisation.
	BASALT: clay matrix, bluish grey, medium strength, fresh, making water, amygdaloidal.
Permian	CLAYSTONE: light orangey brown, low strength, extremely weathered.
	COAL: black, bright.
	COAL (50%): black, bright, / SILTSTONE (50%): blackish brown, medium strength, fresh.



Bore Description

Protective lockable steel collar
Stick up: +0.74 m

Bentonite grout (5 %): 0 m to 38.4 m

50 mm ø uPVC Class 18 blank casing: 0 m to 41 m

Drilling method:
140 mm ø Hammer: 0 m to 48 m (Air rotary)

Bentonite seal: 38.4 m to 39.9 m

3 mm ø washed, rounded, quartz gravel pack:
39.9 m to 48 m

50 mm ø uPVC Class 18 machine slotted casing,
slot aperture: 1 mm, 41 m to 47 m

End cap

End of hole: 48 m BGL
Developed with injected water

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BOREHOLE LOG

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MB19CVM05T

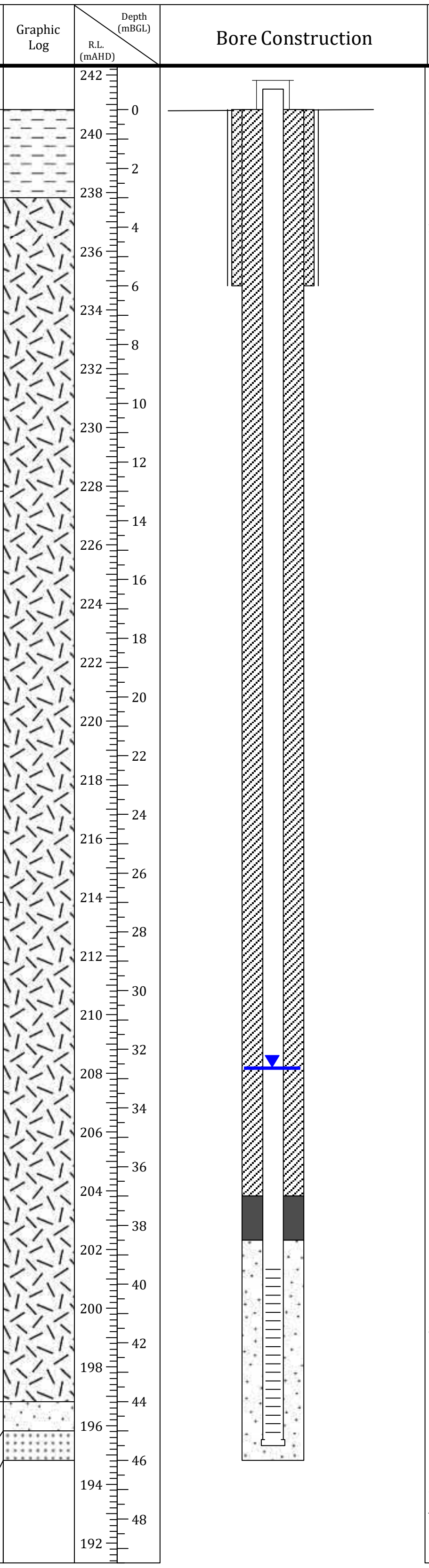
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **22-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **610968 mE**
NORTHING: **7551248 mN**
DATUM: **AGD84 z55**
RL: **240.82 mAHD**
TD: **46 mBGL**

COMMENTS: **End of hole airlift = 0.1 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	CLAY: medium plasticity, black / brown, stiff.
Tertiary	BASALT: dark brownish grey, high strength, distinctly weathered.
Tertiary	BASALT: dark brownish grey, high strength, slightly weathered.
Tertiary	BASALT: dark brownish grey, high strength, fresh.
Tertiary	SAND: coarse sand to fine gravel, sub-rounded, quartzitic/lithic, brownish white / grey / brown, loose, making water.
Permian	SANDSTONE: fine sand, sub-angular, lithic, light grey, medium strength, fresh.



Bore Description

Protective lockable steel collar
Stick up: +0.74 m

Bentonite grout (5 %): 0 m to 37 m

50 mm ø uPVC Class 18 blank casing: 0 m to 39.5 m
150 mm ø uPVC Class 9 surface casing: 0 m to 6 m

Drilling method:
203 mm ø Blade: 0 m to 6 m (Air rotary)
140 mm ø Hammer: 6 m to 46 m (Air rotary)

Bentonite seal: 37 m to 38.5 m

3 mm ø washed, rounded, quartz gravel pack: 38.5 m to 46 m

50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm, 39.5 m to 45.5 m

End cap
End of hole: 46 m BGL

Bore development: 1 hr; EC: 1504 µS/cm; pH: 8.67
Airlift flow rate: 0.03 L/s
Clear

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BOREHOLE LOG

page:1 of 2

MB19CVM06P

PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **14-03-19**
LOGGED BY: **Dean Newborn**

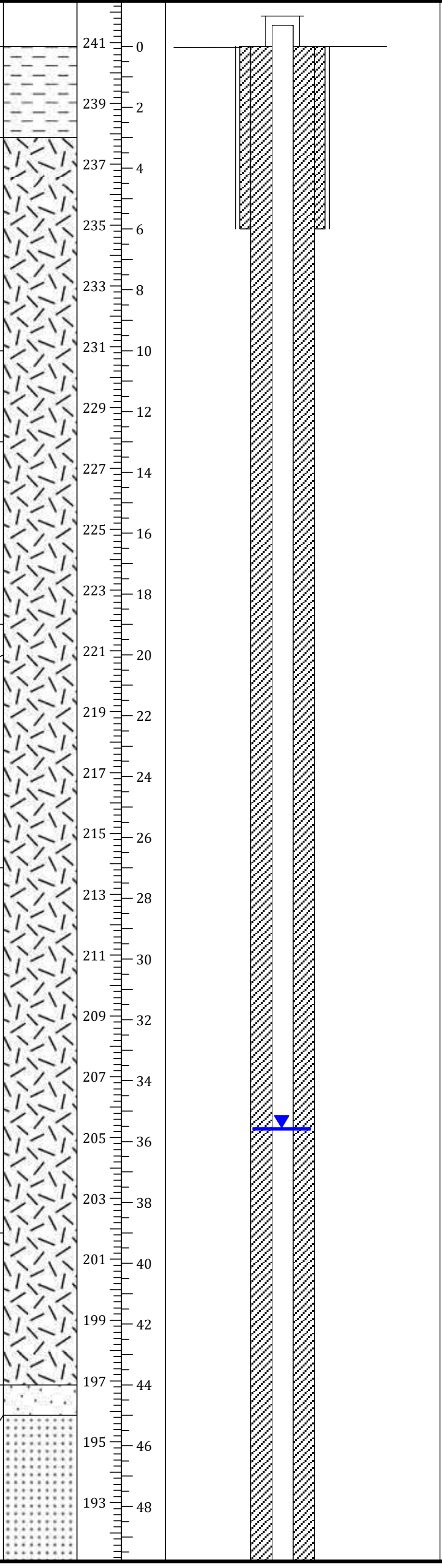
DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **610961 mE**
NORTHING: **7551249 mN**
DATUM: **AGD84 z55**
RL: **240.87 mAHD**
TD: **74 mBGL**

COMMENTS: **End of hole airlift = 0.4 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	CLAY: medium plasticity, black / brown, stiff.
Tertiary	BASALT: greyish brown / black / red, low strength, distinctly weathered.
Tertiary	BASALT: brownish grey, high strength, distinctly weathered.
Tertiary	BASALT: brownish grey, high strength, slightly weathered, possibly fractured in part.
Tertiary	BASALT: brownish grey / red / white, medium strength, distinctly weathered.
Tertiary	BASALT: brownish grey, high strength, slightly weathered, possibly fractured in part.
Tertiary	BASALT: brownish grey, very high strength, fresh, calcite inclusions (10%).
Tertiary	BASALT: brownish grey, high strength, slightly weathered, likely fractured in part.
Tertiary	SAND: coarse sand to fine gravel, sub-rounded, quartzitic/lithic, brownish white / grey / brown, loose, making water.
	SANDSTONE: fine sand, sub-angular, lithic, grey, medium strength, fresh.

Graphic Log | Depth (mBGL) / R.L. (mAHD) | Bore Construction



Bore Description

Protective lockable steel collar
Stick up: +0.78 m

Bentonite grout (5 %): 0 m to 62.5 m

50 mm ø uPVC Class 18 blank casing: 0 m to 67 m

150 mm ø uPVC Class 9 surface casing: 0 m to 6 m

Drilling method:
203 mm ø PCD: 0 m to 6 m (Air rotary)
140 mm ø Hammer: 6 m to 74 m (Air rotary)

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BOREHOLE LOG

MB19CVM06P

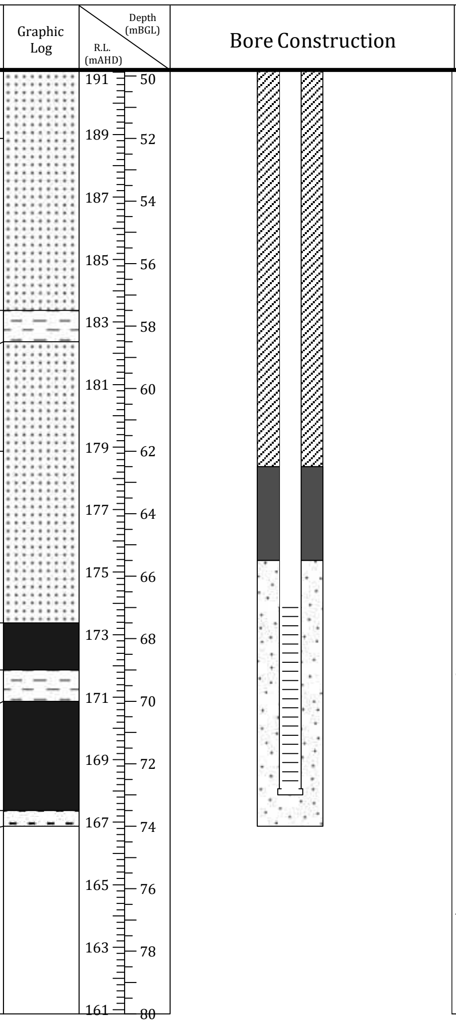
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **14-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **610961 mE**
NORTHING: **7551249 mN**
DATUM: **AGD84 z55**
RL: **240.87 mAHD**
TD: **74 mBGL**

COMMENTS: **End of hole airlift = 0.4 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Permian	SANDSTONE: fine sand, sub-angular, lithic, grey, medium strength, fresh.
	SANDSTONE: fine sand, sub-angular, lithic, blackish grey, medium strength, fresh, carbonaceous.
	SILTSTONE: grey / black, medium strength, fresh, carbonaceous.
	SANDSTONE: fine sand, sub-angular, lithic, brownish grey, medium strength, fresh.
	SANDSTONE: fine sand, sub-angular, lithic, grey / brown, medium strength, fresh, interbedded carbonaceous siltstone (20%).
	COAL: black, making water, 50% bright.
	SILTSTONE: blackish grey, medium strength, fresh, carbonaceous.
	COAL: black, making water, 50% bright.
	CLAYSTONE: brown, low strength, fresh.



Bore Description

Bentonite seal: 62.5 m to 65.5 m

3 mm ø washed, rounded, quartz gravel pack: 65.5 m to 74 m

50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm, 67 m to 73 m

End cap

End of hole: 74 m BGL

Bore development: 1 hr 4 mins; EC: 19910 µS/cm; pH: 8.07
Airlift flow rate: 0.03 L/s
Clear

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BOREHOLE LOG

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MB19CVM07T

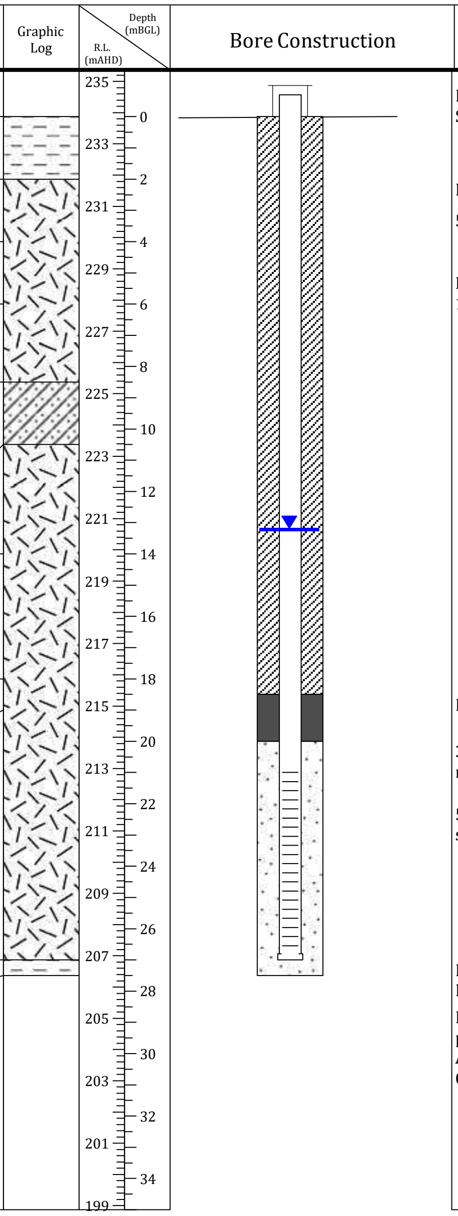
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **05-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **611464 mE**
NORTHING: **7552357 mN**
DATUM: **AGD84 z55**
RL: **233.87 mAHD**
TD: **27.5 mBGL**

COMMENTS: **End of hole airlift = 0.7 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	CLAY: medium plasticity, brownish black, stiff, occassional ferruginous siltstone clasts.
	BASALT: brownish grey / red, high strength, distinctly weathered.
	BASALT: greyish brown, medium strength, distinctly weathered.
	BASALT: brownish grey, high strength, distinctly weathered.
	CLAY (85%): medium plasticity, light orangey brown, soft, / SAND (15%): coarse sand, angular, lithic, well graded, brownish grey, weathered basalt sand, quartzitic at base (10%).
	BASALT: greyish brown, medium strength, distinctly weathered.
	BASALT: greyish brown / red, medium strength, distinctly weathered, amygdaloidal.
	BASALT: bluish grey, high strength, slightly weathered.
	BASALT: bluish grey / brown / red, high strength, slightly weathered, making water, amygdaloidal.
	CLAY: high plasticity, reddish grey, soft.



Bore Description

Protective lockable steel collar
Stick up: +0.84 m

Bentonite grout (5 %): 0 m to 18.5 m

50 mm ø uPVC Class 18 blank casing: 0 m to 21 m

Drilling method:
140 mm ø Hammer: 0 m to 27.5 m (Air rotary)

Bentonite seal: 18.5 m to 20 m

3 mm ø washed, rounded, quartz gravel pack: 20 m to 27.5 m

50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm, 21 m to 27 m

End cap
End of hole: 27.5 m BGL

Bore development: 1 hr 2 mins; EC: 1192 µS/cm; pH: 8.34
Airlift flow rate: 0.3 L/s
Clear

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Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

MB19CVM08P

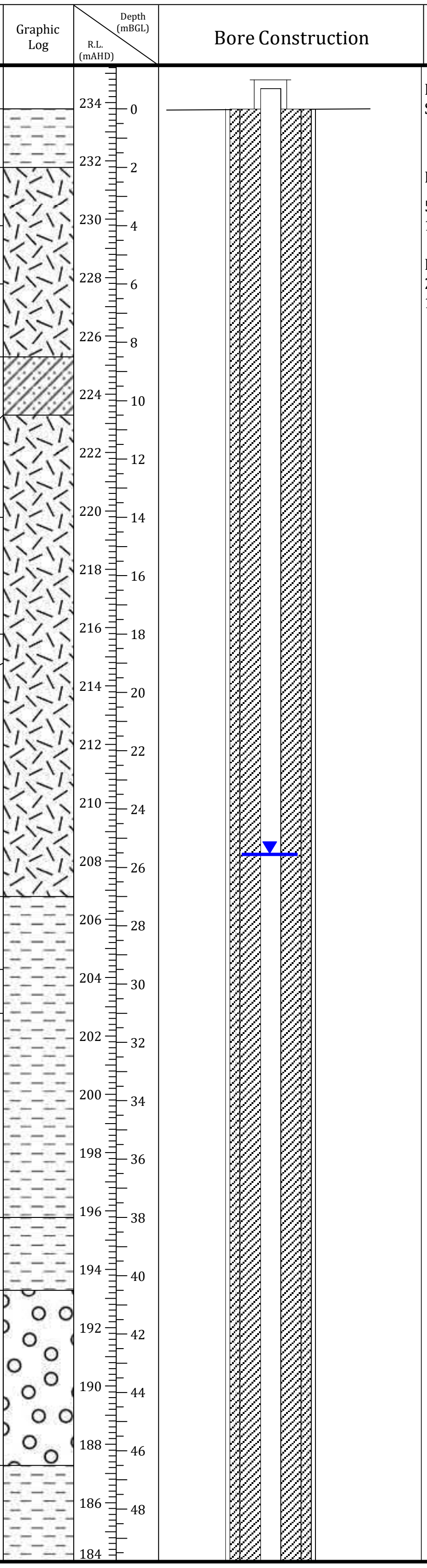
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **04-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **611465 mE**
NORTHING: **7552346 mN**
DATUM: **AGD84 z55**
RL: **233.78 mAHD**
TD: **164 mBGL**

COMMENTS: **End of hole airlift > 1.5 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	CLAY: medium plasticity, brownish black, stiff, occassional ferruginous clasts.
	BASALT: brownish grey / red, high strength, distinctly weathered.
	BASALT: greyish brown, medium strength, distinctly weathered.
	BASALT: brownish grey, high strength, distinctly weathered.
	CLAY (85%): medium plasticity, light orangey brown, soft, / SAND (15%): coarse sand, angular, lithic, well graded, brownish grey, basal sand, quartzitic at base (10%).
	BASALT: greyish brown, medium strength, distinctly weathered.
	BASALT: greyish brown / red, medium strength, distinctly weathered, amygdaloidal.
	BASALT: bluish grey, high strength, slightly weathered.
	BASALT: bluish grey / brown / red, high strength, slightly weathered, making water, amygdaloidal.
	CLAY: high plasticity, reddish grey, soft.
	CLAY: high plasticity, reddish grey, soft, extremely weathered siltstone clasts throughout (15%).
	CLAY: high plasticity, brownish grey, soft, extremely weathered siltstone clasts throughout (15%).
	SILTSTONE: grey, low strength, distinctly weathered.
	GRAVEL: coarse gravel to coarse sand, angular to sub-rounded, lithic/quartzitic, brown / grey / white.
	SILTSTONE: grey, medium strength, slightly weathered, carbonaceous 56.7 to 57 mbgl.



Bore Description

Protective lockable steel collar
Stick up: +0.80 m

Bentonite grout (5 %): 0 m to 152 m

50 mm ø uPVC Class 18 blank casing: 0 m to 157.5 m

Drilling method:
203 mm ø Hammer: 0 m to 54 m (Air rotary)
140 mm ø PCD: 54 m to 164 m (Air rotary)

BOREHOLE LOG

MB19CVM08P

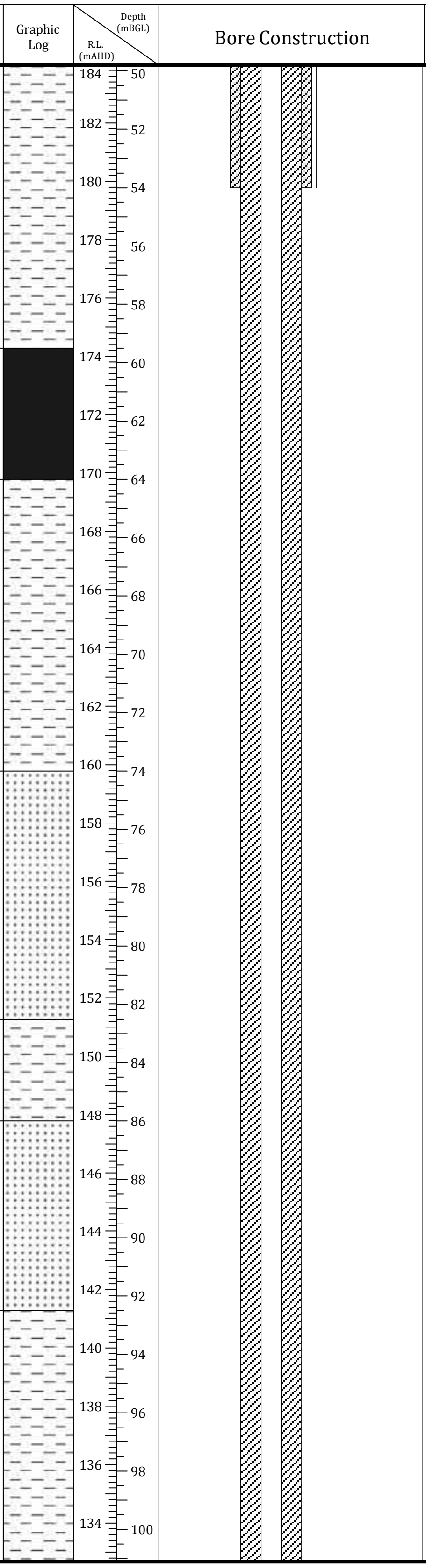
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **04-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **611465 mE**
NORTHING: **7552346 mN**
DATUM: **AGD84 z55**
RL: **233.78 mAHD**
TD: **164 mBGL**

COMMENTS: **End of hole airlift > 1.5 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description	Bore Description
	SILTSTONE: grey, medium strength, slightly weathered, carbonaceous 56.7 to 57 mbgl.	150 mm ø uPVC Class 9 surface casing: 0 m to 53.5 m
	COAL: black, potentially making water, 50% bright, interbedded carbonaceous claystone (10%).	
	SILTSTONE: grey, medium strength, fresh.	
	SANDSTONE: medium sand to fine sand, sub-angular, light grey, medium strength, fresh.	
	SILTSTONE: grey, medium strength, fresh.	
	SANDSTONE: medium sand to fine sand, sub-angular, brownish grey, medium strength, fresh.	
	SILTSTONE: dark grey, medium strength, fresh, occassional claystone bedding.	



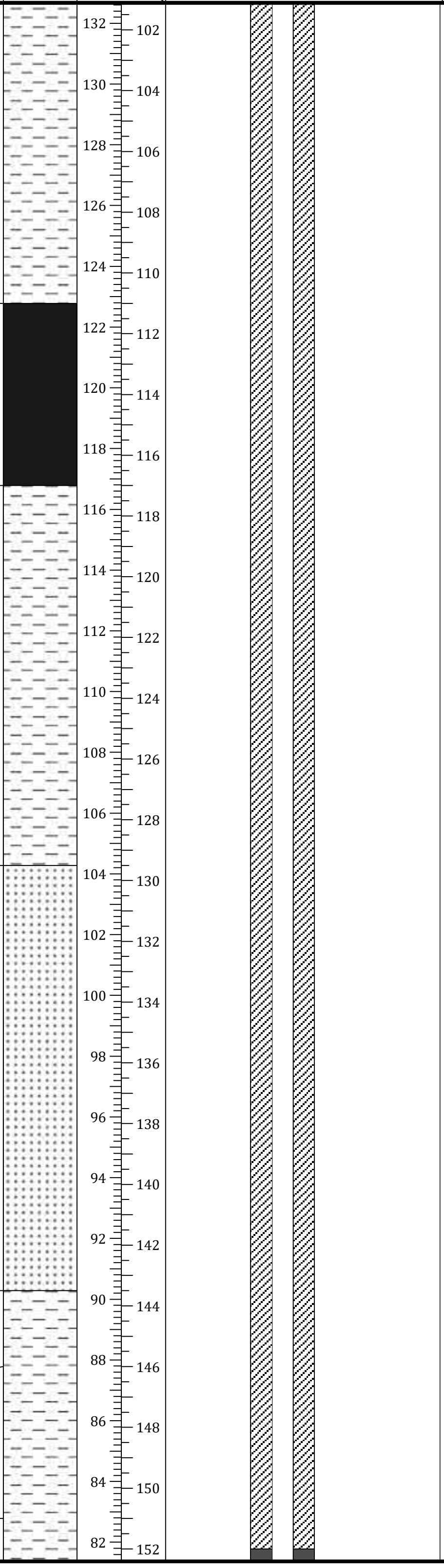
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **04-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **611465 mE**
NORTHING: **7552346 mN**
DATUM: **AGD84 z55**
RL: **233.78 mAHD**
TD: **164 mBGL**

COMMENTS: **End of hole airlift > 1.5 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description	Graphic Log	R.L. (mAHD) / Depth (mBGL)	Bore Construction	Bore Description
Permian	SILTSTONE: dark grey, medium strength, fresh, occassional claystone bedding.				
	COAL: black, making water, 80% bright, minor inclusions of claystone at base.				
	SILTSTONE: brownish grey, medium strength, fresh, tuff inclusions 117 to 119 mbgl.				
	SANDSTONE: medium sand to fine sand, sub-angular, light grey, medium strength, fresh.				
	SILTSTONE (50%): brownish grey, medium strength, fresh, / SANDSTONE (50%): medium sand to fine sand, sub-angular, light grey, medium strength, fresh.				
	SILTSTONE: grey, medium strength, fresh.				
	SILTSTONE (60%): grey, medium strength, fresh, / SANDSTONE (40%): medium sand to fine sand, sub-angular, light grey, medium strength, fresh.				



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BOREHOLE LOG

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MB19CVM08P

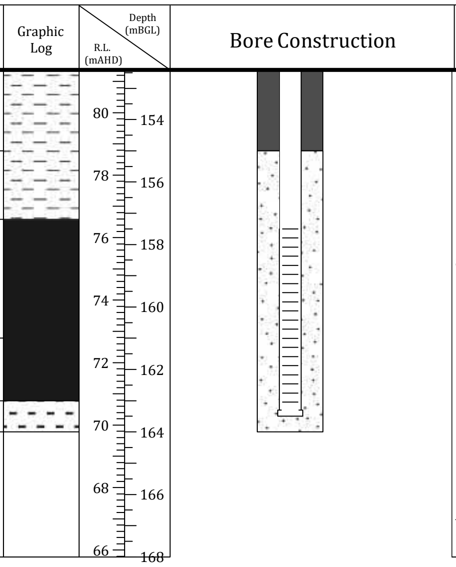
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **04-03-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **611465 mE**
NORTHING: **7552346 mN**
DATUM: **AGD84 z55**
RL: **233.78 mAHD**
TD: **164 mBGL**

COMMENTS: **End of hole airlift > 1.5 L/s. One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
	SILTSTONE (60%): grey, medium strength, fresh, / SANDSTONE (40%): medium sand to fine sand, sub-angular, light grey, medium strength, fresh.
	SILTSTONE: grey, medium strength, fresh.
	COAL: black, making water, bright, minor siltstone banding.
	COAL: greyish black, making water, dull.
	CLAYSTONE: brownish grey, low strength, fresh.



Bore Description

Bentonite seal: 152 m to 155 m

3 mm ø washed, rounded, quartz gravel pack: 155 m to 164 m

50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm 157.5 m to 163.5 m

End cap
End of hole: 164 m BGL
Bore development: 1 hr 18 mins; EC: 3963 µS/cm; pH: 8.41
Airlift flow rate: 0.17 L/s
Clear

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BOREHOLE LOG

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MB19CVM09A

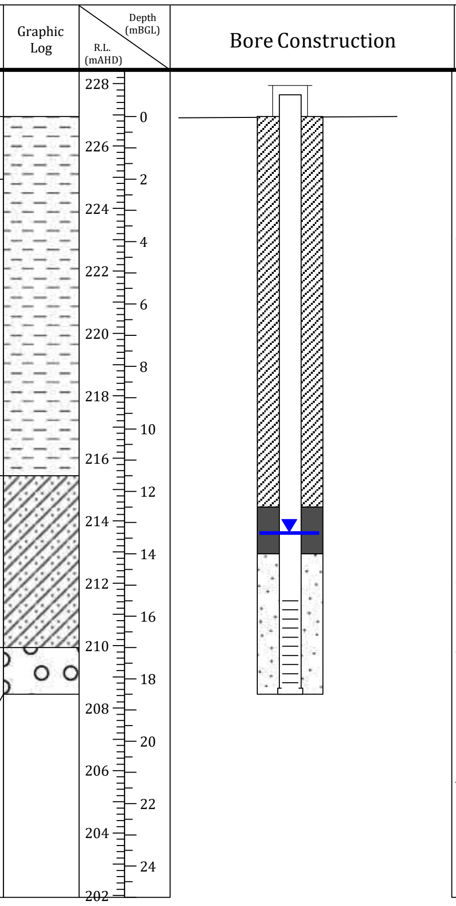
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **19-02-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Mud rotary**
DRILL RIG: **Fraste 400**

EASTING: **612446 mE**
NORTHING: **7550699 mN**
DATUM: **AGD84 z55**
RL: **226.94 mAHD**
TD: **18.5 mBGL**

COMMENTS: **One centraliser per 18m/screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	CLAY: medium plasticity, light brown, soft.
	CLAY: medium plasticity, light brown / grey, firm, trace fine sand throughout.
	CLAY (50%): low plasticity, orangey brown, soft, moist, / SAND (50%): fine sand, sub-rounded, lithic, poorly graded, grey / red / white.
	CLAY (60%): low plasticity, orangey brown / grey, soft, making water, 10% fine sand. / GRAVEL (40%): coarse gravel to fine gravel, sub-angular to sub-rounded, lithic, well graded, blackish grey.



Bore Description

Protective lockable steel collar
Stick up: +0.93 m

Bentonite grout (5 %): 0 m to 12.5 m

50 mm ø uPVC Class 18 blank casing: 0 m to 12.5 m

Drilling method:
140 ø mm PCD: 0 m to 18.5 m (Mud rotary)

Bentonite seal: 12.5 m to 14 m

3 mm ø washed, rounded, quartz gravel pack: 14 m to 18.5 m

50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm, 15.5 m to 18.5 m

End cap
End of hole: 18.5 m BGL

Bore development: 3 hrs 31 mins; EC: 3693 µS/cm; pH: 7.31
Airlift flow rate: 0.02 L/s
Clear, minor chlorine odour remaining

BOREHOLE LOG

MB19CVM10P

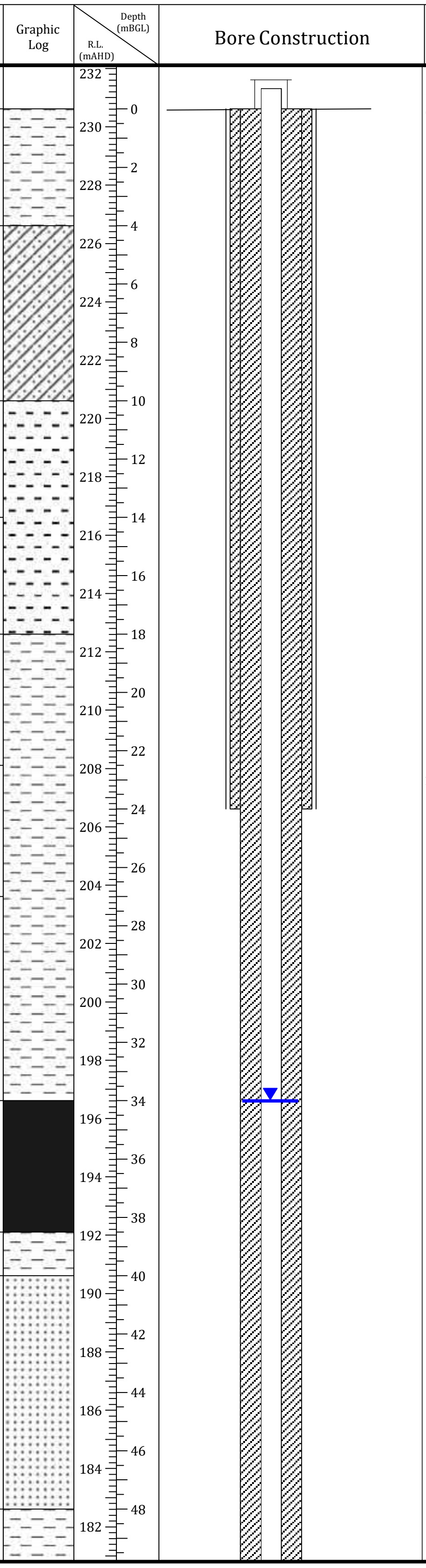
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **17-02-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **613180 mE**
NORTHING: **7549768 mN**
DATUM: **AGD84 z55**
RL: **230.61 mAHD**
TD: **131 mBGL**

COMMENTS: **Hydrogeologist not on site. End of hole airlift = 1 L/s. One centraliser per 18m/ screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
Tertiary	CLAY: reddish brown, soft,
	CLAY (85%): reddish brown, soft, / SAND (15%): trace fine gravel throughout.
	CLAYSTONE: brownish grey, low strength, distinctly weathered, samples lost 12 to 14 mbgl (likely gravel).
	CLAYSTONE: brownish grey, medium strength, distinctly weathered.
	SILTSTONE: light greyish black, low strength, distinctly weathered, carbonaceous, potentially making water.
	SILTSTONE: light brownish grey, low strength, slightly weathered.
	SILTSTONE: light grey, medium strength, fresh.
	COAL: black, potentially making water, bright, interbedded siltstone throughout (20%).
	SILTSTONE: light grey, medium strength, fresh.
	SANDSTONE: medium sand to fine sand, sub-rounded, grey, medium strength, fresh, minor interbedded siltstone.
	SILTSTONE: grey, medium strength, fresh, minor interbedded sandstone.



Bore Description

Protective lockable steel collar
Stick up: +0.87 m

Bentonite grout (5 %): 0 m to 118.5 m

50 mm ø uPVC Class 18 blank casing: 0 m to 123.5 m

Drilling method:
203 mm ø PCD: 0 m to 24 m (Air rotary)
140 mm ø PCD: 24 m to 131 m (Air rotary)

150 mm ø uPVC Class 9 surface casing: 0 m to 24 m

BOREHOLE LOG

MB19CVM10P

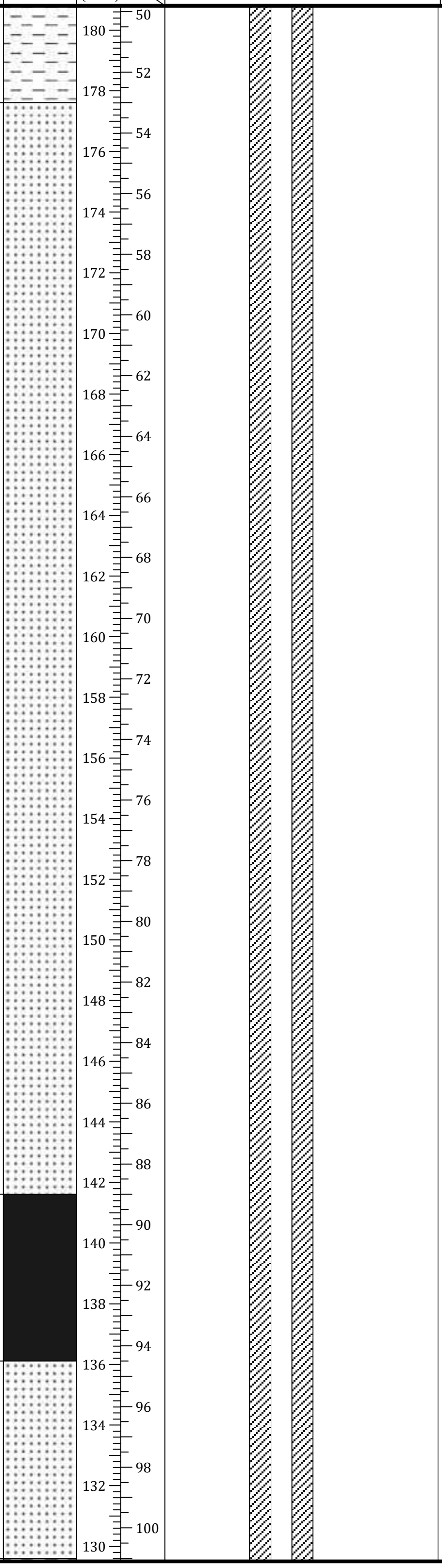
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **17-02-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **613180 mE**
NORTHING: **7549768 mN**
DATUM: **AGD84 z55**
RL: **230.61 mAHD**
TD: **131 mBGL**

COMMENTS: **Hydrogeologist not on site. End of hole airlift = 1 L/s. One centraliser per 18m/ screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description	Graphic Log	R.L. (mAHD) / Depth (mBGL)	Bore Construction	Bore Description
Permian	SILTSTONE: grey, medium strength, fresh, minor interbedded sandstone.				
	SANDSTONE: medium sand to fine sand, sub-rounded, grey, medium strength, fresh, minor interbedded siltstone (63 to 73 mbgl & 87 to 89 mbgl).				
	COAL: black, making water, bright.				
	SANDSTONE: medium sand to fine sand, sub-rounded, grey, medium strength, fresh.				
	SILTSTONE: grey, medium strength, fresh, minor interbedded sandstone.				



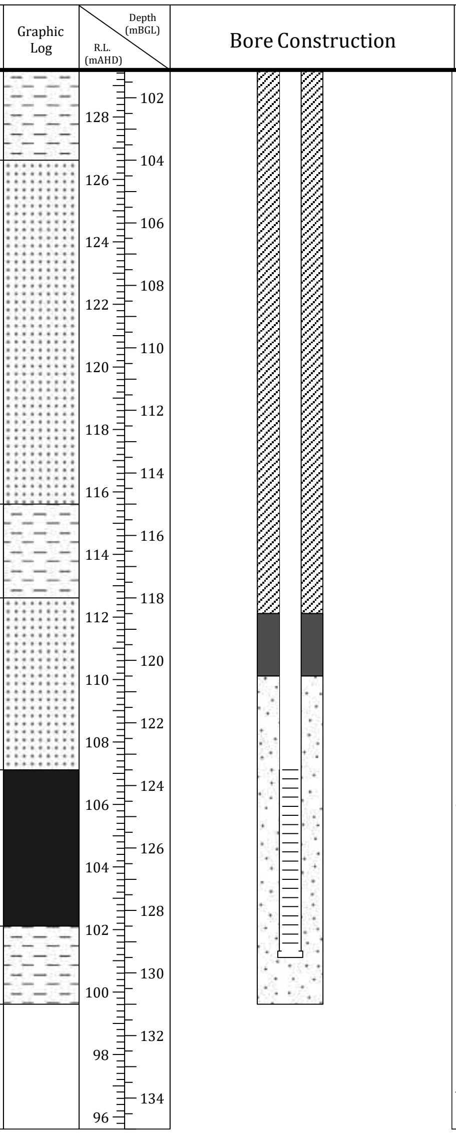
PROJECT No: **G1628A**
PROJECT NAME: **BMA - Caval Ridge**
DATE DRILLED: **17-02-19**
LOGGED BY: **Dean Newborn**

DRILLING COMPANY: **J&S Drilling**
DRILLER: **Ryan Sainsbury**
DRILLING METHOD: **Air rotary**
DRILL RIG: **Fraste 400**

EASTING: **613180 mE**
NORTHING: **7549768 mN**
DATUM: **AGD84 z55**
RL: **230.61 mAHD**
TD: **131 mBGL**

COMMENTS: **Hydrogeologist not on site. End of hole airlift = 1 L/s. One centraliser per 18m/ screen top & bottom.**

Stratigraphic Column	Soil or Rock Field Material Description
	SILTSTONE: grey, medium strength, fresh, minor interbedded sandstone.
	SANDSTONE: medium sand to fine sand, sub-rounded, grey, high strength, fresh.
	SILTSTONE: grey, medium strength, fresh.
	SANDSTONE: medium sand to fine sand, sub-rounded, grey, medium strength, fresh, fine grained sandstone/siltstone towards base of unit.
	COAL: black, making water, bright, interbedded carbonaceous siltstone (20%).
	SILTSTONE: grey, medium strength, fresh.



Bore Description

Bentonite seal: 118.5 m to 120.5 m

3 mm ø washed, rounded, quartz gravel pack: 120.5 m to 131 m

50 mm ø uPVC Class 18 machine slotted casing, slot aperture: 1 mm, 123.5 m to 129.5 m

End cap

End of hole: 131 m BGL

Bore development: 1 hr 32 mins; EC: 1781 µS/cm; pH: 8.84
Airlift flow rate: 0.09 L/s
Clear

Appendix B **Permeability test results**

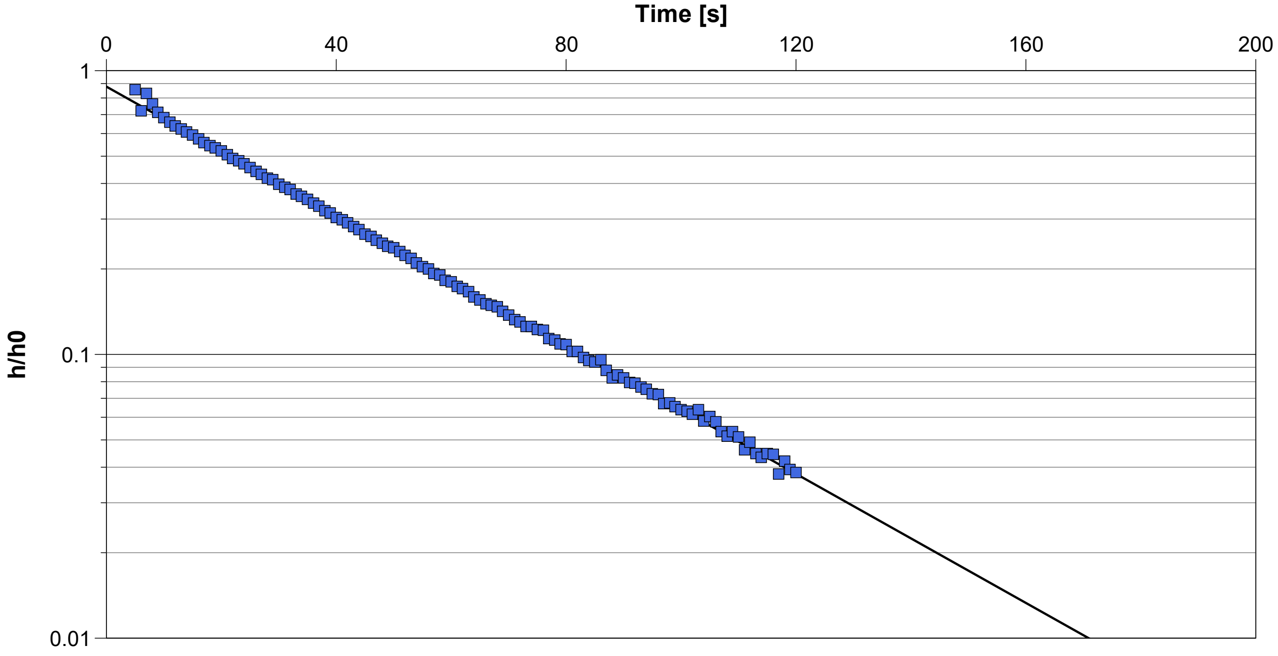
Slug Test Analysis Report

Project: Caval Ridge

Number: G1628A

Client: BMA

Location: Moranbah	Slug Test: 03T_FHT	Test Well: MB19CVM03T
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 2/04/2019
Aquifer Thickness: 10.00 m		

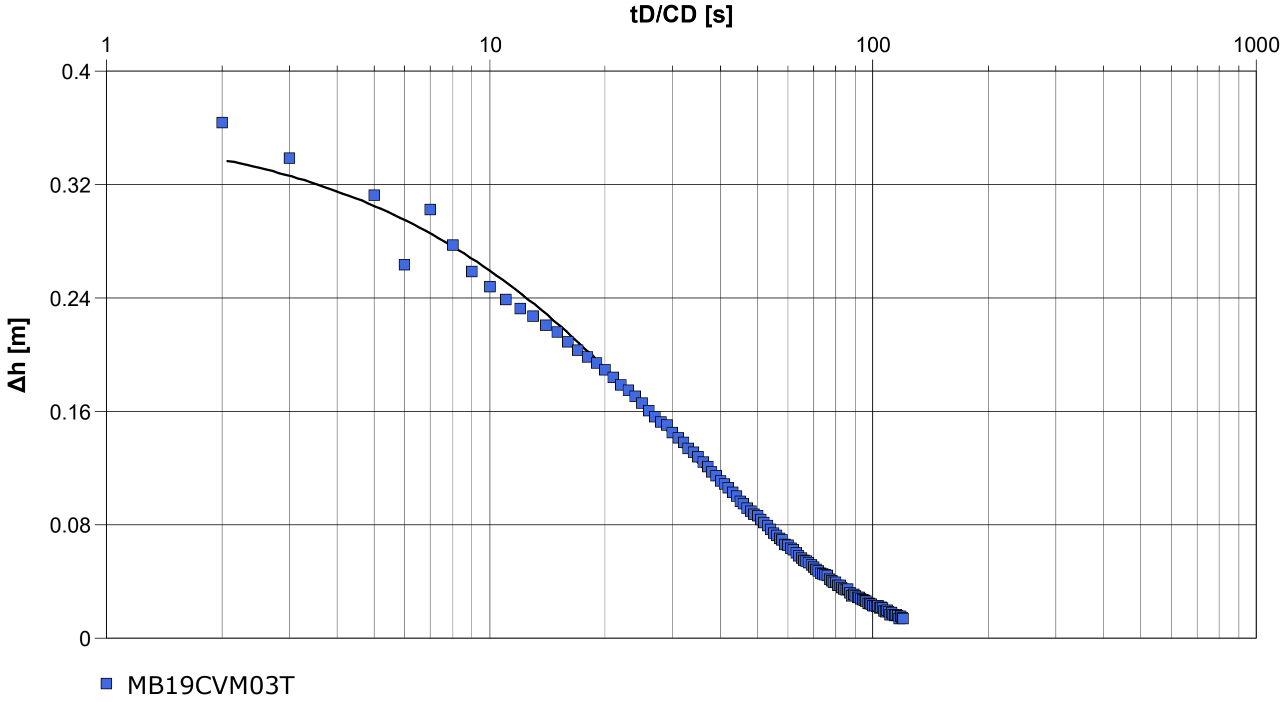


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM03T	6.50×10^{-1}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 03T_FHT	Test Well: MB19CVM03T
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 2/04/2019
Aquifer Thickness: 10.00 m		

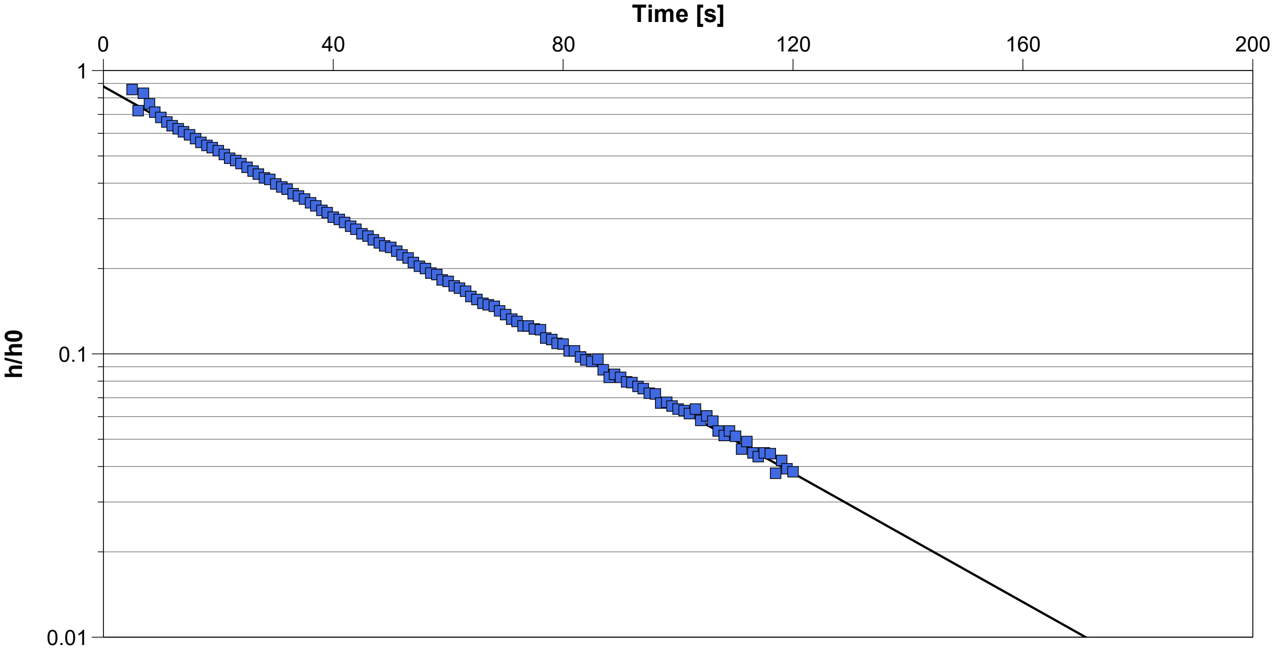


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM03T	8.10×10^{0}	8.10×10^{-1}	3.18×10^{-8}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 03T_FHT	Test Well: MB19CVM03T
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 2/04/2019
Aquifer Thickness: 10.00 m		

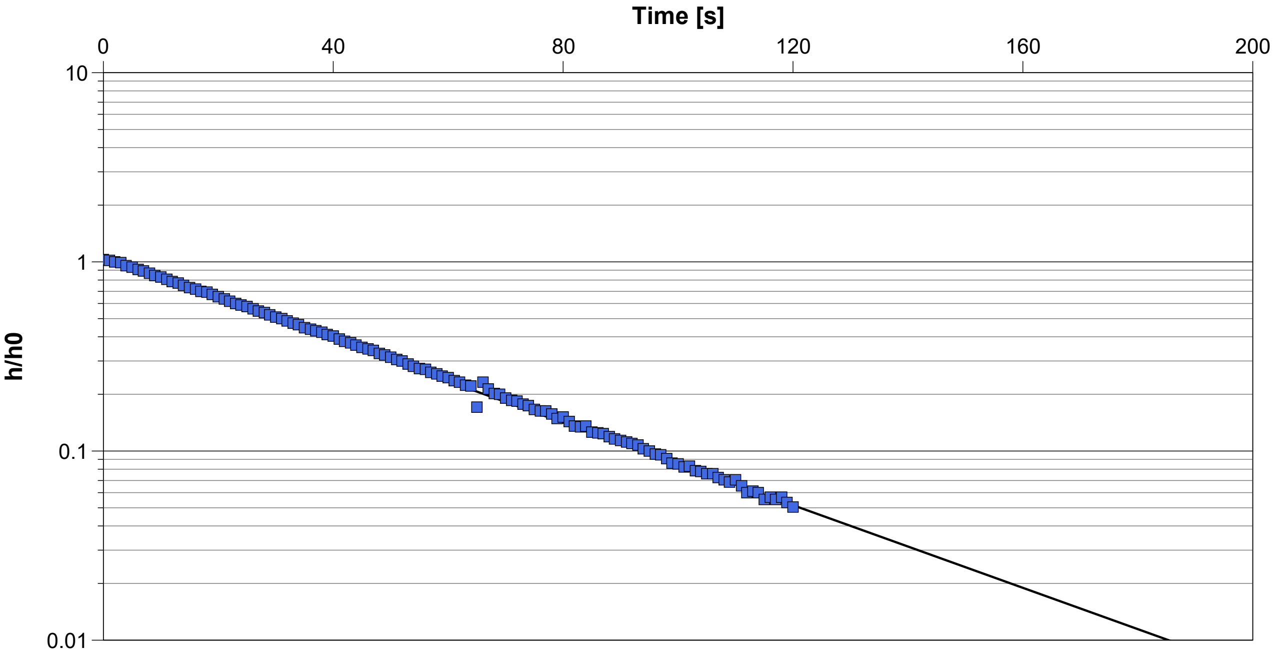


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM03T	5.10×10^{-1}	

Slug Test Analysis Report	
Project:	Caval Ridge
Number:	G1628A
Client:	BMA

Location: Moranbah	Slug Test: 03T_RHT	Test Well: MB19CVM03T
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 2/04/2019
Aquifer Thickness: 10.00 m		

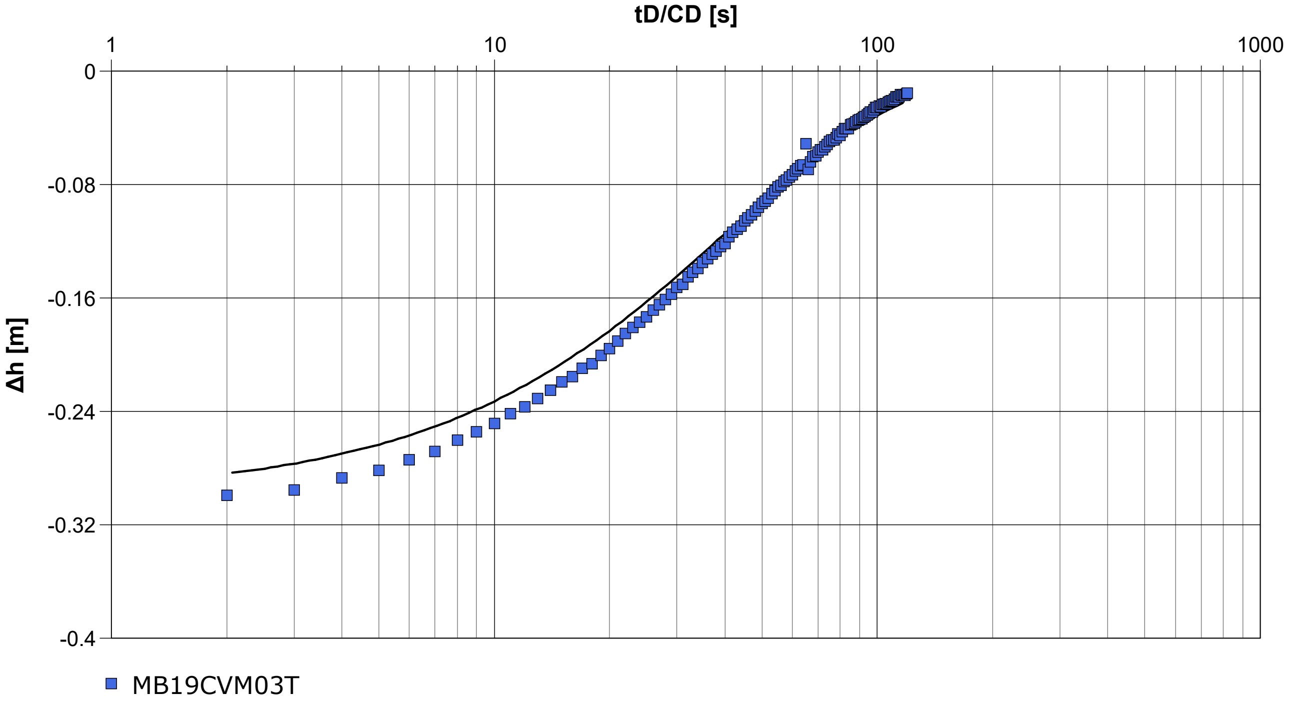


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM03T	6.25×10^{-1}	

Slug Test Analysis Report
Project: Caval Ridge
Number: G1628A
Client: BMA

Location: Moranbah	Slug Test: 03T_RHT	Test Well: MB19CVM03T
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 2/04/2019
Aquifer Thickness: 10.00 m		

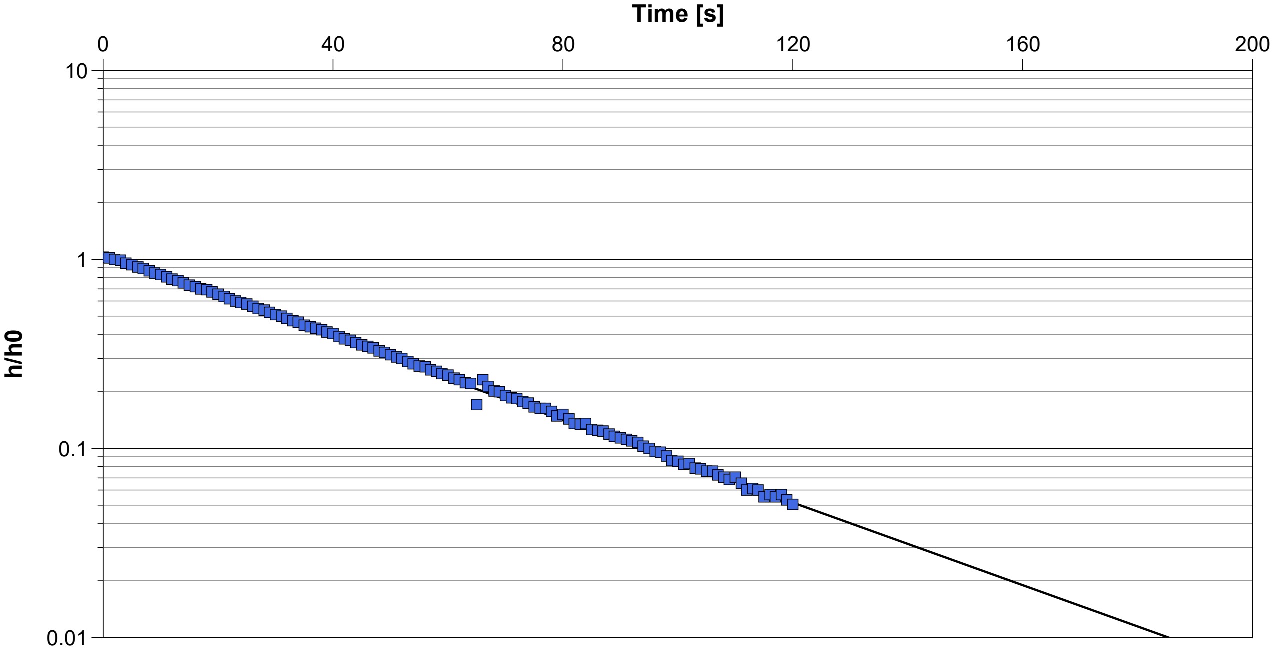


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM03T	1.30×10^{1}	1.30×10^{0}	5.50×10^{-17}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 03T_RHT	Test Well: MB19CVM03T
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 2/04/2019
Aquifer Thickness: 10.00 m		

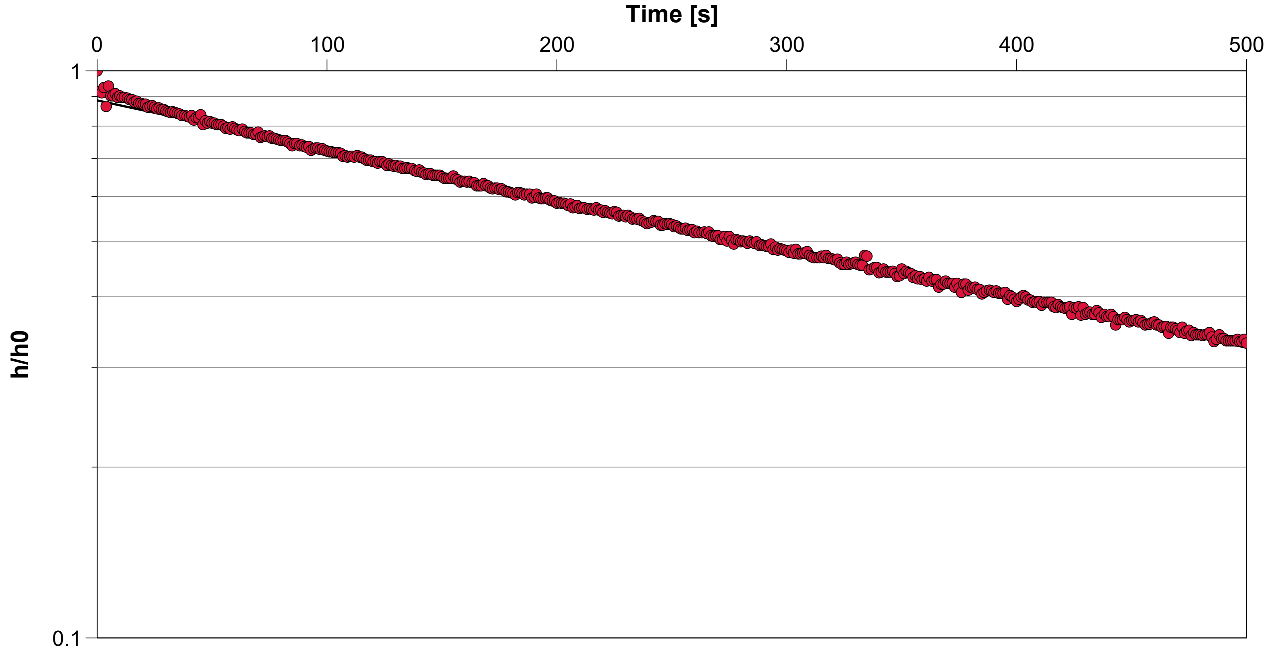


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM03T	4.90×10^{-1}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 05T_FHT	Test Well: MB19CVM05T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 2/04/2019
Aquifer Thickness: 12.00 m		

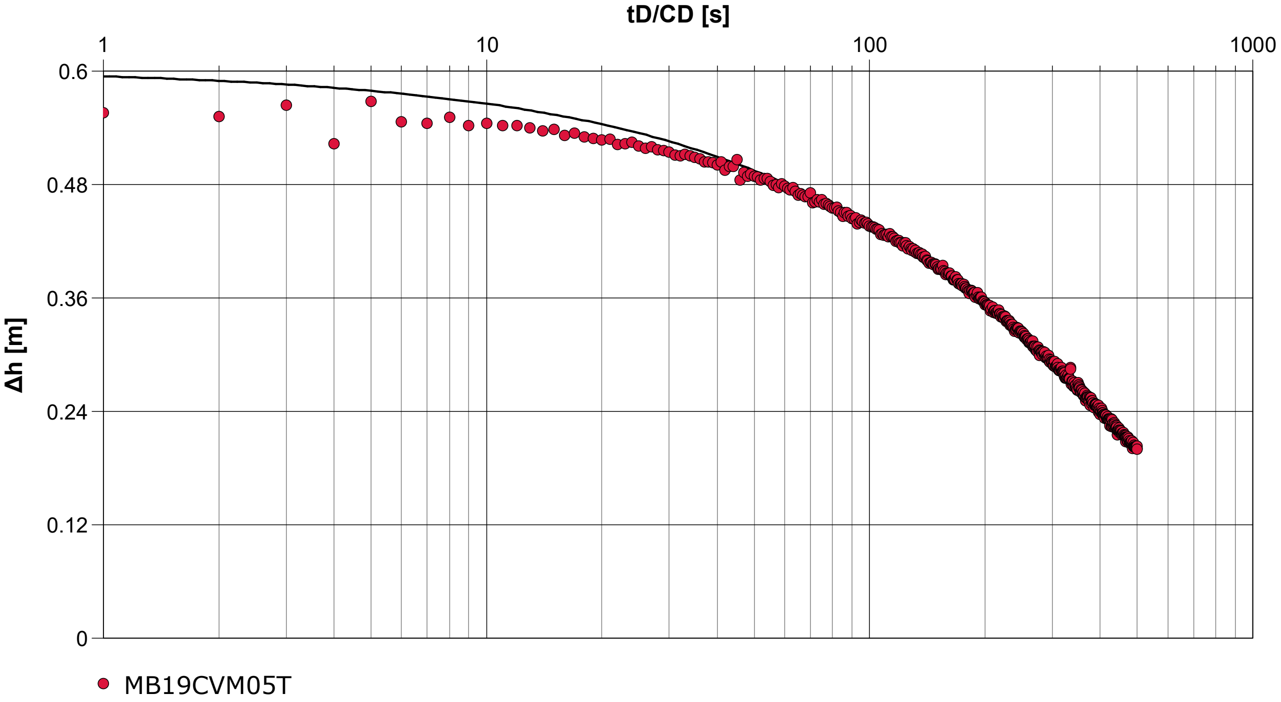


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM05T	4.98×10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 05T_FHT	Test Well: MB19CVM05T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 2/04/2019
Aquifer Thickness: 12.00 m		

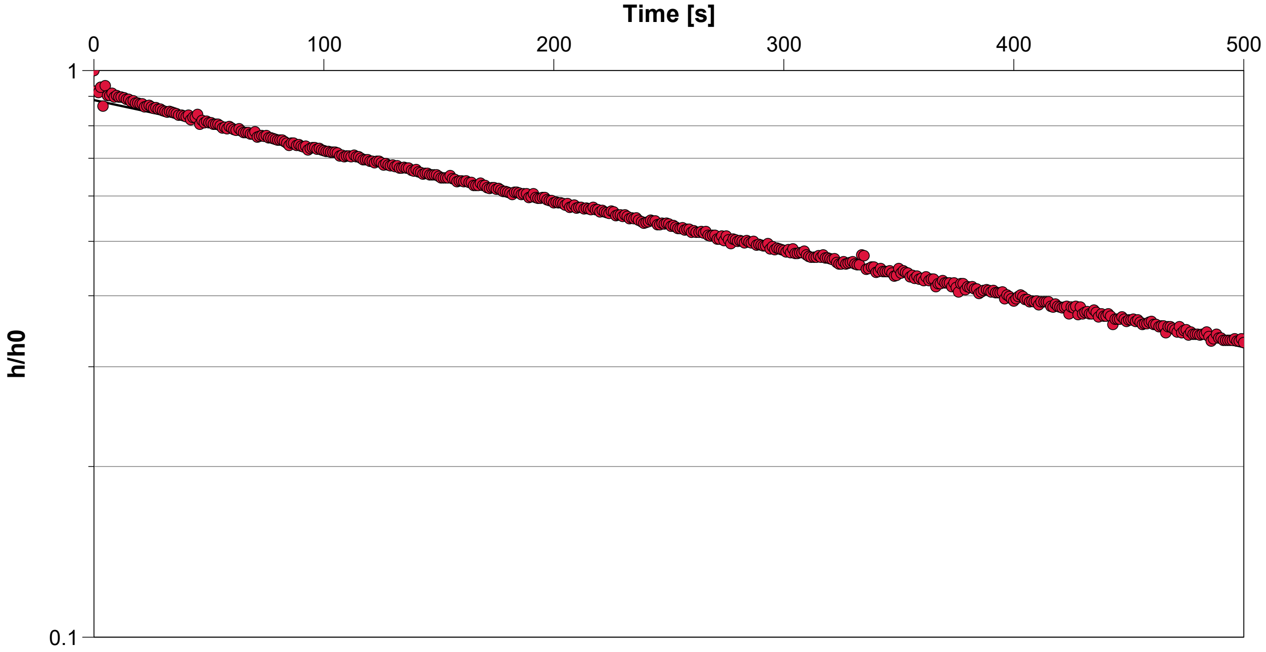


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM05T	1.63×10^{-1}	1.36×10^{-2}	1.11×10^{-2}	

Slug Test Analysis Report	
Project:	Caval Ridge
Number:	G1628A
Client:	BMA

Location: Moranbah	Slug Test: 05T_FHT	Test Well: MB19CVM05T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 2/04/2019
Aquifer Thickness: 12.00 m		

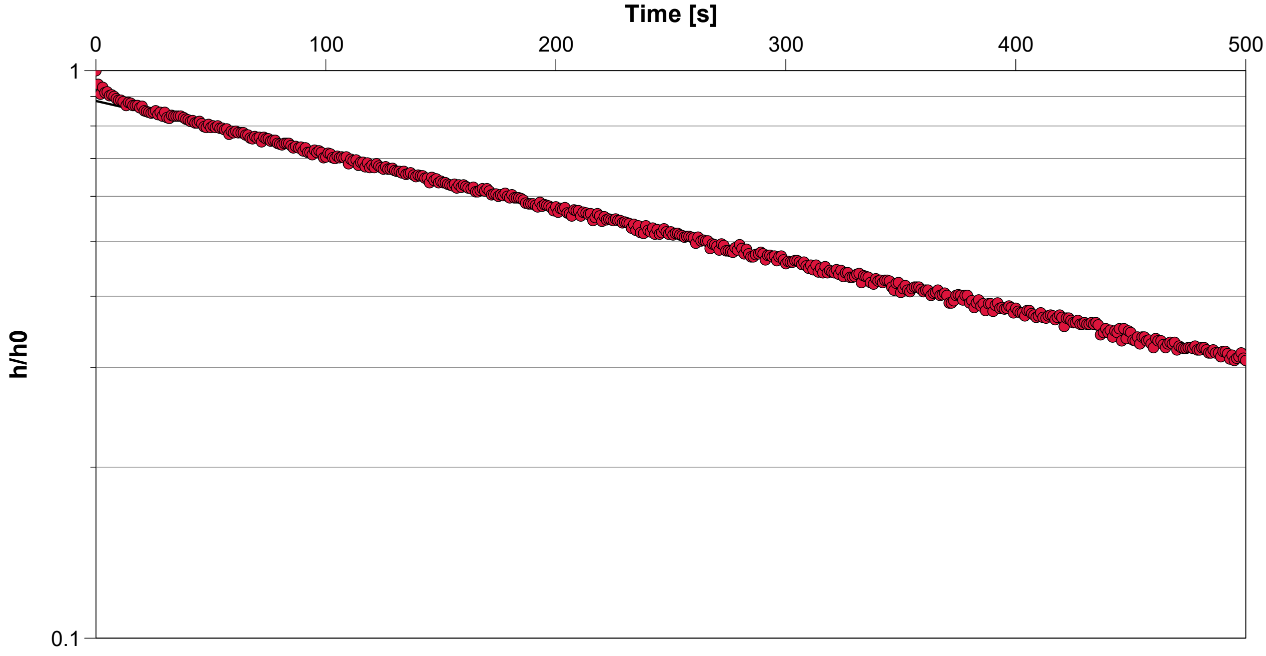


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM05T	3.91 × 10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 05T_RHT	Test Well: MB19CVM05T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 2/04/2019
Aquifer Thickness: 12.00 m		

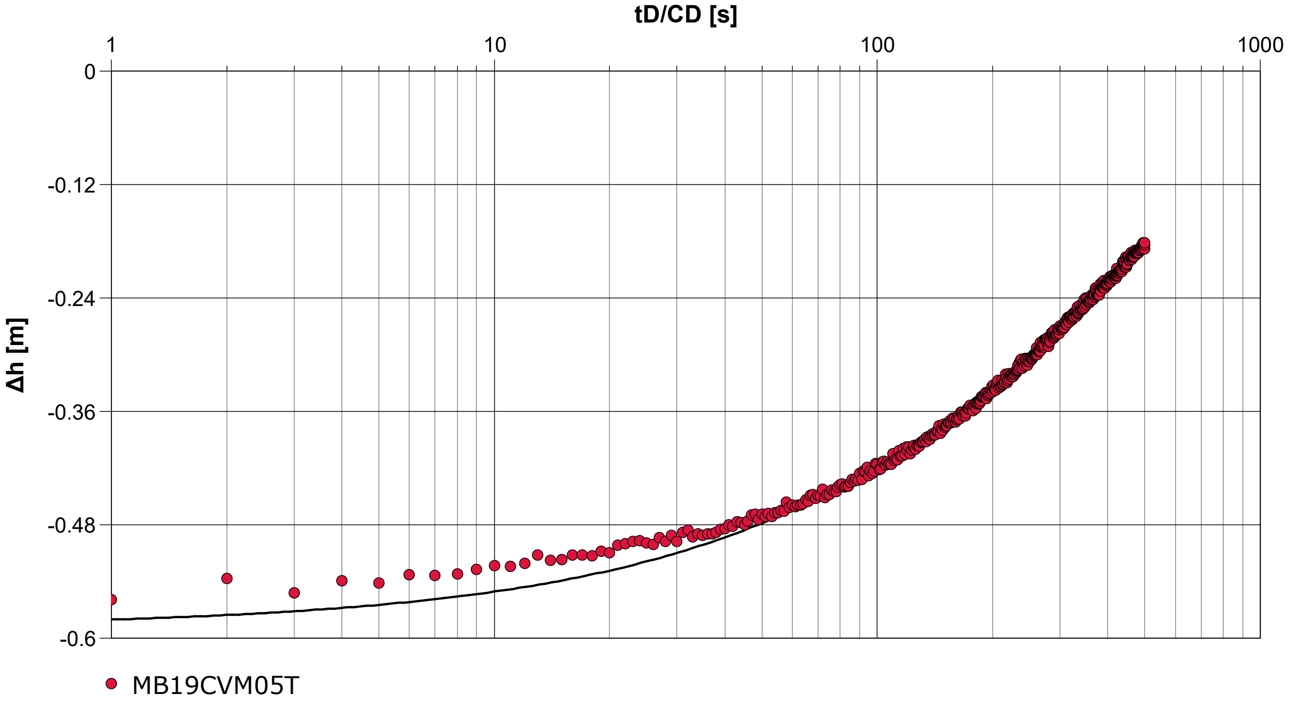


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM05T	5.28×10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 05T_RHT	Test Well: MB19CVM05T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 2/04/2019
Aquifer Thickness: 12.00 m		

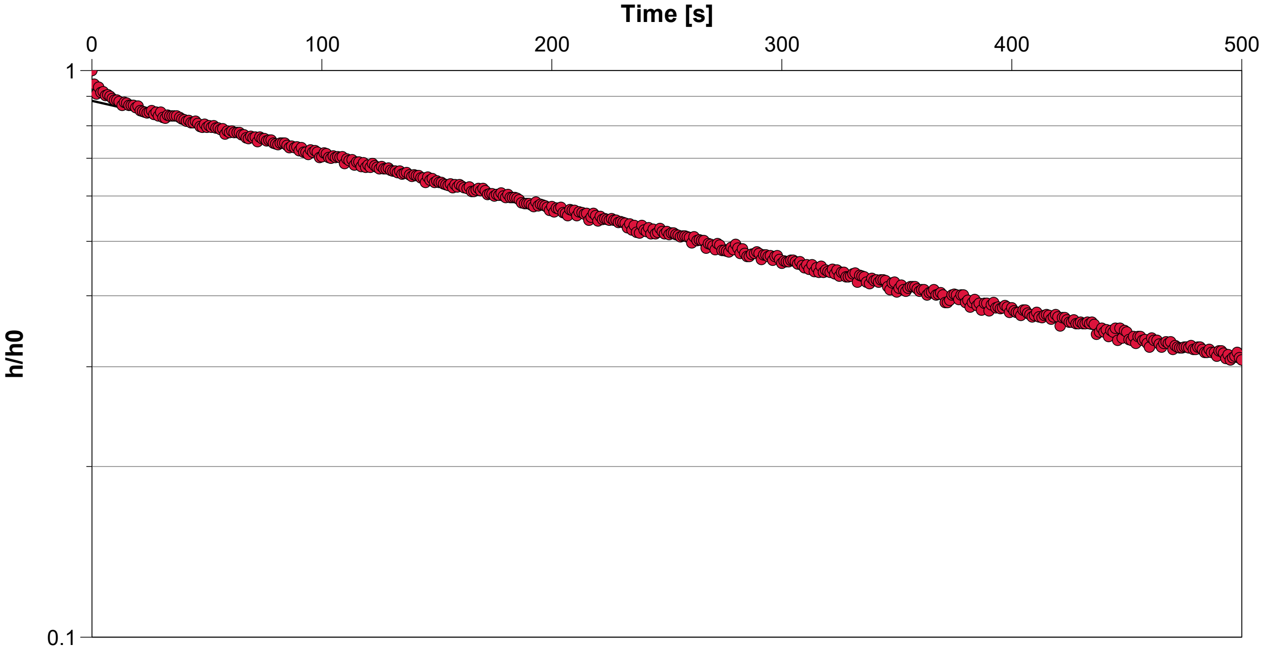


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM05T	1.76×10^{-1}	1.47×10^{-2}	1.10×10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 05T_RHT	Test Well: MB19CVM05T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 2/04/2019
Aquifer Thickness: 12.00 m		

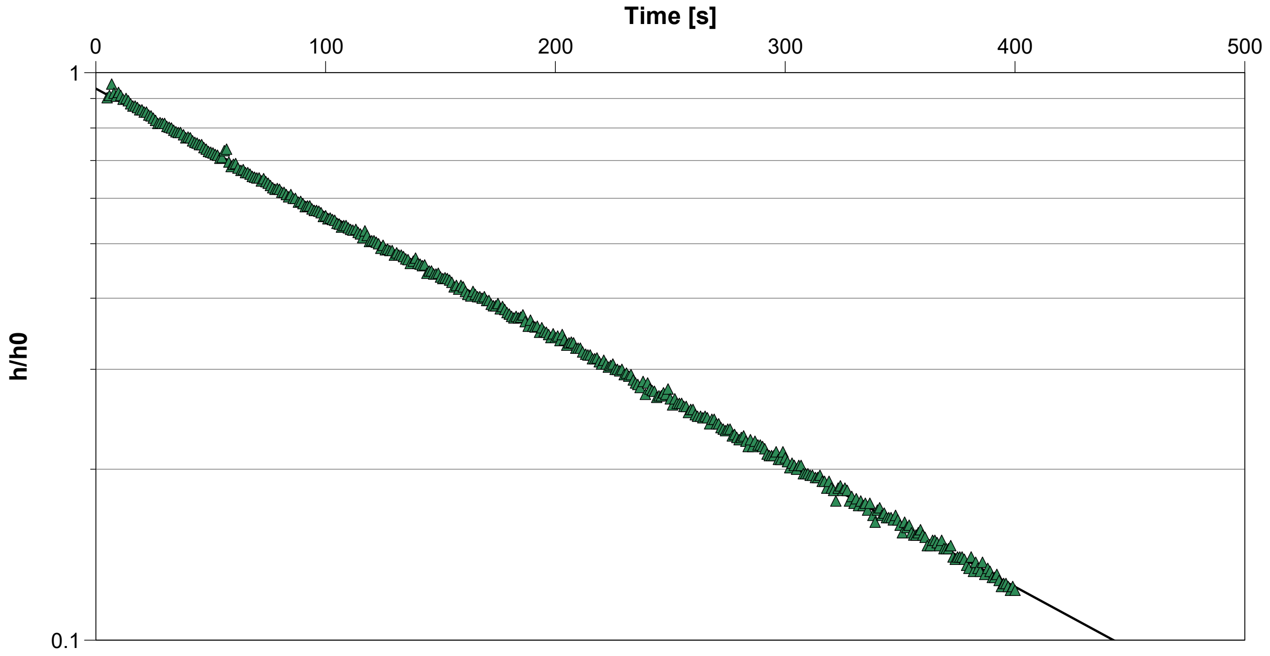


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM05T	4.14×10^{-2}	

Slug Test Analysis Report
Project: Caval Ridge
Number: G1628A
Client: BMA

Location: Moranbah	Slug Test: 06P_FHT	Test Well: MB19CVM06P
Test Conducted by: DN		Test Date: 23/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 2/04/2019
Aquifer Thickness: 6.00 m		

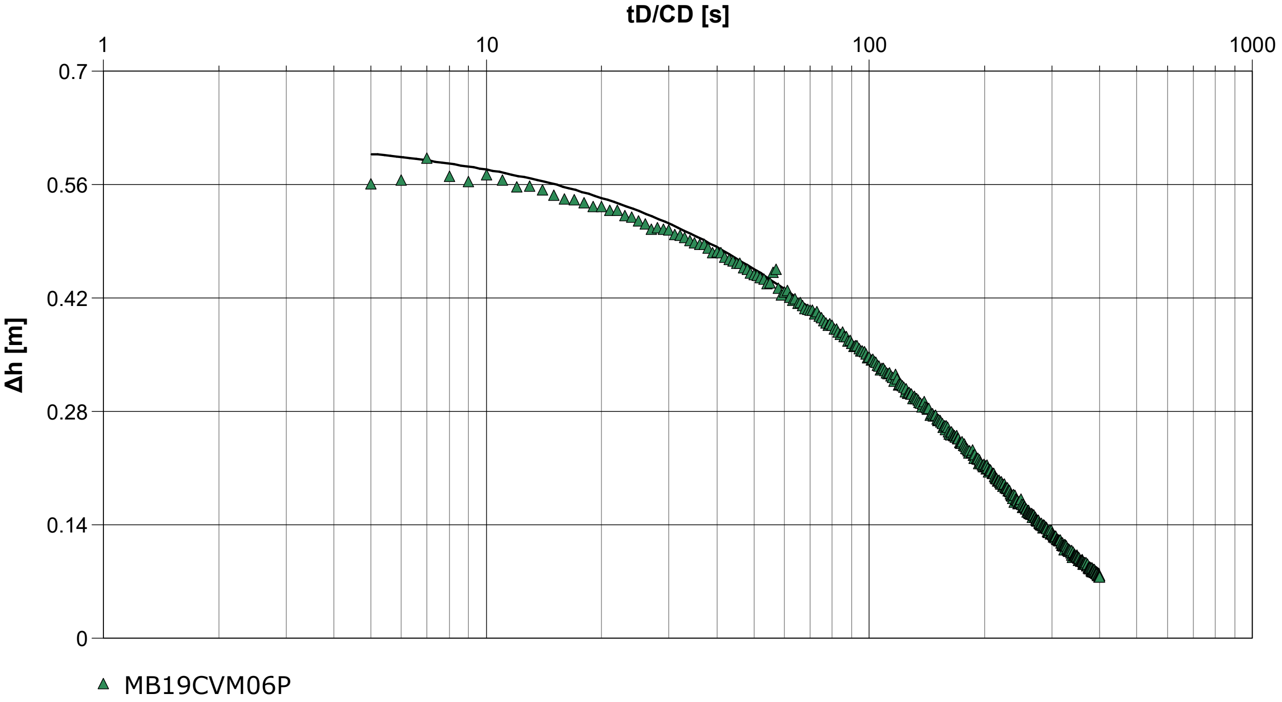


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM06P	1.25 × 10^{-1}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 06P_FHT	Test Well: MB19CVM06P
Test Conducted by: DN		Test Date: 23/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 2/04/2019
Aquifer Thickness: 6.00 m		



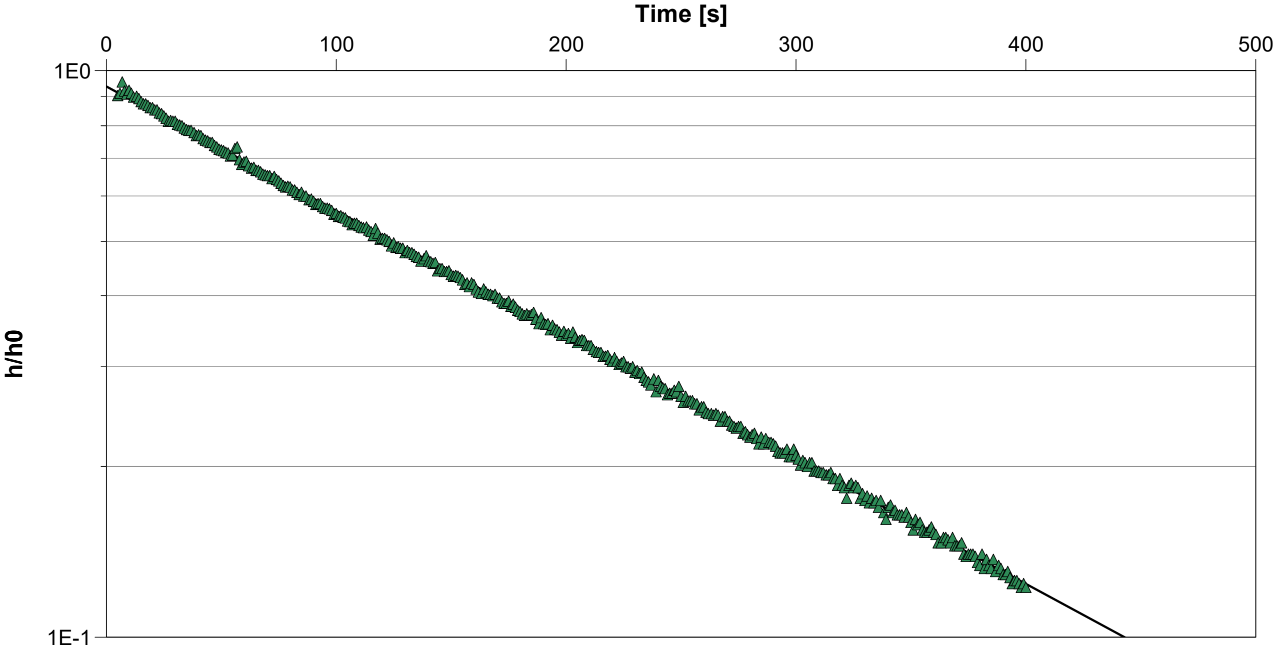
Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM06P	1.28×10^{0}	2.13×10^{-1}	2.52×10^{-7}	

Slug Test Analysis Report

Project:	Caval Ridge
Number:	G1628A
Client:	BMA

Location: Moranbah	Slug Test: 06P_FHT	Test Well: MB19CVM06P
Test Conducted by: DN		Test Date: 23/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 2/04/2019
Aquifer Thickness: 6.00 m		

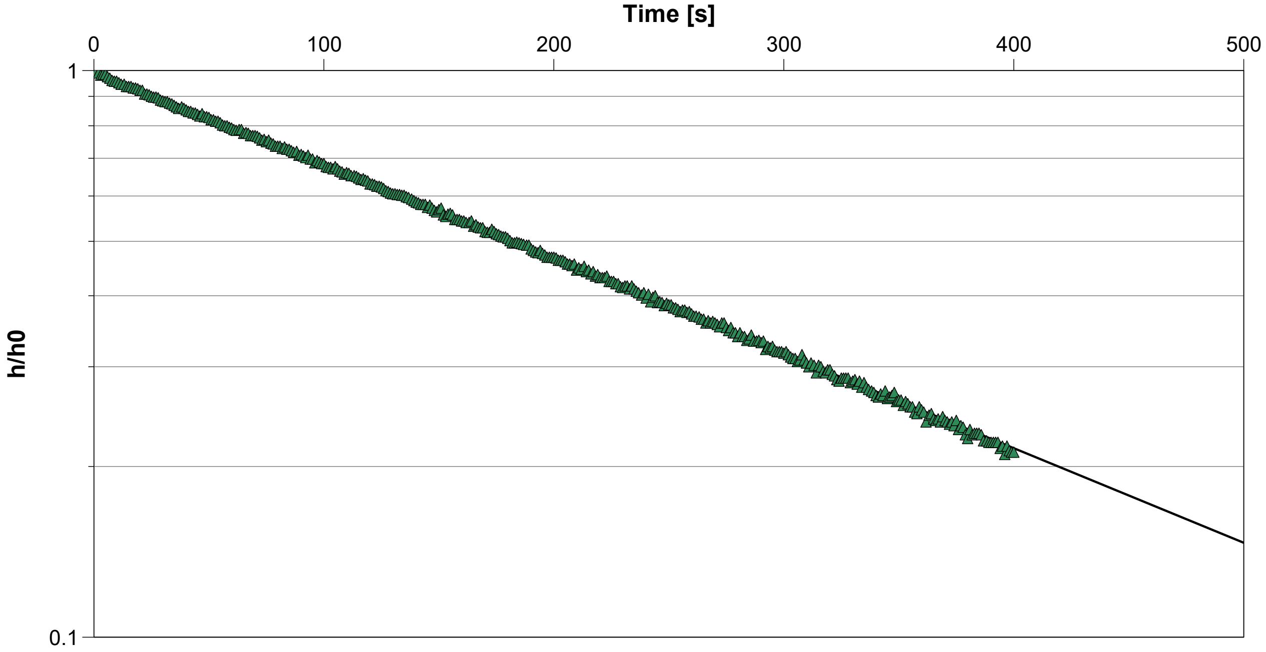


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM06P	9.83×10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 06P_RHT	Test Well: MB19CVM06P
Test Conducted by: DN		Test Date: 21/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 2/04/2019
Aquifer Thickness: 6.00 m		

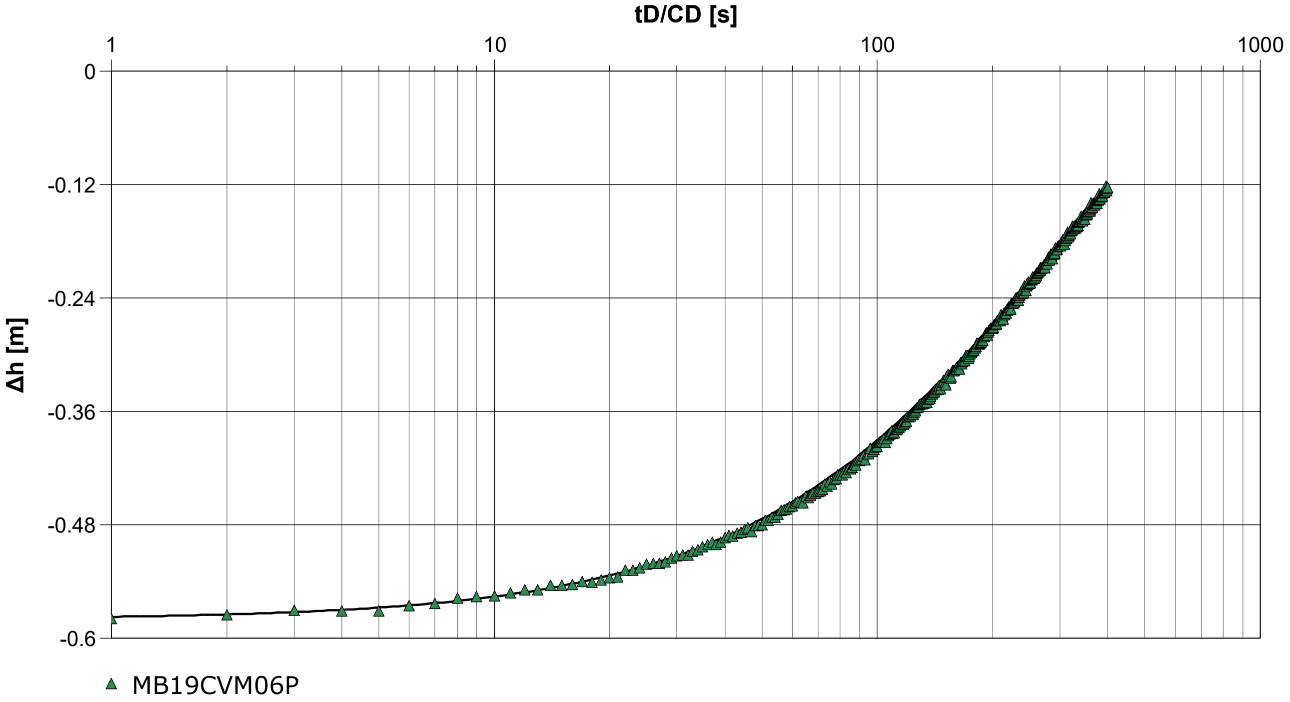


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM06P	9.53×10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 06P_RHT	Test Well: MB19CVM06P
Test Conducted by: DN		Test Date: 21/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 2/04/2019
Aquifer Thickness: 6.00 m		

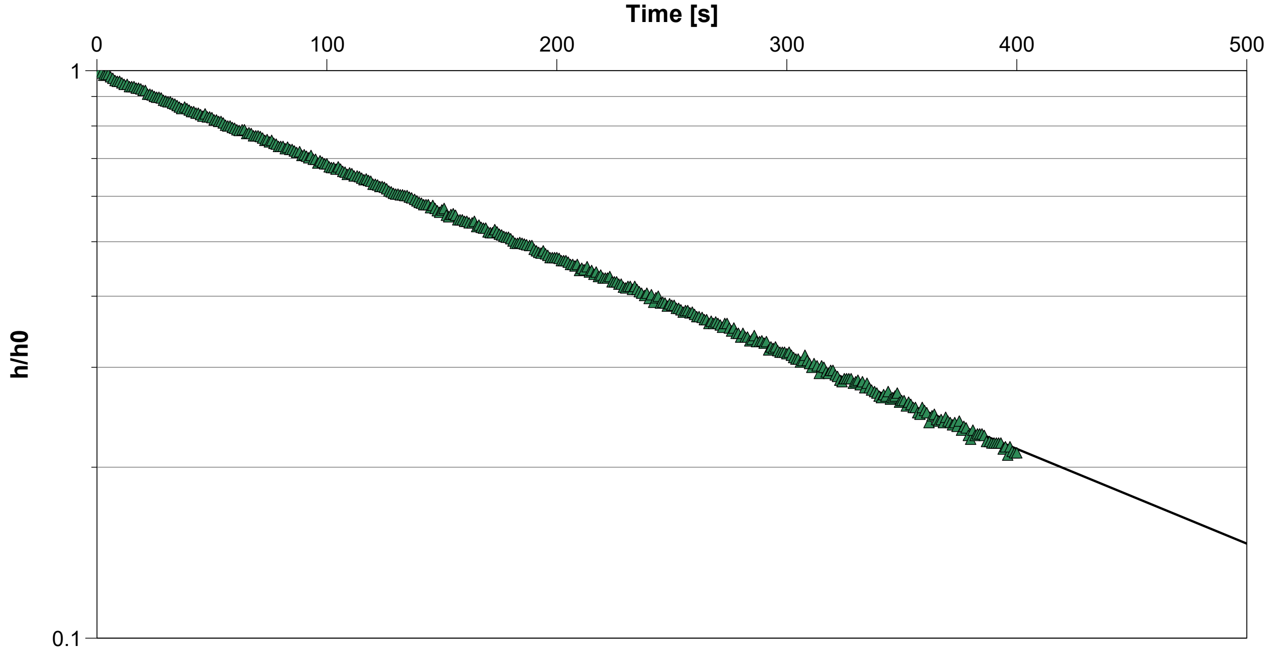


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM06P	1.99×10^{0}	3.31×10^{-1}	2.75×10^{-16}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 06P_RHT	Test Well: MB19CVM06P
Test Conducted by: DN		Test Date: 21/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 2/04/2019
Aquifer Thickness: 6.00 m		

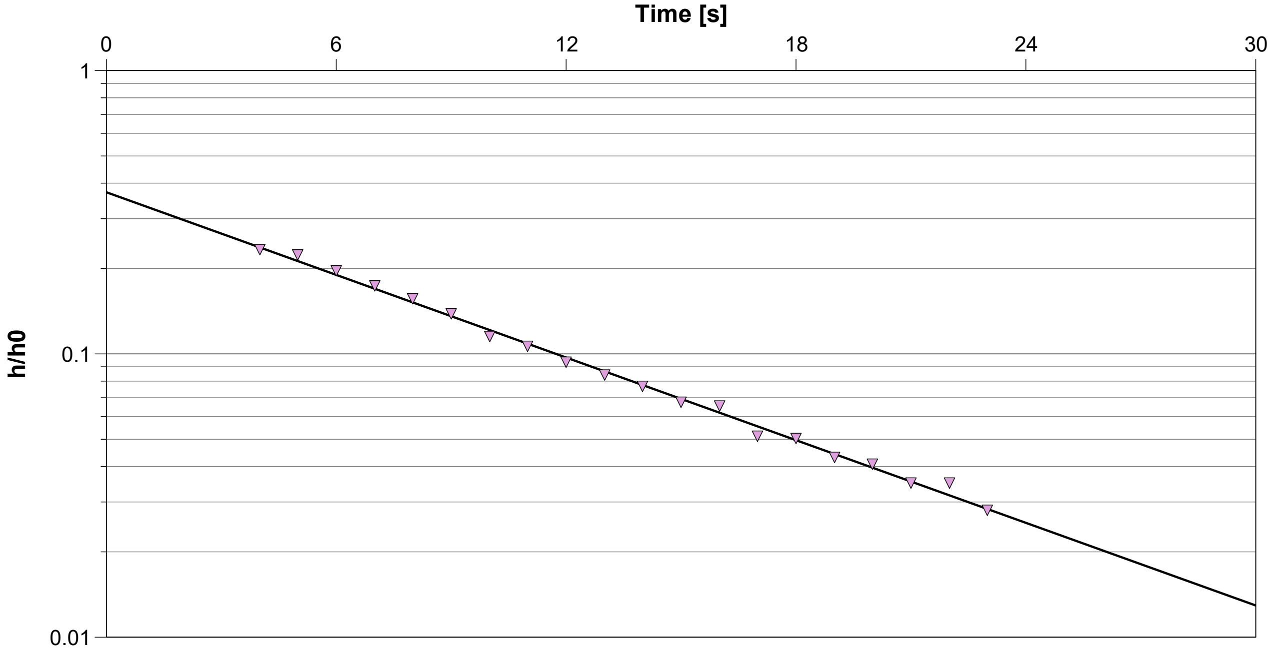


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM06P	7.48 × 10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 07T_FHT	Test Well: MB19CVM07T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 2/04/2019
Aquifer Thickness: 13.00 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM07T	2.78×10^{0}	

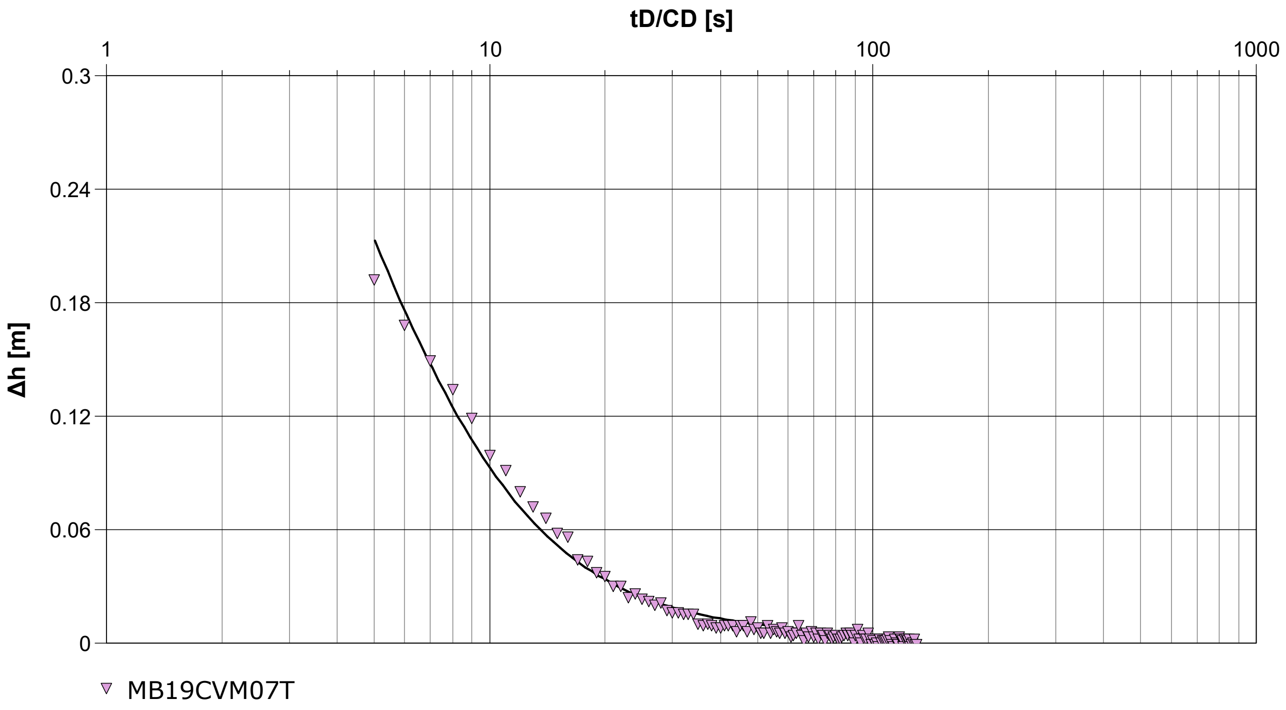
Slug Test Analysis Report

Project: Caval Ridge

Number: G1628A

Client: BMA

Location: Moranbah	Slug Test: 07T_FHT	Test Well: MB19CVM07T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 2/04/2019
Aquifer Thickness: 13.00 m		

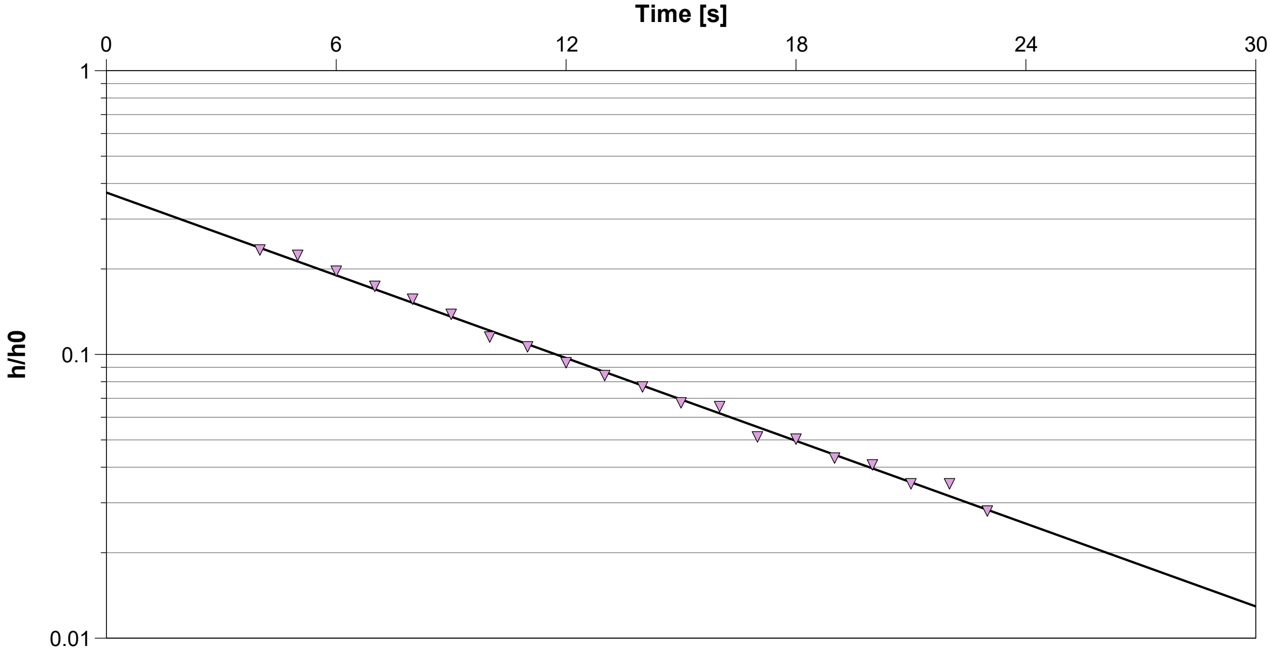


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM07T	2.78×10^{1}	2.14×10^{0}	4.32×10^{-3}	

AGE	**Slug Test Analysis Report**
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 07T_FHT	Test Well: MB19CVM07T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 2/04/2019
Aquifer Thickness: 13.00 m		

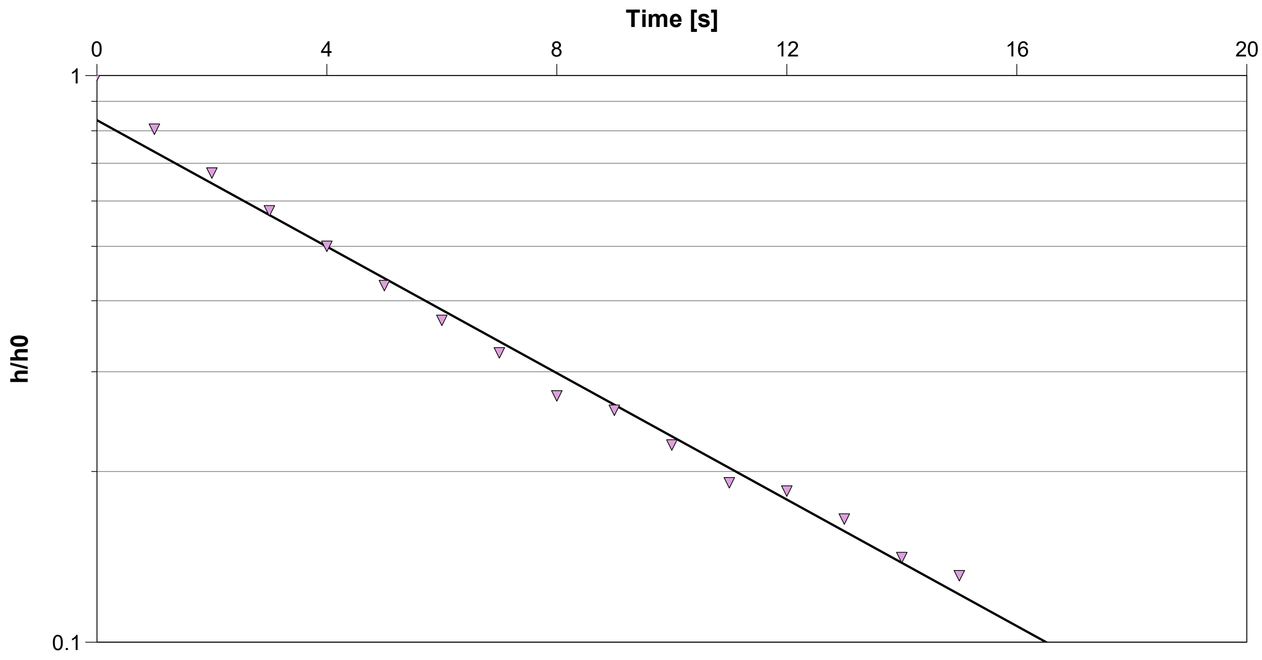


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM07T	2.18×10^{0}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 07T_RHT	Test Well: MB19CVM07T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 2/04/2019
Aquifer Thickness: 13.00 m		



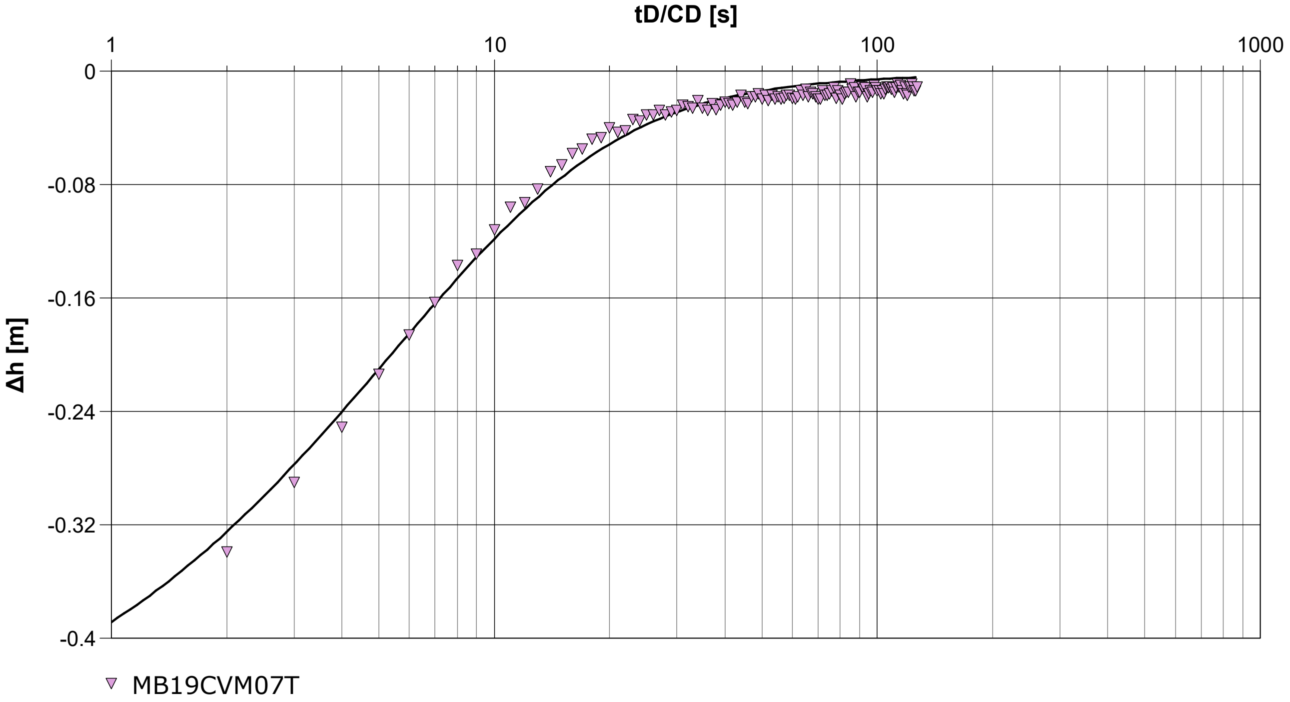
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM07T	3.19×10^{0}	

Slug Test Analysis Report

Project:	Caval Ridge
Number:	G1628A
Client:	BMA

Location: Moranbah	Slug Test: 07T_RHT	Test Well: MB19CVM07T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 2/04/2019
Aquifer Thickness: 13.00 m		

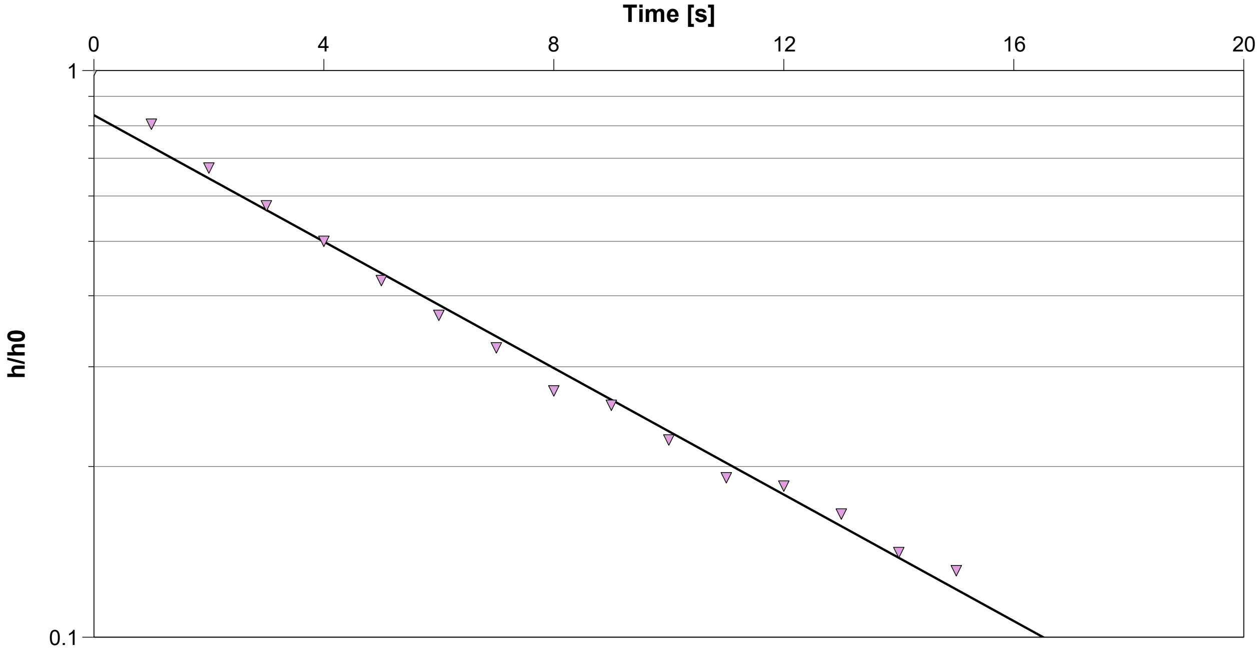


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM07T	1.39×10^{1}	1.07×10^{0}	6.30×10^{-3}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 07T_RHT	Test Well: MB19CVM07T
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 2/04/2019
Aquifer Thickness: 13.00 m		

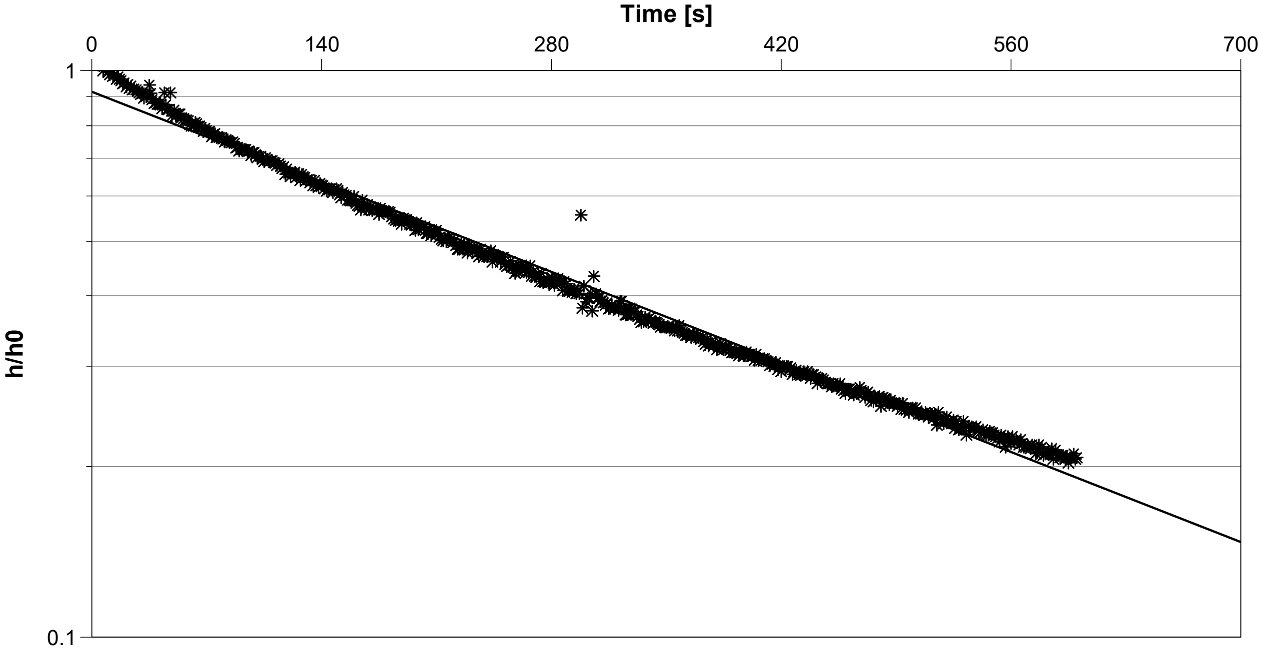


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM07T	2.50×10^{0}	

AGE	**Slug Test Analysis Report**
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 08P_FHT	Test Well: MB19CVM08P
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 3/04/2019
Aquifer Thickness: 5.50 m		

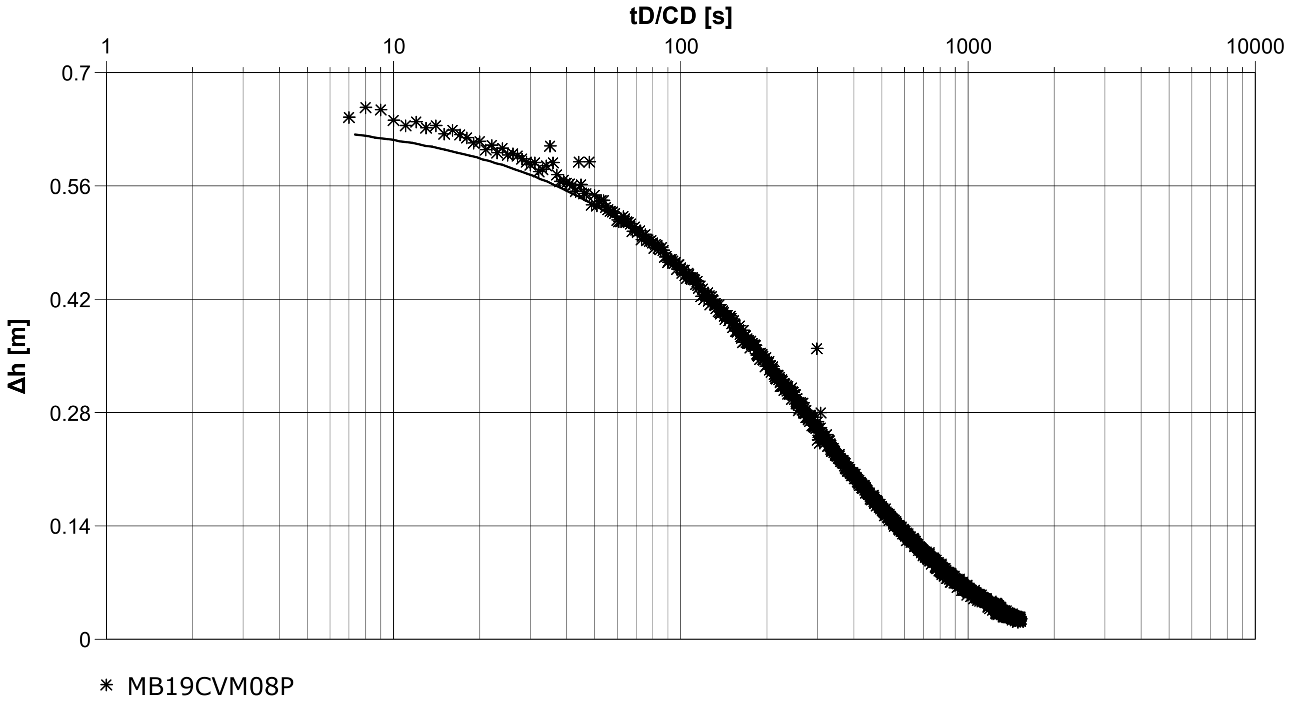


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM08P	6.48×10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 08P_FHT	Test Well: MB19CVM08P
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 3/04/2019
Aquifer Thickness: 5.50 m		

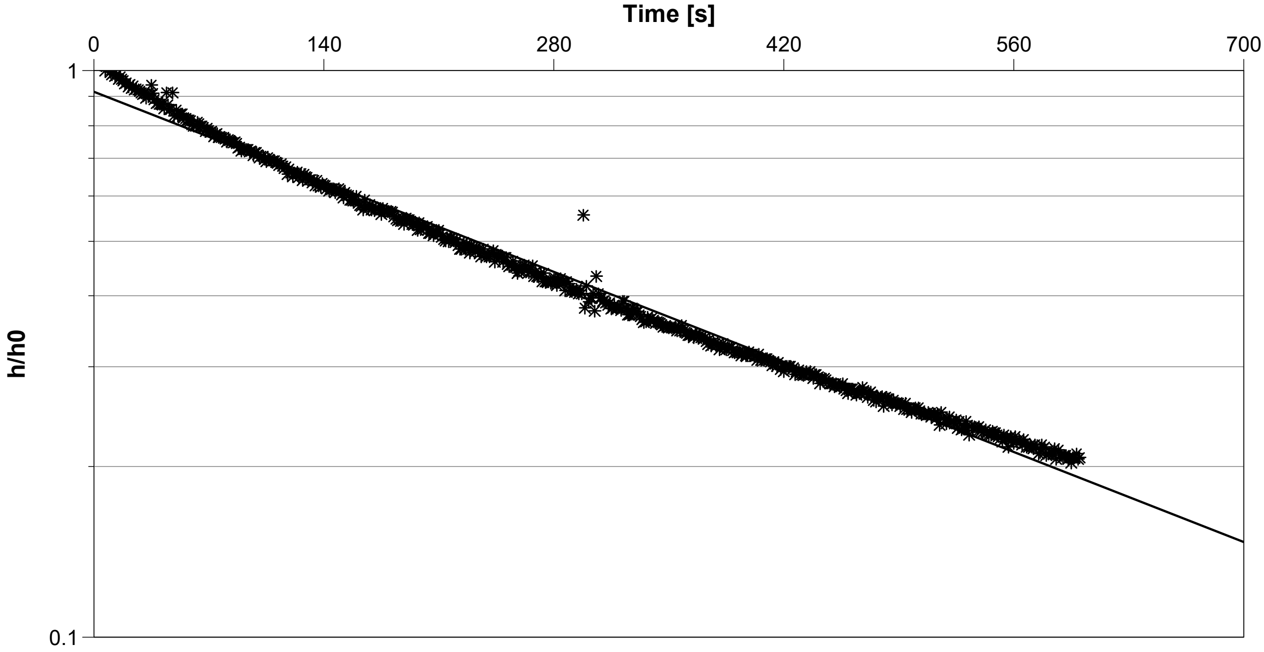


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM08P	4.71×10^{-1}	8.56×10^{-2}	3.42×10^{-5}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 08P_FHT	Test Well: MB19CVM08P
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 3/04/2019
Aquifer Thickness: 5.50 m		

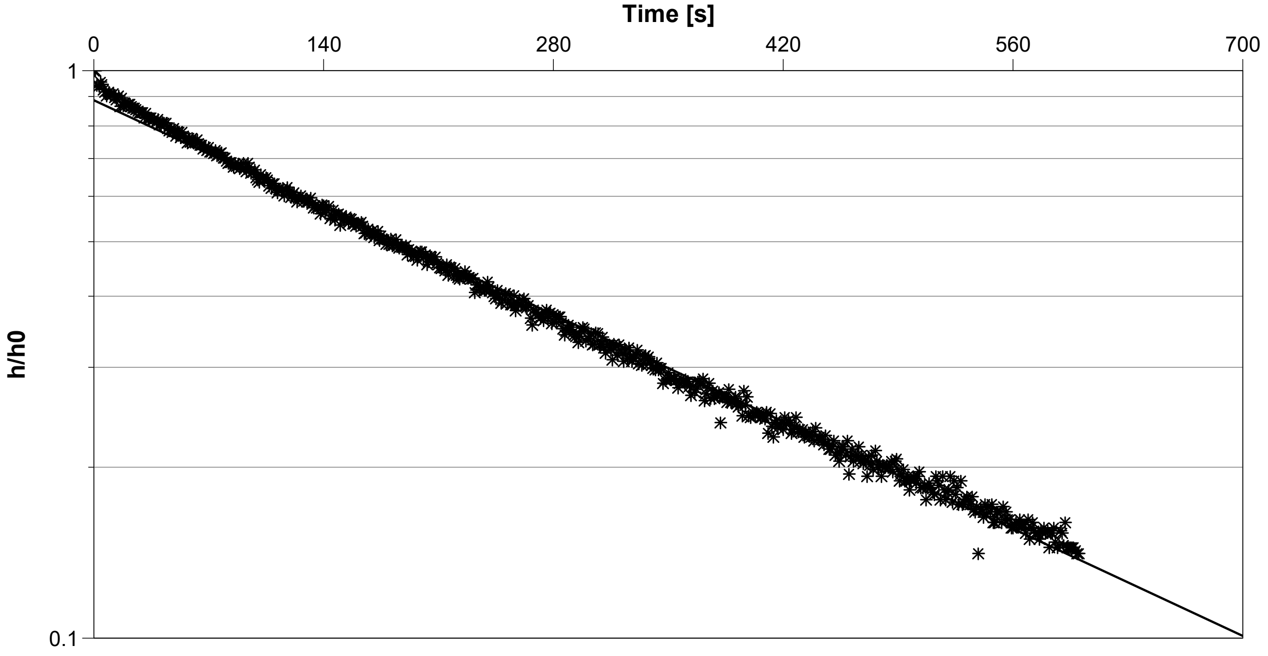


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM08P	5.09×10^{-2}	

AGE	**Slug Test Analysis Report**
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 08P_RHT	Test Well: MB19CVM08P
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 3/04/2019
Aquifer Thickness: 5.50 m		

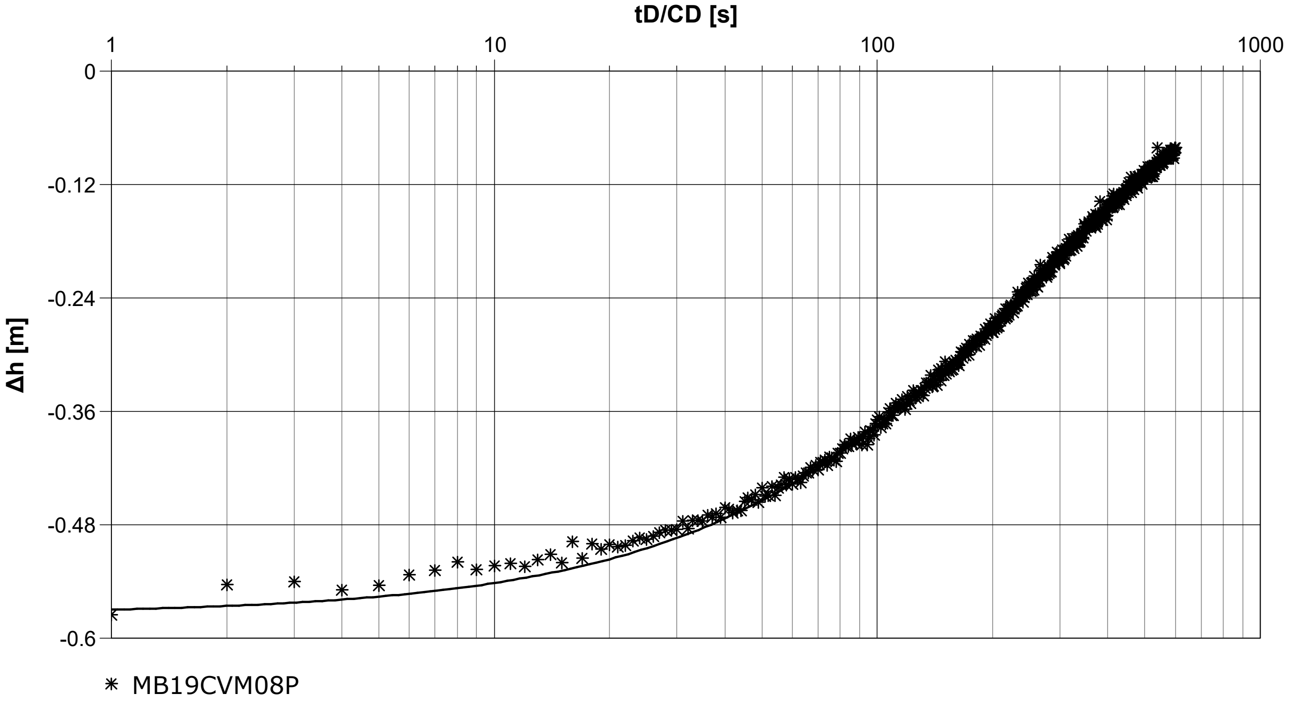


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM08P	7.70 × 10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 08P_RHT	Test Well: MB19CVM08P
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by:	CBP	Analysis Date: 3/04/2019
Aquifer Thickness: 5.50 m		

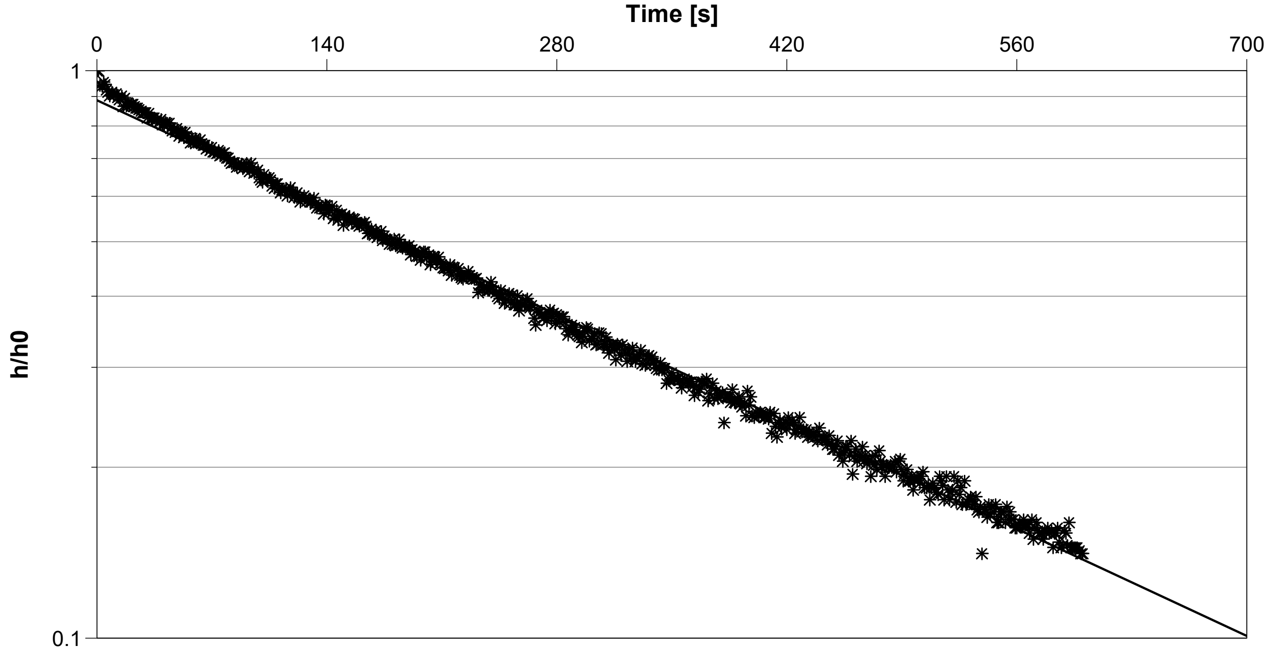


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM08P	5.00×10^{-1}	9.09×10^{-2}	1.86×10^{-4}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 08P_RHT	Test Well: MB19CVM08P
Test Conducted by: DN		Test Date: 24/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 3/04/2019
Aquifer Thickness: 5.50 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM08P	6.05×10^{-2}	

Slug Test Analysis Report

Project: Caval Ridge

Number: G1628A

Client: BMA

Location: Moranbah

Slug Test: 09A_RHT

Test Well: MB19CVM09A

Test Conducted by: DN

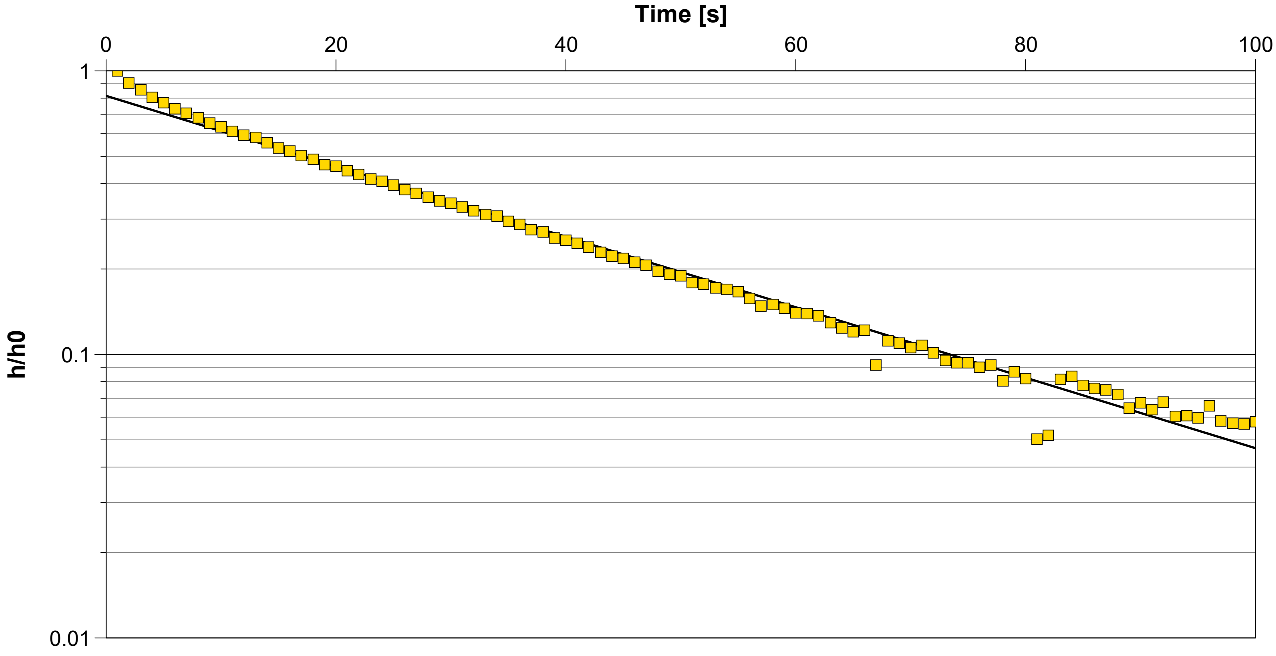
Test Date: 10/03/2019

Analysis Performed by: DN

Hvorslev

Analysis Date: 3/04/2019

Aquifer Thickness: 5.50 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]
MB19CVM09A	1.24×10^{0}

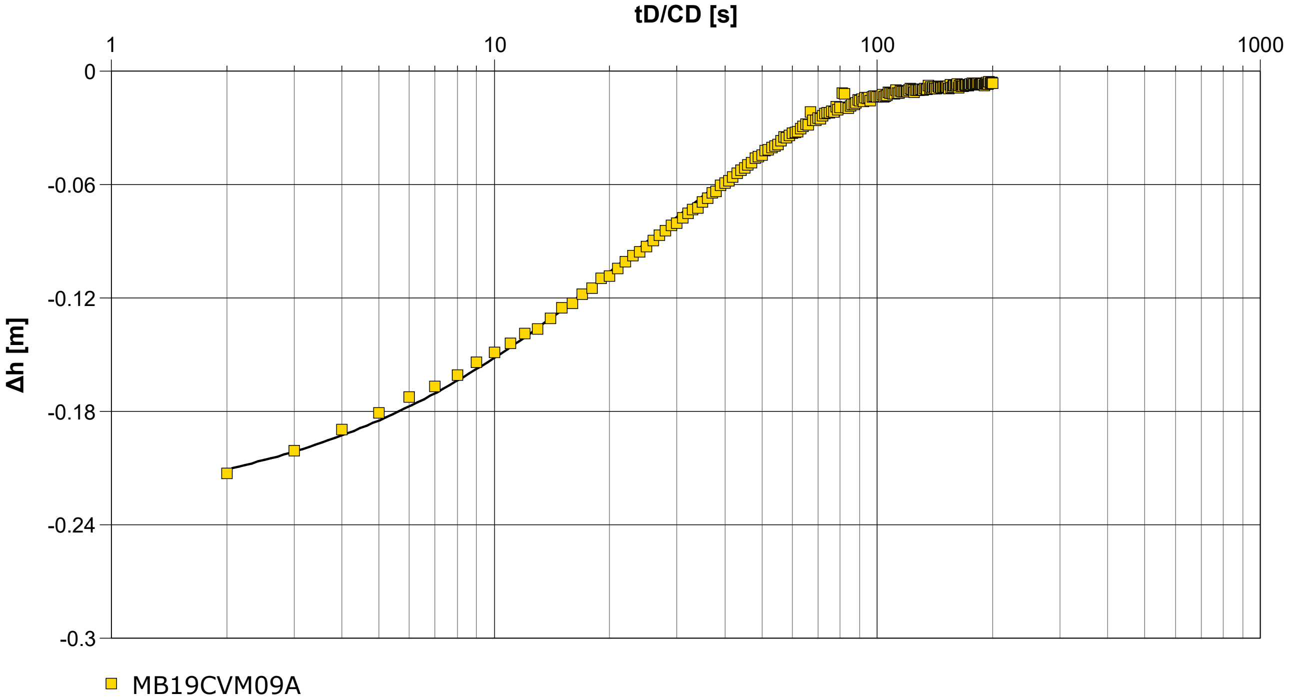
Slug Test Analysis Report

Project: Caval Ridge

Number: G1628A

Client: BMA

Location: Moranbah	Slug Test: 09A_RHT	Test Well: MB19CVM09A
Test Conducted by: DN		Test Date: 10/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 3/04/2019
Aquifer Thickness: 5.50 m		



Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM09A	5.35 × 10^{0}	9.73 × 10^{-1}	1.29 × 10^{-4}	

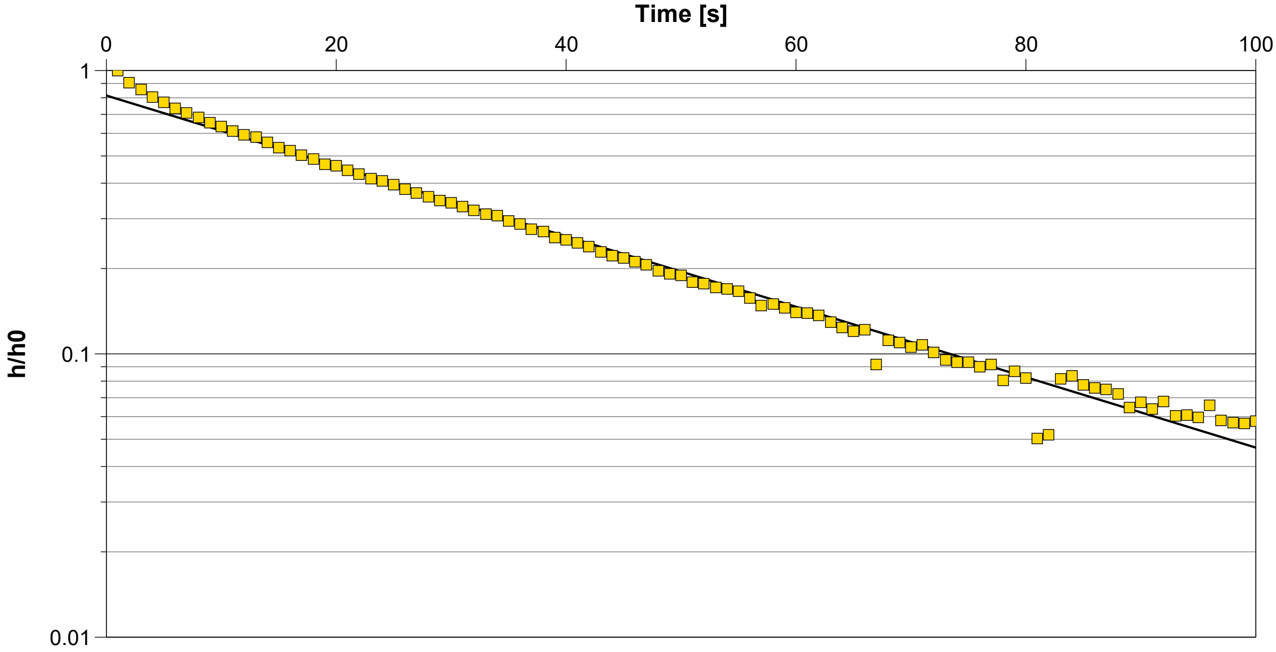
Slug Test Analysis Report

Project: Caval Ridge

Number: G1628A

Client: BMA

Location: Moranbah	Slug Test: 09A_RHT	Test Well: MB19CVM09A
Test Conducted by: DN		Test Date: 10/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 3/04/2019
Aquifer Thickness: 5.50 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM09A	9.59×10^{-1}	

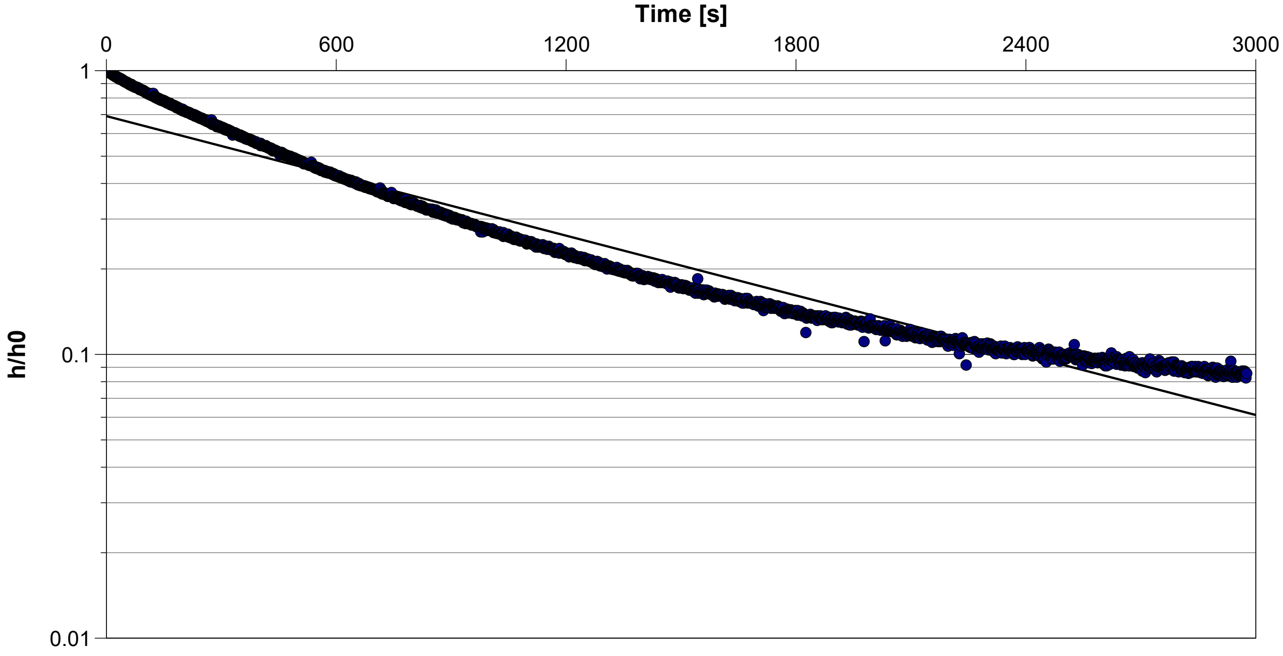
Slug Test Analysis Report

Project: Caval Ridge

Number: G1628A

Client: BMA

Location: Moranbah	Slug Test: 10P_FHT	Test Well: MB19CVM10P
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 3/04/2019
Aquifer Thickness: 5.00 m		

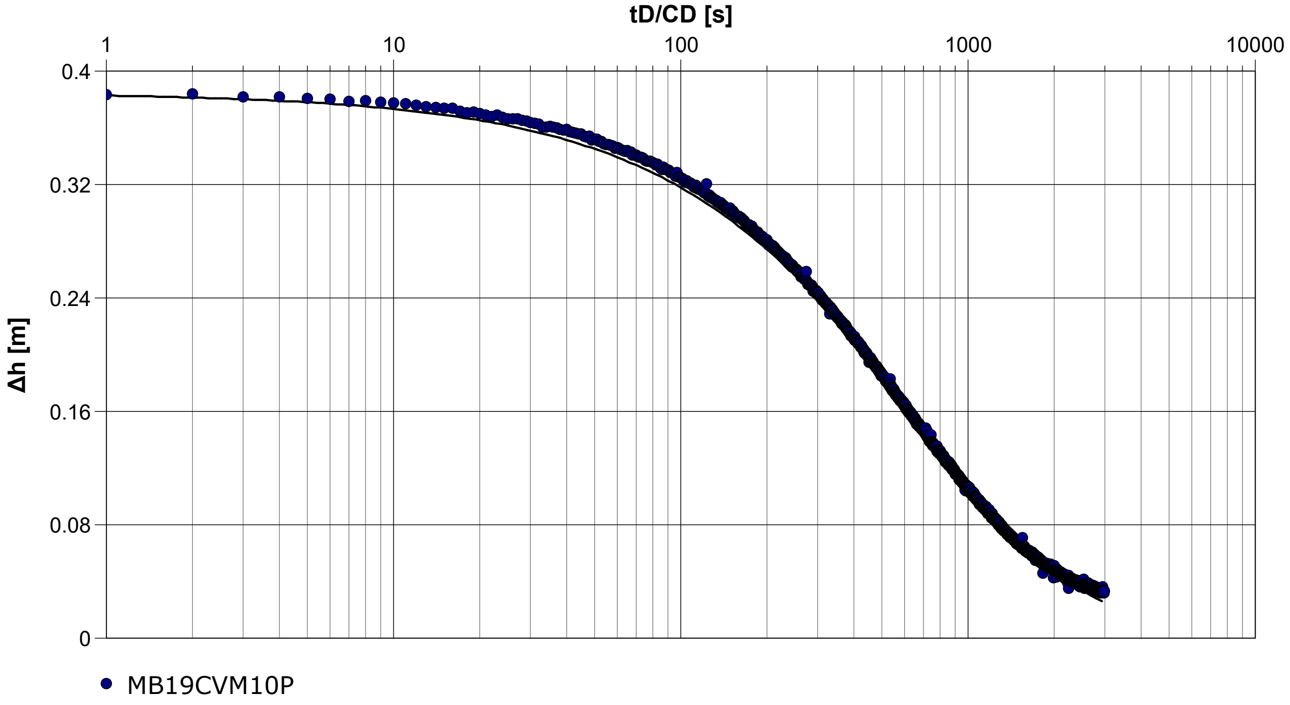


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM10P	2.00×10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 10P_FHT	Test Well: MB19CVM10P
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 3/04/2019
Aquifer Thickness: 5.00 m		

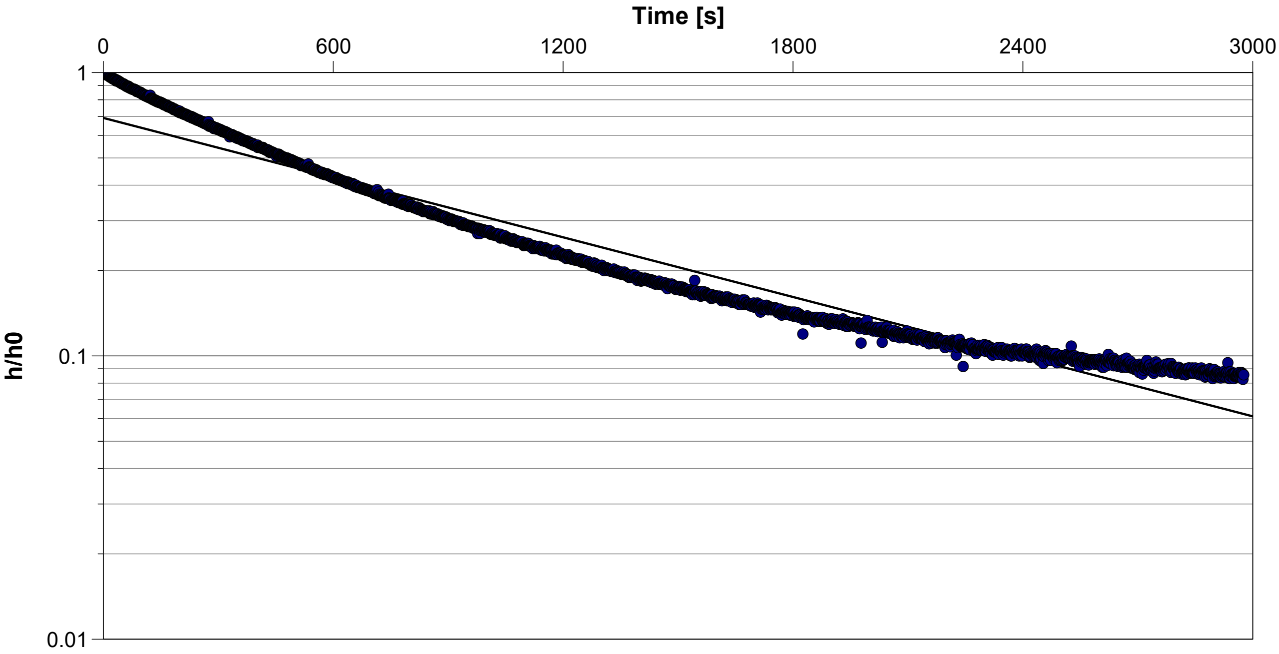


Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM10P	1.52×10^{-1}	3.03×10^{-2}	8.66×10^{-4}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 10P_FHT	Test Well: MB19CVM10P
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 3/04/2019
Aquifer Thickness: 5.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM10P	1.57×10^{-2}	

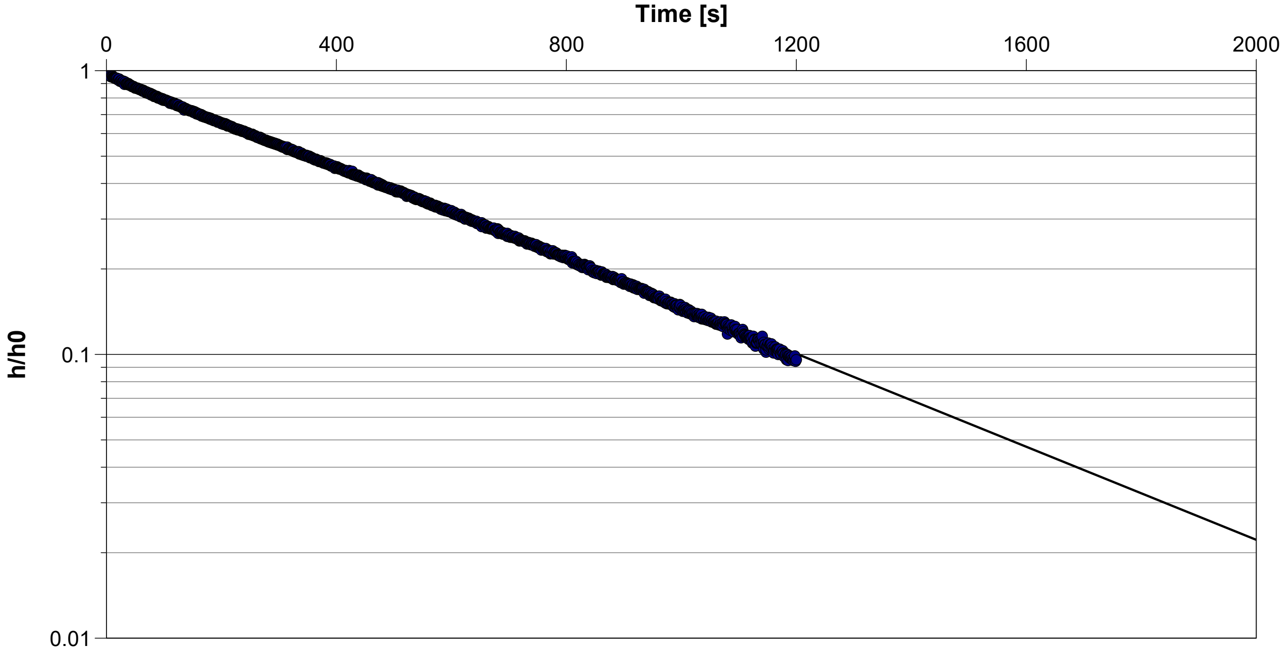
Slug Test Analysis Report

Project: Caval Ridge

Number: G1628A

Client: BMA

Location: Moranbah	Slug Test: 10P_RHT	Test Well: MB19CVM10P
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	Hvorslev	Analysis Date: 3/04/2019
Aquifer Thickness: 5.00 m		

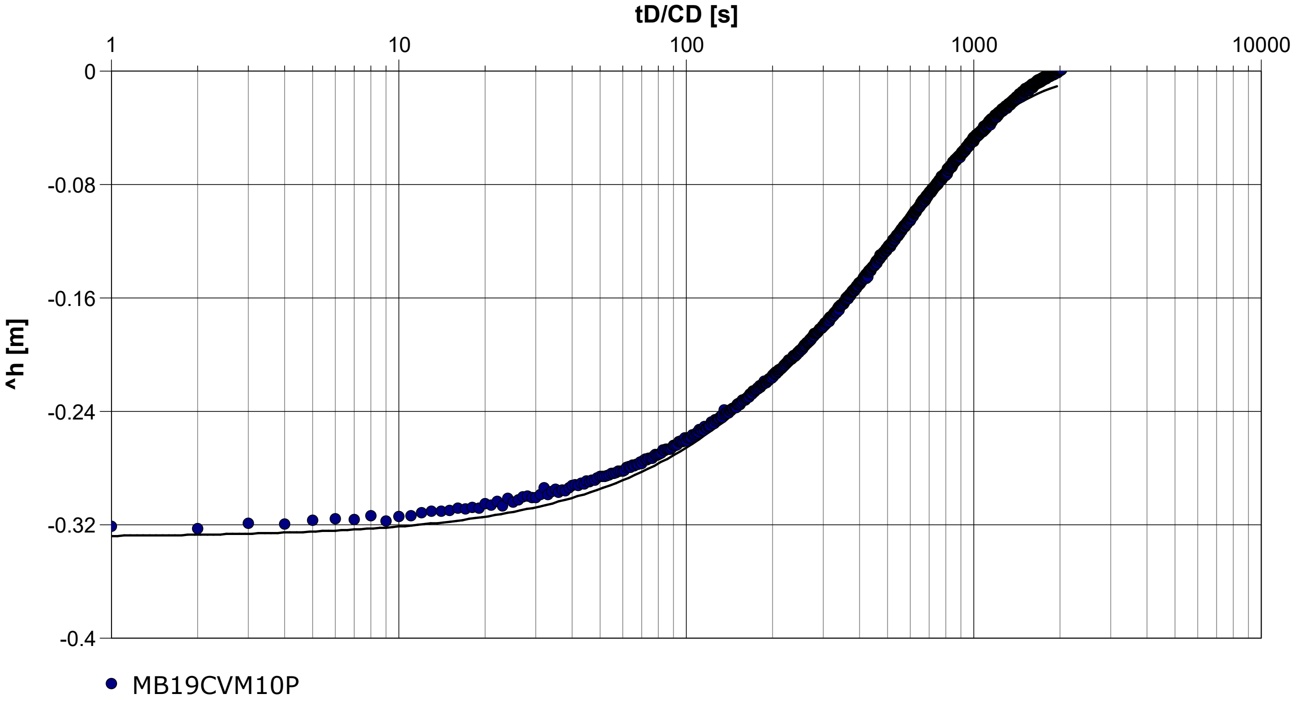


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM10P	4.68×10^{-2}	

	Slug Test Analysis Report
	Project: Caval Ridge
	Number: G1628A
	Client: BMA

Location: Moranbah	Slug Test: 10P_RHT	Test Well: MB19CVM10P
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	CBP	Analysis Date: 3/04/2019
Aquifer Thickness: 5.00 m		



Calculation using Cooper-Bredehoeft-Papadopulos

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Well-bore storage coefficient	
MB19CVM10P	1.09×10^{0}	2.19×10^{-1}	5.50×10^{-17}	

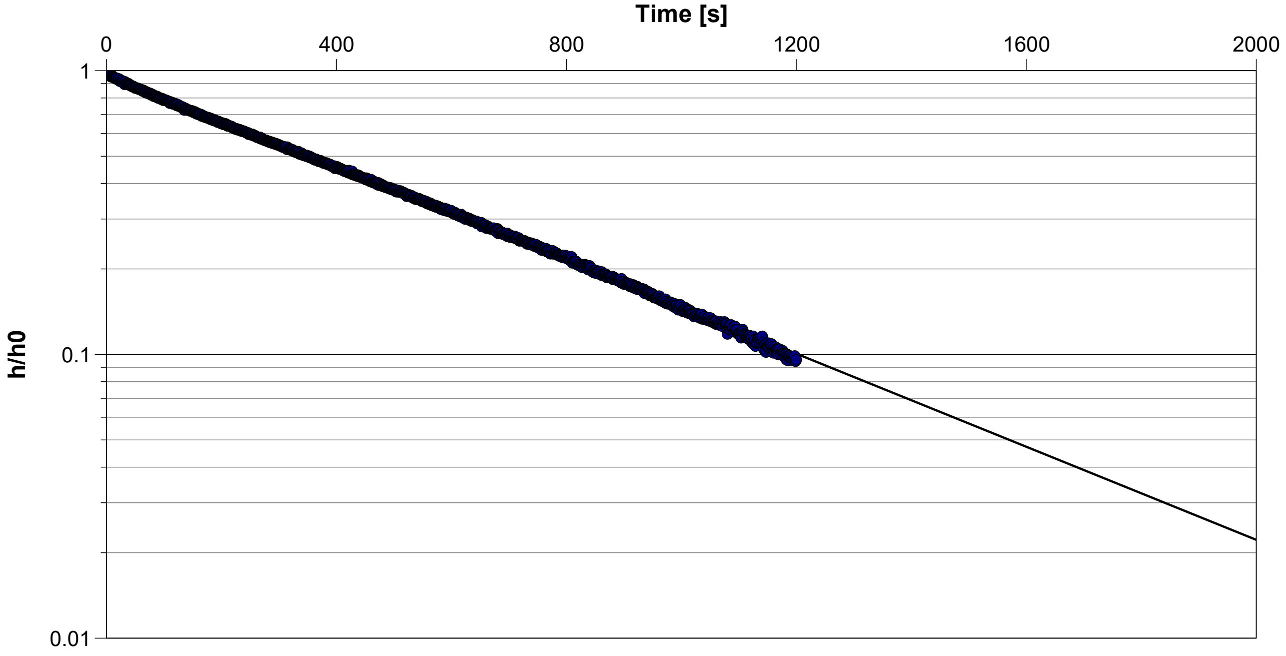
Slug Test Analysis Report

Project: Caval Ridge

Number: G1628A

Client: BMA

Location: Moranbah	Slug Test: 10P_RHT	Test Well: MB19CVM10P
Test Conducted by: DN		Test Date: 11/03/2019
Analysis Performed by: DN	Bouwer & Rice	Analysis Date: 3/04/2019
Aquifer Thickness: 5.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/d]	
MB19CVM10P	3.68×10^{-2}	

Appendix C Water quality results

G1628A.Caval Ridge - Groundwater Investigation

Groundwater Quality Results - Table 1 of 2

Parameter	Units	LOR[#]							
Sample Location			MB19CVM03T	MB19CVM05T	MB19CVM06P	MB19CVM07T	MB19CVM08P	MB19CVM09A	MB19CVM10P
Date Sampled	-	-	10/03/2019	23/03/2019	23/03/2019	12/03/2019	12/03/2019	21/02/2019	21/02/2019
Lithology	-	-	Basalt	Basalt/basal sand	Coal/siltstone	Basalt	Coal/siltstone	Alluvium	Coal/siltstone
Field Parameters									
Electrical Conductivity	µS/cm	1	3176	1504	19910	1192	3963	3693	1781
pH Value	pH Unit	0.01	11.38	8.67	8.07	8.34	8.41	7.31	8.84
Physical Parameters									
pH Value	pH Unit	0.01	10.7	8.54	7.81	8.36	8.22	7.76	8.68
Electrical Conductivity	µS/cm	1	2960	1420	19500	1100	3770	3680	1790
Total Dissolved Solids	mg/L	10	1630	784	13800	664	2160	2230	1050
Major Ions									
Chloride	mg/L	1	681	258	6980	97	955	843	294
Calcium	mg/L	1	2	48	806	44	77	79	25
Magnesium	mg/L	1	2	62	1090	45	52	77	13
Sodium	mg/L	1	629	180	2020	157	666	596	357
Potassium	mg/L	1	13	5	17	4	6	13	4
Sulfate as SO4 2-	mg/L	1	-	59	1500	-	-	-	-
Sulfur as S	mg/L	1	-	20	499	-	-	-	-
Silicon as SiO2	mg/L	0.1	-	27.5	19	-	-	-	-
Silicon	mg/L	0.05	8.47	12.8	8.88	21.8	9.31	26.6	9.36
Sulfate as SO4 - Turbidimetric	mg/L	1	147	54	1390	20	160	367	161
Fluoride	mg/L	0.1	0.8	0.2	0.2	0.1	<0.1	0.2	0.1
Bromide	mg/L	0.01	-	0.425	12.5	-	-	10.2	0.8
Total Anions	meq/L	0.01	29.4	15.5	231	12.4	37.2	36.9	18.7
Total Cations	meq/L	0.01	28	15.4	218	12.8	37.2	36.5	17.9
Ionic Balance	%	0.01	2.52	0.26	2.82	1.85	0.03	0.54	2.15
Dissolved metals									
Aluminium	mg/L	0.01	0.02	0.02	<0.01	<0.01	0.03	0.57	0.01
Antimony	mg/L	0.001	0.003	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Arsenic	mg/L	0.001	<0.001	0.002	0.001	<0.001	0.001	0.001	0.002
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	0.007	0.124	0.127	0.128	0.084	0.05	0.025
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001
Chromium	mg/L	0.001	0.106	0.001	<0.001	<0.001	0.001	0.04	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	<0.001	0.011	0.334	0.06	0.01	0.018	0.01
Molybdenum	mg/L	0.001	0.042	0.006	0.002	0.002	0.01	0.008	0.003
Nickel	mg/L	0.001	<0.001	0.001	0.004	<0.001	<0.001	0.009	0.001
Selenium	mg/L	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
Strontium	mg/L	0.001	0.067	1.03	17.2	2.19	10.1	1.09	1.77
Uranium	mg/L	0.001	-	-	-	-	-	0.002	<0.001
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	0.008	0.01	0.007
Boron	mg/L	0.05	0.07	0.13	0.23	0.22	0.25	0.22	0.26
Iron	mg/L	0.05	-	-	-	-	-	0.22	<0.05
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001
Ferrous Iron	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total metals									
Aluminium	mg/L	0.01	0.98	0.75	0.11	0.16	0.43	0.96	0.5
Antimony	mg/L	0.001	0.003	<0.001	<0.001	<0.001	<0.001	0.003	<0.001
Arsenic	mg/L	0.001	0.002	0.002	0.002	<0.001	0.001	0.001	0.003
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	0.008	0.131	0.133	0.14	0.113	0.066	0.042
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001
Chromium	mg/L	0.001	0.099	0.004	<0.001	<0.001	0.002	0.045	0.001
Cobalt	mg/L	0.001	<0.001	0.001	0.004	<0.001	<0.001	0.002	<0.001
Copper	mg/L	0.001	0.002	0.003	<0.001	<0.001	0.002	0.013	0.002
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Manganese	mg/L	0.001	0.004	0.043	0.327	0.065	0.025	0.064	0.024
Molybdenum	mg/L	0.001	0.044	0.006	0.002	0.002	0.012	0.01	0.004
Nickel	mg/L	0.001	<0.001	0.004	0.006	<0.001	0.001	0.013	0.002
Selenium	mg/L	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
Strontium	mg/L	0.001	0.066	1.03	17.8	2.28	10.7	1.2	2.04
Uranium	mg/L	0.001	-	-	-	-	-	0.002	<0.001
Vanadium	mg/L	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	<0.005	0.013	<0.005	<0.005	<0.005	0.027	<0.005
Boron	mg/L	0.05	0.06	0.13	0.25	0.21	0.23	0.22	0.27
Iron	mg/L	0.05	-	-	-	-	-	1.15	1.05
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001

#	Limit of Reporting (LOR).
-	No value.

G1628A.Caval Ridge - Groundwater Investigation
Groundwater Quality Results - Table 2 of 2

Parameter	Units	LOR[#]							
Sample Location			**MB19CVM03T**	**MB19CVM05T**	**MB19CVM06P**	**MB19CVM07T**	**MB19CVM08P**	**MB19CVM09A**	**MB19CVM10P**
Date Sampled	-	-	10/03/2019	23/03/2019	23/03/2019	12/03/2019	12/03/2019	21/02/2019	21/02/2019
Lithology	-	-	Basalt	Basalt/basal sand	Coal/siltstone	Basalt	Coal/siltstone	Alluvium	Coal/siltstone
Alkalinity									
Hydroxide Alkalinity as CaCO3	mg/L	1	46	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	mg/L	1	311	30	<1	16	<1	<1	40
Bicarbonate Alkalinity as CaCO3	mg/L	1	<1	326	254	446	348	276	316
Total Alkalinity as CaCO3	mg/L	1	357	357	254	461	348	276	355
Total Hardness as CaCO3	mg/L	1	13	375	6500	295	406	514	116
Nutrients									
Ammonia as N	mg/L	0.01	0.12	0.18	1.01	0.19	1.46	0.26	0.6
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	0.04	0.01	<0.01	<0.01	<0.01	0.17	<0.01
Nitrite + Nitrate as N	mg/L	0.01	0.04	0.01	<0.01	<0.01	<0.01	0.17	<0.01
Total Kjeldahl Nitrogen as N	mg/L	0.1	0.2	0.4	1.4	0.2	1.5	2.5	0.7
Total Nitrogen as N	mg/L	0.1	0.2	0.4	1.4	0.2	1.5	2.7	0.7
Total Phosphorus as P	mg/L	0.01	0.02	0.09	0.09	0.03	0.02	0.08	0.04
Reactive Phosphorus as P	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
TPH									
C6 - C9 Fraction	µg/L	20	<20	<20	<20	<20	<20	90	<20
C10 - C14 Fraction	µg/L	50	<50	<50	<50	<50	<50	440	<50
C15 - C28 Fraction	µg/L	100	<100	270	<100	<100	<100	1400	<100
C29 - C36 Fraction	µg/L	50	<50	670	<50	<50	<50	80	50
C10 - C36 Fraction (sum)	µg/L	50	<50	940	<50	<50	<50	1920	50
TRH									
C6 - C10 Fraction	µg/L	20	<20	<20	<20	<20	<20	80	<20
C6 - C10 Fraction minus BTEX (F1)	µg/L	20	<20	<20	<20	<20	<20	80	<20
>C10 - C16 Fraction	µg/L	100	<100	<100	<100	<100	<100	860	<100
>C16 - C34 Fraction	µg/L	100	<100	770	<100	<100	<100	1020	<100
>C34 - C40 Fraction	µg/L	100	<100	340	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	µg/L	100	<100	1110	<100	<100	<100	1880	<100
>C10 - C16 Fraction minus Naphthalene (F2)	µg/L	100	<100	<100	<100	<100	<100	860	<100
BTEXN									
Benzene	µg/L	1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	µg/L	2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	µg/L	2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	µg/L	2	<2	<2	<2	<2	<2	<2	<2
Total Xylenes	µg/L	2	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	µg/L	1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	5	<5	<5	<5	<5	<5	<5	<5

#	Limit of Reporting (LOR).
-	No value.

Appendix D **Laboratory transcripts**

ALS Environmental

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095
Ph: 08 8359 0890 E: adelaide@alsglobal.com
☐BRISBANE 32 Shand Street Stafford QLD 4053
Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680
Ph: 07 7471 5600 E: gladstone@alsglobal.com

☐MACKAY 78 Harbour Road Mackay QLD 4740
Ph: 07 4944 0177 E: mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 27 Sydney Road Mudgee NSW 2850
Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

☐NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304
Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541
Ph: 024423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090
Ph: 08 9209 7655 E: samples.perth@alsglobal.com

☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818
Ph: 07 4796 0600 E: townesville.environmental@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500
Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: BM Alliance Coal Operations Pty Ltd (ALS Code: BMALLI)
OFFICE: Caval Ridge Mine
PROJECT: G1628A
ORDER NUMBER: TBA
PROJECT MANAGER: David Whiting **CONTACT PH:** 0448082311
SAMPLER: Dean Newborn **SAMPLER MOBILE:** 0429091645
COC emailed to ALS? (YES) **EDD FORMAT (or default):** BMA Envirosys
Email Reports to (will default to PM if no other addresses are listed): dean@ageconsultants.com.au; davidw@ageconsultants.com.au
Email Invoice to (will default to PM if no other addresses are listed): dean@ageconsultants.com.au; davidw@ageconsultants.com.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☐ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: BN/449/15/V4 - Planned Event - BMA Contract

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comment:

RELINQUISHED BY: *Will Taylor (refer to original BHP COC)*
DATE/TIME: 20.02.19 @ 11:00

RECEIVED BY: M. BIRCH
DATE/TIME: 9.20 27/2/2019

RELINQUISHED BY:
DATE/TIME:

RECEIVED BY:
DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	BMA Water release weekly suite	Alkalinity, hardness, SAR, Ca, Mg, K, chloride, Bromide, Fluoride	Silicon	Ferrous Fe	Additional Metals total & Dissolved - Ag, Ba, Be, Sb, Sr	BTEX			Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	9A	21.02.19	W		7	x	x	x	x	x	x			
	10P	21.02.19	W		7	x	x	x	x	x	x			
					TOTAL 14									

Environmental Division
Brisbane
Work Order Reference
EB1904971

Telephone : +61-7-3243 7222

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic;
F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: **EB1904971**		
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DAVID WHITING	Contact	: Customer Services EB
Address	: LEVEL 2, 15 MALLON STREET BOWEN HILLS QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: davidw@ageconsultants.com.au	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: ----	Telephone	: +61-7-3243 7222
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: G1628A	Page	: 1 of 4
Order number	: TBA	Quote number	: EB2017AUSGRO0001 (EN/222)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: DEAN NEWBORN		

Dates

Date Samples Received	: 27-Feb-2019 09:20	Issue Date	: 27-Feb-2019
Client Requested Due Date	: 06-Mar-2019	Scheduled Reporting Date	: **06-Mar-2019**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 16.2°C - Ice Bricks present
Receipt Detail	: MEDIUM ESKY	No. of samples received / analysed	: 2 / 2

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

Method *Client sample ID*	**Sample Container Received**	**Preferred Sample Container for Analysis**
Ferrous Iron by Discrete Analyser : EG051G		
9A	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - HCl - Filtered
10P	- Clear Plastic Bottle - Natural	- Clear Plastic Bottle - HCl - Filtered

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - EA005P pH (PCT)	WATER - EA010P Electrical Conductivity (PCT)	WATER - EA015H Total Dissolved Solids - Standard Level	WATER - EA025H Suspended Solids - Standard Level	WATER - ED093F Dissolved Major Cations	WATER - EG035T Total Mercury	WATER - NT-01D & 02A Major Cations & Anions (Ca, Mg, Na, K, Cl, SO4,
EB1904971-001	21-Feb-2019 00:00	9A	✓	✓	✓	✓	✓	✓	✓
EB1904971-002	21-Feb-2019 00:00	10P	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - ED009-X Standard Anions (Extended method	WATER - EG020F Dissolved Metals by ICP/MS	WATER - EG020T Total Metals by ICP/MS (including digestion)	WATER - EG035F Dissolved Mercury	WATER - EG052F Silicon Silicon by ICPAES (ED040F)	WATER - NT-11 Total Nitrogen and Total Phosphorus	WATER - W-04 TRH/BTEXN
EB1904971-001	21-Feb-2019 00:00	9A	✓	✓	✓	✓	✓	✓	✓
EB1904971-002	21-Feb-2019 00:00	10P	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - EA030H Total Solids	WATER - EG051G Ferrous Iron	WATER - EK055G Ammonia as N By Discrete Analyser	WATER - EK058G Nitrate as N by Discrete Analyser
EB1904971-001	21-Feb-2019 00:00	9A	✓	✓	✓	✓
EB1904971-002	21-Feb-2019 00:00	10P	✓	✓	✓	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method		**Due for extraction**	**Due for analysis**	**Samples Received**		**Instructions Received**	
Client Sample ID(s)	**Container**			**Date**	**Evaluation**	**Date**	**Evaluation**
EA005-P: pH by PC Titrator							
10P	Clear Plastic Bottle - Natural	----	21-Feb-2019	27-Feb-2019	✗	----	----
9A	Clear Plastic Bottle - Natural	----	21-Feb-2019	27-Feb-2019	✗	----	----
EG051G: Ferrous Iron by Discrete Analyser							
10P	Clear Plastic Bottle - Natural	----	22-Feb-2019	27-Feb-2019	✗	----	----
9A	Clear Plastic Bottle - Natural	----	22-Feb-2019	27-Feb-2019	✗	----	----
EK055G: Ammonia as N by Discrete analyser							
10P	Clear Plastic Bottle - Natural	----	22-Feb-2019	27-Feb-2019	✗	----	----
9A	Clear Plastic Bottle - Natural	----	22-Feb-2019	27-Feb-2019	✗	----	----
EK057G: Nitrite as N by Discrete Analyser							
10P	Clear Plastic Bottle - Natural	----	23-Feb-2019	27-Feb-2019	✗	----	----
9A	Clear Plastic Bottle - Natural	----	23-Feb-2019	27-Feb-2019	✗	----	----
EK059G: Nitrite and Nitrate as N (NOx) by Discrete Analyser							
10P	Clear Plastic Bottle - Natural	----	23-Feb-2019	27-Feb-2019	✗	----	----
9A	Clear Plastic Bottle - Natural	----	23-Feb-2019	27-Feb-2019	✗	----	----
EK061G: Total Kjeldahl Nitrogen as N By Discrete Analyser							
10P	Clear Plastic Bottle - Natural	22-Feb-2019	22-Mar-2019	27-Feb-2019	✗	----	----
9A	Clear Plastic Bottle - Natural	22-Feb-2019	22-Mar-2019	27-Feb-2019	✗	----	----
EK067G: Total Phosphorus as P By Discrete Analyser							
10P	Clear Plastic Bottle - Natural	23-Feb-2019	23-Mar-2019	27-Feb-2019	✗	----	----
9A	Clear Plastic Bottle - Natural	23-Feb-2019	23-Mar-2019	27-Feb-2019	✗	----	----

Requested Deliverables

DAVID WHITING

- *AU Certificate of Analysis - NATA (COA)	Email	davidw@ageconsultants.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	davidw@ageconsultants.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	davidw@ageconsultants.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	davidw@ageconsultants.com.au
- A4 - AU Tax Invoice (INV)	Email	davidw@ageconsultants.com.au
- Chain of Custody (CoC) (COC)	Email	davidw@ageconsultants.com.au
- EDI Format - XTab (XTAB)	Email	davidw@ageconsultants.com.au

DEAN NEWBORN

- *AU Certificate of Analysis - NATA (COA)	Email	dean@ageconsultants.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	dean@ageconsultants.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	dean@ageconsultants.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	dean@ageconsultants.com.au
- A4 - AU Tax Invoice (INV)	Email	dean@ageconsultants.com.au
- Chain of Custody (CoC) (COC)	Email	dean@ageconsultants.com.au
- EDI Format - XTab (XTAB)	Email	dean@ageconsultants.com.au

INVOICES BOWEN HILLS

- A4 - AU Tax Invoice (INV)	Email	brisbane@ageconsultants.com.au

CERTIFICATE OF ANALYSIS

Work Order	: **EB1904971**	Page	: 1 of 7
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DAVID WHITING	Contact	: Customer Services EB
Address	: LEVEL 2, 15 MALLON STREET BOWEN HILLS QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: G1628A	Date Samples Received	: 27-Feb-2019 09:20
Order number	: TBA	Date Analysis Commenced	: 27-Feb-2019
C-O-C number	: ----	Issue Date	: 06-Mar-2019 18:23
Sampler	: DEAN NEWBORN		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 2		
No. of samples analysed	: 2		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Sarah Ashworth	Laboratory Manager - Brisbane	Brisbane Organics, Stafford, QLD

General Comments

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

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

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

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

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

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

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

- EG035F (Dissolved Mercury): Positive mercury results have been confirmed by re-extraction and re-analysis.
- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for sample EB1904971-002(10P). However, the difference is within experimental variation of the methods.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**9A**	**10P**	**----**	**----**	**----**
			Client sampling date / time	21-Feb-2019 00:00	21-Feb-2019 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1904971-001**	**EB1904971-002**	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.76**	**8.68**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**3680**	**1790**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**2230**	**1050**	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**49**	**33**	----	----	----
EA030: Total Solids dried at 104 ± 2°C								
Total Solids	----	10	mg/L	**2330**	**1060**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	**40**	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**276**	**316**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**276**	**355**	----	----	----
ED040F: Dissolved Major Anions								
Silicon	7440-21-3	0.05	mg/L	**26.6**	**9.36**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**367**	**161**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**843**	**294**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**79**	**25**	----	----	----
Magnesium	7439-95-4	1	mg/L	**77**	**13**	----	----	----
Sodium	7440-23-5	1	mg/L	**596**	**357**	----	----	----
Potassium	7440-09-7	1	mg/L	**13**	**4**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**514**	**116**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.57**	**0.01**	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.001**	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.001**	**0.002**	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.050**	**0.025**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**9A**	**10P**	**----**	**----**	**----**
			Client sampling date / time	21-Feb-2019 00:00	21-Feb-2019 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1904971-001**	**EB1904971-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.040**	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.006**	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.018**	**0.010**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.008**	**0.003**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.009**	**0.001**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**1.09**	**1.77**	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.010**	**0.007**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.22**	**0.26**	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.22**	<0.05	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.96**	**0.50**	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.003**	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.001**	**0.003**	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.066**	**0.042**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0002**	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.045**	**0.001**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.002**	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.013**	**0.002**	----	----	----
Lead	7439-92-1	0.001	mg/L	**0.002**	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.064**	**0.024**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.010**	**0.004**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.013**	**0.002**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**1.20**	**2.04**	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**9A**	**10P**	**----**	**----**	**----**
			Client sampling date / time	21-Feb-2019 00:00	21-Feb-2019 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1904971-001**	**EB1904971-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG020T: Total Metals by ICP-MS - Continued								
Zinc	7440-66-6	0.005	mg/L	**0.027**	<0.005	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.22**	**0.27**	----	----	----
Iron	7439-89-6	0.05	mg/L	**1.15**	**1.05**	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	**0.0001**	<0.0001	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	**0.0001**	<0.0001	----	----	----
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.1**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.26**	**0.60**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.17**	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.17**	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**2.5**	**0.7**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**2.7**	**0.7**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.04**	----	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**36.9**	**18.7**	----	----	----
Total Cations	----	0.01	meq/L	**36.5**	**17.9**	----	----	----
Ionic Balance	----	0.01	%	**0.54**	**2.15**	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**90**	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	**440**	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L	**1400**	<100	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**9A**	**10P**	**----**	**----**	**----**
			Client sampling date / time	21-Feb-2019 00:00	21-Feb-2019 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1904971-001**	**EB1904971-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued								
C29 - C36 Fraction	----	50	µg/L	**80**	**50**	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**1920**	**50**	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	**80**	<20	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	**80**	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	**860**	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L	**1020**	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**1880**	<100	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	**860**	<100	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----
Toluene	108-88-3	2	µg/L	<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
^ **Total Xylenes**	----	2	µg/L	<2	<2	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	----	----	----
ED009: Anions								
Bromide	24959-67-9	0.010	mg/L	**10.2**	**0.800**	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**107**	**115**	----	----	----
Toluene-D8	2037-26-5	2	%	**104**	**99.1**	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**108**	**104**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	*CAS Number*	***Recovery Limits (%)*** *Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1904971**	Page	: 1 of 11
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DAVID WHITING	Telephone	: +61-7-3243 7222
Project	: G1628A	Date Samples Received	: 27-Feb-2019
Site	: ----	Issue Date	: 06-Mar-2019
Sampler	: DEAN NEWBORN	No. of samples received	: 2
Order number	: TBA	No. of samples analysed	: 2

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	**Analyte**	CAS Number	Data	Limits	**Comment**
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB1904963--001	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED045G: Chloride by Discrete Analyser	EB1904963--001	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EK067G: Total Phosphorus as P by Discrete Analyser	EB1904937--001	Anonymous	**Total Phosphorus as P**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)	*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
9A, 10P	----	----	----	28-Feb-2019	21-Feb-2019	**7**
EG051G: Ferrous Iron by Discrete Analyser						
Clear Plastic Bottle - Natural						
9A, 10P	----	----	----	27-Feb-2019	22-Feb-2019	**5**
EK055G: Ammonia as N by Discrete Analyser						
Clear Plastic Bottle - Natural						
9A, 10P	----	----	----	27-Feb-2019	22-Feb-2019	**5**
EK057G: Nitrite as N by Discrete Analyser						
Clear Plastic Bottle - Natural						
9A, 10P	----	----	----	27-Feb-2019	23-Feb-2019	**4**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser						
Clear Plastic Bottle - Natural						
9A, 10P	----	----	----	27-Feb-2019	23-Feb-2019	**4**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser						
Clear Plastic Bottle - Natural						
9A, 10P	05-Mar-2019	22-Feb-2019	**11**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser						
Clear Plastic Bottle - Natural						
9A, 10P	05-Mar-2019	23-Feb-2019	**10**	----	----	----

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
TRH - Semivolatile Fraction	0	19	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
TRH - Semivolatile Fraction	0	19	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P) 9A, 10P	**21-Feb-2019**	**----**	----	----	**28-Feb-2019**	21-Feb-2019	✘
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) 9A, 10P	**21-Feb-2019**	**----**	----	----	**28-Feb-2019**	21-Mar-2019	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H) 9A, 10P	**21-Feb-2019**	**----**	----	----	**28-Feb-2019**	28-Feb-2019	✓
EA025: Total Suspended Solids dried at 104 ± 2°C							
Clear Plastic Bottle - Natural (EA025H) 9A, 10P	**21-Feb-2019**	**----**	----	----	**28-Feb-2019**	28-Feb-2019	✓
EA030: Total Solids dried at 104 ± 2°C							
Clear Plastic Bottle - Natural (EA030H) 9A, 10P	**21-Feb-2019**	**----**	----	----	**28-Feb-2019**	28-Feb-2019	✓
ED009: Anions							
Clear Plastic Bottle - Natural (ED009-X) 9A, 10P	**21-Feb-2019**	**----**	----	----	**28-Feb-2019**	21-Mar-2019	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) 9A, 10P	**21-Feb-2019**	**----**	----	----	**28-Feb-2019**	07-Mar-2019	✓
ED040F: Dissolved Major Anions							
Clear Plastic Bottle - Natural (ED040F) 9A, 10P	**21-Feb-2019**	**----**	----	----	**27-Feb-2019**	21-Mar-2019	✓

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method	***Sample Date***	*Extraction / Preparation*			*Analysis*		
***Container** / Client Sample ID(s)*		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**27-Feb-2019**	21-Mar-2019	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**27-Feb-2019**	21-Mar-2019	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**01-Mar-2019**	21-Mar-2019	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**01-Mar-2019**	21-Mar-2019	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020B-F)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**01-Mar-2019**	20-Aug-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020B-T)							
9A, 10P	**21-Feb-2019**	**04-Mar-2019**	20-Aug-2019	✓	**04-Mar-2019**	20-Aug-2019	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**04-Mar-2019**	21-Mar-2019	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**05-Mar-2019**	21-Mar-2019	✓
EG051G: Ferrous Iron by Discrete Analyser							
Clear Plastic Bottle - Natural (EG051G)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**27-Feb-2019**	22-Feb-2019	✗
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**28-Feb-2019**	21-Mar-2019	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK055G)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**27-Feb-2019**	22-Feb-2019	✗
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**27-Feb-2019**	23-Feb-2019	✗
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Natural (EK059G)							
9A, 10P	**21-Feb-2019**	**----**	----	----	**27-Feb-2019**	23-Feb-2019	✗

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method ***Container*** */ Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Natural (EK061G) 9A, 10P	**21-Feb-2019**	**05-Mar-2019**	22-Feb-2019	✗	**05-Mar-2019**	02-Apr-2019	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Natural (EK067G) 9A, 10P	**21-Feb-2019**	**05-Mar-2019**	23-Feb-2019	✗	**05-Mar-2019**	02-Apr-2019	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071) 9A, 10P	**21-Feb-2019**	**28-Feb-2019**	28-Feb-2019	✓	**28-Feb-2019**	09-Apr-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) 9A, 10P	**21-Feb-2019**	**04-Mar-2019**	07-Mar-2019	✓	**04-Mar-2019**	07-Mar-2019	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071) 9A, 10P	**21-Feb-2019**	**28-Feb-2019**	28-Feb-2019	✓	**28-Feb-2019**	09-Apr-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) 9A, 10P	**21-Feb-2019**	**04-Mar-2019**	07-Mar-2019	✓	**04-Mar-2019**	07-Mar-2019	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) 9A, 10P	**21-Feb-2019**	**04-Mar-2019**	07-Mar-2019	✓	**04-Mar-2019**	07-Mar-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		*Count*		*Rate (%)*			*Quality Control Specification*
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Solids	EA030H	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	19	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	7	**28.57**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	5	**40.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	7	**28.57**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Solids	EA030H	2	2	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Solids	EA030H	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	19	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Total Solids	EA030H	WATER	In house: Referenced to APHA 2540 B. A gravimetric procedure employed to determine the amount of residue in a aqueous sample. The sample is evaporated to dryness and dried to constant weight at 104+/-2C. This method is compliant with NEPM (2013) Schedule B(3)
Standard Anions -by IC (Extended Method)	ED009-X	WATER	In house: Referenced to APHA 4110B. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Major Anions - Dissolved	ED040F	WATER	In house: Referenced to APHA 3120. The 0.45µm filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ferrous Iron by Discrete Analyser	EG051G	WATER	In house: Referenced to APHA 3500 Fe-B. A colorimetric determination based on the reaction between phenanthroline and ferrous iron at pH 3.2-3.3 to form an orange-red complex that is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1904971**	Page	: 1 of 12
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DAVID WHITING	Contact	: Customer Services EB
Address	: LEVEL 2, 15 MALLON STREET BOWEN HILLS QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: G1628A	Date Samples Received	: 27-Feb-2019
Order number	: TBA	Date Analysis Commenced	: 27-Feb-2019
C-O-C number	: ----	Issue Date	: 06-Mar-2019
Sampler	: DEAN NEWBORN		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 2		
No. of samples analysed	: 2		

ilac-MRA NATA

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Sarah Ashworth	Laboratory Manager - Brisbane	Brisbane Organics, Stafford, QLD

General Comments

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

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

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

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED009: Anions (QC Lot: 2209758)									
EB1904617-004	Anonymous	ED009-X: Bromide	24959-67-9	0.01	mg/L	0.700	0.685	2.17	0% - 20%
EB1904776-003	Anonymous	ED009-X: Bromide	24959-67-9	0.01	mg/L	0.019	0.019	0.00	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 2211429)									
EB1904971-002	10P	EA005-P: pH Value	----	0.01	pH Unit	8.68	8.69	0.115	0% - 20%
EB1904971-001	9A	EA005-P: pH Value	----	0.01	pH Unit	7.76	7.79	0.386	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 2211428)									
EB1904971-002	10P	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	1790	1790	0.229	0% - 20%
EB1904971-001	9A	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	3680	3670	0.279	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 2209488)									
EB1902060-003	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	165	164	0.00	0% - 50%
EA025: Total Suspended Solids dried at 104 ± 2°C (QC Lot: 2209489)									
EB1905005-003	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	<5	<5	0.00	No Limit
EB1904971-001	9A	EA025H: Suspended Solids (SS)	----	5	mg/L	49	51	3.51	0% - 50%
EA030: Total Solids dried at 104 ± 2°C (QC Lot: 2209490)									
EB1904971-001	9A	EA030H: Total Solids	----	10	mg/L	2330	2320	0.703	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2211427)									
EB1904971-002	10P	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	40	41	3.07	0% - 20%
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	316	317	0.446	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	355	358	0.743	0% - 20%
EB1904971-001	9A	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	276	284	2.92	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	276	284	2.92	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED040F: Dissolved Major Anions (QC Lot: 2208939)									
EB1904971-001	9A	ED040F: Silicon	7440-21-3	0.05	mg/L	26.6	26.7	0.642	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2208937)									
EB1904971-001	9A	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	367	374	1.90	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 2208934)									
EB1904948-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	<1	<1	0.00	No Limit
ED093F: Dissolved Major Cations (QC Lot: 2209274)									
EB1904971-001	9A	ED093F: Calcium	7440-70-2	1	mg/L	79	80	1.30	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	77	76	0.00	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	596	597	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	13	13	0.00	0% - 50%
EB1904677-004	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	193	192	0.623	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	88	87	0.00	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	305	306	0.502	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	1	1	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2209276)									
EB1904677-004	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	2.06	2.03	1.55	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.002	0.002	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2209278)									
EB1904971-001	9A	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0001	0.0001	0.00	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.050	0.050	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.040	0.040	0.00	0% - 20%
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.018	0.018	0.00	0% - 50%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.008	0.008	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.009	0.010	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.010	0.007	31.1	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.57	0.58	0.00	0% - 20%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.22	0.22	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.22	0.23	0.00	No Limit
EB1904974-012	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2209278) - continued									
EB1904974-012	Anonymous	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2209377)									
EB1904765-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	3.28	3.34	1.66	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.007	0.007	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.005	0.005	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.001	0.002	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.051	0.051	0.00	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.014	0.013	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.58	0.65	11.7	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.34	0.34	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	13.7	13.6	1.16	0% - 20%
EB1904992-016	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.5 µg/L	0.0005	0.00	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	2 µg/L	0.002	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	46 µg/L	0.045	3.40	0% - 20%

Sub-Matrix: **WATER**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 2209377) - continued									
EB1904992-016	Anonymous	EG020A-T: Chromium	7440-47-3	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	349 µg/L	0.348	0.322	0% - 20%
		EG020A-T: Copper	7440-50-8	0.001	mg/L	3 µg/L	0.003	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	2 µg/L	0.002	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	9140 µg/L	9.26	1.29	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	362 µg/L	0.362	0.00	0% - 20%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	1540 µg/L	1.54	0.259	0% - 20%
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	280 µg/L	0.28	0.00	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<10 µg/L	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<10 µg/L	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	190 µg/L	0.19	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	4050 µg/L	4.04	0.00	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 2209378)									
EB1904765-001	Anonymous	EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020B-T: Strontium	7440-24-6	0.001	mg/L	5.71	5.77	1.12	0% - 20%
		EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
EB1904992-016	Anonymous	EG020B-T: Silver	7440-22-4	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.488	0.479	1.79	0% - 20%
		EG020B-T: Uranium	7440-61-1	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 2209277)									
EB1904933-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1904974-012	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2209376)									
EB1904765-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG051G: Ferrous Iron by Discrete Analyser (QC Lot: 2208910)									
EB1904751-007	Anonymous	EG051G: Ferrous Iron	----	0.05	mg/L	0.06	0.05	17.2	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 2211430)									
EB1904971-001	9A	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2208577)									
EB1904759-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.04	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2208938)									
EB1904971-001	9A	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2208576)									
--------		EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	----	0.05	0.00	No Limit
EB1904759-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2215357)									
ET1900622-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.1	0.1	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2215357) - continued									
EB1904851-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	258	261	0.946	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2215356)									
ET1900622-002	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.12	0.09	23.8	0% - 50%
EB1904851-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	177	180	1.76	0% - 20%
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2214620)									
EB1904764-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EB1904882-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2214620)									
EB1904764-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EB1904882-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 2214620)									
EB1904764-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EB1904882-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
ED009: Anions (QCLot: 2209758)								
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	100	80	115
EA005P: pH by PC Titrator (QCLot: 2211429)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	101	98	102
				----	7 pH Unit	100	98	102
EA010P: Conductivity by PC Titrator (QCLot: 2211428)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	2100 µS/cm	101	91	107
				<1	24800 µS/cm	101	91	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 2209488)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	101	88	112
				<10	2000 mg/L	100	88	112
EA025: Total Suspended Solids dried at 104 ± 2°C (QCLot: 2209489)								
EA025H: Suspended Solids (SS)	----	5	mg/L	<5	150 mg/L	103	88	112
				<5	1000 mg/L	100	88	112
EA030: Total Solids dried at 104 ± 2°C (QCLot: 2209490)								
EA030H: Total Solids	----	10	mg/L	<10	2150 mg/L	99.8	80	120
				<10	1293 mg/L	99.8	80	120
ED037P: Alkalinity by PC Titrator (QCLot: 2211427)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	97.8	80	120
ED040F: Dissolved Major Anions (QCLot: 2208939)								
ED040F: Silicon	7440-21-3	0.05	mg/L	<0.05	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2208937)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	105	85	118
				<1	100 mg/L	107	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 2208934)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	95.9	90	115
				<1	1000 mg/L	103	90	115
ED093F: Dissolved Major Cations (QCLot: 2209274)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2209276)								
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.1 mg/L	102	85	114

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2209276) - continued								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.5 mg/L	96.5	86	111
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2209278)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	95.2	79	118
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	98.3	87	113
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.4	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	88.2	81	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	100	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	97.1	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	96.8	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.5	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	97.0	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.1	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	95.8	89	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	95.2	89	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	93.1	89	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	94.9	83	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	103	88	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	95.0	87	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	96.4	81	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	99.7	82	114
EG020T: Total Metals by ICP-MS (QCLot: 2209377)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	104	80	114
EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	107	87	115
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	103	88	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	102	81	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	102	70	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	98.3	88	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	105	89	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	105	89	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	113	88	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	103	89	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	105	88	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	106	90	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	104	88	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	102	79	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	112	87	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	99.5	84	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	106	82	128

Sub-Matrix: **WATER**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG020T: Total Metals by ICP-MS (QCLot: 2209377) - continued								
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	111	82	118
EG020T: Total Metals by ICP-MS (QCLot: 2209378)								
EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	0.1 mg/L	110	84	117
EG020B-T: Strontium	7440-24-6	0.001	mg/L	<0.001	0.5 mg/L	109	86	112
EG020B-T: Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
EG035F: Dissolved Mercury by FIMS (QCLot: 2209277)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	96.1	84	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2209376)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	93.3	84	118
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 2208910)								
EG051G: Ferrous Iron	----	0.05	mg/L	<0.05	2 mg/L	94.0	85	120
EK040P: Fluoride by PC Titrator (QCLot: 2211430)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	101	80	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2208577)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	99.7	86	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2208938)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	97.2	90	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2208576)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	98.0	89	115
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2215357)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	89.4	70	108
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2215356)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	90.8	79	105
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2209280)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	1070 µg/L	124	65	135
EP071: C15 - C28 Fraction	----	100	µg/L	<100	1770 µg/L	105	62	138
EP071: C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2214620)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	160 µg/L	99.0	76	122
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2209280)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	1560 µg/L	118	66	134
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	1190 µg/L	106	61	139
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2214620)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	185 µg/L	96.9	75	123

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2214620) - continued								
EP080: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
EP080: BTEXN (QCLot: 2214620)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	105	77	119
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	99.5	78	122
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	99.1	78	119
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	20 µg/L	104	77	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	105	76	121
EP080: Total Xylenes	----	2	µg/L	<2	----	----	----	----
EP080: Sum of BTEX	----	1	µg/L	<1	----	----	----	----
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	98.4	75	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
ED009: Anions (QCLot: 2209758)							
EB1904617-005	Anonymous	ED009-X: Bromide	24959-67-9	2.5 mg/L	95.4	70	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2208937)							
EB1904963-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 2208934)							
EB1904963-001	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2209278)							
EB1904971-002	10P	EG020A-F: Aluminium	7429-90-5	0.5 mg/L	97.4	70	130
		EG020A-F: Antimony	7440-36-0	0.1 mg/L	92.1	70	130
		EG020A-F: Arsenic	7440-38-2	0.1 mg/L	102	70	130
		EG020A-F: Beryllium	7440-41-7	0.1 mg/L	98.8	70	130
		EG020A-F: Barium	7440-39-3	0.5 mg/L	102	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	99.3	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	94.5	70	130
		EG020A-F: Cobalt	7440-48-4	0.1 mg/L	96.8	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	95.7	70	130

Sub-Matrix: **WATER**

Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Matrix Spike (MS) Report* *Spike* *Concentration*	*SpikeRecovery(%)* *MS*	*Recovery Limits (%)* *Low*	*High*
EG020F: Dissolved Metals by ICP-MS (QCLot: 2209278) - continued							
EB1904971-002	10P	EG020A-F: Lead	7439-92-1	0.1 mg/L	95.4	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	95.9	70	130
		EG020A-F: Molybdenum	7439-98-7	0.1 mg/L	88.8	70	130
		EG020A-F: Nickel	7440-02-0	0.1 mg/L	90.3	70	130
		EG020A-F: Selenium	7782-49-2	0.1 mg/L	96.9	70	130
		EG020A-F: Vanadium	7440-62-2	0.1 mg/L	95.9	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	97.1	70	130
		EG020A-F: Boron	7440-42-8	0.5 mg/L	95.3	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2209377)							
EB1904786-001	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	95.9	70	130
		EG020A-T: Beryllium	7440-41-7	0.1 mg/L	96.0	70	130
		EG020A-T: Barium	7440-39-3	1 mg/L	89.1	70	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	92.1	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	94.1	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	93.5	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	96.3	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	87.7	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	90.2	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	98.5	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	96.5	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	94.4	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2209277)							
EB1904974-001	Anonymous	EG035F: Mercury	7439-97-6	0.05 mg/L	80.0	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2209376)							
EB1904958-001	Anonymous	EG035T: Mercury	7439-97-6	0.05 mg/L	99.0	70	130
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 2208910)							
EB1904971-001	9A	EG051G: Ferrous Iron	----	2 mg/L	103	70	130
EK040P: Fluoride by PC Titrator (QCLot: 2211430)							
EB1904995-001	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	90.8	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2208577)							
EB1904971-001	9A	EK055G: Ammonia as N	7664-41-7	2 mg/L	99.4	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2208938)							
EB1904963-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	91.4	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2208576)							
EB1904971-001	9A	EK059G: Nitrite + Nitrate as N	----	2 mg/L	80.1	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2215357)							

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2215357) - continued							
EB1904937-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	84.6	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2215356)							
EB1904937-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	# Not Determined	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2214620)							
EB1904764-002	Anonymous	EP080: C6 - C9 Fraction	----	40 µg/L	79.0	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2214620)							
EB1904764-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	40 µg/L	78.8	70	130
EP080: BTEXN (QCLot: 2214620)							
EB1904764-002	Anonymous	EP080: Benzene	71-43-2	10 µg/L	96.8	70	130
		EP080: Toluene	108-88-3	10 µg/L	95.1	70	130

ALS Environmental

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095
Ph: 08 8359 0890 E: adelaide@alsglobal.com
☐BRISBANE 32 Shand Street Stafford QLD 4053
Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680
Ph: 07 7471 5600 E: gladstone@alsglobal.com

☐MACKAY 78 Harbour Road Mackay QLD 4740
Ph: 07 4944 0177 E: mackay@alsglobal.com
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☐MUDGEE 27 Sydney Road Mudgee NSW 2850
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☐NEWCASTLE 5/585 Maitland Rd Mayfield West NSW 2304
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☐NOWRA 4/13 Geary Place North Nowra NSW 2541
Ph: 024423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090
Ph: 08 9209 7655 E: samples.perth@alsglobal.com

☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

Environmental Division
Brisbane
Work Order Reference
EB1906632

Telephone : + 61-7-3243 7222

CLIENT: AGE Consultants
OFFICE: Brisbane
PROJECT: G1628A
ORDER NUMBER: EN/222/18
PROJECT MANAGER: Dean Newborn CONTACT PH: 0429 091 645
SAMPLER: Dean Newborn SAMPLER MOBILE: "
COC emailed to ALS? (YES / NO) EDD FORMAT (or default): Default
Email Reports to (will default to PM if no other addresses are listed): dean@ageconsultants.com.au
Email Invoice to (will default to PM if no other addresses are listed): davidw@ageconsultants.com.au

TURNAROUND REQUIREMENTS : ☑ Standard TAT (List due date):
(Standard TAT may be longer for some tests e.g.. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.:

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LAB
Custody Se
Free ice / fr receipt? N/A
Random Sa N/A
Other comn

RELINQUISHED BY: P. Berghofer
DATE/TIME: 13/3/19 10.30am

RECEIVED BY:
DATE/TIME: 9.45 15/3/19

RELINQUISHED
DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).							Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Physical parameters: pH, EC, TDS, hardness, SAR	Cations/anions: CO3, HCO3, Cl, SO4, Ca, Mg, Na, K	Bromide, silicon and fluoride.	Dissolved/total metals: Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe2+, Hg, Mn, Mo, Ni, Pb, Sb, Sr, Se, V, Zn	TRH/TPH: (C6 - C40) / (C6 - C36)	Nutrients: NH3-N, NO2, NO3, NOx, TKN, Total N, reactive P, total P	BTEXN: benzene, toluene, ethyl benzene, meta- & para-xylene, ortho-xylene, total xylenes, sum of BTEX, and naphthalene	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	MB19CVM03T	10/03/2019	W	As required	8	x	x	x	x	x	x	x	Labelled as 3T.
2	MB19CVM07T	12/03/2019	W	As required	8	x	x	x	x	x	x	x	Labelled as 7T
3	MB19CVM08P	12/03/2019	W	As required	8	x	x	x	x	x	x	x	Labelled as 8P
TOTAL					24	3	3	3	3	3	3	3	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB1906632**

Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DEAN NEWBORN	Contact	: Customer Services EB
Address	: LEVEL 2, 15 MALLON STREET BOWEN HILLS QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: dean@ageconsultants.com.au	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: ----	Telephone	: +61-7-3243 7222
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: G1628A	Page	: 1 of 3
Order number	:	Quote number	: EB2017AUSGRO0001 (EN/222)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: DEAN NEWBORN		

Dates

Date Samples Received	: 15-Mar-2019 09:45	Issue Date	: 15-Mar-2019
Client Requested Due Date	: 22-Mar-2019	Scheduled Reporting Date	: **22-Mar-2019**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 9.8°C - Ice present
Receipt Detail	: MED ESKY	No. of samples received / analysed	: 3 / 3

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - EA005P pH (PCT)	WATER - EA006 (only) SAR	WATER - EA010P Electrical Conductivity (PCT)	WATER - EA015H Total Dissolved Solids - Standard Level	WATER - EA065 (only) Total Hardness	WATER - ED045G Chloride by Discrete Analyser	WATER - NT-01 & 02 Ca, Mg, Na, K, Cl, SO4, Alkalinity
EB1906632-001	10-Mar-2019 00:00	MB19CVM03T	✓	✓	✓	✓	✓	✓	✓
EB1906632-002	12-Mar-2019 00:00	MB19CVM07T	✓	✓	✓	✓	✓	✓	✓
EB1906632-003	12-Mar-2019 00:00	MB19CVM08P	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - ED041G Sulfate (Turbidimetric) as SO4 2 by Discrete	WATER - EG020F Dissolved Metals by ICP/MS	WATER - EG020T Total Metals by ICP/MS (including digestion)	WATER - EG035F Dissolved Mercury	WATER - EG035T Total Mercury	WATER - EK040-P Fluoride (PCT)	WATER - NT-08A Total Nitrogen + NO2 + NO3 + NH3 + Total P +
EB1906632-001	10-Mar-2019 00:00	MB19CVM03T	✓	✓	✓	✓	✓	✓	✓
EB1906632-002	12-Mar-2019 00:00	MB19CVM07T	✓	✓	✓	✓	✓	✓	✓
EB1906632-003	12-Mar-2019 00:00	MB19CVM08P	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - ED009-X Standard Anions (Extended method	WATER - ED040F Dissolved Major Anions	WATER - EG051G Ferrous Iron	WATER - W-04 TRH/BTEXN
EB1906632-001	10-Mar-2019 00:00	MB19CVM03T	✓	✓	✓	✓
EB1906632-002	12-Mar-2019 00:00	MB19CVM07T	✓	✓	✓	✓
EB1906632-003	12-Mar-2019 00:00	MB19CVM08P	✓	✓	✓	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method **Client Sample ID(s)**	**Container**	**Due for extraction**	**Due for analysis**	**Samples Received**		**Instructions Received**	
				Date	**Evaluation**	**Date**	**Evaluation**
EA005-P: pH by PC Titrator							
MB19CVM03T	Clear Plastic Bottle - Natural	----	10-Mar-2019	15-Mar-2019	✘	----	----
MB19CVM07T	Clear Plastic Bottle - Natural	----	12-Mar-2019	15-Mar-2019	✘	----	----
MB19CVM08P	Clear Plastic Bottle - Natural	----	12-Mar-2019	15-Mar-2019	✘	----	----
EG051G: Ferrous Iron by Discrete Analyser							
MB19CVM08P	Clear Plastic Bottle - HCl	----	13-Mar-2019	15-Mar-2019	✘	----	----
EK057G: Nitrite as N by Discrete Analyser							
MB19CVM03T	Clear Plastic Bottle - Natural	----	12-Mar-2019	15-Mar-2019	✘	----	----
MB19CVM07T	Clear Plastic Bottle - Natural	----	14-Mar-2019	15-Mar-2019	✘	----	----
MB19CVM08P	Clear Plastic Bottle - Natural	----	14-Mar-2019	15-Mar-2019	✘	----	----
EK071G: Reactive Phosphorus as P-By Discrete Analyser							
MB19CVM03T	Clear Plastic Bottle - Natural	----	12-Mar-2019	15-Mar-2019	✘	----	----
MB19CVM07T	Clear Plastic Bottle - Natural	----	14-Mar-2019	15-Mar-2019	✘	----	----
MB19CVM08P	Clear Plastic Bottle - Natural	----	14-Mar-2019	15-Mar-2019	✘	----	----

Requested Deliverables

ALL INVOICES		
- A4 - AU Tax Invoice (INV)	Email	brisbane@ageconsultants.com.au
DAVID WHITING		
- A4 - AU Tax Invoice (INV)	Email	davidw@ageconsultants.com.au
DEAN NEWBORN		
- *AU Certificate of Analysis - NATA (COA)	Email	dean@ageconsultants.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	dean@ageconsultants.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	dean@ageconsultants.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	dean@ageconsultants.com.au
- Chain of Custody (CoC) (COC)	Email	dean@ageconsultants.com.au
- EDI Format - XTab (XTAB)	Email	dean@ageconsultants.com.au
INVOICES BOWEN HILLS		
- A4 - AU Tax Invoice (INV)	Email	brisbane@ageconsultants.com.au

CERTIFICATE OF ANALYSIS

Work Order : **EB1906632**
Client : **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**
Contact : DEAN NEWBORN
Address : LEVEL 2, 15 MALLON STREET
BOWEN HILLS QLD, AUSTRALIA 4006
Telephone : ----
Project : G1628A
Order number :
C-O-C number : ----
Sampler : DEAN NEWBORN
Site : ----
Quote number : EN/222
No. of samples received : 3
No. of samples analysed : 3

Page : 1 of 7
Laboratory : Environmental Division Brisbane
Contact : Customer Services EB
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 15-Mar-2019 09:45
Date Analysis Commenced : 15-Mar-2019
Issue Date : 22-Mar-2019 13:53

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Santusha Pandra	Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

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

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

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

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

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

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

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

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB19CVM03T**	**MB19CVM07T**	**MB19CVM08P**	**----**	**----**
			Client sampling date / time	10-Mar-2019 00:00	12-Mar-2019 00:00	12-Mar-2019 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1906632-001**	**EB1906632-002**	**EB1906632-003**	**--------**	**--------**
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**10.7**	**8.36**	**8.22**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2960**	**1100**	**3770**	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**1630**	**664**	**2160**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	**46**	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**311**	**16**	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	**446**	**348**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**357**	**461**	**348**	----	----
ED040F: Dissolved Major Anions								
Silicon	7440-21-3	0.05	mg/L	**8.47**	**21.8**	**9.31**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**147**	**20**	**160**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**681**	**97**	**955**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	**44**	**77**	----	----
Magnesium	7439-95-4	1	mg/L	**2**	**45**	**52**	----	----
Sodium	7440-23-5	1	mg/L	**629**	**157**	**666**	----	----
Potassium	7440-09-7	1	mg/L	**13**	**4**	**6**	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**13**	**295**	**406**	----	----
^ **Sodium Adsorption Ratio**	----	0.01	-	**75.2**	**3.98**	**14.4**	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	<0.01	**0.03**	----	----
Antimony	7440-36-0	0.001	mg/L	**0.003**	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.001**	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	**0.007**	**0.128**	**0.084**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	**0.106**	<0.001	**0.001**	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB19CVM03T**	**MB19CVM07T**	**MB19CVM08P**	----	----
			Client sampling date / time	10-Mar-2019 00:00	12-Mar-2019 00:00	12-Mar-2019 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1906632-001**	**EB1906632-002**	**EB1906632-003**	--------	--------
				Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	**0.060**	**0.010**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.042**	**0.002**	**0.010**	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Strontium	7440-24-6	0.001	mg/L	**0.067**	**2.19**	**10.1**	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	**0.008**	----	----
Boron	7440-42-8	0.05	mg/L	**0.07**	**0.22**	**0.25**	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.98**	**0.16**	**0.43**	----	----
Antimony	7440-36-0	0.001	mg/L	**0.003**	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	<0.001	**0.001**	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L	**0.008**	**0.140**	**0.113**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	**0.099**	<0.001	**0.002**	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	<0.001	**0.002**	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.004**	**0.065**	**0.025**	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.044**	**0.002**	**0.012**	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	**0.001**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Strontium	7440-24-6	0.001	mg/L	**0.066**	**2.28**	**10.7**	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.01**	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	----	----
Boron	7440-42-8	0.05	mg/L	**0.06**	**0.21**	**0.23**	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**MB19CVM03T**	**MB19CVM07T**	**MB19CVM08P**	----	----
			Client sampling date / time	10-Mar-2019 00:00	12-Mar-2019 00:00	12-Mar-2019 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1906632-001**	**EB1906632-002**	**EB1906632-003**	--------	--------
				Result	Result	Result	----	----
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	<0.05	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.8**	**0.1**	<0.1	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.12**	**0.19**	**1.46**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.04**	<0.01	<0.01	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.04**	<0.01	<0.01	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.2**	**0.2**	**1.5**	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.2**	**0.2**	**1.5**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.02**	**0.03**	**0.02**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**29.4**	**12.4**	**37.2**	----	----
Total Cations	----	0.01	meq/L	**28.0**	**12.8**	**37.2**	----	----
Ionic Balance	----	0.01	%	**2.52**	**1.85**	**0.03**	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	<50	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**MB19CVM03T**	**MB19CVM07T**	**MB19CVM08P**	**----**	**----**
			Client sampling date / time	10-Mar-2019 00:00	12-Mar-2019 00:00	12-Mar-2019 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1906632-001**	**EB1906632-002**	**EB1906632-003**	**--------**	**--------**
				Result	Result	Result	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ **Total Xylenes**	----	2	µg/L	<2	<2	<2	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
ED009: Anions								
Bromide	24959-67-9	0.010	mg/L	**1.48**	**0.285**	**2.22**	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**95.3**	**95.9**	**92.2**	----	----
Toluene-D8	2037-26-5	2	%	**96.1**	**96.2**	**98.8**	----	----
4-Bromofluorobenzene	460-00-4	2	%	**109**	**111**	**115**	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	*CAS Number*	*Recovery Limits (%)* Low	*Recovery Limits (%)* High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1906632**	Page	: 1 of 12
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DEAN NEWBORN	Telephone	: +61-7-3243 7222
Project	: G1628A	Date Samples Received	: 15-Mar-2019
Site	: ----	Issue Date	: 22-Mar-2019
Sampler	: DEAN NEWBORN	No. of samples received	: 3
Order number	:	No. of samples analysed	: 3

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	**Analyte**	CAS Number	Data	Limits	**Comment**
Matrix Spike (MS) Recoveries							
ED009: Anions	EB1906632--003	MB19CVM08P	**Bromide**	24959-67-9	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB1906632--003	MB19CVM08P	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)	*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural MB19CVM03T	----	----	----	18-Mar-2019	10-Mar-2019	**8**
Clear Plastic Bottle - Natural MB19CVM07T, MB19CVM08P	----	----	----	18-Mar-2019	12-Mar-2019	**6**
EG051G: Ferrous Iron by Discrete Analyser						
Clear Plastic Bottle - HCl MB19CVM08P	----	----	----	19-Mar-2019	13-Mar-2019	**6**
Clear Plastic Bottle - HCl - Filtered MB19CVM03T	----	----	----	19-Mar-2019	17-Mar-2019	**2**
EK057G: Nitrite as N by Discrete Analyser						
Clear Plastic Bottle - Natural MB19CVM03T	----	----	----	15-Mar-2019	12-Mar-2019	**3**
Clear Plastic Bottle - Natural MB19CVM07T, MB19CVM08P	----	----	----	15-Mar-2019	14-Mar-2019	**1**
EK071G: Reactive Phosphorus as P by discrete analyser						
Clear Plastic Bottle - Natural MB19CVM03T	----	----	----	15-Mar-2019	12-Mar-2019	**3**
Clear Plastic Bottle - Natural MB19CVM07T, MB19CVM08P	----	----	----	15-Mar-2019	14-Mar-2019	**1**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
TRH - Semivolatile Fraction	0	19	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					

Matrix: **WATER**

Quality Control Sample Type Method	Count QC	 Regular	Rate (%) Actual	 Expected	Quality Control Specification
Matrix Spikes (MS) - Continued					
TRH - Semivolatile Fraction	0	19	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method ***Container*** */ Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation* ***Date extracted***	 *Due for extraction*	 *Evaluation*	*Analysis* ***Date analysed***	 *Due for analysis*	 *Evaluation*
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**18-Mar-2019**	10-Mar-2019	✗
Clear Plastic Bottle - Natural (EA005-P) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**18-Mar-2019**	12-Mar-2019	✗
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**18-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Natural (EA010-P) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**18-Mar-2019**	09-Apr-2019	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**16-Mar-2019**	17-Mar-2019	✓
Clear Plastic Bottle - Natural (EA015H) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**16-Mar-2019**	19-Mar-2019	✓
ED009: Anions							
Clear Plastic Bottle - Natural (ED009-X) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**16-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Natural (ED009-X) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**20-Mar-2019**	09-Apr-2019	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**18-Mar-2019**	24-Mar-2019	✓
Clear Plastic Bottle - Natural (ED037-P) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**18-Mar-2019**	26-Mar-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
ED040F: Dissolved Major Anions							
Clear Plastic Bottle - Natural (ED040F) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**15-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Natural (ED040F) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**15-Mar-2019**	09-Apr-2019	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**15-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Natural (ED041G) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**15-Mar-2019**	09-Apr-2019	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**15-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Natural (ED045G) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**15-Mar-2019**	09-Apr-2019	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**19-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**19-Mar-2019**	09-Apr-2019	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**19-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**19-Mar-2019**	09-Apr-2019	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**19-Mar-2019**	06-Sep-2019	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**19-Mar-2019**	08-Sep-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) MB19CVM03T	**10-Mar-2019**	**18-Mar-2019**	06-Sep-2019	✓	**18-Mar-2019**	06-Sep-2019	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**18-Mar-2019**	08-Sep-2019	✓	**18-Mar-2019**	08-Sep-2019	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**19-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**19-Mar-2019**	09-Apr-2019	✓

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**18-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**18-Mar-2019**	09-Apr-2019	✓
EG051G: Ferrous Iron by Discrete Analyser							
Clear Plastic Bottle - HCl (EG051G) MB19CVM08P	**12-Mar-2019**	**----**	----	----	**19-Mar-2019**	13-Mar-2019	✗
Clear Plastic Bottle - HCl - Filtered (EG051G) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**19-Mar-2019**	17-Mar-2019	✗
Clear Plastic Bottle - HCl - Filtered (EG051G) MB19CVM07T	**12-Mar-2019**	**----**	----	----	**19-Mar-2019**	19-Mar-2019	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**18-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Natural (EK040P) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**18-Mar-2019**	09-Apr-2019	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**21-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**21-Mar-2019**	09-Apr-2019	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**15-Mar-2019**	12-Mar-2019	✗
Clear Plastic Bottle - Natural (EK057G) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**15-Mar-2019**	14-Mar-2019	✗
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**21-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**21-Mar-2019**	09-Apr-2019	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) MB19CVM03T	**10-Mar-2019**	**20-Mar-2019**	07-Apr-2019	✓	**20-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**20-Mar-2019**	09-Apr-2019	✓	**20-Mar-2019**	09-Apr-2019	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) MB19CVM03T	**10-Mar-2019**	**20-Mar-2019**	07-Apr-2019	✓	**20-Mar-2019**	07-Apr-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**20-Mar-2019**	09-Apr-2019	✓	**20-Mar-2019**	09-Apr-2019	✓

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method ***Container*** / *Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) MB19CVM03T	**10-Mar-2019**	**----**	----	----	**15-Mar-2019**	12-Mar-2019	✗
Clear Plastic Bottle - Natural (EK071G) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**----**	----	----	**15-Mar-2019**	14-Mar-2019	✗
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071) MB19CVM03T	**10-Mar-2019**	**15-Mar-2019**	17-Mar-2019	✓	**18-Mar-2019**	24-Apr-2019	✓
Amber Glass Bottle - Unpreserved (EP071) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**15-Mar-2019**	19-Mar-2019	✓	**18-Mar-2019**	24-Apr-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) MB19CVM03T	**10-Mar-2019**	**18-Mar-2019**	24-Mar-2019	✓	**18-Mar-2019**	24-Mar-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**18-Mar-2019**	26-Mar-2019	✓	**18-Mar-2019**	26-Mar-2019	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071) MB19CVM03T	**10-Mar-2019**	**15-Mar-2019**	17-Mar-2019	✓	**18-Mar-2019**	24-Apr-2019	✓
Amber Glass Bottle - Unpreserved (EP071) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**15-Mar-2019**	19-Mar-2019	✓	**18-Mar-2019**	24-Apr-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) MB19CVM03T	**10-Mar-2019**	**18-Mar-2019**	24-Mar-2019	✓	**18-Mar-2019**	24-Mar-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**18-Mar-2019**	26-Mar-2019	✓	**18-Mar-2019**	26-Mar-2019	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) MB19CVM03T	**10-Mar-2019**	**18-Mar-2019**	24-Mar-2019	✓	**18-Mar-2019**	24-Mar-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) MB19CVM07T, MB19CVM08P	**12-Mar-2019**	**18-Mar-2019**	26-Mar-2019	✓	**18-Mar-2019**	26-Mar-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	2	3	**66.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	4	30	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	3	**66.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	4	26	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	31	**12.90**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	19	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	24	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type *Analytical Methods*	*Method*	*Count* *QC*	 *Regular*	*Rate (%)* ***Actual***	 ***Expected***	 *Evaluation*	*Quality Control Specification*
Laboratory Control Samples (LCS) - Continued							
Nitrite as N by Discrete Analyser	EK057G	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	3	**66.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	2	26	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	31	**12.90**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	5	**40.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	2	3	**66.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	3	**66.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	2	26	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	2	26	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	19	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Standard Anions -by IC (Extended Method)	ED009-X	WATER	In house: Referenced to APHA 4110B. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Major Anions - Dissolved	ED040F	WATER	In house: Referenced to APHA 3120. The 0.45µm filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ferrous Iron by Discrete Analyser	EG051G	WATER	In house: Referenced to APHA 3500 Fe-B. A colorimetric determination based on the reaction between phenanthroline and ferrous iron at pH 3.2-3.3 to form an orange-red complex that is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1906632**	Page	: 1 of 12
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DEAN NEWBORN	Contact	: Customer Services EB
Address	: LEVEL 2, 15 MALLON STREET BOWEN HILLS QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: G1628A	Date Samples Received	: 15-Mar-2019
Order number	:	Date Analysis Commenced	: 15-Mar-2019
C-O-C number	: ----	Issue Date	: 22-Mar-2019
Sampler	: DEAN NEWBORN		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 3		
No. of samples analysed	: 3		

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Santusha Pandra	Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
\# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED009: Anions (QC Lot: 2239022)									
EB1904708-003	Anonymous	ED009-X: Bromide	24959-67-9	0.01	mg/L	7.90	8.45	6.73	0% - 20%
EB1906301-012	Anonymous	ED009-X: Bromide	24959-67-9	0.01	mg/L	0.123	0.126	2.41	0% - 20%
ED009: Anions (QC Lot: 2245576)									
EB1906632-002	MB19CVM07T	ED009-X: Bromide	24959-67-9	0.01	mg/L	0.285	0.310	8.40	0% - 20%
EB1906783-009	Anonymous	ED009-X: Bromide	24959-67-9	0.01	mg/L	52.4	53.4	1.89	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 2240239)									
EB1906645-002	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	9.01	9.02	0.111	0% - 20%
EB1906653-002	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.67	7.67	0.00	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 2240240)									
EB1906645-002	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	6350	6350	0.00	0% - 20%
EB1906653-002	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	582	580	0.346	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 2238916)									
EB1906632-001	MB19CVM03T	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1630	1560	4.07	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2240237)									
EB1906581-004	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	90	91	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	90	91	0.00	0% - 20%
EB1906479-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	163	158	3.12	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	163	158	3.12	0% - 20%
ED040F: Dissolved Major Anions (QC Lot: 2238109)									
EB1906632-001	MB19CVM03T	ED040F: Silicon	7440-21-3	0.05	mg/L	8.47	8.34	1.58	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED040F: Dissolved Major Anions (QC Lot: 2238571)									
EB1906632-002	MB19CVM07T	ED040F: Silicon	7440-21-3	0.05	mg/L	21.8	21.7	0.430	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2238105)									
EB1906600-081	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.00	No Limit
EB1906632-001	MB19CVM03T	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	147	148	0.00	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2238572)									
EB1906659-003	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1320	1360	2.36	0% - 20%
EB1906632-002	MB19CVM07T	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	20	21	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 2238106)									
EB1906600-081	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	2990	3010	0.894	0% - 20%
EB1906632-001	MB19CVM03T	ED045G: Chloride	16887-00-6	1	mg/L	681	679	0.275	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 2238573)									
EB1906632-002	MB19CVM07T	ED045G: Chloride	16887-00-6	1	mg/L	97	97	0.00	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 2238939)									
EB1906645-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	23	22	6.60	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	31	29	8.36	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	850	795	6.72	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	5	4	0.00	No Limit
EB1906632-001	MB19CVM03T	ED093F: Calcium	7440-70-2	1	mg/L	2	3	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	2	2	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	629	614	2.36	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	13	12	0.00	0% - 50%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2238941)									
EB1906645-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.1 µg/L	<0.0001	0.00	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	10 µg/L	0.009	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.137	0.128	6.20	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	2 µg/L	0.002	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	4 µg/L	0.004	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	86 µg/L	0.091	4.87	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	1 µg/L	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<5 µg/L	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	1210 µg/L	1.28	5.14	0% - 20%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<10 µg/L	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<10 µg/L	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	170 µg/L	0.18	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2238941) - continued									
EB1906632-001	MB19CVM03T	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.007	0.008	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.106	0.103	2.96	0% - 20%
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.042	0.041	0.00	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.02	0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.07	0.06	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2238942)									
EB1906645-001	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<1 µg/L	<0.001	0.00	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	3.16	3.24	2.54	0% - 20%
EB1906632-001	MB19CVM03T	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.067	0.066	0.00	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 2239015)									
EB1906447-009	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.0001	0.0002	0.00	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.037	0.037	0.00	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.002	0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.009	0.009	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.054	0.054	0.00	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.001	0.002	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.109	0.108	0.00	0% - 20%
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.58	0.52	10.7	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.07	0.06	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 2239015) - continued									
EB1905206-053	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.016	0.015	0.00	0% - 50%
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.153	0.155	1.25	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.021	0.021	0.00	0% - 20%
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.554	0.528	4.88	0% - 20%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.953	0.934	2.04	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.014	0.014	0.00	0% - 50%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.030	0.008	116	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.03	0.02	44.2	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.16	0.16	6.25	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2239016)									
EB1905206-053	Anonymous	EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.668	0.656	1.67	0% - 20%
EG035F: Dissolved Mercury by FIMS (QC Lot: 2238940)									
EB1906645-002	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.1 µg/L	<0.0001	0.00	No Limit
EB1906632-001	MB19CVM03T	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2239011)									
EB1905206-053	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1906447-010	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG051G: Ferrous Iron by Discrete Analyser (QC Lot: 2242361)									
EB1906632-001	MB19CVM03T	EG051G: Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EB1906813-002	Anonymous	EG051G: Ferrous Iron	----	0.05	mg/L	13.4	13.4	0.366	0% - 20%
EK040P: Fluoride by PC Titrator (QC Lot: 2240236)									
EB1906645-002	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	1.2	1.2	0.00	0% - 50%
EB1906479-003	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2245490)									
EB1906632-001	MB19CVM03T	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.12	0.12	0.00	0% - 50%
EB1906679-005	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	1.42	1.51	5.66	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2238107)									
EB1906600-081	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1906632-001	MB19CVM03T	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2238570)									

Sub-Matrix: **WATER**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2238570) - continued									
EB1906659-003	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.02	0.02	0.00	No Limit
EB1906632-002	MB19CVM07T	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2245491)									
EB1906632-001	MB19CVM03T	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.04	0.04	0.00	No Limit
EB1906679-005	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2245355)									
ET1900877-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.5	1.4	8.96	0% - 50%
EB1906632-001	MB19CVM03T	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.2	0.2	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2245354)									
ET1900884-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	2.83	2.75	3.04	0% - 20%
EB1906632-001	MB19CVM03T	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.02	<0.01	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2238108)									
EB1906632-001	MB19CVM03T	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2238574)									
EB1906632-002	MB19CVM07T	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2240721)									
EB1905161-045	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EB1906634-007	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2240721)									
EB1905161-045	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EB1906634-007	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 2240721)									
EB1905161-045	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EB1906634-007	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
ED009: Anions (QCLot: 2239022)								
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	104	80	115
ED009: Anions (QCLot: 2245576)								
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	96.6	80	115
EA005P: pH by PC Titrator (QCLot: 2240239)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98	102
				----	7 pH Unit	100	98	102
EA010P: Conductivity by PC Titrator (QCLot: 2240240)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	4000 µS/cm	102	91	107
				<1	24800 µS/cm	99.1	91	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 2238916)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	104	88	112
				<10	2000 mg/L	99.2	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 2240237)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	104	80	120
ED040F: Dissolved Major Anions (QCLot: 2238109)								
ED040F: Silicon	7440-21-3	0.05	mg/L	<0.05	----	----	----	----
ED040F: Dissolved Major Anions (QCLot: 2238571)								
ED040F: Silicon	7440-21-3	0.05	mg/L	<0.05	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2238105)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	106	85	118
				<1	100 mg/L	96.8	85	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2238572)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	105	85	118
				<1	100 mg/L	96.6	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 2238106)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	99.4	90	115
				<1	1000 mg/L	105	90	115
ED045G: Chloride by Discrete Analyser (QCLot: 2238573)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.3	90	115
				<1	1000 mg/L	102	90	115
ED093F: Dissolved Major Cations (QCLot: 2238939)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED093F: Dissolved Major Cations (QCLot: 2238939) - continued								
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2238941)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	101	79	118
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	102	87	113
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	103	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	106	81	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	92.0	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	97.0	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	101	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	103	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	108	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	98.6	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	101	89	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	99.4	89	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	100	89	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	105	83	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	111	88	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	98.8	87	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	107	81	125
EG020F: Dissolved Metals by ICP-MS (QCLot: 2238942)								
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.1 mg/L	108	85	114
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.5 mg/L	103	86	111
EG020T: Total Metals by ICP-MS (QCLot: 2239015)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	99.0	80	114
EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	105	87	115
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	108	88	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	99.5	81	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	112	70	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	104	88	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	107	89	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	107	89	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	109	88	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	103	89	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	106	88	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	105	90	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	106	88	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	104	79	111

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
						Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Spike Concentration	LCS	Low	High
EG020T: Total Metals by ICP-MS (QCLot: 2239015) - continued								
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	101	87	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	105	84	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	93.4	82	128
EG020T: Total Metals by ICP-MS (QCLot: 2239016)								
EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	0.1 mg/L	113	84	117
EG020B-T: Strontium	7440-24-6	0.001	mg/L	<0.001	0.5 mg/L	110	86	112
EG035F: Dissolved Mercury by FIMS (QCLot: 2238940)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	96.6	84	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2239011)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	90.2	84	118
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 2242361)								
EG051G: Ferrous Iron	----	0.05	mg/L	<0.05	2 mg/L	92.3	85	120
EK040P: Fluoride by PC Titrator (QCLot: 2240236)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	100	80	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2245490)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	98.9	86	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2238107)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	98.5	90	110
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2238570)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	95.8	90	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2245491)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	95.5	89	115
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2245355)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	96.0	70	108
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2245354)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	93.4	79	105
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2238108)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	102	88	115
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2238574)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	94.0	88	115
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2238290)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	1070 µg/L	80.0	65	135
EP071: C15 - C28 Fraction	----	100	µg/L	<100	1770 µg/L	88.8	62	138
EP071: C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2240721)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	160 µg/L	87.9	67	125

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2238290)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	1560 µg/L	82.3	66	134
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	1190 µg/L	92.2	61	139
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2240721)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	185 µg/L	89.4	66	123
EP080: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
EP080: BTEXN (QCLot: 2240721)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	93.3	73	119
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	94.9	75	119
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	97.1	73	118
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	20 µg/L	95.4	77	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	93.7	76	121
EP080: Total Xylenes	----	2	µg/L	<2	----	----	----	----
EP080: Sum of BTEX	----	1	µg/L	<1	----	----	----	----
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	95.6	75	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED009: Anions (QCLot: 2239022)							
EB1904708-004	Anonymous	ED009-X: Bromide	24959-67-9	0.8 mg/L	92.2	70	130
ED009: Anions (QCLot: 2245576)							
EB1906632-003	MB19CVM08P	ED009-X: Bromide	24959-67-9	0.5 mg/L	# Not Determined	70	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2238105)							
EB1906600-082	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	101	70	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2238572)							
EB1906632-003	MB19CVM08P	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 2238106)							
EB1906600-082	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	71.2	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
ED045G: Chloride by Discrete Analyser (QCLot: 2238573)							
EB1906632-003	MB19CVM08P	ED045G: Chloride	16887-00-6	400 mg/L	74.9	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2238941)							
EB1906632-002	MB19CVM07T	EG020A-F: Aluminium	7429-90-5	0.5 mg/L	95.1	70	130
		EG020A-F: Antimony	7440-36-0	0.1 mg/L	86.2	70	130
		EG020A-F: Arsenic	7440-38-2	0.1 mg/L	101	70	130
		EG020A-F: Beryllium	7440-41-7	0.1 mg/L	94.9	70	130
		EG020A-F: Barium	7440-39-3	0.5 mg/L	93.7	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	95.1	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	95.5	70	130
		EG020A-F: Cobalt	7440-48-4	0.1 mg/L	95.1	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	96.3	70	130
		EG020A-F: Lead	7439-92-1	0.1 mg/L	93.5	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	94.8	70	130
		EG020A-F: Molybdenum	7439-98-7	0.1 mg/L	84.7	70	130
		EG020A-F: Nickel	7440-02-0	0.1 mg/L	96.8	70	130
		EG020A-F: Selenium	7782-49-2	0.1 mg/L	96.0	70	130
		EG020A-F: Vanadium	7440-62-2	0.1 mg/L	98.1	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	97.1	70	130
		EG020A-F: Boron	7440-42-8	0.5 mg/L	94.4	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2239015)							
EB1905206-054	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	109	70	130
		EG020A-T: Beryllium	7440-41-7	0.1 mg/L	92.5	70	130
		EG020A-T: Barium	7440-39-3	1 mg/L	109	70	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	100	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	106	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	105	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	103	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	96.7	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	99.6	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	97.0	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	103	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	95.6	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2238940)							
EB1906632-002	MB19CVM07T	EG035F: Mercury	7439-97-6	0.01 mg/L	83.4	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2239011)							
EB1905206-054	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	70.1	70	130
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 2242361)							
EB1906632-002	MB19CVM07T	EG051G: Ferrous Iron	----	2 mg/L	91.9	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK040P: Fluoride by PC Titrator (QCLot: 2240236)							
EB1906479-004	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	97.6	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2245490)							
EB1906632-002	MB19CVM07T	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	80.1	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2238107)							
EB1906600-082	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	96.8	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2238570)							
EB1906632-003	MB19CVM08P	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	104	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2245491)							
EB1906632-002	MB19CVM07T	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	95.8	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2245355)							
EB1906632-002	MB19CVM07T	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	109	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2245354)							
EB1906632-002	MB19CVM07T	EK067G: Total Phosphorus as P	----	1 mg/L	104	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2238574)							
EB1906632-003	MB19CVM08P	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	104	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2240721)							
EB1906632-001	MB19CVM03T	EP080: C6 - C9 Fraction	----	40 µg/L	82.9	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2240721)							
EB1906632-001	MB19CVM03T	EP080: C6 - C10 Fraction	C6_C10	40 µg/L	86.0	70	130
EP080: BTEXN (QCLot: 2240721)							
EB1906632-001	MB19CVM03T	EP080: Benzene	71-43-2	10 µg/L	98.9	70	130
		EP080: Toluene	108-88-3	10 µg/L	98.6	70	130

MYTC173373

ALS Environmental

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095
Ph: 08 8359 0890 E: adelaide@alsglobal.com

☐BRISBANE 32 Shand Street Stafford QLD 4053
Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680
Ph: 07 7471 5600 E: gladstone@alsglobal.com

☐MACKAY 78 Harbour Road Mackay QLD 4740
Ph: 07 4944 0177 E: mackay@alsglobal.com

☐MELBOURNE 2-4 Westall Road Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

☐MUDGEE 27 Sydney Road Mudgee NSW 2850
Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

☐NEWCASTLE 5/585 Maitland Rd Mayfield West NSW 2304
Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

☐NOWRA 4/13 Geary Place North Nowra NSW 2541
Ph: 024423 2063 E: nowra@alsglobal.com

☐PERTH 10 Hod Way Malaga WA 6090
Ph: 08 9209 7655 E: samples.perth@alsglobal.com

☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818
Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com

☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500
Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: AGE Consultants

OFFICE: Brisbane

PROJECT: G1628A

ORDER NUMBER: EN/222/18

PROJECT MANAGER: David Whiting **CONTACT PH:** 0488 082 311

SAMPLER: Joel Vos **SAMPLER MOBILE:** 0434 562 695

COC emailed to ALS? (YES / NO) **EDD FORMAT (or default):** Default

Email Reports to (will default to PM if no other addresses are listed): dean@ageconsultants.com.au

Email Invoice to (will default to PM if no other addresses are listed): davidw@ageconsultants.com.au

→ joel@ageconsultants.com.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)

☑ Standard TAT **(List due date):**

☐ Non Standard or urgent TAT **(List due date):**

ALS QUOTE NO.:

COC SEQUENCE NUMBER (Circle)

COC: [✓ 1] 2 3 4 5 6 7

OF: [✓ 1] 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact? Yes No N/A

Free ice / frozen ice bricks present upon receipt? Yes No N/A

Random Sample Temperature on Receipt: °C

Other comment:

RELINQUISHED BY:	**RECEIVED BY:**	**RELINQUISHED BY:**	**RECEIVED BY:**
		Attw	DON. B
DATE/TIME:	DATE/TIME:	DATE/TIME: 27.03.19 2:30pm	DATE/TIME: 28-3-19 9.35

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION									Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	**Physical parameters:** pH, EC, TDS, hardness, SAR	**Cations/anions:** CO3, HCO3, Cl, SO4, Ca, Mg, Na, K	Bromide, silicon and fluoride.	**Dissolved/total metals:** Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe2+, Hg, Mn, Mo, Ni, Pb, Sb, Sr, Se, V, Zn	**TRH/TPH:** (C6 - C40) / (C6 - C36)	**Nutrients:** NH3-N, NO2, NO3, NOx, TKN, Total N, reactive P, total P	**BTEXN:** benzene, toluene, ethyl benzene, meta- & para-xylene, ortho-xylene, total xylenes, sum of BTEX, and naphthalene	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	5T	23.03.19, 8:10	W	As required	8	x	x	x	x	x	x	x	PLEASE TEST FOR BTEX
	6P	23.03.19, 9:45	W	As required	8	x	x	x	x	x	x	x	AS LISTED ON LEFT
			~~W~~	~~As required~~	~~8~~	~~x~~	~~x~~	~~x~~	~~x~~	~~x~~	~~x~~	~~x~~	FOR 5T - SMALL
													PURPLE VIALS ARE
													FOR TOC → UNDERSTOOD
													TO BE FOR BTEX?
				TOTAL	16 ~~24~~	3	3	3	3	3	3	3	

Environmental Division
Brisbane
Work Order Reference
EB1907985

Telephone : + 61-7-3243 7222

HT

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB1907985**

Client : **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**
Contact : DAVID WHITING
Address : LEVEL 2, 15 MALLON STREET
BOWEN HILLS QLD, AUSTRALIA 4006

E-mail : davidw@ageconsultants.com.au
Telephone : ----
Facsimile : ----

Project : G1628A
Order number : EN/222/18
C-O-C number : ----
Site : ----
Sampler : JOEL VOS

Laboratory : Environmental Division Brisbane
Contact : Customer Services EB
Address : 2 Byth Street Stafford QLD Australia 4053

E-mail : ALSEnviro.Brisbane@alsglobal.com
Telephone : +61-7-3243 7222
Facsimile : +61-7-3243 7218

Page : 1 of 3
Quote number : EB2017AUSGRO0001 (EN/222)
QC Level : NEPM 2013 B3 & ALS QC Standard

Dates

Date Samples Received : 28-Mar-2019 09:35
Client Requested Due Date : 03-Apr-2019

Issue Date : 28-Mar-2019
Scheduled Reporting Date : **03-Apr-2019**

Delivery Details

Mode of Delivery : Carrier
No. of coolers/boxes : 1
Receipt Detail : SMALL ESKY

Security Seal : Intact.
Temperature : 15.4°C - Ice present
No. of samples received / analysed : 2 / 2

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - EA005P pH (PCT)	WATER - EA010P Electrical Conductivity (PCT)	WATER - EA015H Total Dissolved Solids - Standard Level	WATER - NT-02A Major Anions (Cl, SO4, Fluoride, Alkalinity)	WATER - NT-08A Total Nitrogen + NO2 + NO3 + NH3 + Total P +	WATER - W-02 8 Metals	WATER - W-04 TRH/BTEXN
EB1907985-001	23-Mar-2019 08:10	5T	✓	✓	✓	✓	✓	✓	✓
EB1907985-002	23-Mar-2019 09:45	6P	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - ED009-X Standard Anions (Extended method	WATER - ED040F Dissolved Major Anions	WATER - EG020F Dissolved Metals by ICP/MS	WATER - EG020T Total Metals by ICP/MS (including digestion)	WATER - EN055 - PG Ionic Balance by ED037P, ED041G, ED045G &	WATER - NT-01D + SAR Major Cations (Ca, Mg, Na, K) + Hardness + SAR	WATER - W-02T 8 metals (Total)
EB1907985-001	23-Mar-2019 08:10	5T	✓	✓	✓	✓	✓	✓	✓
EB1907985-002	23-Mar-2019 09:45	6P	✓	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - EG051G Ferrous Iron
EB1907985-001	23-Mar-2019 08:10	5T	✓
EB1907985-002	23-Mar-2019 09:45	6P	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method **Client Sample ID(s)**	**Container**	**Due for extraction**	**Due for analysis**	**Samples Received**		**Instructions Received**	
				Date	**Evaluation**	**Date**	**Evaluation**
EA005-P: pH by PC Titrator							
5T	Clear Plastic Bottle - Natural	----	23-Mar-2019	28-Mar-2019	×	----	----
6P	Clear Plastic Bottle - Natural	----	23-Mar-2019	28-Mar-2019	×	----	----
EG051G: Ferrous Iron by Discrete Analyser							
5T	Clear Plastic Bottle - HCl	----	24-Mar-2019	28-Mar-2019	×	----	----
6P	Clear Plastic Bottle - HCl	----	24-Mar-2019	28-Mar-2019	×	----	----
EK057G: Nitrite as N by Discrete Analyser							
5T	Clear Plastic Bottle - Natural	----	25-Mar-2019	28-Mar-2019	×	----	----
6P	Clear Plastic Bottle - Natural	----	25-Mar-2019	28-Mar-2019	×	----	----
EK071G: Reactive Phosphorus as P-By Discrete Analyser							
5T	Clear Plastic Bottle - Natural	----	25-Mar-2019	28-Mar-2019	×	----	----
6P	Clear Plastic Bottle - Natural	----	25-Mar-2019	28-Mar-2019	×	----	----

Requested Deliverables

ALL INVOICES		
- A4 - AU Tax Invoice (INV)	Email	brisbane@ageconsultants.com.au
DAVID WHITING		
- *AU Certificate of Analysis - NATA (COA)	Email	davidw@ageconsultants.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	davidw@ageconsultants.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	davidw@ageconsultants.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	davidw@ageconsultants.com.au
- A4 - AU Tax Invoice (INV)	Email	davidw@ageconsultants.com.au
- Chain of Custody (CoC) (COC)	Email	davidw@ageconsultants.com.au
- EDI Format - XTab (XTAB)	Email	davidw@ageconsultants.com.au
DEAN NEWBORN		
- *AU Certificate of Analysis - NATA (COA)	Email	dean@ageconsultants.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	dean@ageconsultants.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	dean@ageconsultants.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	dean@ageconsultants.com.au
- Chain of Custody (CoC) (COC)	Email	dean@ageconsultants.com.au
- EDI Format - XTab (XTAB)	Email	dean@ageconsultants.com.au
INVOICES BOWEN HILLS		
- A4 - AU Tax Invoice (INV)	Email	brisbane@ageconsultants.com.au
JOEL VOS		
- *AU Certificate of Analysis - NATA (COA)	Email	joel@ageconsultants.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	joel@ageconsultants.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	joel@ageconsultants.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	joel@ageconsultants.com.au
- Chain of Custody (CoC) (COC)	Email	joel@ageconsultants.com.au
- EDI Format - XTab (XTAB)	Email	joel@ageconsultants.com.au

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1907985**	Page	: 1 of 7
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DAVID WHITING	Contact	: Customer Services EB
Address	: LEVEL 2, 15 MALLON STREET BOWEN HILLS QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: G1628A	Date Samples Received	: 28-Mar-2019 09:35
Order number	: EN/222/18	Date Analysis Commenced	: 28-Mar-2019
C-O-C number	: ----	Issue Date	: 03-Apr-2019 16:12
Sampler	: JOEL VOS		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 2		
No. of samples analysed	: 2		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Santusha Pandra	Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

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

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

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

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

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

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

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

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**5T**	**6P**	**----**	**----**	**----**
			Client sampling date / time	23-Mar-2019 08:10	23-Mar-2019 09:45	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1907985-001**	**EB1907985-002**	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.54**	**7.81**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1420**	**19500**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**784**	**13800**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**30**	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**326**	**254**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**357**	**254**	----	----	----
ED040F: Dissolved Major Anions								
Sulfate as SO4 2-	14808-79-8	1	mg/L	**59**	**1500**	----	----	----
Sulfur as S	63705-05-5	1	mg/L	**20**	**499**	----	----	----
Silicon as SiO2	14464-46-1	0.1	mg/L	**27.5**	**19.0**	----	----	----
Silicon	7440-21-3	0.05	mg/L	**12.8**	**8.88**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**54**	**1390**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**258**	**6980**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**48**	**806**	----	----	----
Magnesium	7439-95-4	1	mg/L	**62**	**1090**	----	----	----
Sodium	7440-23-5	1	mg/L	**180**	**2020**	----	----	----
Potassium	7440-09-7	1	mg/L	**5**	**17**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**375**	**6500**	----	----	----
^ **Sodium Adsorption Ratio**	----	0.01	-	**4.04**	**10.9**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	<0.01	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.001**	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.124**	**0.127**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Client sample ID	**5T**	**6P**	**----**	**----**	**----**
			Client sampling date / time	23-Mar-2019 08:10	23-Mar-2019 09:45	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1907985-001**	**EB1907985-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	**0.001**	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.003**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	**0.004**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.011**	**0.334**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.006**	**0.002**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**1.03**	**17.2**	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.13**	**0.23**	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.75**	**0.11**	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.002**	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.131**	**0.133**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.004**	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.003**	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.001**	**0.004**	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.004**	**0.006**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.013**	<0.005	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.043**	**0.327**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.006**	**0.002**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**1.03**	**17.8**	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.13**	**0.25**	----	----	----
EG035F: Dissolved Mercury by FIMS								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**5T**	**6P**	**----**	**----**	**----**
			Client sampling date / time	23-Mar-2019 08:10	23-Mar-2019 09:45	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB1907985-001**	**EB1907985-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG035F: Dissolved Mercury by FIMS - Continued								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.2**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.18**	**1.01**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.01**	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.01**	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.4**	**1.4**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**0.4**	**1.4**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.09**	**0.09**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	----	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**15.5**	**231**	----	----	----
Total Cations	----	0.01	meq/L	**15.4**	**218**	----	----	----
Ionic Balance	----	0.01	%	**0.26**	**2.82**	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L	**270**	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L	**670**	<50	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**940**	<50	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**5T**	**6P**	**----**	**----**	**----**
			Client sampling date / time	23-Mar-2019 08:10	23-Mar-2019 09:45	----	----	----
Compound	CAS Number	LOR	Unit	**EB1907985-001**	**EB1907985-002**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L	**770**	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L	**340**	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**1110**	<100	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----
Toluene	108-88-3	2	µg/L	<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
^ **Total Xylenes**	----	2	µg/L	<2	<2	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	----	----	----
ED009: Anions								
Bromide	24959-67-9	0.010	mg/L	**0.425**	**12.5**	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**103**	**102**	----	----	----
Toluene-D8	2037-26-5	2	%	**98.8**	**98.6**	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**102**	**102**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	66	138
Toluene-D8	2037-26-5	79	120
4-Bromofluorobenzene	460-00-4	74	118

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1907985**	Page	: 1 of 10
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DAVID WHITING	Telephone	: +61-7-3243 7222
Project	: G1628A	Date Samples Received	: 28-Mar-2019
Site	: ----	Issue Date	: 03-Apr-2019
Sampler	: JOEL VOS	No. of samples received	: 2
Order number	: EN/222/18	No. of samples analysed	: 2

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)	*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
5T, 6P	----	----	----	02-Apr-2019	23-Mar-2019	**10**
EG051G: Ferrous Iron by Discrete Analyser						
Clear Plastic Bottle - HCl						
5T, 6P	----	----	----	29-Mar-2019	24-Mar-2019	**5**
EK057G: Nitrite as N by Discrete Analyser						
Clear Plastic Bottle - Natural						
5T, 6P	----	----	----	28-Mar-2019	25-Mar-2019	**3**
EK071G: Reactive Phosphorus as P by discrete analyser						
Clear Plastic Bottle - Natural						
5T, 6P	----	----	----	28-Mar-2019	25-Mar-2019	**3**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
TRH - Semivolatile Fraction	0	12	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
TRH - Semivolatile Fraction	0	12	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method	***Sample Date***	*Extraction / Preparation*			*Analysis*		
***Container** / Client Sample ID(s)*		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
5T, 6P	**23-Mar-2019**	**----**	----	----	**02-Apr-2019**	23-Mar-2019	✗
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
5T, 6P	**23-Mar-2019**	**----**	----	----	**02-Apr-2019**	20-Apr-2019	✓

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H) 5T, 6P	**23-Mar-2019**	**----**	----	----	**29-Mar-2019**	30-Mar-2019	✓
ED009: Anions							
Clear Plastic Bottle - Natural (ED009-X) 5T, 6P	**23-Mar-2019**	**----**	----	----	**30-Mar-2019**	20-Apr-2019	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) 5T, 6P	**23-Mar-2019**	**----**	----	----	**02-Apr-2019**	06-Apr-2019	✓
ED040F: Dissolved Major Anions							
Clear Plastic Bottle - Natural (ED040F) 5T, 6P	**23-Mar-2019**	**----**	----	----	**29-Mar-2019**	20-Apr-2019	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) 5T, 6P	**23-Mar-2019**	**----**	----	----	**28-Mar-2019**	20-Apr-2019	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) 5T, 6P	**23-Mar-2019**	**----**	----	----	**28-Mar-2019**	20-Apr-2019	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) 5T, 6P	**23-Mar-2019**	**----**	----	----	**01-Apr-2019**	20-Apr-2019	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) 5T, 6P	**23-Mar-2019**	**----**	----	----	**01-Apr-2019**	20-Apr-2019	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020B-F) 5T, 6P	**23-Mar-2019**	**----**	----	----	**01-Apr-2019**	19-Sep-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020B-T) 5T, 6P	**23-Mar-2019**	**02-Apr-2019**	19-Sep-2019	✓	**02-Apr-2019**	19-Sep-2019	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) 5T, 6P	**23-Mar-2019**	**----**	----	----	**01-Apr-2019**	20-Apr-2019	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T) 5T, 6P	**23-Mar-2019**	**----**	----	----	**02-Apr-2019**	20-Apr-2019	✓
EG051G: Ferrous Iron by Discrete Analyser							
Clear Plastic Bottle - HCl (EG051G) 5T, 6P	**23-Mar-2019**	**----**	----	----	**29-Mar-2019**	24-Mar-2019	✗

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P) 5T, 6P	**23-Mar-2019**	**----**	----	----	**02-Apr-2019**	20-Apr-2019	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) 5T	**23-Mar-2019**	**----**	----	----	**02-Apr-2019**	20-Apr-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) 6P	**23-Mar-2019**	**----**	----	----	**29-Mar-2019**	20-Apr-2019	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) 5T, 6P	**23-Mar-2019**	**----**	----	----	**28-Mar-2019**	25-Mar-2019	✗
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) 5T	**23-Mar-2019**	**----**	----	----	**02-Apr-2019**	20-Apr-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) 6P	**23-Mar-2019**	**----**	----	----	**29-Mar-2019**	20-Apr-2019	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) 5T, 6P	**23-Mar-2019**	**01-Apr-2019**	20-Apr-2019	✓	**01-Apr-2019**	20-Apr-2019	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) 5T, 6P	**23-Mar-2019**	**01-Apr-2019**	20-Apr-2019	✓	**01-Apr-2019**	20-Apr-2019	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) 5T, 6P	**23-Mar-2019**	**----**	----	----	**28-Mar-2019**	25-Mar-2019	✗
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071) 5T, 6P	**23-Mar-2019**	**29-Mar-2019**	30-Mar-2019	✓	**29-Mar-2019**	08-May-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) 5T, 6P	**23-Mar-2019**	**29-Mar-2019**	06-Apr-2019	✓	**29-Mar-2019**	06-Apr-2019	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071) 5T, 6P	**23-Mar-2019**	**29-Mar-2019**	30-Mar-2019	✓	**29-Mar-2019**	08-May-2019	✓
Amber VOC Vial - Sulfuric Acid (EP080) 5T, 6P	**23-Mar-2019**	**29-Mar-2019**	06-Apr-2019	✓	**29-Mar-2019**	06-Apr-2019	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080) 5T, 6P	**23-Mar-2019**	**29-Mar-2019**	06-Apr-2019	✓	**29-Mar-2019**	06-Apr-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		*Count*		*Rate (%)*			*Quality Control Specification*
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	4	35	**11.43**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	4	36	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	12	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	36	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Dissolved	ED040F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	36	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite B	EG020B-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	36	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions -by IC (Extended Method)	ED009-X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	12	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of \`filterable\` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Standard Anions -by IC (Extended Method)	ED009-X	WATER	In house: Referenced to APHA 4110B. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Major Anions - Dissolved	ED040F	WATER	In house: Referenced to APHA 3120. The 0.45µm filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocyanate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ferrous Iron by Discrete Analyser	EG051G	WATER	In house: Referenced to APHA 3500 Fe-B. A colorimetric determination based on the reaction between phenanthroline and ferrous iron at pH 3.2-3.3 to form an orange-red complex that is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

QUALITY CONTROL REPORT

Work Order	: **EB1907985**	Page	: 1 of 12
Client	: **AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: DAVID WHITING	Contact	: Customer Services EB
Address	: LEVEL 2, 15 MALLON STREET BOWEN HILLS QLD, AUSTRALIA 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: G1628A	Date Samples Received	: 28-Mar-2019
Order number	: EN/222/18	Date Analysis Commenced	: 28-Mar-2019
C-O-C number	: ----	Issue Date	: 03-Apr-2019
Sampler	: JOEL VOS		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 2		
No. of samples analysed	: 2		

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Santusha Pandra	Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED009: Anions (QC Lot: 2267863)									
EB1907562-002	Anonymous	ED009-X: Bromide	24959-67-9	0.01	mg/L	56.0	54.2	3.17	0% - 20%
EB1907761-001	Anonymous	ED009-X: Bromide	24959-67-9	0.01	mg/L	0.052	0.051	0.00	0% - 20%
EA005P: pH by PC Titrator (QC Lot: 2269793)									
EB1907981-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.79	7.80	0.128	0% - 20%
EB1908012-002	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.13	8.10	0.370	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 2269794)									
EB1907981-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	249 mS/m	2480	0.404	0% - 20%
EB1908012-002	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	210	211	0.475	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 2265089)									
EB1907933-004	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	3790	3820	0.880	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2269792)									
EB1907981-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	72	74	1.49	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	72	74	1.49	0% - 20%
EB1908012-002	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	82	82	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	82	82	0.00	0% - 20%
ED040F: Dissolved Major Anions (QC Lot: 2264478)									
EB1907783-001	Anonymous	ED040F: Silicon	7440-21-3	0.05	mg/L	5.81	5.79	0.289	0% - 20%
		ED040F: Silicon as SiO2	14464-46-1	0.1	mg/L	12.4	12.4	0.00	0% - 20%
		ED040F: Sulfate as SO4 2-	14808-79-8	1	mg/L	5	6	0.00	No Limit
		ED040F: Sulfur as S	63705-05-5	1	mg/L	2	2	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2264476)									
EB1907985-002	6P	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1390	1400	0.852	0% - 20%
EB1907783-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	5	5	0.00	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 2264477)									
EB1907985-002	6P	ED045G: Chloride	16887-00-6	1	mg/L	6980	7010	0.417	0% - 20%
EB1907783-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	16	16	0.00	0% - 50%
ED093F: Dissolved Major Cations (QC Lot: 2265162)									
EB1907987-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	22	22	0.00	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	2	2	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	31	31	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.00	No Limit
EB1907963-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	288	292	1.34	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	547	559	2.09	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	4160	4220	1.44	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	119	120	1.39	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2265159)									
EB1907757-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.057	0.055	2.69	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.008	0.007	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.007	0.007	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.01	0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.15	0.15	0.00	No Limit
EB1907963-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0004	0.0004	0.00	No Limit
		EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.027	0.027	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.337	0.340	0.971	0% - 20%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.00	No Limit

Sub-Matrix: **WATER**				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2265159) - continued									
EB1907963-002	Anonymous	EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	2.62	2.64	1.06	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.558	0.556	0.295	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	1.22	1.22	0.170	0% - 20%
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	2.46	2.46	0.00	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2265160)									
EB1907757-001	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.777	0.783	0.823	0% - 20%
EB1907963-002	Anonymous	EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020B-F: Strontium	7440-24-6	0.001	mg/L	5.64	5.57	1.18	0% - 20%
EG020T: Total Metals by ICP-MS (QC Lot: 2265250)									
EB1907733-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.0004	<0.0001	117	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.002	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EB1907978-004	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.005	0.003	52.5	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.003	0.003	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 2265250) - continued									
EB1907978-004	Anonymous	EG020A-T: Lead	7439-92-1	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.093	0.100	6.86	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.008	0.008	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.016	0.015	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.07	0.08	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2265251)									
EB1907783-001	Anonymous	EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.172	0.183	6.15	0% - 20%
EB1907978-004	Anonymous	EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020B-T: Strontium	7440-24-6	0.001	mg/L	0.158	0.158	0.00	0% - 20%
EG035F: Dissolved Mercury by FIMS (QC Lot: 2265161)									
EB1907978-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1907757-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2265255)									
EB1907783-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1907987-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG051G: Ferrous Iron by Discrete Analyser (QC Lot: 2265906)									
EB1907804-001	Anonymous	EG051G: Ferrous Iron	----	0.05	mg/L	66.0	66.8	1.22	0% - 20%
EK040P: Fluoride by PC Titrator (QC Lot: 2269795)									
EB1908012-002	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EB1908095-003	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.1	0.1	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2266650)									
EB1907815-046	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.72	0.72	0.00	0% - 20%
EB1907815-056	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.97	0.97	0.00	0% - 20%
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2268716)									
EB1907981-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.25	0.25	0.00	0% - 20%
EB1907991-003	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	30 µg/L	0.03	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2264474)									
EB1907779-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1907985-002	6P	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2266651)									
EB1907815-046	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1907815-056	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.03	106	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2268717)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2268717) - continued									
EB1907981-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.23	0.24	0.00	0% - 20%
EB1907991-003	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2267042)									
EB1907817-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.1	<0.1	0.00	No Limit
EB1908090-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.2	0.2	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2267043)									
EB1907817-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.04	0.04	0.00	No Limit
EB1908090-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.02	0.01	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2264475)									
EB1907779-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.02	0.02	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2265317)									
EB1905514-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EB1905514-014	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 2265317)									
EB1905514-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EB1905514-014	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 2265317)									
EB1905514-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
EB1905514-014	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED009: Anions (QCLot: 2267863)								
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	104	80	115
EA005P: pH by PC Titrator (QCLot: 2269793)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	101	98	102
				----	7 pH Unit	100	98	102
EA010P: Conductivity by PC Titrator (QCLot: 2269794)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	4000 µS/cm	98.3	91	107
				<1	12890 µS/cm	95.9	91	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 2265089)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	106	88	112
				<10	2000 mg/L	95.4	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 2269792)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	96.5	80	120
ED040F: Dissolved Major Anions (QCLot: 2264478)								
ED040F: Sulfate as SO4 2-	14808-79-8	1	mg/L	<1	----	----	----	----
ED040F: Sulfur as S	63705-05-5	1	mg/L	<1	----	----	----	----
ED040F: Silicon as SiO2	14464-46-1	0.1	mg/L	<0.1	----	----	----	----
ED040F: Silicon	7440-21-3	0.05	mg/L	<0.05	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2264476)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	105	85	118
				<1	100 mg/L	97.4	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 2264477)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	98.5	90	115
				<1	1000 mg/L	106	90	115
ED093F: Dissolved Major Cations (QCLot: 2265162)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2265159)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	95.4	79	118
EG020A-F: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	105	87	113
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	102	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	90.1	81	117

Sub-Matrix: **WATER**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG020F: Dissolved Metals by ICP-MS (QCLot: 2265159) - continued								
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	95.6	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	94.3	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	94.8	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	97.3	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	106	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	95.6	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	98.5	89	120
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	106	89	112
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	106	89	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	99.9	83	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	103	88	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	98.1	87	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	96.0	81	125
EG020F: Dissolved Metals by ICP-MS (QCLot: 2265160)								
EG020B-F: Silver	7440-22-4	0.001	mg/L	<0.001	0.1 mg/L	96.3	85	114
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.5 mg/L	99.1	86	111
EG020T: Total Metals by ICP-MS (QCLot: 2265250)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	96.8	80	114
EG020A-T: Antimony	7440-36-0	0.001	mg/L	<0.001	0.1 mg/L	108	87	115
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.5	88	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	95.6	81	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	101	70	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	94.9	88	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	100	89	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	104	89	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	113	88	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	101	89	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	98.6	88	114
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	107	90	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	107	88	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	100	79	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	102	87	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	98.2	84	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	103	82	128
EG020T: Total Metals by ICP-MS (QCLot: 2265251)								
EG020B-T: Silver	7440-22-4	0.001	mg/L	<0.001	0.1 mg/L	102	84	117
EG020B-T: Strontium	7440-24-6	0.001	mg/L	<0.001	0.5 mg/L	107	86	112
EG035F: Dissolved Mercury by FIMS (QCLot: 2265161)								

Sub-Matrix: **WATER**

				Method Blank (MB) Report	*Laboratory Control Spike (LCS) Report*			
					Spike	*Spike Recovery (%)*	*Recovery Limits (%)*	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG035F: Dissolved Mercury by FIMS (QCLot: 2265161) - continued								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	103	84	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2265255)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	101	84	118
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 2265906)								
EG051G: Ferrous Iron	----	0.05	mg/L	<0.05	2 mg/L	91.9	85	120
EK040P: Fluoride by PC Titrator (QCLot: 2269795)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	98.0	80	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2266650)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	94.6	86	112
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2268716)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	89.9	86	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2264474)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	101	90	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2266651)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	101	89	115
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2268717)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	97.7	89	115
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2267042)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	1 mg/L	81.6	70	108
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2267043)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	0.442 mg/L	96.8	79	105
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2264475)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	107	88	115
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2265317)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	160 µg/L	104	67	125
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2266943)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	1070 µg/L	89.2	65	135
EP071: C15 - C28 Fraction	----	100	µg/L	<100	1770 µg/L	85.6	62	138
EP071: C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2265317)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	185 µg/L	106	66	123
EP080: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2266943)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	1560 µg/L	89.5	66	134
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	1190 µg/L	85.9	61	139

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2266943) - continued								
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
EP080: BTEXN (QCLot: 2265317)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	101	73	119
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	97.4	75	119
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	94.2	73	118
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	20 µg/L	96.0	77	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	94.6	76	121
EP080: Total Xylenes	----	2	µg/L	<2	----	----	----	----
EP080: Sum of BTEX	----	1	µg/L	<1	----	----	----	----
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	97.2	75	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
				Concentration	MS	Low	High
ED009: Anions (QCLot: 2267863)							
EB1907562-004	Anonymous	ED009-X: Bromide	24959-67-9	0.5 mg/L	98.6	70	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2264476)							
EB1907783-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	86.0	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 2264477)							
EB1907783-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	108	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2265159)							
EB1907757-002	Anonymous	EG020A-F: Aluminium	7429-90-5	0.5 mg/L	95.4	70	130
		EG020A-F: Antimony	7440-36-0	0.1 mg/L	93.3	70	130
		EG020A-F: Arsenic	7440-38-2	0.1 mg/L	102	70	130
		EG020A-F: Beryllium	7440-41-7	0.1 mg/L	97.0	70	130
		EG020A-F: Barium	7440-39-3	0.5 mg/L	102	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	94.5	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	90.7	70	130
		EG020A-F: Cobalt	7440-48-4	0.1 mg/L	91.5	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	98.6	70	130
		EG020A-F: Lead	7439-92-1	0.1 mg/L	96.1	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	92.4	70	130
		EG020A-F: Molybdenum	7439-98-7	0.1 mg/L	100	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2265159) - continued							
EB1907757-002	Anonymous	EG020A-F: Nickel	7440-02-0	0.1 mg/L	98.2	70	130
		EG020A-F: Selenium	7782-49-2	0.1 mg/L	95.9	70	130
		EG020A-F: Vanadium	7440-62-2	0.1 mg/L	96.8	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	92.9	70	130
		EG020A-F: Boron	7440-42-8	0.5 mg/L	103	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2265250)							
EB1907733-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	97.6	70	130
		EG020A-T: Beryllium	7440-41-7	0.1 mg/L	87.6	70	130
		EG020A-T: Barium	7440-39-3	1 mg/L	101	70	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	95.6	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	101	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	102	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	98.2	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	97.3	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	96.0	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	97.6	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	99.1	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	90.1	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2265161)							
EB1907757-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	78.9	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2265255)							
EB1907783-002	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	89.7	70	130
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 2265906)							
EB1907923-001	Anonymous	EG051G: Ferrous Iron	----	2 mg/L	100	70	130
EK040P: Fluoride by PC Titrator (QCLot: 2269795)							
EB1907985-001	5T	EK040P: Fluoride	16984-48-8	5 mg/L	95.8	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2266650)							
EB1907815-047	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	90.5	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2268716)							
EB1907981-003	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	101	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2264474)							
EB1907779-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	95.2	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2266651)							
EB1907815-047	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	96.4	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2268717)							
EB1907981-003	Anonymous						

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2268717) - continued							
EB1907981-003	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	108	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2267042)							
EB1907841-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	25 mg/L	100	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2267043)							
EB1907829-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	103	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2264475)							
EB1907779-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	102	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2265317)							
EB1905514-002	Anonymous	EP080: C6 - C9 Fraction	----	40 µg/L	89.1	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 2265317)							
EB1905514-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	40 µg/L	108	70	130
EP080: BTEXN (QCLot: 2265317)							
EB1905514-002	Anonymous	EP080: Benzene	71-43-2	10 µg/L	100	70	130
		EP080: Toluene	108-88-3	10 µg/L	96.2	70	130

Appendix B – Groundwater Modelling Technical Report

CAVAL RIDGE MINE

Horse Pit Extension Project
Groundwater Modelling Technical Report

Prepared for:

BMA
480 Queen St
Brisbane QLD 4000 Australia

SLR Ref: 620.13593.00005-R02
Version No: -v7.0
August 2021

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with BMA (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
620.13593.00005-R02-v7.0	25 August 2021	Arash Mohajeri	Derwin Lyons	Derwin Lyons
620.13593.00005-R02-v6.0	13 August 2021	Arash Mohajeri	Derwin Lyons	Derwin Lyons
620.13593.00005-R02-v5.0	5 August 2021	Arash Mohajeri	Derwin Lyons	Derwin Lyons
620.13593.00005-R02-v4.0	19 July 2021	Arash Mohajeri	Derwin Lyons	Derwin Lyons
620.13593.00005-R02-v3.0	7 July 2021	Arash Mohajeri	Derwin Lyons	Derwin Lyons
620.13593.00005-R02-v2.0	4 June 2021	Arash Mohajeri	Brian Rask	Brian Rask
620.13593.00005-R02-v1.0	6 April 2021	Arash Mohajeri	Brian Rask	Derwin Lyons

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by BM Alliance Coal Operations Pty Ltd (BMA) to undertake a Groundwater Assessment for the Caval Ridge Mine (CVM) Horse Pit Extension (HPE) Project, for incorporation into an application for an EA Amendment and EPBC Act Approval.

As a part of the Groundwater Assessment, numerical groundwater modelling was undertaken to predict impacts of the Project on the local groundwater regime. The overall objectives of this modelling are to:

- assess the groundwater inflow to the mine workings as a function of mine position and timing;
- simulate and predict the extent of dewatering due to the Project and the level and rate of drawdown at specific locations; and
- identify areas of potential risk, where groundwater impact management measures may be necessary.

Conceptualisation of the groundwater regime and the calibration of the model against observed data are key to achieving a reliable numerical model. Conceptualisation is a simplified overview of the groundwater regime (i.e. the distribution and flow of groundwater) based on available data and experience. Consistency between numerical model results and the conceptual understanding of the groundwater regime increases the credibility of the numerical model predictions. The conceptualisation of the groundwater regime was carried out by SLR in 2021 and is reported in the *Caval Ridge Mine Horse Pit Extension Project Groundwater Impact Assessment Report* (SLR, 2021a) of which this groundwater modelling technical report forms an appendix.

Confidence in the numerical model is increased by calibration of numerical model results against observed data. A well calibrated model has demonstrated the ability to simulate groundwater levels that approximate observed levels at specific locations.

The numerical groundwater model for the Project builds on the Olive Downs Project model (the foundational model) (HydroSimulations, 2018). The foundational model was subsequently updated for the Moorvale South Project in 2019 (SLR, 2019) and again for the Winchester South Project in 2020 (SLR, 2020), and most recently for the Lake Vermont North Project (in conjunction with the Project). BMA has established groundwater data sharing agreements with the owners of each of these projects/mines, which allows for the sharing of groundwater data, models and documentation. Under these agreements, the groundwater models developed as part of each project/mine's groundwater assessment have been adopted as a base for the Project groundwater assessment where relevant. Of note, the current update of the groundwater model reported herein is the first iteration to include data and information from the Lake Vermont North Project as well as a number of BHP sites (CVM, Poitrel, Daunia and Saraji).

Previous groundwater modelling for CVM includes the GHD (2017) numerical groundwater model. The GHD (2017) was built on the site geological model and reported on the model calibration, predicted mine inflows, predicted drawdown extents. The GHD model did not simulate cumulative impacts from the neighbouring mines. The results from this modelling work are compared against the GHD (2017) model in **Section 2.6.2**, **Section 3.4** and **Section 3.5**.

A range of model updates were deemed required for the model to be considered fit for purpose for the Project. The updates to the model design from that reported in SLR (2020) included:

- Model extent and grid – revise grid extent and refinement around CVM pits.
- Model layers – update layers to deepest mined seams at CVM, capture stratification of alluvium and update model layers to match CVM geological model surfaces and update LiDAR data.

- Timing – update calibration model to extend to December 2020 and refine timing to capture seasonality and mine progression changes.
- Boundary Conditions – update model boundary conditions with revised grid extent and regional flows.
- Stresses – Maintain inputs, but with updates from more recent and site-specific data.

Further details on the updates are discussed in **Section 2** of this modelling report which presents how the conceptualisation has been developed as a numerical groundwater model, and **Section 2.6** presents how well the model replicates observed data (calibration). Details on how the model represents the Project and other future approved and foreseeable activities within the region is outlined within **Section 3** of this report.

2 Model Construction and Development

2.1 Model Code

MODFLOW-USG Transport was used as the model code (Panday *et al.* 2013). MODFLOW-USG is the latest version of industry standard MODFLOW code and was determined to be the most suitable modelling code for accomplishing the model objectives. MODFLOW-USG optimises the model grid and increases numerical stability by using unstructured, variably sized cells. These cells take any polygonal shape, with variable size constraints allowing for refinement in areas of interest (i.e. geological or mining features).

Where previous MODFLOW versions restricted interlayer flow to vertical connectivity, MODFLOW-USG offers lateral connectivity between model layers. Lateral connectivity enables more accurate representations of hydrostratigraphic units, particularly those that pinch out, outcrop, or cross geological faults.

MODFLOW-USG is also able to simulate unsaturated conditions, allowing progressive mine dewatering and post closure rewetting to be represented by the model. For the Project model, vadose zone properties have been excluded, and the unsaturated zone was simulated using the upstream-weighting method.

Fortran code and a MODFLOW-USG edition of the Groundwater Data Utilities (Watermark Numerical Computing) were used to construct the MODFLOW-USG input files.

2.2 Model Extent and Mesh Design

The model extent has been updated from the Winchester South Project model (SLR, 2020) through the extension of the model domain into the north, west and northwest (**Figure 2-1**). Herein, this report will use the term "model extension" to refer to the additional area now occupied by the model. The model extension is intended to place boundary conditions sufficiently distant from the Project so as not affect the modelling results (i.e. no edge effects). The model domain is designed large enough to allow the adjacent mines/projects to be assessed for potential cumulative impacts.

Major watercourses within the model domain are also shown in **Figure 2-1.** As discussed in Groundwater Impact Assessment Report (SLR, 2021a), the watercourses have been classified as "Major" or "Minor" based on the Hierarchy attribute within the Geoscience Australia dataset.

To reduce the number of the model cells away from the Project area, the eastern boundary of the model was brought in to follow the Devlin Creek. Elsewhere along the model perimeter, boundary locations are consistent with those of the Winchester South Project model (SLR, 2020).

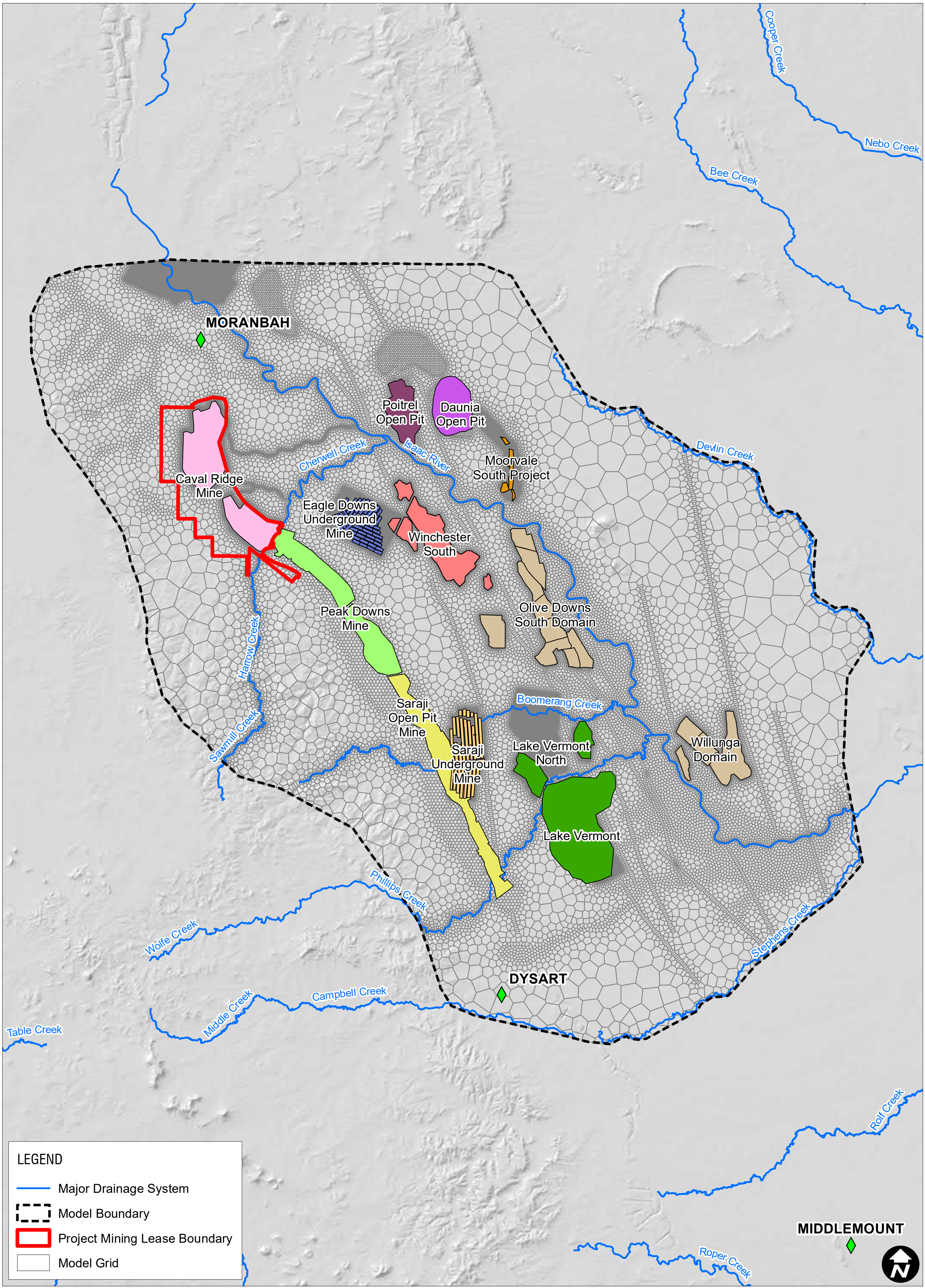
The model encompasses the Project and elongation is in the direction of geological strike (northwest to southeast). At its widest extents, the model is approximately 62 kilometres (km) x 95 km. The model domain was selected based on the following considerations:

- The western boundary is represented by the outcrop boundary of the Back Creek Group, which is considered the regional low permeability basement for the purpose of this modelling.
- The northern boundary contains the primary aquifers being mined by the Project and is 20 km away from the proposed pits.
- The southern boundary is set along the Stephens Creek and is expected to be far outside the range of predicted Project related drawdown.

To allow stable numerical modelling of the large spatial area of the model domain, an unstructured grid with varying Voronoi cell sizes was designed using Algomesh (HydroAlgorithmics, 2014). Varying Voronoi cell sizes allowed refinement around areas of interest, while a coarser resolution elsewhere reduces the total cell count to a manageable size. The model domain was vertically discretised into 19 layers, each layer comprising a cell count up to 77,639. The total number of cells in the model is 1,137,811. This is after pinching out areas in layers 3 to 19 where a layer is not present based on the structural geology.

The following features have been included in the grid design:

- The Isaac River is represented in the model with a 50 metre (m) Voronoi cell size constraint.
- Open cut mining for the Project is represented with a 100 m cell size constraint.
- Open cut mine areas for CVM, the Winchester South Project and Olive Downs Project have a 100 m Voronoi cell size constraint.
- Open cut mining at Poitrel, Daunia, Peak Downs and the Moorvale South Project have a maximum cell size of 200 m.
- Open cut mining at Saraji has a maximum cell size of 400 m.
- Longwall mining at Grosvenor and Eagle Downs has an oriented regular grid of 100 m width squares to represent longwalls. Proposed mining at Saraji East is represented similarly by 100 m squares.
- Faults are represented using a 100 m Voronoi cell constraint.



H:\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Modelling Figures\62030095 F2-1 Model Domain.mxd

Scale: 1:500,000
GDA 1994 MGA Zone 55

05-Mar-2021
620.13593

Sheet Size : A4

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0 5 10 15
km

Model Domain

FIGURE 2-1

2.3 Model Layers

Topography within the model domain has been defined using numerous sources of varying accuracy. Data extents of the sources used to construct model topography are shown in **Figure 2-2**.

High resolution (1 m) Digital Elevation Model (DEM) data, provided by BMA, was used to define local surface elevation within the Project area. Outside the extents of the DEM dataset for the Project, LiDAR data from the Moorvale South Project, Winchester South Project, and the Olive Downs Project were used to define surface elevation, where available. Public domain 25 m DEM data sourced from Geoscience Australia (with 3 m subtracted for consistency between datasets) was used to define topography in the remainder of the model domain.

The model domain is discretised into 19 layers, as listed in **Table 2-1**. Model layer extents (lateral and vertical) have been defined using data from the following sources:

- BMA, CVM Mine site geological model;
- BMA, CVM Mine site bore hole logs;
- Jellinbah Mining Pty Ltd, Lake Vermont North site geological model;
- Jellinbah Mining Pty Ltd, Lake Vermont North bore logs;
- Whitehaven Coal Pty Ltd - Winchester South Project groundwater model (as of November 2019);
- CSIRO Regolith depth survey;
- Queensland Globe bore hole logs; and
- Queensland surface geology and basement geological maps.

Table 2-1 Model Layers and Thicknesses

Model Layer	Formation	Unit	Average Thickness (m)
1	Alluvium, colluvium, Tertiary basalt	Surface cover	6.5
2	Tertiary sediments, Tertiary basalt	Tertiary and minor Triassic Clematis, weathered Permian, Tertiary basalt	16.5
3	Rewan Group	Triassic	139.0
4	Rangal Coal Measures	Leichhardt overburden	36.0
5		Leichhardt seam	4.9
6		Interburden	36.5
7		Vermont seam	4.0
8		Vermont underburden	26.5
9	Fort Cooper Coal Measures	Fort Cooper overburden	61.5
10		Fort Cooper seams (combined)	61.5
11		Fort Cooper underburden	60.0
12	Moranbah Coal Measures	Q Seam	1.5
13		Interburden	17.0
14		P Seam	2.5
15		Interburden	41.0
16		H Seam	4.5
17		Interburden	65.5
18		D Seam	8.5
19		Interburden	100.0

Model Layer 1 is fully extensive across the model with an average thickness of 6.5 m. In the model extension, the base of Layer 1 was interpreted from Queensland Globe bore log lithology data. The base of Layer 1 was also updated using the bore logs available for the Project area.

Model Layer 2 is also fully present across the model area with a minimum thickness of 1 m. The Winchester South Project model and the CVM site geology model were used to define the base of model Layer 2. In the model extension, the base of Layer 2 was interpreted from CSIRO regolith survey depths and Queensland Globe bore log lithology data.

The underlying Triassic and Permian layers are present only to their outcrop extents, with some inference made for the presence of older units beneath the surface outcrop due to folding and faulting. The layering above the Moranbah Coal Measures is generally consistent with the Winchester South Project model. However, updates have been made to layers 1 to 8 using the Lake Vermont North site specific geology model.

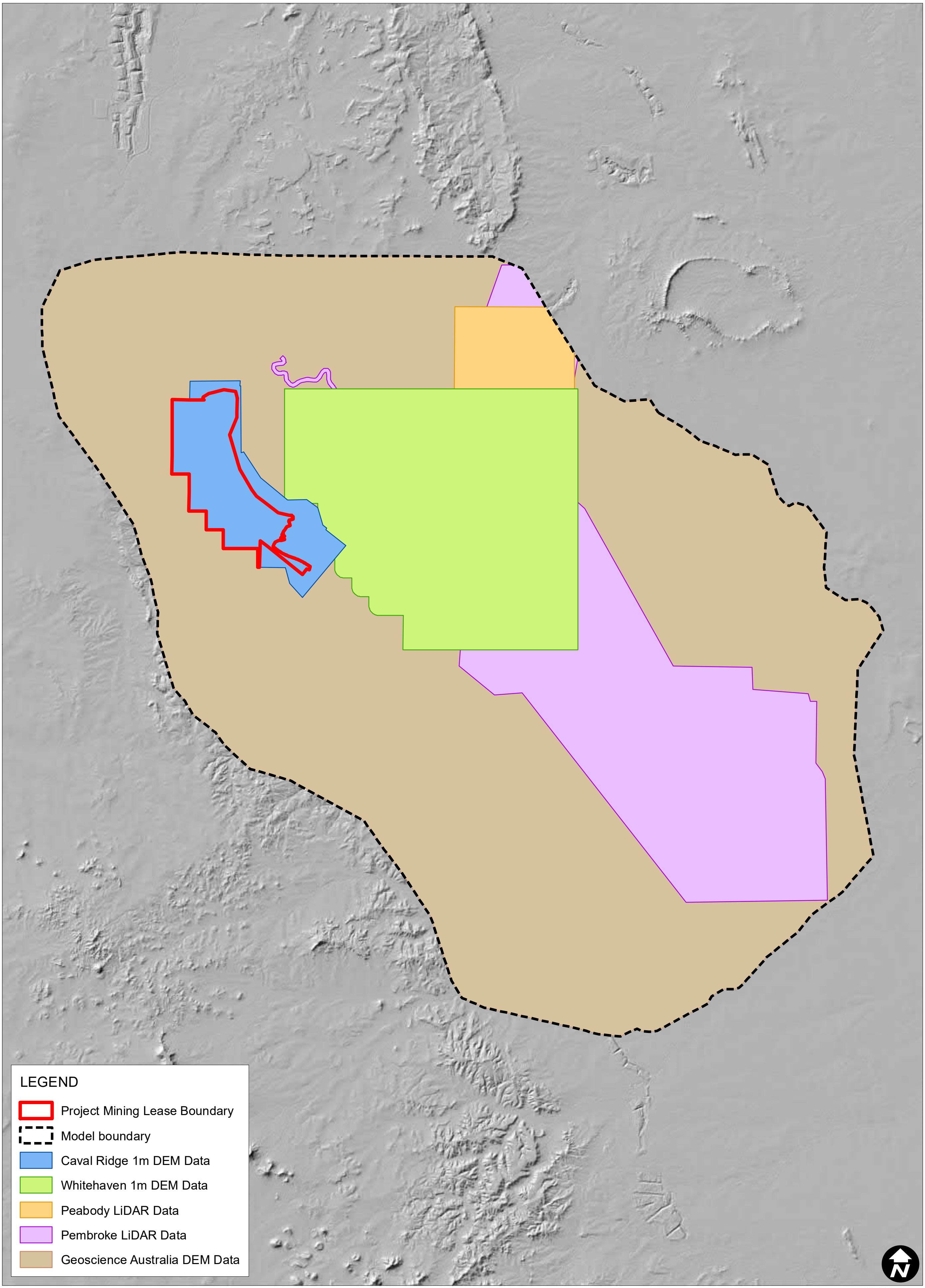
The Winchester South Project groundwater model represented Moranbah Coal Measures with 3 layers (SLR, 2020). To include all the target seams in Moranbah Coal Measures at CVM in the groundwater model, the number of layers representing the Moranbah Coal Measures was increased to 8. The CVM site geology model was used for layers 12 to 18 representing the Moranbah Coal Measures. Outside of the CVM geology model extent, where bore logs with information on Moranbah Coal Measures were available this information was included in the layer elevations. Elsewhere, average thicknesses were extrapolated out into the extended model area.

It is not possible to represent every individual coal seam (typically <1 m thickness) in a regional groundwater model, therefore a “combined thickness” totalling the individual seam thicknesses for each relevant seam has been simulated. Site specific information for the Q, P, H and D seams at the Project, has been included in the model. The following values were used to define the combined seam thicknesses in the local geology at CVM:

- Q Seam thickness: 1.5 m
- P Seam Thickness: 2.5 m
- H Seam Thickness: 4.5 m
- D Seam Thickness: 8.5 m

The Back Creek Group is considered the regional low-permeability basement for the purpose of this modelling and defines the base of the model, and the western and eastern model boundaries.

Table 2-1 presents the average and maximum thicknesses across the model domain for each layer.



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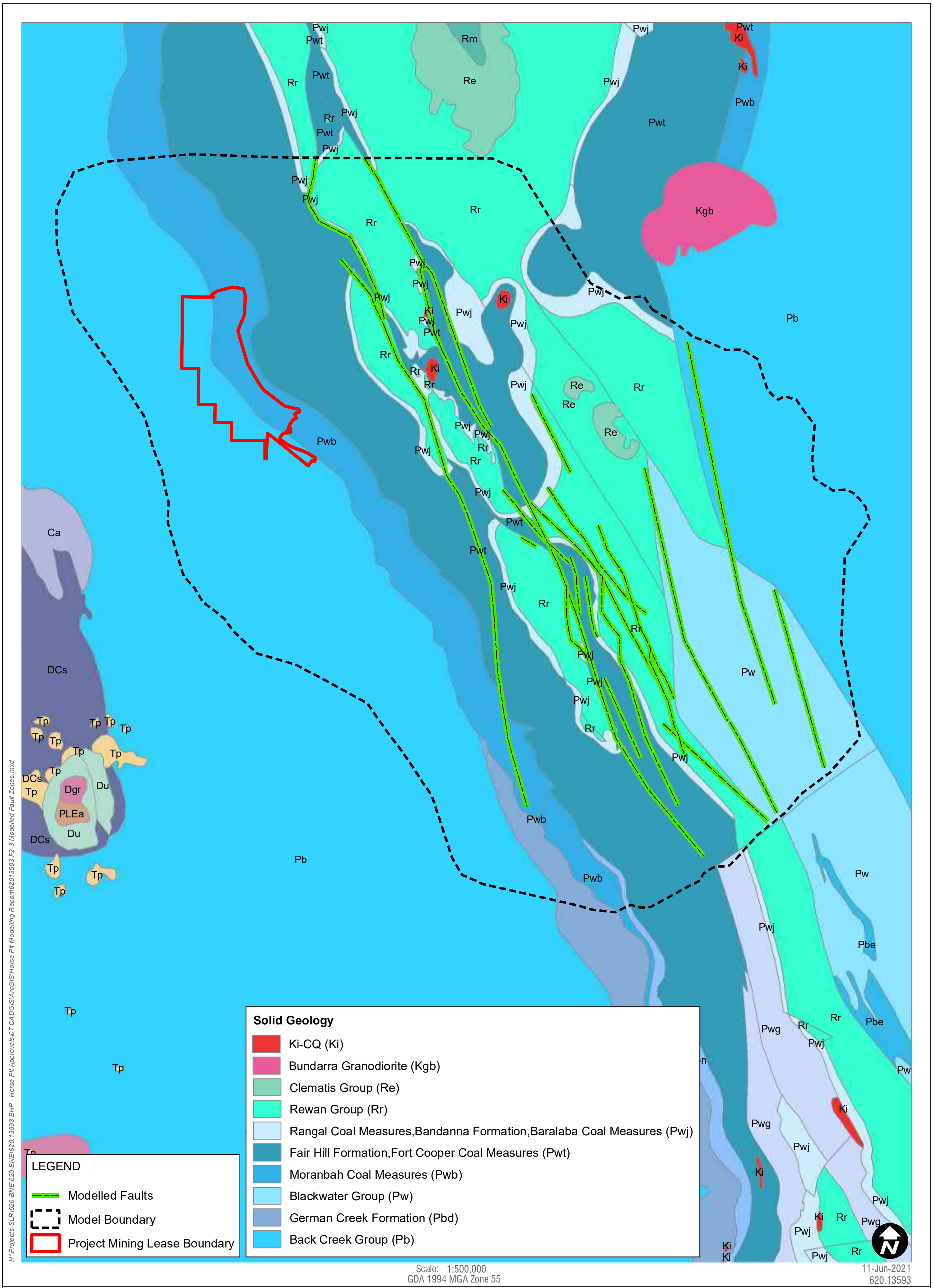
0 5 10 15 Kilometers

Topography Data Extents

FIGURE 2-2

2.3.1 Geological Faults

As discussed in the baseline report (SLR, 2021 a), there are no major faults mapped within the CVM mine area. The modelling of faults within the groundwater model domain has been updated from the Winchester South Project model at the Project area through the inclusion of major regional and local scale faults using the fault mapping and the site-specific geology model where available. Mesh refinement (100 m) has been used along fault lines to allow for isolated changes of hydraulic properties along fault zones during calibration. **Figure 2-3** shows the locations of geological fault zones represented in the model.



H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Horse Pit Modelling Report\62013593 F2-3 Modelled Fault Zones.mxd

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Modelled Fault Zones

FIGURE 2-3

2.4 Model Stresses and Boundary Conditions

2.4.1 Regional Groundwater Flow

General Head Boundary (GHB) have been specified along the eastern, southern and part of the northern model boundaries. The GHB boundary condition is used to represent the regional flow into and out of the model area and has been assigned using GHB cells in all layers using pre-mining head elevations. Groundwater will enter the model where the head set in the GHB is higher than the modelled head in the adjacent cell and will leave the model when the water level is lower in the GHB. GHB conductance is calculated using the hydraulic conductivity and the dimensions of each GHB cells and is therefore variable in this model due to variable cell-size.

No flow boundary was applied to the western boundary of the model that represents the outcrop of the Back Creek Group.

A drain boundary condition was used in the northern model boundary to simulate the mining at the Grosvenor Mine.

2.4.2 Watercourses

Major rivers (including Isaac River) as well as minor creeks were built into the model using MODFLOW-USG RIV package. River cells in the model are shown in **Figure 2-4** . The rivers within and around the project that were included in the RIV package are presented in **Table 2-2**.

Surveyed river stage data was available at several locations along the Isaac River. The closest gauging station to the site, located at Deverill, records average monthly water levels as shown in **Table 2-2**. This data was extrapolated to provide continuous stage elevations.

River and creek widths, thickness and conductance values were adopted from the Winchester South Project model. The rivers are set with the river bed 1 to 11 m below the surrounding topography to represent the steep-banked incised channels. The river widths were assumed to be fixed for each river in the model. The river widths were estimated using aerial photography and aligned with assumptions within the Winchester South Project model (SLR, 2020).

The river conductance was calculated using river width, river length, riverbed thickness, and the vertical hydraulic conductivity of river bed material (Kz). Therefore, the river conductance is variable due to the non-constant spatial discretisation in each of the model river cells. The vertical hydraulic conductivity of river beds for different rivers in the model were adopted from the Winchester South Project model.

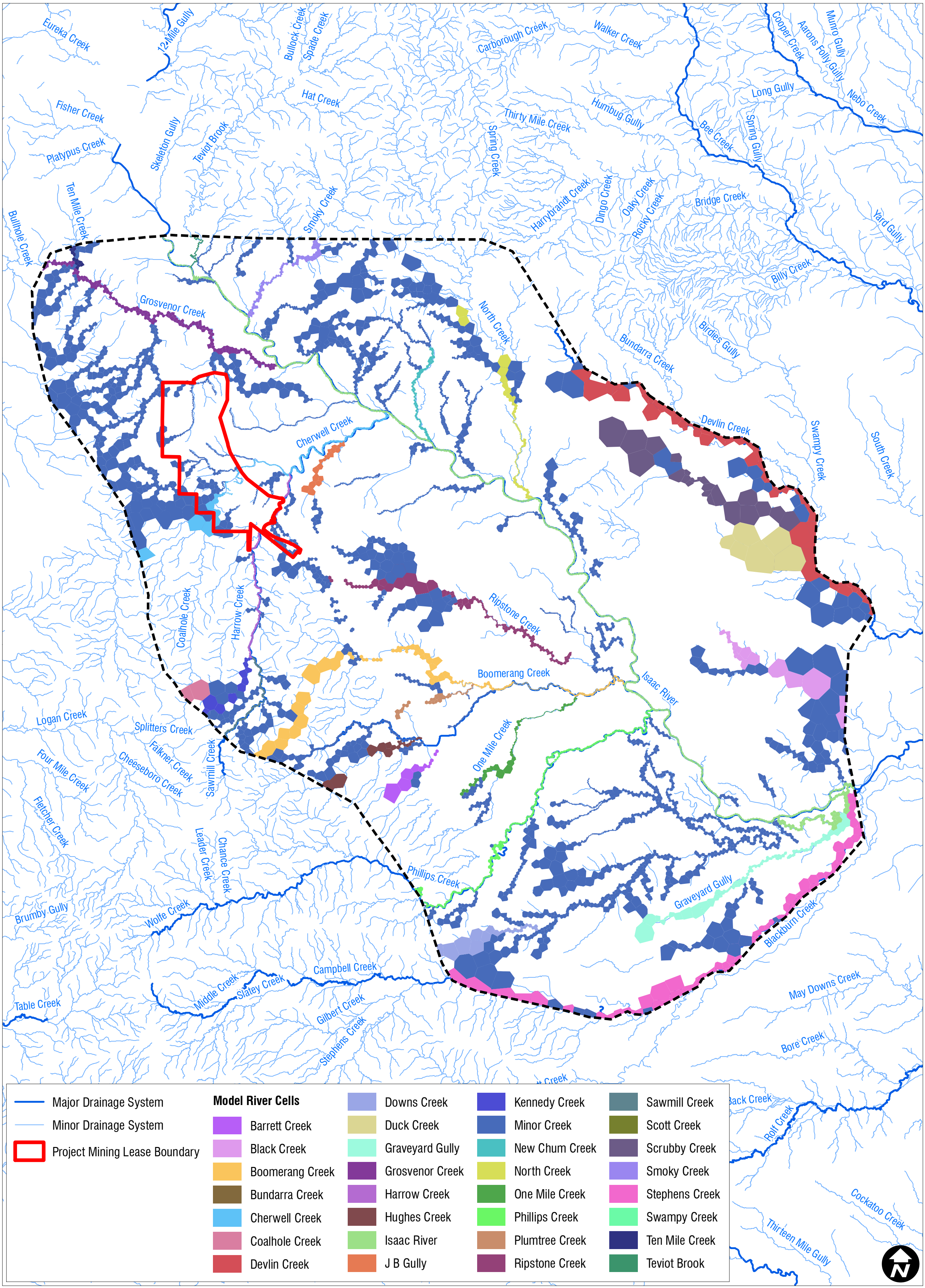
The river stage height in the minor tributaries or drainage lines was set to 0 m (i.e. river stage elevation was equal to river bottom elevation). Therefore, the minor tributaries or drainage lines act as drains to the groundwater system and do not result in any recharge.

Table 2-2 Average Stage Heights (m) Used to Develop Transient Sequence

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Isaac at Deveril	0.46	0.89	0.68	0.39	0.23	0.15	0.16	0.10	0.08	0.02	0.09	0.41	0.31

Table 2-3 River and Surface Water Features in the CVM Model

Boundary	River Stage (m)	River Bed Kz (m/day)
Isaac River	Warm Up Simulation - Long term Average (2008-2020) Calibration simulation - Historical Quarterly Averages Prediction simulation- Fixed Stage Height- Long term Average (2008-2020)	1.0×10^{-2}
Grosvenor Creek	0	1.0×10^{-1}
Cherwell Creek	0	1.0×10^{-1}
Smoky Creek	0	1.0×10^{-1}
Other Minor Creeks	0	1.0×10^{-2} to 1.0×10^{-1}



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km

River Cells

FIGURE 2-4

2.4.3 Rainfall Recharge

The dominant mechanism for recharge to the groundwater system is through diffuse infiltration of rainfall through the soil profile and subsequent deep drainage to underlying groundwater systems. Diffuse rainfall recharge to the model was represented using the MODFLOW-USG Recharge package (RCH).

The recharge rates were established through the calibration process, with bounds based on the conceptual understanding of the system and comparing them with other groundwater models prepared for the region. The starting values adopted in the calibration process were from the Winchester South Project model (SLR, 2020). Rainfall recharge was imposed as a percentage of actual rainfall from the SILO Grid Point observations. Long-term average rainfall was used for the steady-state model. For the transient calibration model, quarterly averages of the historical rainfall data were used (2008 to 2020). For the prediction model, annual averages of 1990-2020 rainfall data was used.

The model included 7 recharge zones as listed below:

- Issac River Flood Plain Alluvium;
- Issac River Channel Alluvium;
- Alluvium– Rest of the model;
- Regolith;
- Basalt;
- Duaringa Formation; and
- Weathered Permian.

An enhanced recharge of 100 % is applied to the final voids in the prediction model. The recharge to the spoil is set to 1 % of actual rainfall.

The calibrated recharge rates are discussed in **Section 2.9**.

2.4.4 Evapotranspiration

The MODFLOW Evapotranspiration (EVT) package was used to simulate evapotranspiration from the groundwater system.

Extinction depths were set to 2 m below ground across the model domain. Maximum potential rates were set using actual evapotranspiration values (from the Bureau of Meteorology), with the average value (600 millimetres per year [mm/year]) used as the transient calibration evapotranspiration rate. An EVT rate of 0 was assigned to the model cells representing the rivers.

2.4.5 Groundwater Use

Private groundwater pumping bores have not been included in the model due to lack of information regarding abstraction rates. Due to generally low groundwater abstraction across the model area, it is likely that the bores have very localised drawdowns and will not significantly impact model results.

2.4.6 Mining

The MODFLOW Drain (DRN) package is used to simulate mine dewatering in the model for the Project and surrounding mines. Boundary conditions for drain cells allow one-way flow of water out of the model. When the computed head drops below the stage elevation of the drain, the drain cells become inactive. This is an effective way of theoretically representing removal of water seeping into a mine over time, with the actual removal of water being via pumping and evaporation.

To simulate open cut mines in the model, drain cells are applied to all active layers from the surface to the base of the lowermost mined seam. Longwall extraction at Grosvenor Mine, Eagle Downs Mine and Saraji East are represented as drain cells in model layer 18 (lowermost coal seam in Moranbah Coal Measures) and the fracture zone extended up to layer 10. The drain cells representing the surrounding mines were interpolated from mine schedule information available from the previous groundwater model, the previous reports, publicly available EIS documentation and aerial photography.

2.4.6.1 Variation in Hydraulic Properties due to mining

For open cut mining, Hawkins (1998) and Mackie (2009) indicate that spoil and waste rock are more permeable than the undisturbed strata. Completed open cut mining areas will be backfilled with waste overburden as the extraction proceeds. Backfilling of open cut mine areas with spoil was also modelled using the TVM package. The model cell properties were updated to spoil properties guided by operational mine plans. Horizontal hydraulic conductivity of 0.3 m/day and vertical hydraulic conductivity of 0.1 m/day is applied to the spoil. The storage parameters used for the spoil were a specific yield of 0.1 and a storage coefficient of 1.0 x 10^{-5} m^{-}.

The hydraulic properties were varied with time using the Time-variant materials (TVM) package of MODFLOW-USG Transport. For the underground mines, the hydraulic properties were changed with time in the goaf and overlying fractured zone directly above each longwall panel.

2.5 Timing

A combined transient warm up and transient calibration model was developed, as follows:

- A transient warm-up model from January 1988 to December 2007 conditions with 20 yearly time interval;
- Transient calibration model from December 2007 to December 2020 with quarterly time intervals to replicate influence of historical mining; and
- Transient predictive model from January 2021 to March 2056 with annual time intervals.

The transient warm-up model was built to incorporate pre-2008 mining activities and their impacts on groundwater levels around the Project area. The warm-up model provided appropriate starting conditions for the calibration model (i.e. starting heads and hydraulic properties).

Together, the warm-up and transient calibrations comprise 54 stress periods. **Table 2-4** summarises the calibration model stress periods and simulated active mine timings. As shown in **Table 2-4** the first stress period of the warm-up model was steady- state and did not include any mining. This was to simulate the pre-mining conditions within the model domain.

To assist the model in overcoming the numerical difficulties, MODFLOW-USG Adaptive Time-Stepping (ATS) option was used. The ATS option of MODFLOW automatically decreases time-step size when the simulation becomes numerically difficult and increases it when the difficulty passes. The minimum time step size used in the simulations was 1 day.

2.6 Calibration Model Simulation Period and Temporal Discretisation

Automated calibration utility PEST ++ (Doherty 2019) and manual calibration were used to match the available transient water level data. The groundwater levels recorded between January 2008 to December 2020 were used for the model calibration. In all, 4342 target heads were established for 400 bores from the following sites:

- CVM included 43 groundwater level observations sites and VWPs;
- Lave Vermont: included 74 groundwater level observations sites and VWPs;
- Winchester South bores: 20 bores including 2 VWPs;
- Olive Downs Project bores; included 46 groundwater level observations sites and VWPs;
- Moorvale South: 16 observations sites; and
- Other bores: 207 other bores, including available data from Saraji Mine, Eagle Downs Mine, Poitrel Mine, Daunia Mine, Grosvenor Mine, Mornabah South Mine and newly added Queensland Globe bore monitoring observations.

Groundwater targets were selected where:

- Valid information on bore construction or geology information was available for the site; and/or
- Data was collected prior to 1988 or reasonably around 1988 to reflect baseline condition at the start of the model.

Groundwater bores used for the calibration were weighted as 1 each in the calibration. Details on each of the observation points and their residuals are presented in **Appendix A** of this report. The locations of these bores are shown in **Figure 2-8**.

The hydraulic properties (i.e., horizontal, vertical conductivity, specific yield and specific storage) and recharge rates were adjusted during the calibration to provide best match between the measurements and model simulated heads.

Table 2-4 Calibration model stress period setup and simulated active mining

Calibration Period	Interval	Stress Period	Date (from)	Date (to)	Moorvale South (OC)	CVM (OC)	Peak Downs (OC)	Saraji (OC)	Grosvenor (UG)	Poitrel (OC)	Daunia (OC)
Steady-State		1	Steady-state								
Warm- up	20 Years	2	Transient Warm up					x		x	
Transient	Quarterly	3	01-01-2008	01-04-2008				x		x	
	Quarterly	4	01-04-2008	01-07-2008				x		x	
	Quarterly	5	02-07-2008	01-10-2008				x		x	
	Quarterly	6	01-10-2008	31-12-2008				x	x	x	
	Quarterly	7	31-12-2008	01-04-2009				x	x	x	
	Quarterly	8	02-04-2009	02-07-2009				x	x	x	
	Quarterly	9	02-07-2009	01-10-2009				x	x	x	
	Quarterly	10	01-10-2009	31-12-2009				x	x	x	
	Quarterly	11	01-01-2010	02-04-2010			x	x	x	x	
	Quarterly	12	02-04-2010	02-07-2010			x	x	x	x	
	Quarterly	13	02-07-2010	01-10-2010			x	x	x	x	
	Quarterly	14	01-10-2010	31-12-2010			x	x	x	x	
	Quarterly	15	01-01-2011	02-04-2011			x	x	x	x	
	Quarterly	16	02-04-2011	02-07-2011			x	x	x	x	
	Quarterly	17	02-07-2011	01-10-2011			x	x	x	x	
	Quarterly	18	02-10-2011	01-01-2012			x	x	x	x	
	Quarterly	19	01-01-2012	01-04-2012			x	x	x	x	
	Quarterly	20	01-04-2012	01-07-2012			x	x	x	x	
	Quarterly	21	02-07-2012	01-10-2012			x	x	x	x	
	Quarterly	22	01-10-2012	31-12-2012			x	x	x	x	
	Quarterly	23	31-12-2012	01-04-2013			x	x	x	x	
	Quarterly	24	02-04-2013	02-07-2013			x	x	x	x	x
	Quarterly	25	02-07-2013	01-10-2013			x	x	x	x	x
	Quarterly	26	01-10-2013	31-12-2013			x	x	x	x	x
	Quarterly	27	01-01-2014	02-04-2014		x	x	x	x	x	x
	Quarterly	28	02-04-2014	02-07-2014		x	x	x	x	x	x
	Quarterly	29	02-07-2014	01-10-2014		x	x	x	x	x	x
	Quarterly	30	01-10-2014	31-12-2014		x	x	x	x	x	x
	Quarterly	31	01-01-2015	02-04-2015		x	x	x	x	x	x
	Quarterly	32	02-04-2015	02-07-2015		x	x	x	x	x	x
	Quarterly	33	02-07-2015	01-10-2015		x	x	x	x	x	x
	Quarterly	34	02-10-2015	01-01-2016		x	x	x	x	x	x

Calibration Period	Interval	Stress Period	Date (from)	Date (to)	Moorvale South (OC)	CVM (OC)	Peak Downs (OC)	Saraji (OC)	Grosvenor (UG)	Poitrel (OC)	Daunia (OC)
	Quarterly	35	01-01-2016	01-04-2016		x	x	x	x	x	x
	Quarterly	36	01-04-2016	01-07-2016		x	x	x	x	x	x
	Quarterly	37	02-07-2016	01-10-2016		x	x	x	x	x	x
	Quarterly	38	01-10-2016	31-12-2016		x	x	x	x	x	x
	Quarterly	39	31-12-2016	01-04-2017		x	x	x	x	x	x
	Quarterly	40	02-04-2017	02-07-2017		x	x	x	x	x	x
	Quarterly	41	02-07-2017	01-10-2017		x	x	x	x	x	x
	Quarterly	42	01-10-2017	31-12-2017		x	x	x	x	x	x
	Quarterly	43	31-12-2017	01-04-2018		x	x	x	x	x	x
	Quarterly	44	01-04-2018	01-07-2018		x	x	x	x	x	x
	Quarterly	45	01-07-2018	30-09-2018		x	x	x	x	x	x
	Quarterly	46	30-09-2018	31-12-2018		x	x	x	x	x	x
	Quarterly	47	31-12-2018	01-04-2019		x	x	x	x	x	x
	Quarterly	48	01-04-2019	01-07-2019		x	x	x	x	x	x
	Quarterly	49	01-07-2019	01-10-2019		x	x	x	x	x	x
	Quarterly	50	01-10-2019	31-12-2019		x	x	x	x	x	x
	Quarterly	51	31-12-2019	31-03-2020	x	x	x	x	x	x	x
	Quarterly	52	31-03-2020	30-06-2020	x	x	x	x	x	x	x
	Quarterly	53	30-06-2020	30-09-2020	x	x	x	x		x	x
	Quarterly	54	30-09-2020	30-12-2020	x	x	x	x		x	x

2.6.1 Calibration Statistics

One of the industry standard methods to evaluate the calibration of the model is to examine the statistical parameters associated with the calibration. This is done by assessing the error between the modelled and observed (measured) water levels in terms of the root mean square (RMS). A RMS is expressed as:

$$\mathrm{RMS} = \left[1/n \sum (h_o - h_m)_i^{\,2} \right]^{0.5}$$

where: n = number of measurements

ho = observed water level

hm = simulated water level

RMS is considered to be the best measure of error if errors are normally distributed. The RMS error calculated for the calibrated model is 12.5 m.

The acceptable value for the calibration criterion depends on the magnitude of the change in heads over the model domain. If the ratio of the RMS error to the total head change in the system is small, the errors are considered small in relation to the overall model response(s). The total measured head change across the model domain is 223 m; therefore, the ratio of RMS to the total head change (scaled root mean square, SRMS) is 5.4 %. While there is no recommended universal SRMS error, The Australian Groundwater Modelling Guidelines suggests that setting Scaled RMS targets such as 5 or 10 % may be appropriate in some circumstances (Barnett et al, 2012).

Figure 2-5 presents the observed and simulated groundwater levels graphically as a scattergram for the initial and historic transient calibration (1988 to 2020).

Figure 2-6 shows the observed and simulated groundwater levels graphically only for the CVM bores. The RMS for the CVM bores is 5.6 m, which is lower than the RMS for the entire model (12.5 m). SRMS for the CVM bores is 9.8%. The higher SRMS compared to the SRMS across the model domain (5.4 %) is due to the narrower range of groundwater measurements at site. The current model shows a better match to the observations comparing to the GHD (2017) model calibration which showed an RMS of 6 m and SRMS of 1 9% for the CVM bores.

Figure 2-7 shows the distribution of calibration residuals. As shown in the figure the calibration residuals in majority of the calibration data points are within ± 20 m. **Figure 2-7** indicates that in general the model tends to over predict groundwater levels.

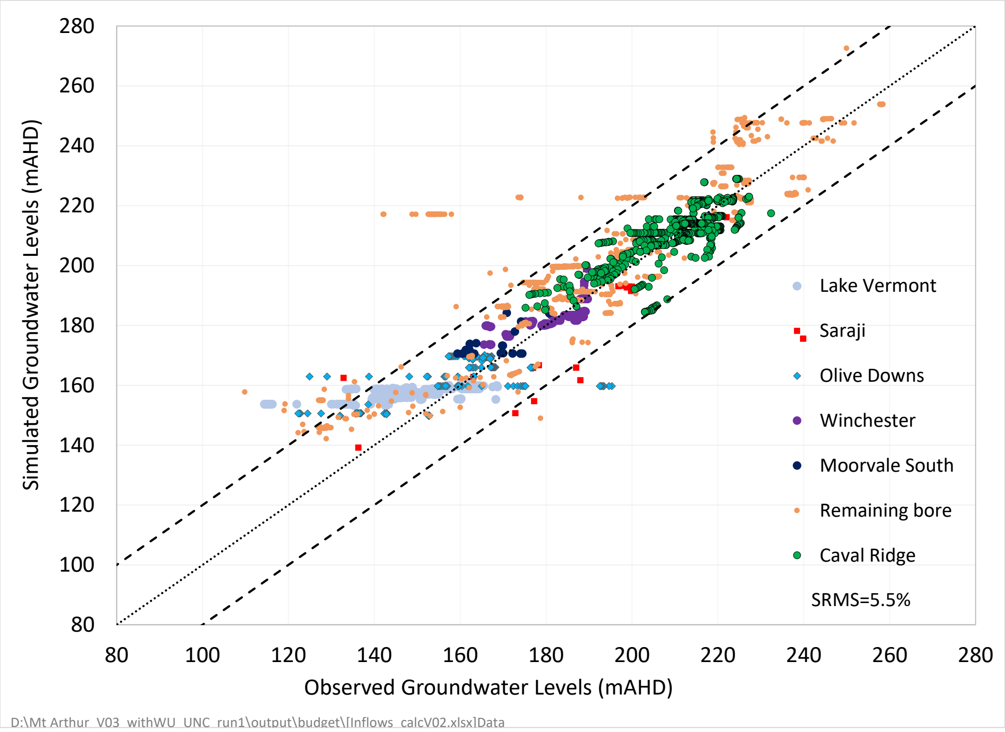


Figure 2-5 Calibration Scattergram – Modelled vs Observed Groundwater Levels (All Bores)

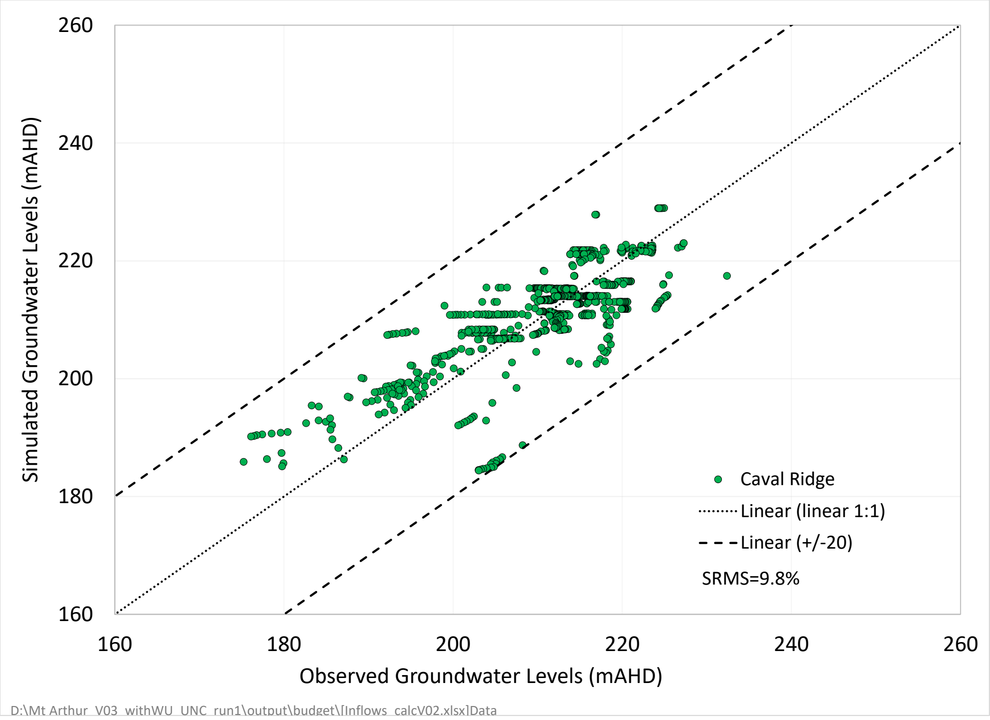


Figure 2-6 Calibration Scattergram – Modelled vs Observed Groundwater Levels (CVM Bores)

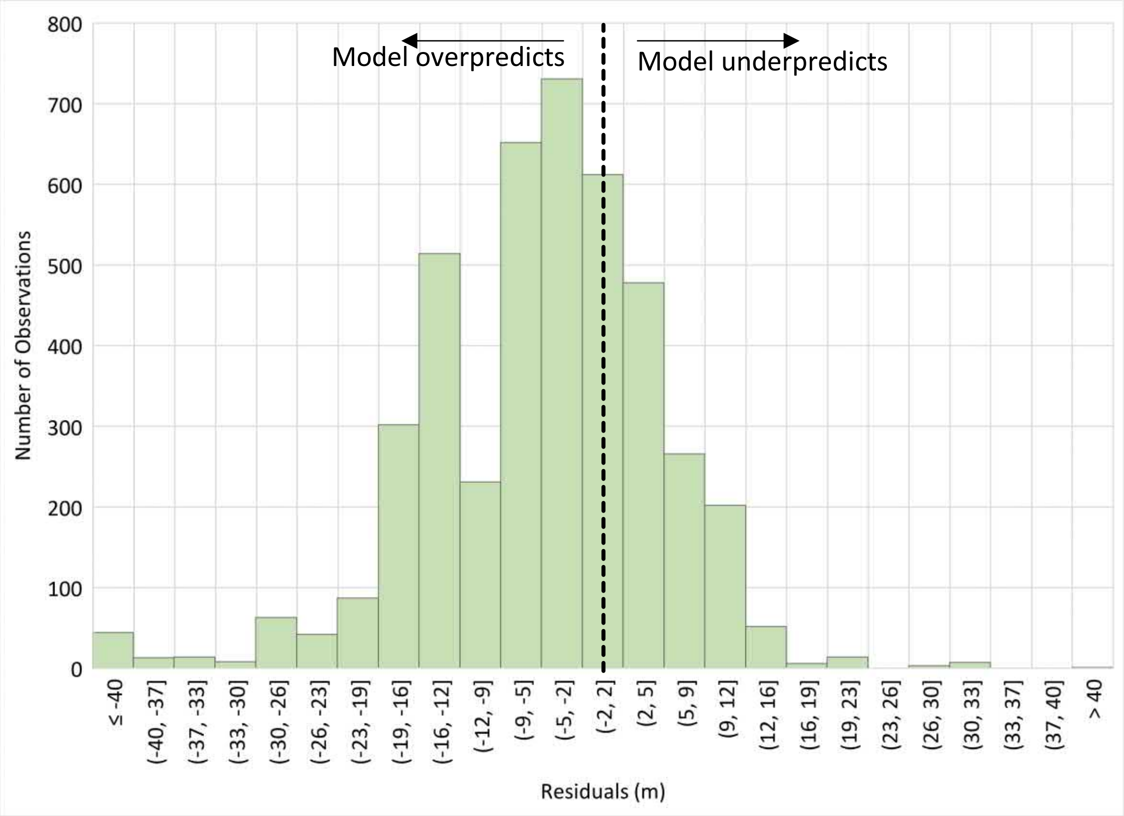


Figure 2-7 Calibration Residual Histogram Scattergram

The overall transient calibration statistics are presented in **Table 2-5.** As shown in the table 95 % (4137/4342 calibration targets) are within ±20 m of the observed measurements. This provides an indication of reasonable fit for the large regional dataset; however, further discussion on the fit between modelled and observed trends is included in **Section 2.6.2**.

Table 2-6 shows the average calibration residual and absolute average residual per model layer. The residual is the difference between the measured and the modelled water level at each bore. A negative residual represents an over estimation of water levels, while a positive residual represents an underestimate. **Table 2-6** shows an overall overestimation of water levels in the model layers across the model domain. The table shows Layer 10 has the highest average and absolute average residual. The table also show overall the simulated groundwater levels are closer to the observed groundwater levels in the model layers representing the Moranbah Coal Measures (Layers 12 to 18).

Table 2-7 shows the average calibration residual and absolute average residual per each site within the model domain. As indicated in the table, there is an average overestimation of 0.2 m in the CVM bores. The table shows the Lake Vermont North bores have the highest average absolute residuals.

Table 2-5 Calibration Statistics

Statistic	Value
Sum of Squares (m2)	651579.9
Mean of Squares (m)	156.9
Square Root of Mean of Squares (RMS) (m)	12.5
Scaled Root Mean Square (SRMS) (%)	5.4 %
Root Mean Fraction Square (RMFS) (%)*	15.9 %
Scaled Root Mean Fraction Square (SRMFS) (%) **	12.6 %
Sum of Residuals (m)	34116.1
Mean Residual (m)	8.2
Scaled Mean Residual (%)	3.5 %
Coefficient of Determination (tend to unity)	1.3
Targets within ±2m	893
Targets within ±5m	2036
Targets within ±20m	4137

*RMFS represents the sample standard deviation of the differences between predicted values and observed values as a fraction of the observed value expressed as a percentage.

** SRMFS scales the RMFS error by the ratio of the mean observed value to the range of the observed values expressed as a percentage.

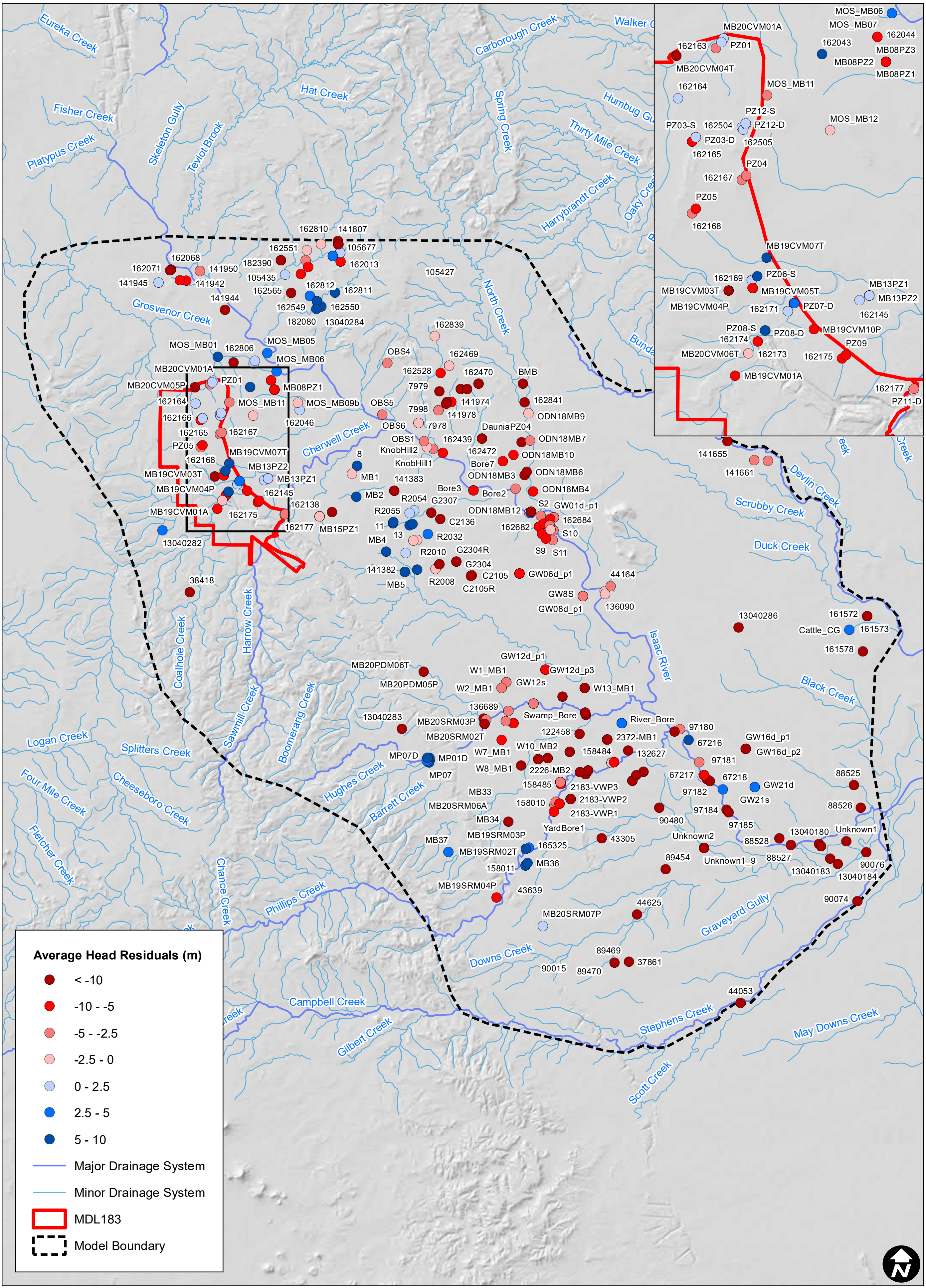
Table 2-6 Average Residual by Model Layer

Model Layer	Formation	Unit	Average Residual (m)	Average Absolute Residual (m)	Number of Observation Targets	Number of bores
1	Alluvium, colluvium, Tertiary basalt	Surface cover	-3.1	7.0	1198	114
2	Tertiary sediments, Tertiary basalt	Tertiary and minor Triassic Clematis, weathered Permian, Tertiary basalt	-1.7	8.5	362	64
3	Rewan Group	Triassic	-6.8	9.3	325	23
4	Rangal Coal Measures	Leichhardt overburden	-8.1	9.5	274	10
5		Leichhardt seam	-5.2	7.7	319	35
6		Interburden	-7.1	9.6	199	10
7		Vermont seam	-9.0	10.7	435	34
8		Vermont underburden	-5.2	5.7	119	11
9	Fort Cooper Coal Measures	Fort Cooper overburden	-3.0	4.4	124	24
10		Fort Cooper seams (combined)	-20.2	20.5	171	13
11		Fort Cooper underburden	0.8	17.2	11	3
12	Moranbah Cooper Coal Measures	Q Seam	-3.3	4.5	66	12
13		Interburden	0.7	4.7	409	12
14		P Seam	-6.2	10.7	13	13
15		Interburden	-3.5	4.2	85	3
16		H Seam	6.3	6.3	61	2
17		Interburden	-6.8	8.4	53	9
18		D Seam	-2.2	4.7	98	7
19		Interburden	-5.0	5.6	20	3

Table 2-7 Average Residual by Site

Site	Average Residual (m)	Average Absolute Residual (m)	Number of Observation Targets	Number of Bores
Lake Vermont North	-8.7	9.8	593	74
Saraji	5.1	16.1	24	24
CVM	-0.2	4.3	928	43
Olive Downs	-4.2	6.8	443	38
Winchester South	-2.2	4.9	622	20
Moorvale South	-7.2	11.0	24	16
Other monitoring bores	-6.0	6.9	1708	187

The spatial distribution of average residuals for each bore from the transient calibration is shown in **Figure 2-8**. The size of the bore symbol in **Figure 2-8** is proportional to the residual (i.e., larger residual has a larger symbol size. **Figure 2-8** shows regionally there is a good match between the observed and simulated groundwater levels.



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Transient Calibration
Average Head Residuals (m)

FIGURE 2-8

2.6.2 Calibration Fit

This section provides discussion on the modelled to observed groundwater level trends (calibration hydrographs) for key bores across the CVM site. Calibration hydrographs for the full calibration dataset is presented as **Appendix B**.

2.6.2.1 Alluvium

Figure 2-9 presents the fit between simulated and observed heads in alluvium bores MB19CVM01A, MB20CVM01A.

Figure 2-9 also shows surface and bottom elevation of alluvium at each of the site alluvium bores included in the calibration. In bores PZ07-S and PZ08-S the simulated groundwater levels were below the bottom of the layer and therefore the alluvium was predicted to be dry in these two bores. Bore PZ07-S has been reported mainly dry with rare presence of water in the bore in response to above average rainfall climatic conditions. The model under predicts groundwater levels at bore PZ08 as groundwater was observed in this bore prior to mid-2019.

The hydrograph for bore MB20CVM01A located to the north of the existing Horse Pit shows a very close match between simulated and measured groundwater levels.

The hydrograph for MB19CVM01A located to the west of the Heyford Pit shows the model over predicts the groundwater levels at this bore by 6.5 m. The over prediction of heads is also considered conservative for impact predictions, as the model has a larger extent of saturated alluvium and larger thickness of saturated alluvium that enables greater predicted drawdown.

As shown in the hydrographs in **Appendix B**, regionally there is a good match between the simulated and measured groundwater levels in alluvial bores such as Olive Downs S series, Winchester South ODN series, Knob Hill 1 and Knob Hill 2. In bores downloaded from QLD Government dataset, the match between the simulated and measured heads varies between over and under prediction.

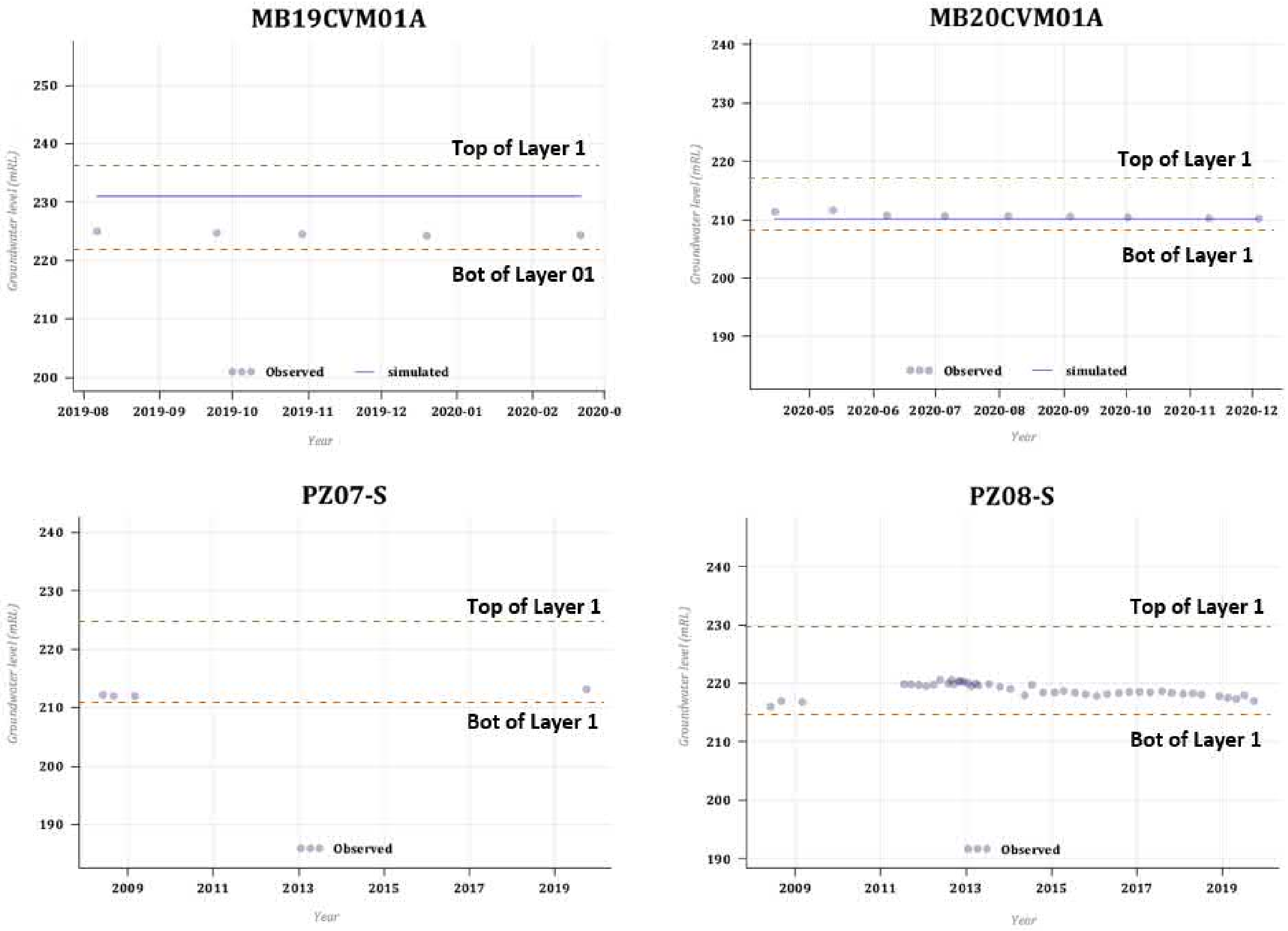


Figure 2-9 Calibration Fit- Alluvium Bores

2.6.2.2 Permian Coal Measures

The CVM site monitoring bores in the Permian coal seams show a good fit with observed groundwater levels and depressurisation due to mining. The hydrographs for some of these Permian bores are shown in **Figure 2-10**.

Figure 2-10 shows that the model replicates depressurisation in the D seam, with a slight over-prediction of water levels in PZ03 and over prediction in the rate (steeper slope) of depressurisation with time in PZ01.

Bores PZ09 and PZ11-D are located less than 1 km east of the Heyford Pit and monitor the P seam. **Figure 2-10** shows that the model replicates the groundwater levels and drawdown trends reasonably well at PZ11-D. The hydrograph for PZ09 shows that the model under predicts the drawdown at this bore after 2018 but matches the groundwater levels and trends closely prior to 2018.

PZ07D and PZ04 monitor the Q seam and show good matches with the observed data (**Figure 2-11)**. The hydrograph for PZ07D shows the decline in groundwater levels replicated in the model; however, there are some differences in the rate of decline. The hydrograph for bore MB19CVM06P is also shown in **Figure 2-11**. MB19CVM06P is in the H seam and is located between Horse Pit and Heyford Pit. The hydrograph for this bore shows 8.2 m of over prediction of groundwater levels.

The hydrographs for other Permian monitoring bores such as RN 162166, 162163, 162175 and 162177, which are surrounding the CVM mine, also show good matches between simulated and observed groundwater levels and trends. The hydrographs for these bores are presented in **Appendix B**.

The calibration data set did not include the vertical gradient in the available piezometers at site. However, the calibration results presented in **Figure 2-9** and **Figure 2-10** show the model is reporting a downward potential groundwater flow which is consistent with site monitoring data.

2.6.2.3 Other Bores

Figure 2-12 shows the hydrographs for other site monitoring bores including the basalt and regolith bores. The hydrographs for basalt monitoring bores show that except MB19CVM07T and MB19CVM03T, the model results in a reasonable (± 5 m) fit between modelled and observed groundwater levels (PZ06S, MB19CVM05T and MB20CVM04T).

The hydrograph for the regolith monitoring bore MB20CVM06T show that the model under predicts the groundwater levels in the bore area by 6 m.

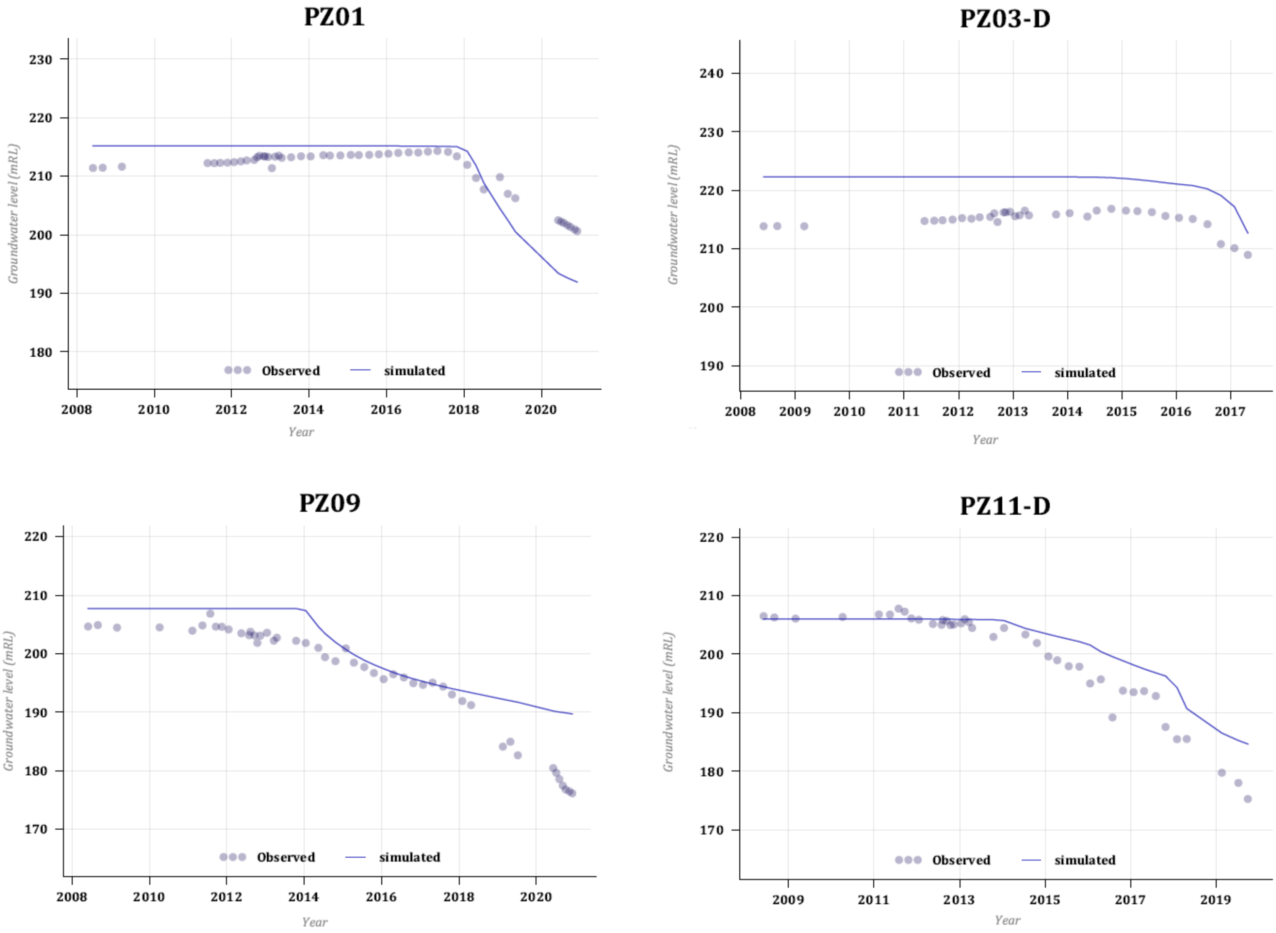


Figure 2-10 Calibration Fit- Permian Bores (PZ01, PZ03-D, PZ09 and PZ11-D)

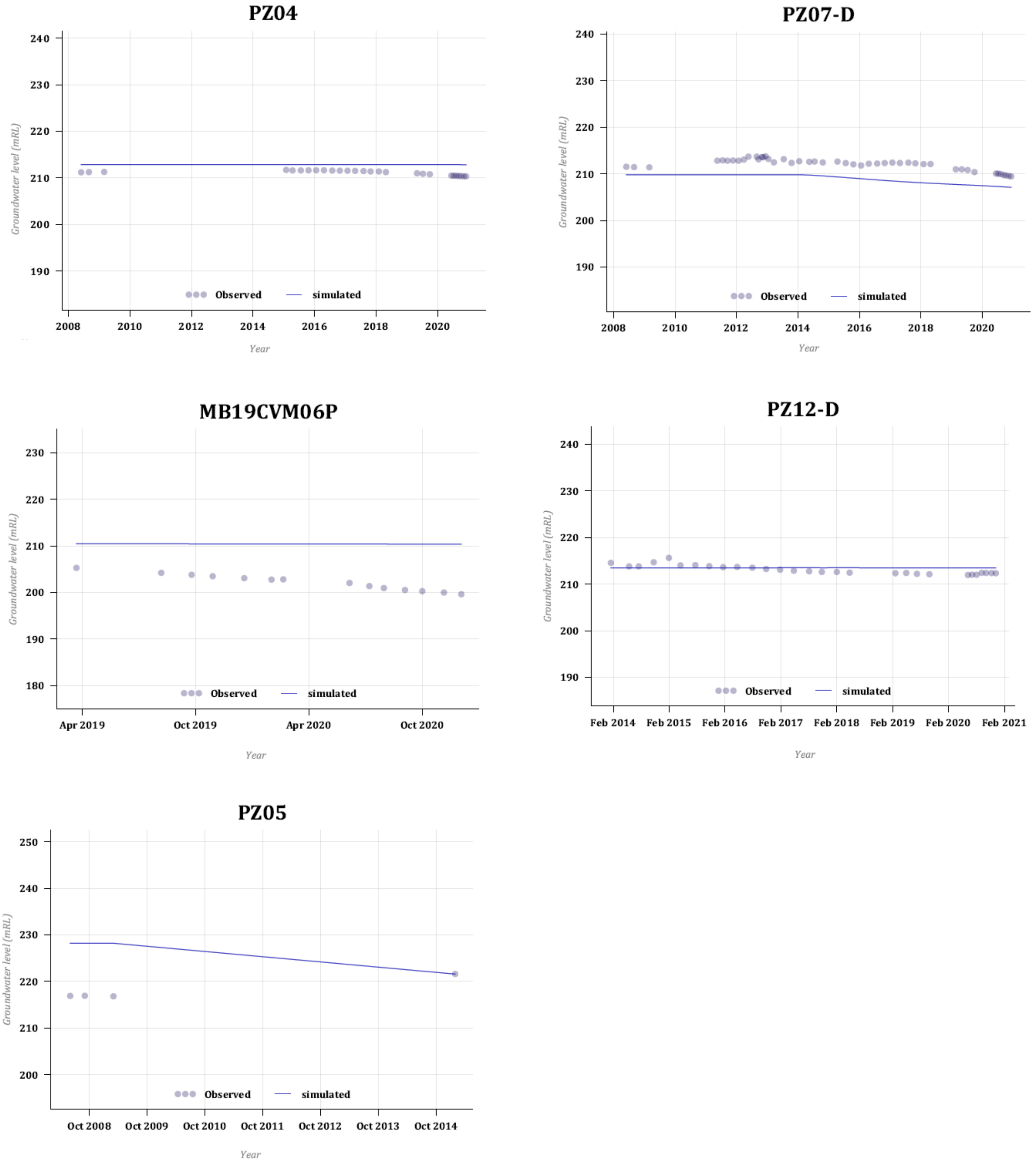


Figure 2-11 Calibration Fit- Permian Bores (PZ04, PZ05, PZ07-D, PZ12-D and MB19CVM06P)

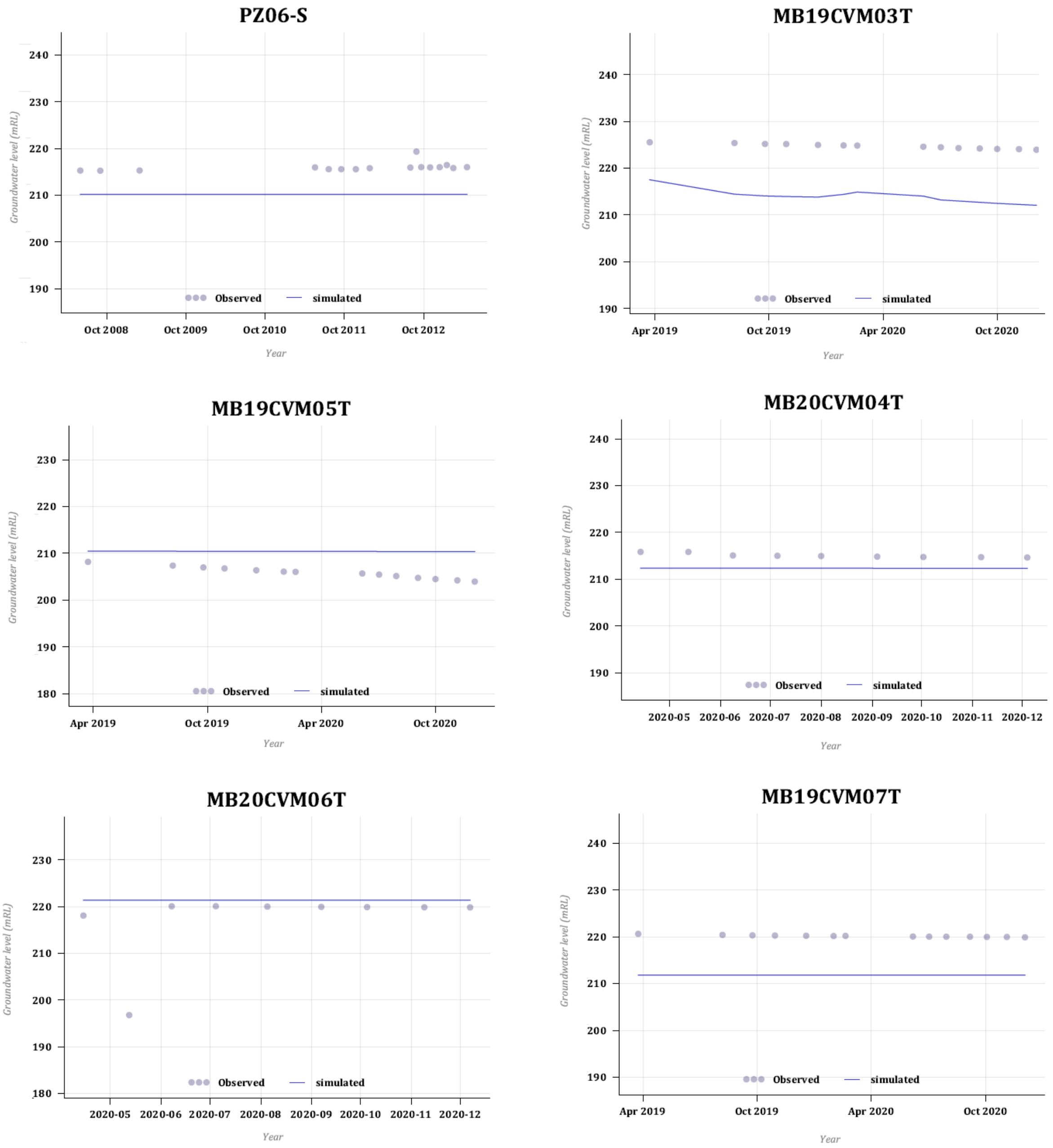


Figure 2-12 Calibration Fit- Other Bores

2.6.3 Water Balance

2.6.3.1 Steady State Calibration

The water balance for the steady state model calibration is shown in **Table 2-8**. The water balance for the steady-state model indicates that recharge was the largest net inflow contributor to the model (3.47 ML/d). Regional groundwater inflow and outflow are 0.12 and 0.93 ML/day respectively, indicating that groundwater leaves the model domain through this boundary.

A net outflow of 0.62 ML/d from the model occurs due to baseflow seepage to the Isaac River (i.e. surface water and groundwater interaction in the Isaac River). This is the largest component of outflow from the model during steady state calibration. Other factors that contribute to outflow from the groundwater system are evapotranspiration (0.54 ML/d outflow) and baseflow seepage to minor drainage systems (1.50 ML/d outflow). The mass balance error for the steady state calibration is 0.00 %, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012), and indicating the model is stable and achieves an accurate numerical solution.

Table 2-8 Steady-State Model Water Balance

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Inflow (%)
Recharge (RCH)	3.47	45.5	0.00	0.0
ET (from GW) (EVT)	0.00	0.0	0.54	7.1
SW-GW Interaction Isaac River (RIV)	4.03	52.9	4.65	61.0
SW-GW Interaction other rivers (RIV)*	0.00	0.0	1.50	19.7
Regional GW Flow (GHB)	0.12	1.6	0.93	12.2
Mines (DRN)	0.00	0.0	0.00	0.0
Storage	-	-	-	-
Total	7.62	100.0	7.62	100.0

* The other tributaries or drainage lines in the model are set as drains to the groundwater system and do not result in any recharge.

2.6.3.2 Transient Calibration

The water balance for the transient simulation averaged over the duration of the calibration period is presented in **Table 2-9**. The mass balance error, that is the difference between calculated model inflows and outflows at the completion of the transient calibration, was 0.00 %, which indicates the model is stable and achieves an accurate numerical solution. The water balance for the transient model indicates that recharge was the largest net inflow contributor to the model, contributing an average of 3.67 ML/d to the groundwater system. **Table 2-9** shows 0.55 ML/day is lost to evapotranspiration in areas where the water table is within 2 m of the land surface. In total 6.68 ML/day is discharged via surface drainages.

A net flow loss of approximately 0.90 ML/day occurs to the Isaac River indicates a gaining condition in the river. The Isaac River net flow presented in **Table 2-9** is for the entire length of the river within the model domain. However, the model outputs showed that to the south of the project area the net flow to the Isaac River is negative indicating Isaac River is a losing system in some part of the model domain. This is consistent with the conceptual model (SLR, 2021a), where Isaac River was discussed to largely be a losing system around RN13040180 located near the Willunga Mine.

Other rivers contribute to a loss of approximately 1.50 ML/day from the groundwater system with no inflow component. The fluxes from the GHB component (inflow and outflow) are 0.16 and 0.94 ML/day respectively. The GHB net flow is less than 1 % of the total flow in water balance for all the scenarios indicating that a small volume of water leaves the model domain through this boundary and therefore, this boundary condition does not have an influence on the model predictions.

6.26 ML/day is removed from the model by the Drain boundary condition that represents historical mining (1988-2020) in the model. The average simulated historical inflows for mines active during the calibration period are:

- CVM – 0.28 ML/day
- Poitrel – 0.96 ML/day
- Daunia – 0.46 ML/day
- Peak Downs – 0.65 ML/day
- Millennium – 1.84 ML/day
- Lake Vermont – 0.61 ML/day
- Moorvale – 0.1 ML/day
- Grosvenor – 0.4 ML/day
- Saraji – 1.0 ML/day

The simulated historical inflow rates are consistent with the previous studies in the region (e.g. Olive Downs South and Willunga EIS 2018, Grosvenor EIS 2016, Saraji EIS 2012).

Table 2-9 Transient Model Water Balance

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Inflow (%)
Recharge (RCH)	3.67	21.5	0.00	0.0
ET (from GW) (EVT)	0.00	0.0	0.55	3.2
SW-GW Interaction Isaac River (RIV)	4.28	25.0	5.18	30.3
SW-GW Interaction other rivers (RIV)*	0.00	0.0	1.50	8.8
Regional GW Flow (GHB)	0.16	0.9	0.94	5.5
Mines (DRN)	0.00	0.0	6.30	36.6
Storage	9.01	52.6	2.65	15.6
Total	17.12	100.0	17.12	100.0

* The other tributaries or drainage lines in the model are set as drains to the groundwater system and do not result in any recharge.

2.7 Calibrated Hydraulic Parameters

Table 2-10 provides a summary of the calibrated values for horizontal and vertical hydraulic conductivity used in the model. The hydraulic parameter zones in all the model layers are presented in **Appendix C**.

Table 2-10 Calibrated Hydraulic Parameters

Model Layer	Formation	Unit	Horizontal Hydraulic Conductivity (m/day)	Anisotropy Kz/Kx
1	Alluvium	Surface cover	12.0	0.2
1	Regolith	Surface cover	1.0	0.1
1	Weathered Permian	Surface cover	0.6	0.06
1	Duaringa Formation	Surface cover	0.5	0.05
1 & 2	Tertiary Basalt	Tertiary basalt	3.2	0.1
2	Regolith	Surface cover	1.0	0.03
3	Rewan Group	Triassic	2.0×10^{-3}	0.07
4	Rangal Coal Measures	Leichhardt overburden	1.0×10^{-5} to 1.0×10^{-2}	0.09
5		Leichhardt seam	1.0×10^{-4} to 9.0×10^{-2}	0.002
6		Interburden	5.0×10^{-5} to 1.0×10^{-2}	0.01
7		Vermont seam	1.0×10^{-4} to 1.0×10^{-2}	0.03
8		Vermont underburden	5.0×10^{-5} to 1.0×10^{-3}	0.002
9	Fort Cooper Coal Measures	Fort Cooper overburden	5.0×10^{-5} to 1.0×10^{-3}	0.1
10		Fort Cooper seam	$1.0 \times 10^{-4}$to 7.0×10^{-3}	0.1
11		Fort Cooper underburden	5.0×10^{-5} to 6.0×10^{-3}	0.1
12	Moranbah Coal Measures	Q Seam	$1.0 \times 10^{-4}$to 8.0×10^{-2}	0.1
13		Interburden	$5.0 \times 10^{-5}$to 7.0×10^{-3}	0.2
14		P Seam	$1.0 \times 10^{-4}$to 1.0×10^{-1}	0.05
15		Interburden	5.0×10^{-5} to 9.0×10^{-3}	0.04
16		H Seam	$1.0 \times 10^{-4}$to 9.0×10^{-2}	0.007
17		Interburden	$5.0 \times 10^{-5}$to 6.0×10^{-3}	0.006
18		D Seam	$1.0 \times 10^{-4}$to 9.0×10^{-2}	0.03
19		Interburden	1.0×10^{-5} to 1.0×10^{-4}	0.05
	Faults		5.0×10^{-5} to 1.0×10^{-2}	0.1
-	Spoil		3.0×10^{-1}	0.2

The hydraulic conductivity of the Permian interburden material in the Rangal Coal Measures, Fort Cooper Coal Measures and Moranbah Coal Measures reduces with depth to reflect field observations. As the decrease of Kx within the interburden rock units is driven by an increase in overburden pressure, the relationship between Kx and depth is different from that of coal seams. The hydraulic conductivity for the interburden material is capped at a minimum of 5.0 x 10^{-5} m/day and the hydraulic conductivity of the coal seams is capped at a minimum of 1.0 x 10^{-4} m/day.

The hydraulic conductivity of the interburden/overburden and coal seam layers decreases with depth according to Equations 1, 2 (exponential) and Equation 3 (power). Equations 1 and 2 were adopted from the Winchester South Project groundwater model. Equations 3 was suggested by AGE (2016) for the interburden units within the Moranbah Coal Measures based upon recent studies in the area:

Coal: $HC = HC_0 \times e(-0.015 \times depth)$ (Eq. 1)

Interburden (RCM and FCCM): $HC = HC_0 \times e(-0.018 \times depth)$ (Eq. 2)

Interburden (MCM): $HC = HC_0 \times -2.1^{depth}$ (Eq. 3)

Where:

- HC is horizontal hydraulic conductivity at specific depth;
- HC_0 is horizontal hydraulic conductivity at depth of 0 m (intercept of the curve);
- depth is depth of the floor of the layer (thickness of the cover material);
- slope is a term representing slope of the formula (steepness of the curve).

HC_0 was estimated in the calibration. It varies for the coal seams and for the interburden and overburden units in the model. The slope function and coefficient of the coal and interburden depth dependence equations were not calibrated. The Kx vs depth relationships for the interburden/overburden are presented in **Figure 2-13**., while the calibrated relationships for coal units are presented in **Figure 2-14**. The figures present the Olive Downs site data (2018), Winchester South site data, Lake Vermont North site data and Coffey (2014) Bowen Basin data. The AGE (2016) and the CVM hydraulic conductivity measurements in the Moranbah Coal Measures are also shown in the figures.

Figure 2-14 presents the lower and upper range for coal horizontal conductivity against depth relationship in Moranbah Coal Measures estimated during the calibration. It was not possible to represent every individual coal seam in the Fort Cooper Coal Measures in the model. Therefore, a “combined thickness” totalling the individual seam thicknesses for each relevant seam has been simulated. **Figure 2-14** also shows the coal horizontal conductivity against depth relationship for the Leichhardt and the Vermont Seam.

Figure 2-15 illustrates the range in horizontal hydraulic conductivity obtained from site testing and publicly available data. The data are focused on the key site units, being the alluvium, regolith, Rewan Group and the coal and interburden sequences of the Rangal and Moranbah Coal Measures. The data are compared to the horizontal hydraulic conductivity values used in the model. A depth dependence equation for the coal measures was used in the numerical groundwater model and therefore the calibrated hydraulic conductivity values vary across the model domain. Accordingly, the average value for the Moranbah Coal Measures at the CVM is displayed. As shown in **Figure 2-15**, the modelled horizontal hydraulic conductivity values are all within the range of field data.

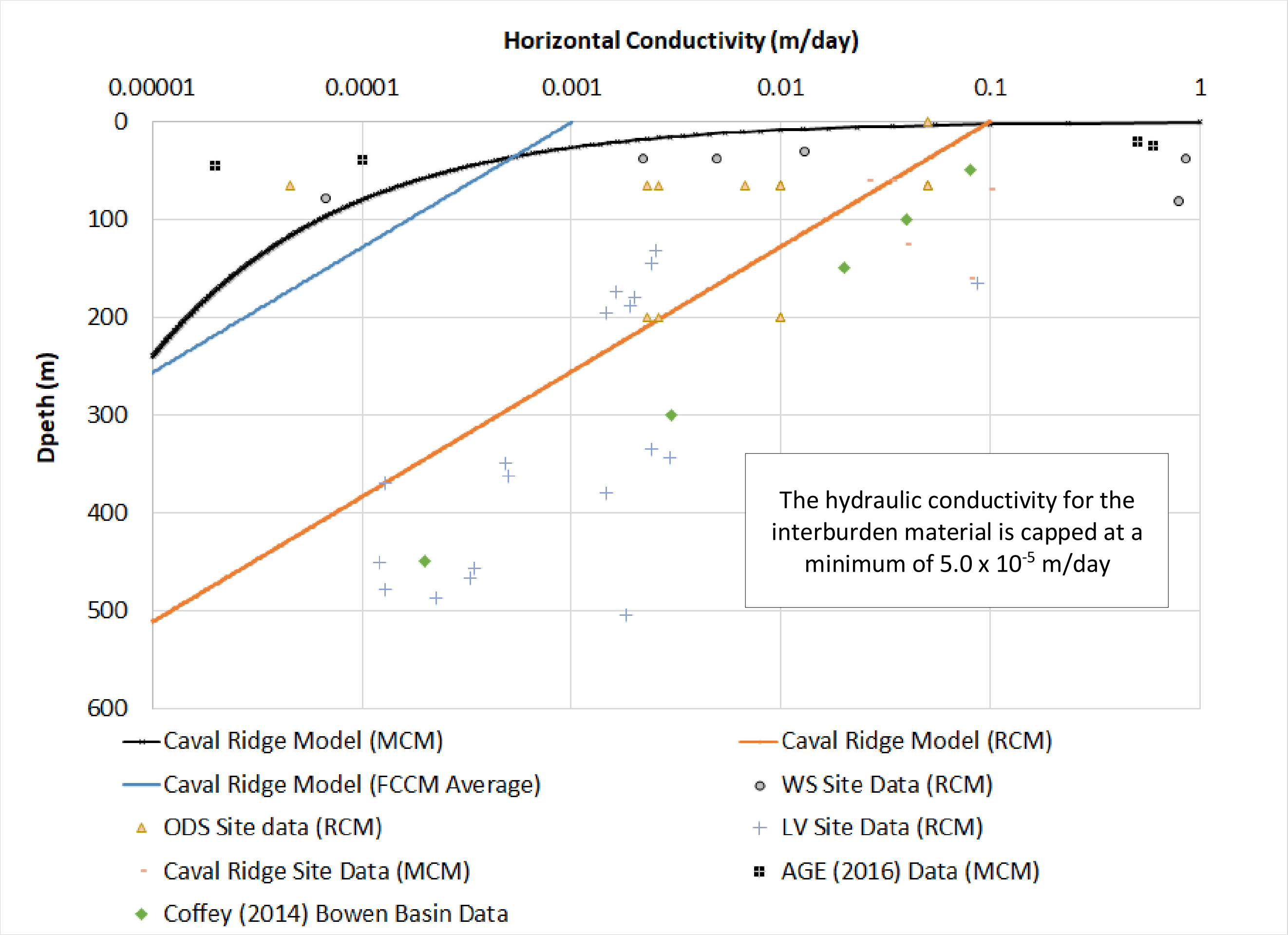


Figure 2-13 Hydraulic Conductivity vs Depth – Interburden/Overburden

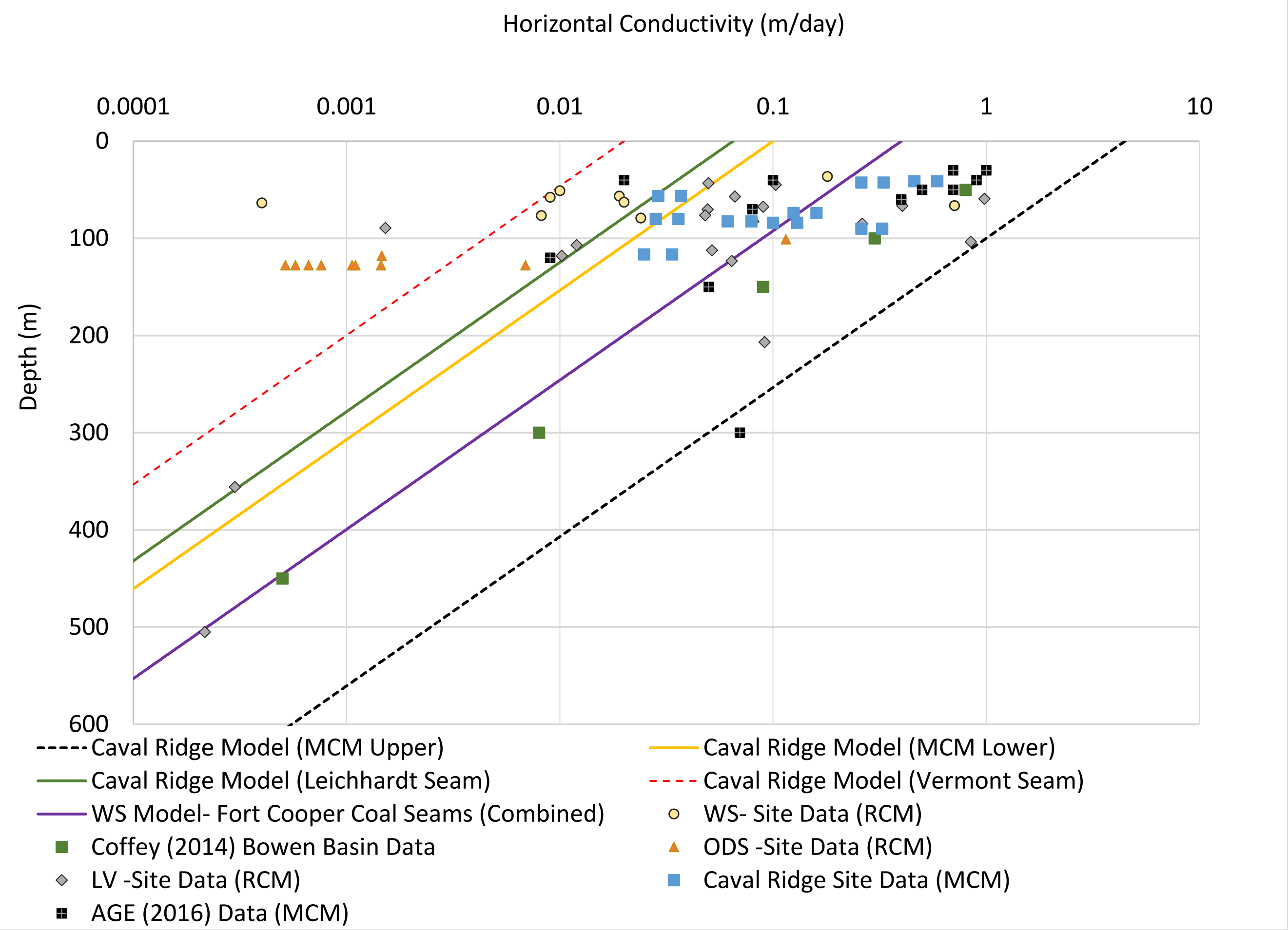


Figure 2-14 Hydraulic Conductivity vs Depth – Coal

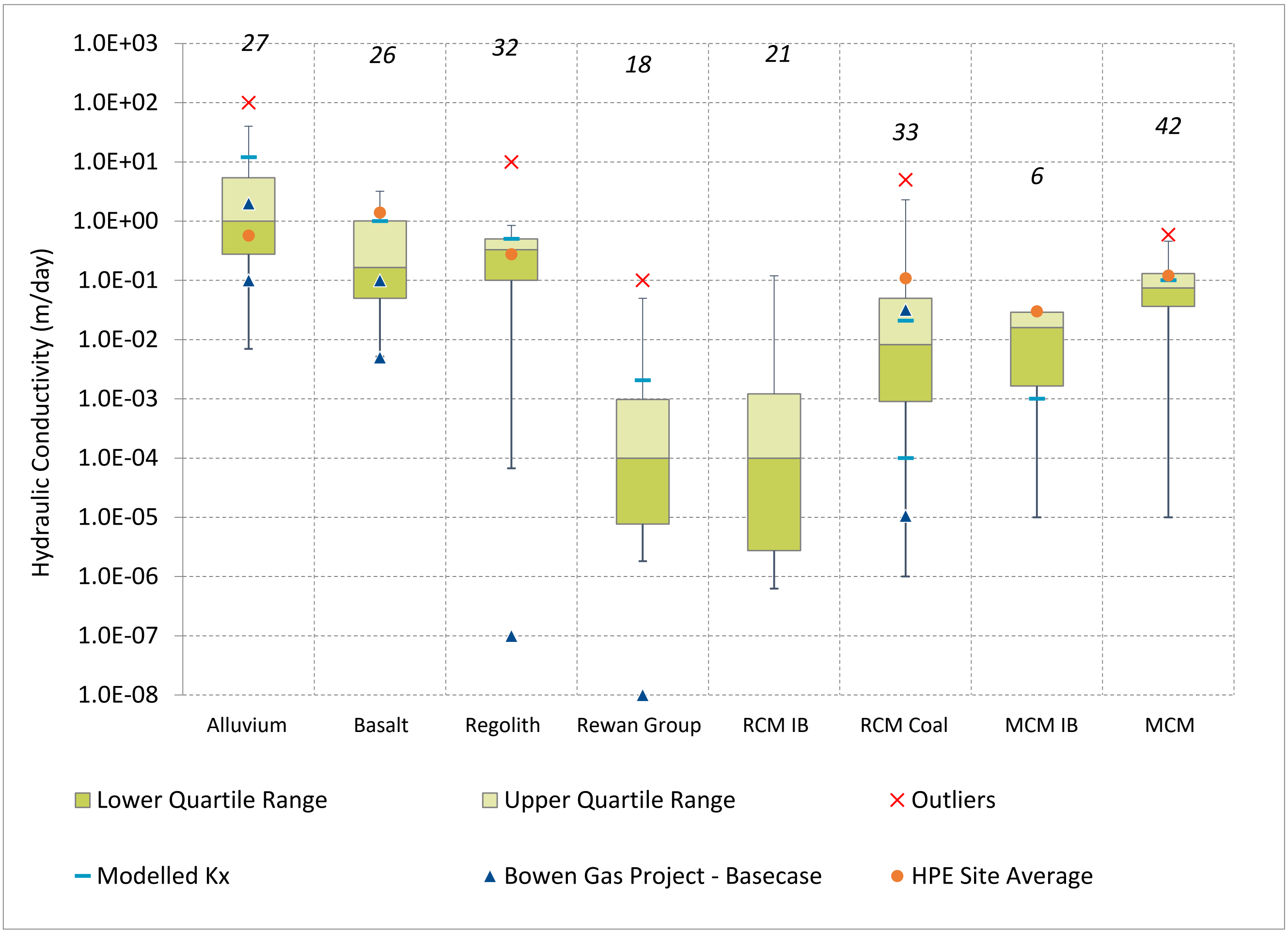


Figure 2-15 Hydraulic Parameters Estimates vs Calibrated Hydraulic Parameters

2.8 Calibrated Storage Properties

Table 2-11 summarises the calibrated values for specific storage and specific yield.

Table 2-11 Calibrated Storage Parameters

Model Layer	Formation	Unit	Specific Yield Sy (%)	Specific Storage Ss (m^{-1})
1	Alluvium	Surface cover	2.5	1.0×10^{-6}
1	Regolith	Surface cover	2.1	3.0×10^{-6}
1	Weathered Permian	Surface cover	0.2	1.0×10^{-7}
1	Duaringa Formation	Surface cover	1.9	4.0×10^{-7}
1 & 2	Tertiary Basalt	Tertiary basalt	1.8	6.0×10^{-7}
2	Regolith	Surface cover	2.0	2.0×10^{-7}
3	Rewan Group	Triassic	0.9	5.0×10^{-7}
4	Rangal Coal Measures	Leichhardt overburden	0.1	3.0×10^{-6}
5		Leichhardt Seam	0.1	5.0×10^{-7}
6		Interburden	0.1	5.0×10^{-7}
7		Vermont Seam	0.2	5.0×10^{-7}
8		Vermont underburden	0.4	1.0×10^{-6}
9	Fort Cooper Coal Measures	Fort Cooper overburden	0.1	5.0×10^{-7}
10		Fort Cooper seam	0.3	2.0×10^{-6}
11		Fort Cooper underburden	0.4	2.0×10^{-6}
12	Moranbah Coal Measures	Q Seam	0.1	2.0×10^{-6}
13		Interburden	0.2	3.0×10^{-6}
14		P Seam	0.2	2.0×10^{-6}
15		Interburden	0.2	4.0×10^{-6}
16		H Seam	0.2	6.0×10^{-7}
17		Interburden	0.2	1.0×10^{-6}
18		D Seam	0.3	7.0×10^{-7}
19		Interburden	0.9	5.0×10^{-7}
	Fault		0.2 to 0.8	7.0×10^{-7} to 2.0×10^{-6}
	Spoil		5	1.0×10^{-5}

2.9 Calibrated Recharge

Table 2-12 presents the calibrated recharge rates for each geological unit in the model. These calibrated recharge rates have been adopted into the predictive model. The recharge zones in the model layers are presented in **Appendix C**.

Table 2-12 Calibrated Rainfall Recharge

Model Geology Zone	(mm/year)	% rain
Isaac River Channel Alluvium	3	0.52
Isaac River Flood Plain Alluvium	1.3	0.23
Other Alluvium	1.3	0.23
Duaringa Formation	0.1	0.01
Tertiary basalts	1.7	0.3
Weathered Permian	0.1	0.01
Regolith	0.1	0.01

Figure 2-16 compares the calibrated recharge rates in the model against the recharge rates estimated for the site using the chloride mass balance (CMB) method for the various units (SLR, 2021a).

As per the conceptual model, higher recharge occurs through the alluvium and lower recharge in regolith and Permian outcrops. Increased recharge through the alluvium of the Isaac River channel has been used to simulate the potential for the Isaac River to provide rapid recharge to the alluvial groundwater system during rainfall events. For comparison, other nearby projects have used modelled recharge as a default value across the domain, with Lake Vermont simulating recharge equivalent of 2 % mean annual rainfall, and Isaac Plains simulating 0.5 % to alluvium and 0.25 % elsewhere. These values indicate overall rainfall recharge to the groundwater system is limited.

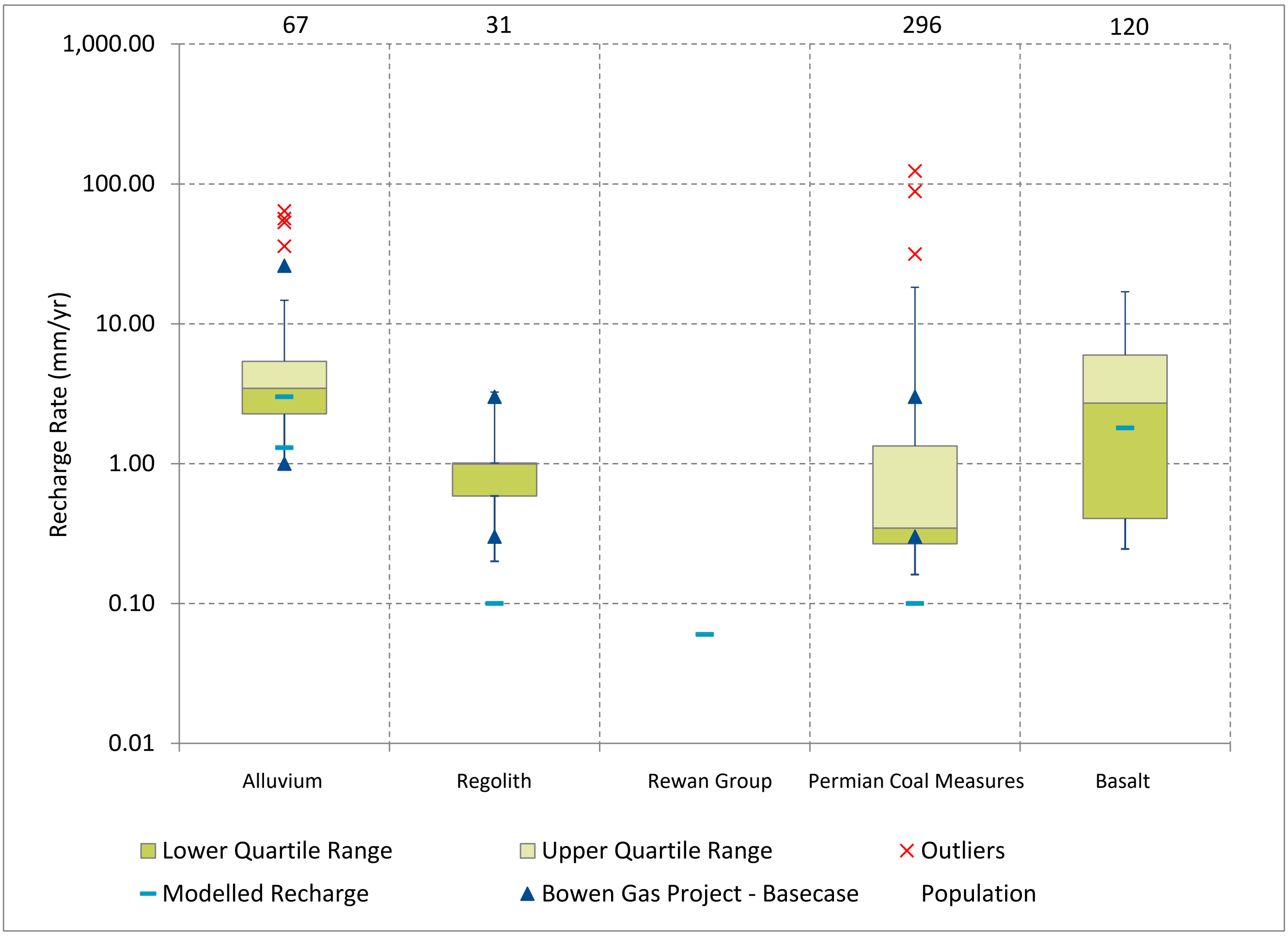


Figure 2-16 Site Recharge Estimates vs Modelled Recharge

3 Predictive Modelling

3.1 Timing and Mining

Transient predictive modelling was used to simulate the proposed mining at the Project as well as mining at other approved and foreseeable mines within the model domain. The predictive part of the model comprises annual stress periods, starting from January 2021 until January 2056.The predictive model stress period setup is detailed in **Table 3-1**, alongside simulated mine timings. The simulated predictive mine progression for the Project is presented **Figure 3-1**.

Transient predictive models have been developed for three model scenarios:

- Cumulative – all approved and foreseeable mining in region and at CVM plus the Project;
- Approved – all approved and foreseeable mining in region and at CVM; and
- Null Run – no mining within region from January 2008 (end of transient warmup).

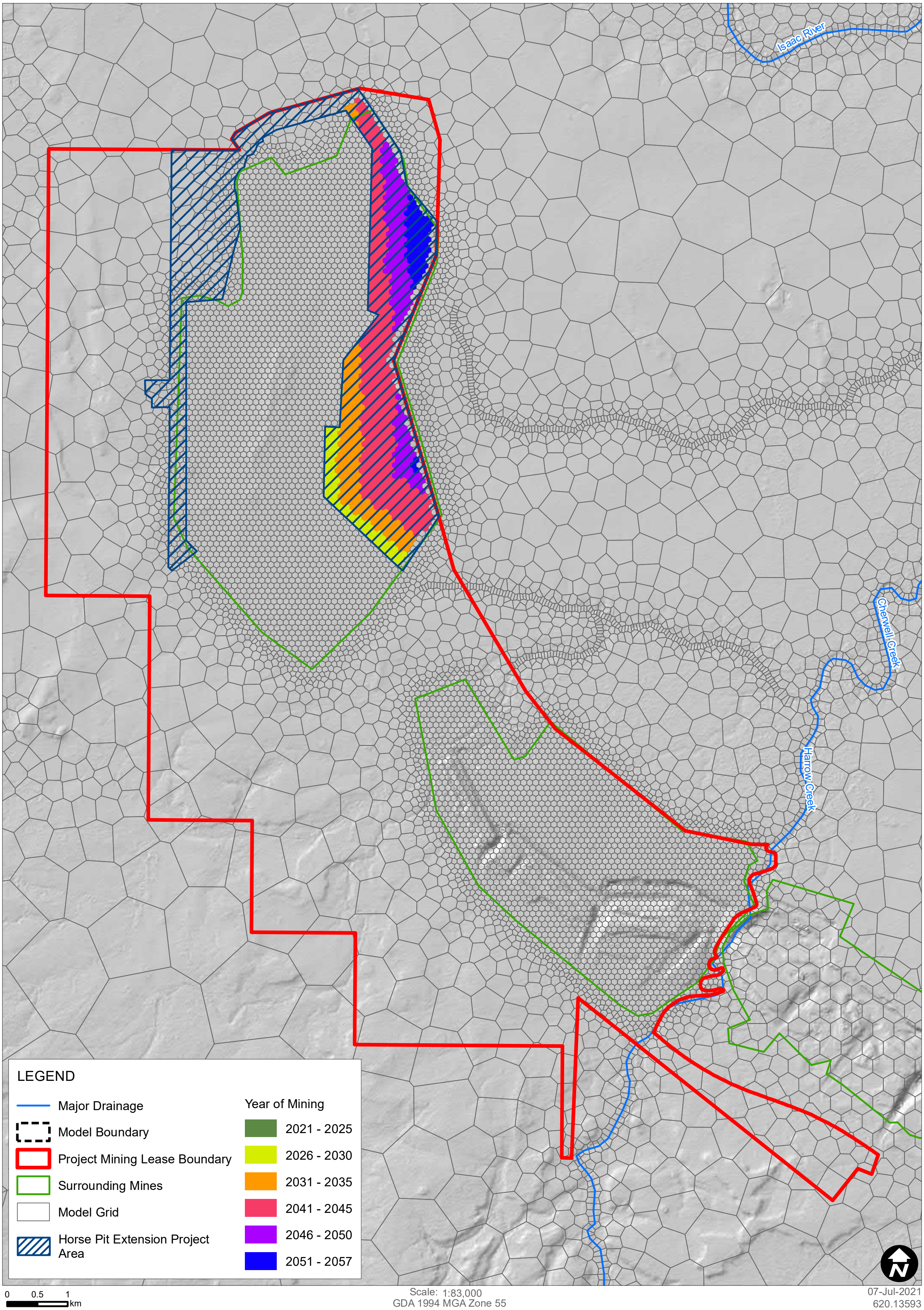
Mining cells progressed annually and drain cells simulating the mining were projected down to the base of the lowermost target coal seam (i.e. the D seam). A two-year operational window was assumed for mine cells at the Project, after which time the drains were removed and the MODFLOW Time Varying Materials (TVM) package was used to assign spoil properties to the cells.

Table 3-1 presents the simulated mine timings for the Project and surrounding mines used in the predictive model. All mines included in the model were simulated using the MODFLOW Drain (DRN) package. A nominally high drain conductance of 100 square metres per day (m^2/day) was applied to drain cells to simulate rapid removal of water from the system.

Table 3-1 Predictive Model Stress Period Setup and Mining

Interval	Stress Period	Date (from)	Date (to)	Winchester South (OC)	Moorvale South (OC)	Olive Downs (OC)	Caval Ridge (OC)	Peak Downs (OC)	Saraji (OC)	Saraji East (UG)	Grosvenor (UG)	Lake Vermont (OC)	Eagle Downs (UG)	Poitrel (OC)	Daunia (OC)
Annually	55	30/12/2020	30/12/2021		x	x	x	x	x		x	x		x	x
Annually	56	30/12/2021	30/12/2022		x	x	x	x	x		x	x		x	x
Annually	57	30/12/2022	30/12/2023		x	x	x	x	x	x	x	x		x	x
Annually	58	30/12/2023	29/12/2024	x	x	x	x	x	x	x	x	x		x	x
Annually	59	29/12/2024	30/12/2025	x	x	x	x	x	x	x	x	x		x	x
Annually	60	30/12/2025	30/12/2026	x	x	x	x	x	x	x	x	x		x	x
Annually	61	30/12/2026	30/12/2027	x	x	x	x	x	x	x	x	x		x	x
Annually	62	30/12/2027	29/12/2028	x	x	x	x	x	x	x	x	x	x	x	x
Annually	63	29/12/2028	30/12/2029	x	x	x	x	x	x	x	x	x	x	x	x
Annually	64	30/12/2029	30/12/2030	x	x	x	x	x	x	x	x	x	x	x	x
Annually	65	30/12/2030	30/12/2031	x	x	x	x	x	x	x	x	x	x	x	x
Annually	66	30/12/2031	29/12/2032	x	x	x	x	x	x	x	x	x	x	x	x
Annually	67	29/12/2032	30/12/2033	x	x	x	x	x	x	x	x	x	x	x	x
Annually	68	30/12/2033	30/12/2034	x	x	x	x	x	x	x	x	x	x	x	x
Annually	69	30/12/2034	30/12/2035	x	x	x	x	x	x	x	x	x	x	x	x
Annually	70	30/12/2035	29/12/2036	x	x	x	x	x	x	x	x	x	x	x	x
Annually	71	29/12/2036	30/12/2037	x	x	x	x	x	x	x	x	x	x	x	x
Annually	72	30/12/2037	30/12/2038	x	x	x	x	x	x	x	x	x	x	x	x
Annually	73	30/12/2038	30/12/2039	x	x	x	x	x	x	x	x	x	x	x	x

Interval	Stress Period	Date (from)	Date (to)	Winchester South (OC)	Moorvale South (OC)	Olive Downs (OC)	Caval Ridge (OC)	Peak Downs (OC)	Saraji (OC)	Saraji East (UG)	Grosvenor (UG)	Lake Vermont (OC)	Eagle Downs (UG)	Poitrel (OC)	Daunia (OC)
Annually	74	30/12/2039	29/12/2040	x	x	x	x	x	x	x	x	x	x	x	x
Annually	75	29/12/2040	30/12/2041	x	x	x	x	x	x	x	x	x	x	x	x
Annually	76	30/12/2041	30/12/2042	x	x	x	x	x	x	x	x	x	x	x	x
Annually	77	30/12/2042	30/12/2043	x	x	x	x	x	x	x	x	x	x	x	x
Annually	78	30/12/2043	29/12/2044	x	x	x	x	x	x	x	x	x	x	x	x
Annually	79	29/12/2044	30/12/2045	x	x	x	x	x	x	x	x	x	x	x	x
Annually	80	30/12/2045	30/12/2046	x	x	x	x	x	x	x	x	x	x	x	x
Annually	81	30/12/2046	30/12/2047	x	x	x	x	x	x	x	x	x	x	x	x
Annually	82	30/12/2047	29/12/2048	x	x	x	x	x	x	x	x	x	x	x	x
Annually	83	29/12/2048	30/12/2049	x	x	x	x	x	x	x	x	x	x	x	x
Annually	84	30/12/2049	30/12/2050	x	x	x	x	x	x	x	x	x	x	x	x
Annually	85	30/12/2050	30/12/2051	x	x	x	x	x	x	x	x	x	x	x	x
Annually	86	30/12/2051	29/12/2052	x	x	x	x	x	x	x	x	x	x	x	x
Annually	87	29/12/2052	30/12/2053	x	x	x	x	x	x	x	x	x	x	x	x
Annually	88	30/12/2053	30/12/2054	x	x	x	x	x	x	x	x	x	x	x	x
Annually	89	31/12/2054	31/12/2055	x	x	x	x	x	x	x	x	x	x	x	x



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SLR

Project Mine Progression

FIGURE 3-1

3.2 Water Balance

Table 3-2 to **Table 3-4** provide average flow rates for water transfer into and out of the predictive model (January 2021 until January 2056 period) for the three predictive scenarios. The mass balance error for all three scenarios was 0.0 % indicating that the model was stable and achieved an accurate numerical solution. All scenarios maintained mass balance errors below 1 % for all time steps throughout the simulations. The low error achieved indicates that the predictive model is stable, and the solution achieved is accurate (Barnett *et al*., 2012).

The tables show that simulated recharge increased from 3.46 ML/d in the Null scenario to 6.20 ML/day in the Cumulative scenario and the Approved scenario. The increase in recharge is due to the presence of open cut mining and enhanced recharge through the spoil to the groundwater system in the Approved and Cumulative scenarios.

Table 3-2 to **Table 3-4** show in all the three predictive scenarios, groundwater leaves the model through regional groundwater flow (GHB). The net flow out of the model decreased from an average of 0.77 ML/day in the Null scenario to 0.27 ML/day in both the Cumulative and Approved scenarios. The GHB net flow is less than 2 % of the total flow in water balance for all the scenarios indicating the model boundary conditions do not have an influence on the model predictions.

Evapotranspiration for the predictive models is approximately 0.5 ML/day. The loss to evapotranspiration happens where the water table is within 2 m of the land surface across the model domain, which is primarily along the saturated extent of Isaac River alluvium near the Isaac River.

Table 3-4 shows a negative river net flow (-1.92 ML/day) in the Null Run indicating flow from the groundwater system to rivers. However, **Table 3-2** shows that in the Cumulative Run the net river exchange flux (RIV) is positive (2.55 ML/day), which indicates that overall, the rivers including Isaac River are losing water to the groundwater system. The difference in river net fluxes is likely due to the modelled influence from mining activities from 2021, resulting in lower groundwater levels and an increase in modelled leakage from the Isaac River to the groundwater system. **Table 3-3** shows a similar net river exchange flux to the Cumulative Run indicating that the proposed mining activities at CVM do not impact the flow out of the Isaac River.

Groundwater outflow from the model mostly occurs via drain cells, used to simulate open cut and underground mining activity in the model. **Table 3-2** and **Table 3-3** show that the Project in the Cumulative scenario resulted in an increase in the average drain outflow (17.18 ML/day from 16.88 ML/day predicted for the Approved scenario).

Table 3-2 Average Simulated Water Balance over the Prediction Period – Cumulative

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/d)	Percent of Total Inflow (%)
Recharge (direct rainfall)	6.20	16.9	-	-
Evapotranspiration (ET)	-	-	0.43	1.2
SW/GW Interaction Isaac River (RIV)	7.23	19.7	3.33	9.2
SW/GW Interaction Other Rivers (RIV)*	0.00	0.0	1.35	3.6
Regional GW flow (GHB)	0.57	1.6	0.84	2.3
Drains (Mine inflows)	-	-	17.18	46.9
Storage	22.61	61.8	13.48	36.8
Total	36.61	100.0	36.61	100.0

* The other tributaries or drainage lines in the model are set as drains to the groundwater system and do not result in any recharge.

Table 3-3 Average Simulated Water Balance over the Prediction Period – Approved

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/d)	Percent of Total Inflow (%)
Recharge (direct rainfall)	6.20	17.1	-	-
Evapotranspiration (ET)	-	-	0.43	1.2
SW/GW Interaction Isaac River (RIV)	7.23	19.9	3.33	9.2
SW/GW Interaction Other Rivers (RIV)*	0.00	0.0	1.35	3.7
Regional GW flow (GHB)	0.57	1.6	0.85	2.3
Drains (Mine inflows)	-	-	16.88	46.4
Storage	22.33	61.4	13.49	37.2
Total	36.33	100.0	36.33	100.0

* The other tributaries or drainage lines in the model are set as drains to the groundwater system and do not result in any recharge.

Table 3-4 Average Simulated Water Balance over the Prediction Period – Null Run

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/d)	Percent of Total Inflow (%)
Recharge (direct rainfall)	3.46	44.7	-	-
Evapotranspiration (ET)	-	-	0.53	6.8
SW/GW Interaction Isaac River (RIV)	4.11	53.0	4.64	59.9
SW/GW Interaction Other Rivers (RIV)*	0.00	0.0	1.39	17.9
Regional GW flow (GHB)	0.13	1.6	0.90	11.7
Drains (Mine inflows)	-	-	0.00	0.00
Storage	0.05	0.7	0.29	3.7
Total	7.76	100.0	7.75	100.0

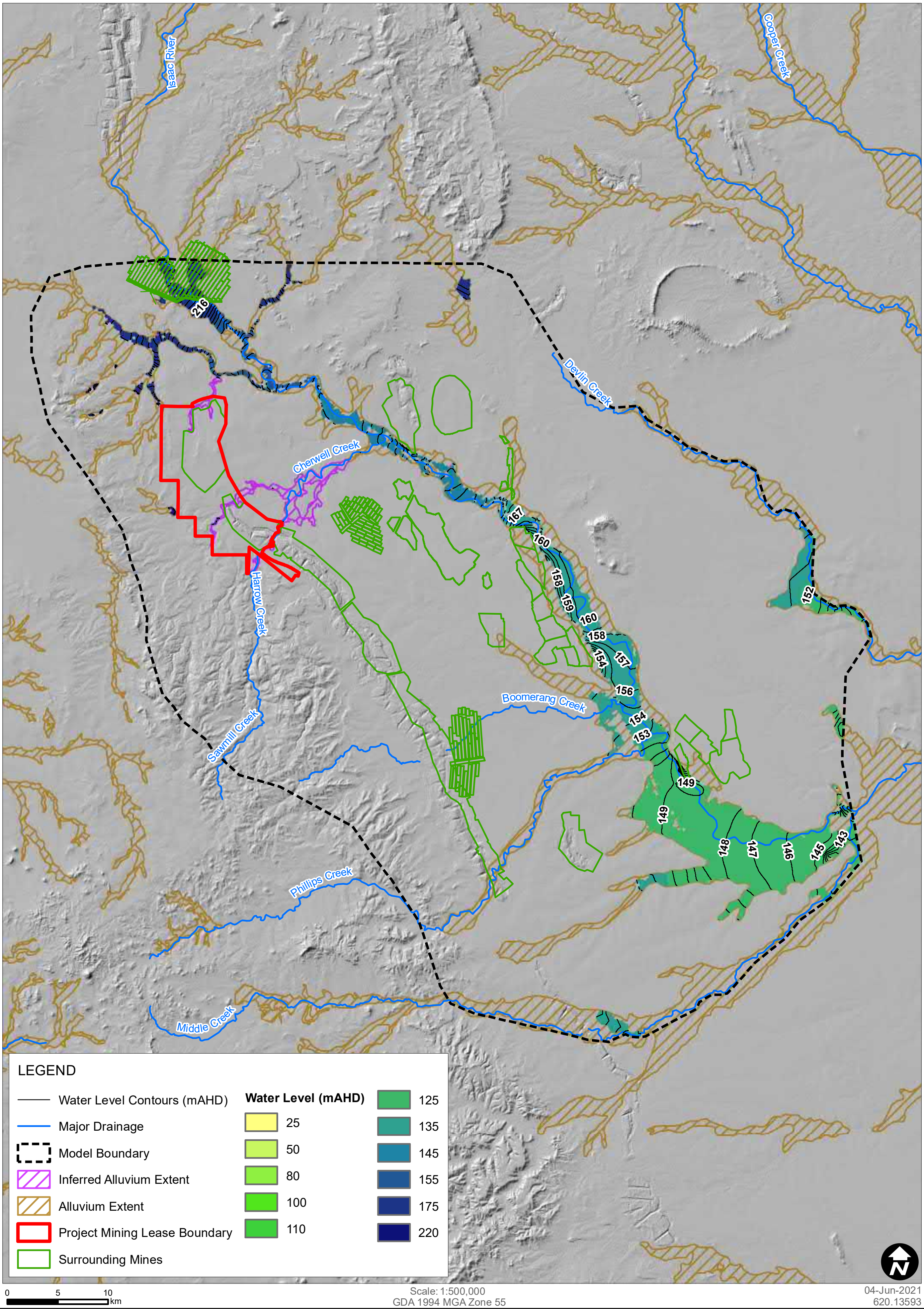
* The other tributaries or drainage lines in the model are set as drains to the groundwater system and do not result in any recharge.

3.3 Predicted Groundwater Levels

Predicted groundwater levels at the end of mining operations for the Approved and Cumulative scenarios are provided in **Figure 3-2** to **Figure 3-7**. The gaps in the water level grids represent unsaturated areas (i.e., where the simulated water level elevation is below the base of cell).

Minimal changes to alluvial groundwater levels (generally less than 0.1 m) are observed between the Approved and Cumulative mining scenarios (**Figure 3-2** and **Figure 3-5**). **Figure 3-3** and **Figure 3-6** show predicted groundwater levels in the regolith at the end of mining for the Approved and Cumulative mining scenarios. Dewatering of the regolith caused by the proposed mining at the Project can be seen by slightly larger unsaturated zone within the Project Area for the Cumulative mining scenario (**Figure 3-6**), relative to the Approved mining scenario (**Figure 3-3**).

Figure 3-4 and **Figure 3-7** show the predicted water levels in the Moranbah Measures overburden (Layer 18) at the end of mining for the Approved and Cumulative mining scenarios. This unit has been chosen to represent head levels in the Permian Coal Measures due to its regional extent. A regional south-easterly hydraulic gradient can be observed, reflecting the downstream flow gradient of the Isaac River. Zones of depressurisation at the Project and surrounding mines are shown to cause localised interruptions to the regional flow gradient. A discussion on groundwater drawdown within the Permian Coal Measures is included in **Section 3.4**.



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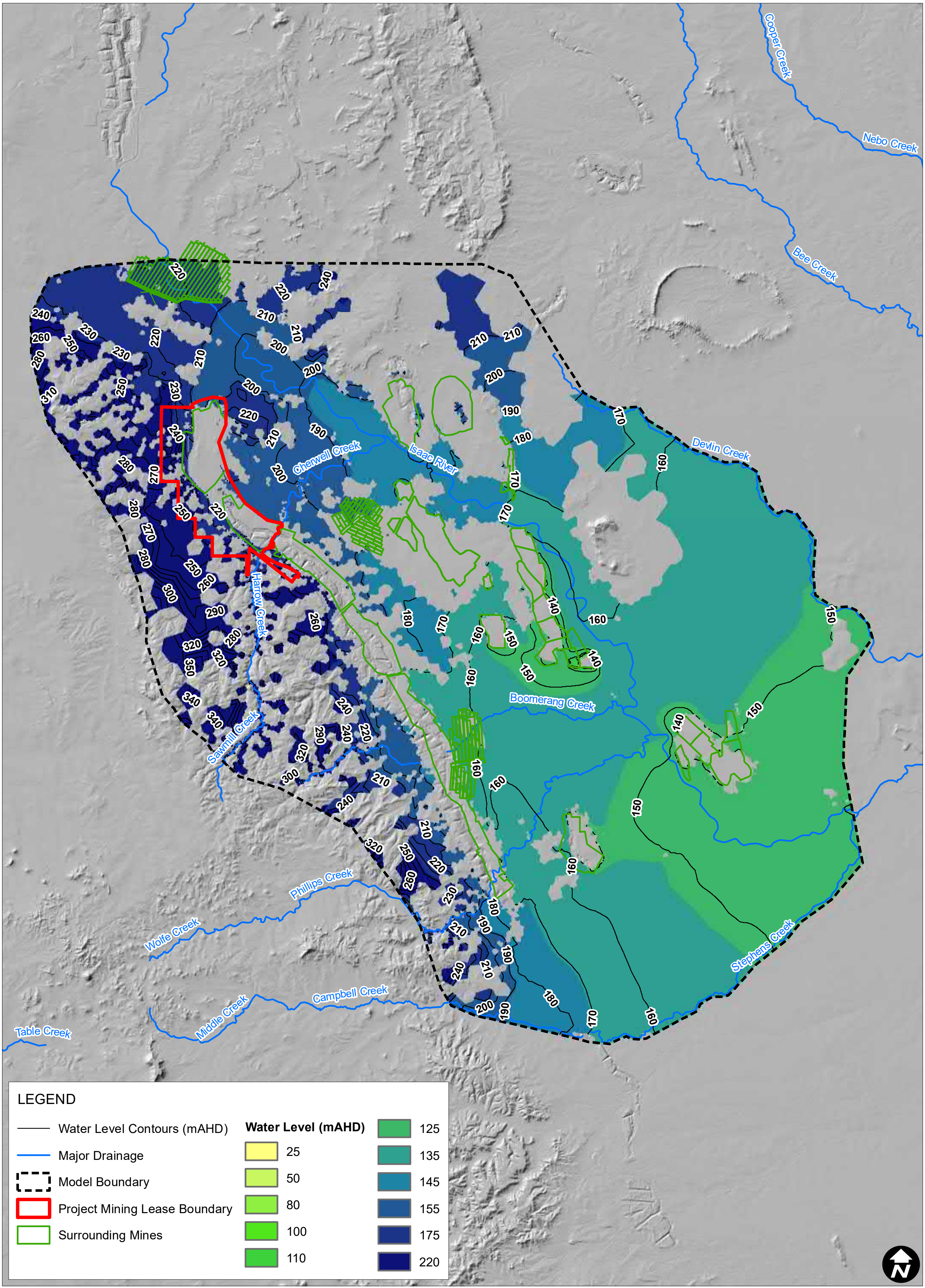
SLR

Predicted Water Level within Quaternary Alluvium (Layer 1) at End of Mining – Approved Operations Only

FIGURE 3-2



0 5 10 km

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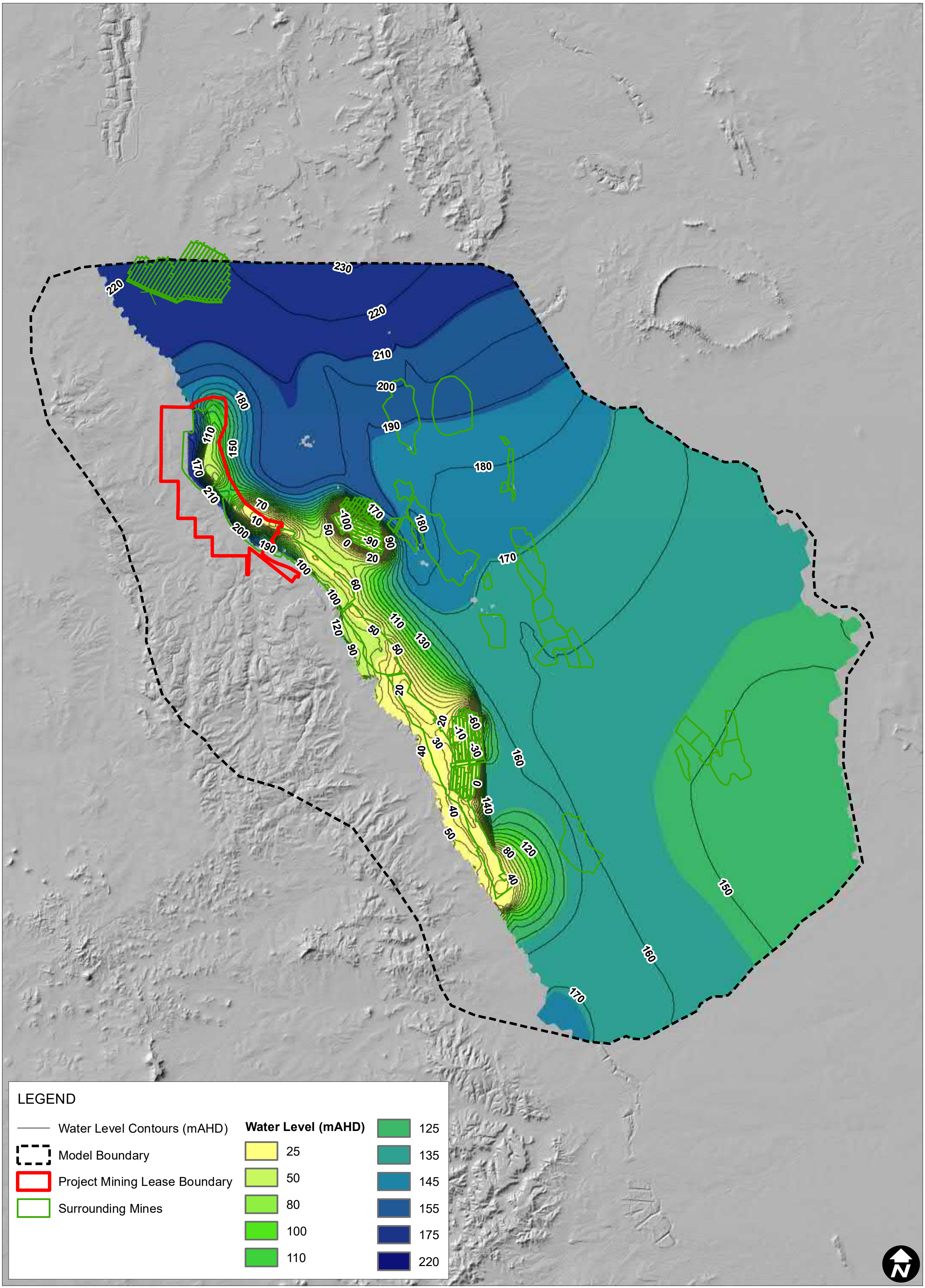
SLR

**Predicted Water Level within Regolith (Layer 2)
at End of Mining – Approved Operations Only**

FIGURE 3-3



0 5 10 km

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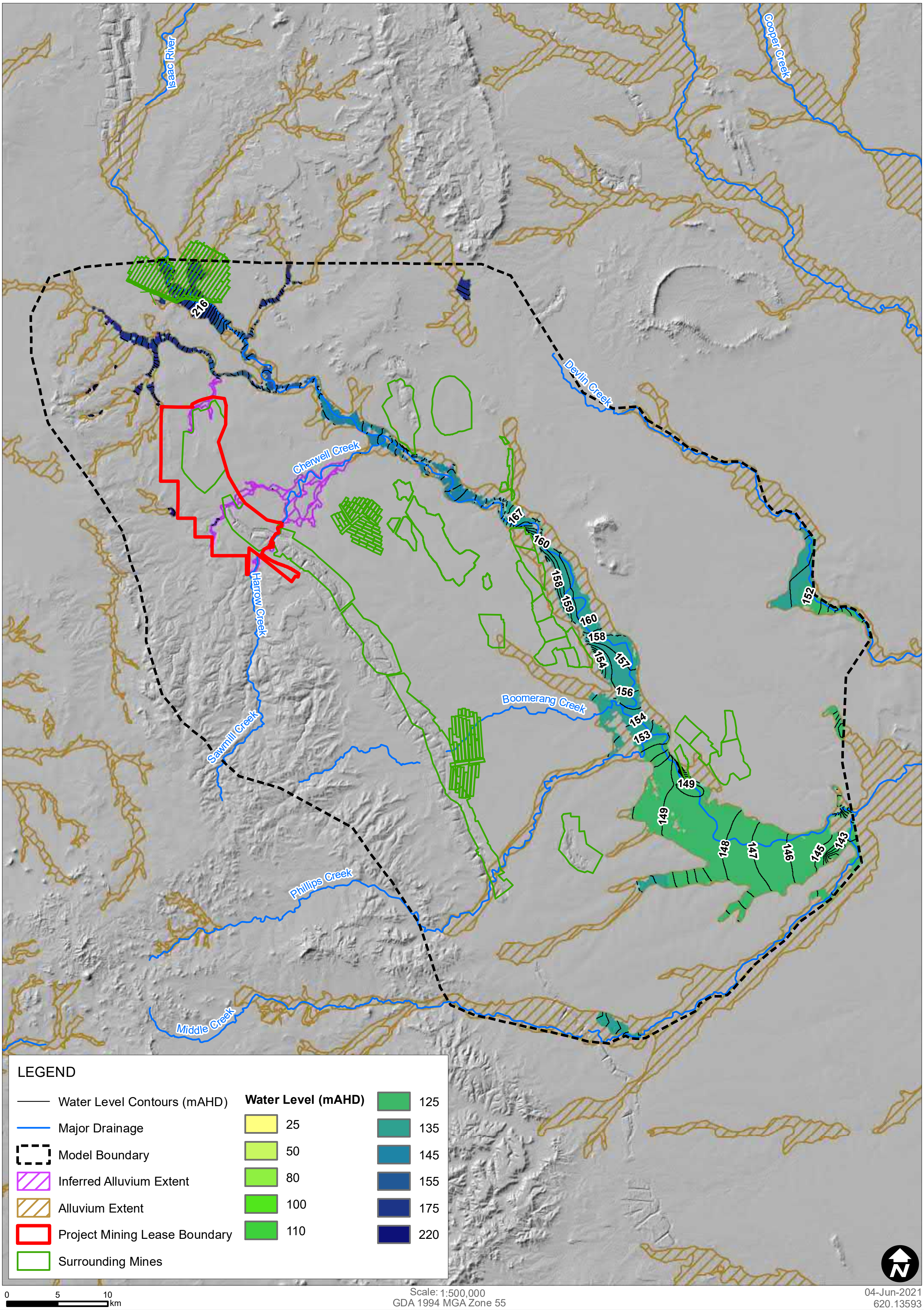
SLR

Predicted Water Level within Permian Coal Measures (Layer 18) at End of Mining – Approved Operations Only

FIGURE 3-4

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Horse Pit Modelling Report\62013593 F 3-5 Predicted Water Level within Quaternary Alluvium (Layer 1) at End of Mining – Cumulative Mining Scenario.mxd



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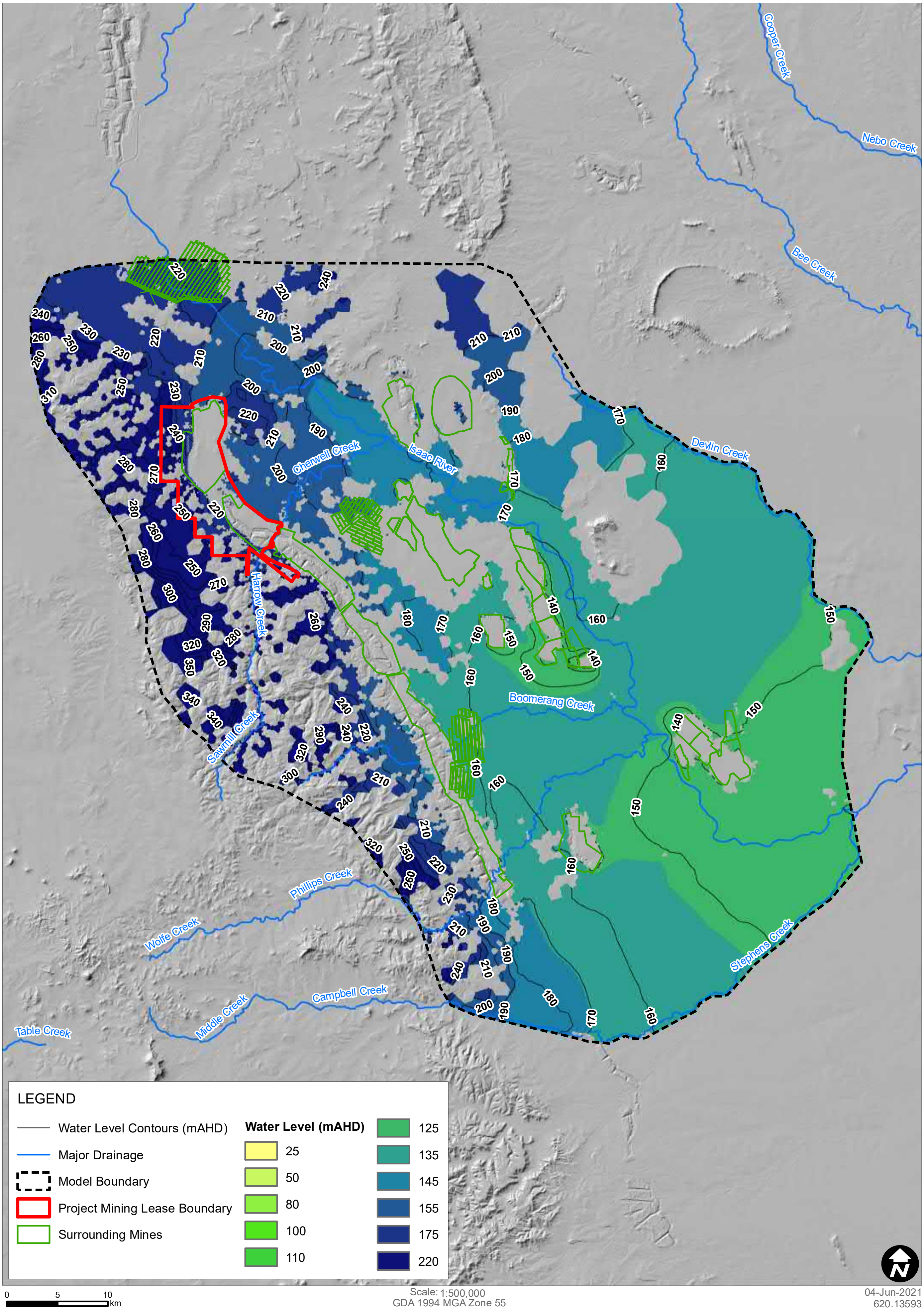
Predicted Water Level within Quaternary Alluvium (Layer 1) at End of Mining – Cumulative Mining Scenario

FIGURE 3-5



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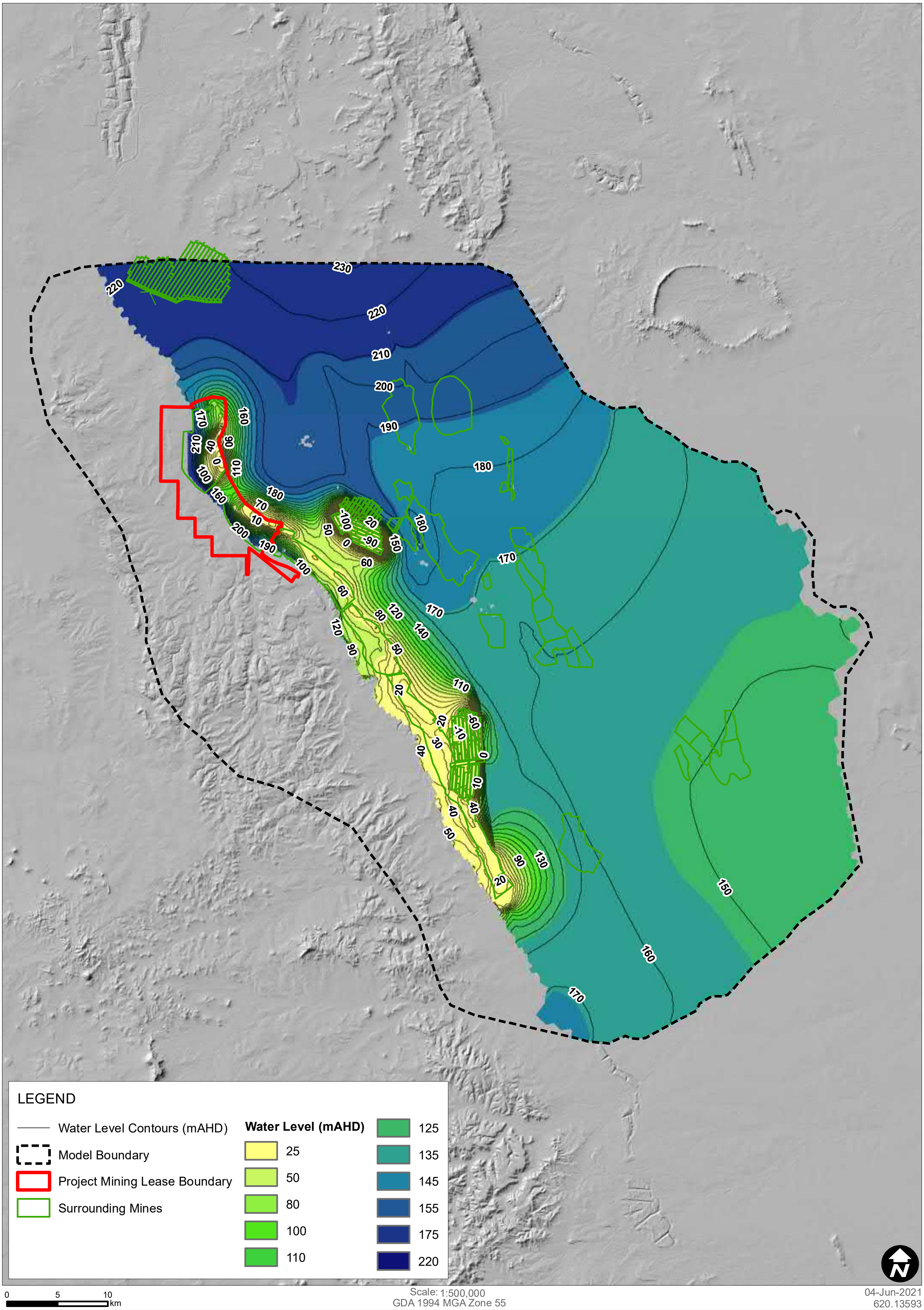
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Horse Pit Modelling Report\62013593 F 3-6 Predicted Water Level within Regolith (Layer 2) at End of Mining – Cumulative Mining Scenario.mxd

Predicted Water Level within Regolith (Layer 2) at End of Mining – Cumulative Mining Scenario

FIGURE 3-6



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H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Horse Pit Modelling Report\62013593 F 3-7 Predicted Water Level within Permian Coal Measures (Layer 12) at End of Mining – Cumulative Mining Scenario.mxd

SLR

Predicted Water Level within Permian Coal Measures (Layer 12) at End of Mining – Cumulative Mining Scenario

FIGURE 3-7

3.4 Maximum Predicted Drawdowns

3.4.1 Incremental Drawdown

The process of mining directly removes water from the groundwater system and reduces water levels in surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown. Aquifer drawdown is greatest at the working coalface and decreases with distance from the mine.

Maximum incremental drawdown refers to the drawdown impact associated with the Project and is obtained by comparing the difference in predicted aquifer groundwater levels for the Approved model scenario and the Cumulative model scenario at matching times. The maximum drawdown represents the maximum drawdown values recorded at each model cell at any time over the model duration. Predicted drawdown figures (**Figure 3-9** to **Figure 3-20**) show where maximum drawdown impacts are predicted to exceed 1 m.

Figures include the locations of known water supply and stock bores within the model domain. In the 2020 CVM bore census, three active water supply and stock bores were identified near the Project (SLR, 2021a). These bores are Grosvenor Downs 1, Coolibah Downs 01 and Winchester Downs 01 located less than 7 km to the east of the Project area. Grosvenor Downs 1 is installed in the alluvium while the other two bores access the Fort Cooper Coal Measures. None of these bores are predicted to be impacted as a result of mining activities at the Project.

No incremental drawdown impacts are predicted for the Quaternary alluvium as a result of mining at the Project. This predicted drawdown extent is consistent with the GHD (2017) model where no water table drawdown was predicted due to the mining at CVM.

For a discussion on the potential incidental water impacts on the Quaternary alluvium, see **Section 3.6.1**.

The maximum predicted incremental drawdowns associated with the Project within the regolith is shown in **Figure 3-9.** The incremental drawdown extent within the regolith (Layer 2) is largely confined to the Project area and is influenced by the distribution of predicted saturated zones in the regolith. At the northern end of the CVM mining lease, 1 m drawdown influence is predicted to extend 2.9 km north of the mining lease boundary.

The coal seams of the Moranbah Coal Measures are the primary groundwater bearing strata targeted by mining at the Project and will experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents. **Figure 3-9** to **Figure 3-12** show the maximum predicted incremental drawdown for Q, P, H and D seam in the Moranbah Coal Measures. The figures show the extent of maximum predicted depressurization of the Permian coal measures is limited to the west of the Project area due to the structural geology (i.e. coal seams subcrop). The extents of maximum predicted incremental drawdown in the Moranbah coal seams are between 10 to 12 km to the east and northeast of the Project mining lease. The cone of depression is predicted to be steepest at the working coalface. The predicted drawdown extents are consistent with the previous predictions by GHD (2017) for the CVM operations.

3.4.2 Cumulative Drawdown

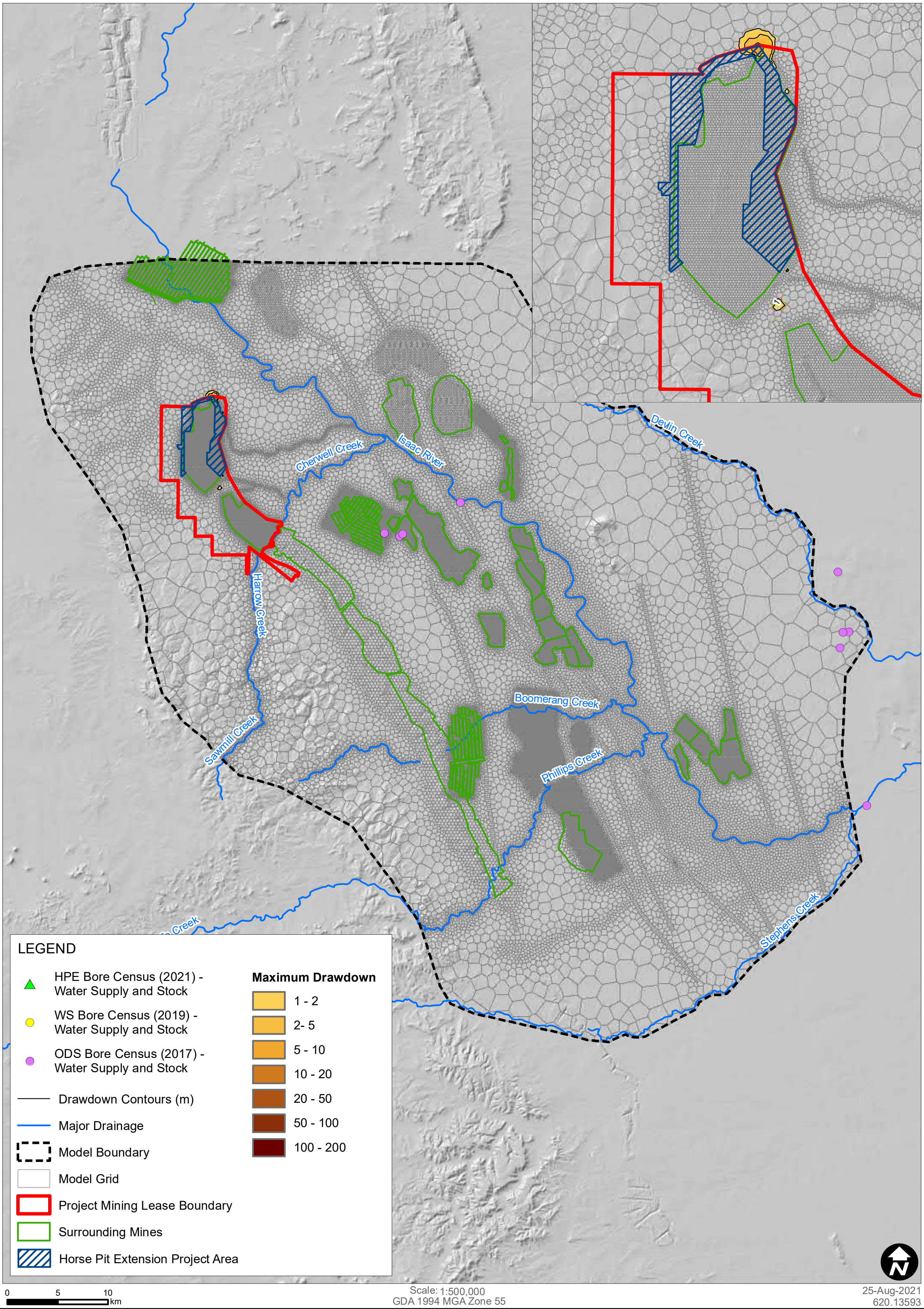
The simulated cumulative drawdown presented in this section show the impacts on different aquifers due to the existing approved works and entitlements within the model domain. The simulated cumulative drawdown also shows whether the zone of impact from the approved neighbouring operations is predicted to interact with the zone of impact from the Project in different aquifers.

Maximum cumulative drawdown impacts in proximity to the Project are shown in **Figure 3-13** to **Figure 3-20**. Maximum cumulative drawdown predictions covering the entire model domain are provided in **Appendix D**. These drawdowns represent the total impact to modelled groundwater levels resulting from all mining within the model domain, by comparing the maximum difference in aquifer groundwater levels for the Cumulative model scenario with those in a theoretical “No Mining” or Null Run scenario, for all times during the predictive model period. The vast majority of these predicted cumulative drawdown impacts are not related to the Project but result from existing and approved mining activities represented in the model.

There are no cumulative drawdown impacts predicted for the Quaternary alluvium within or around the CVM area (**Figure 3-13)**.

Cumulative impacts within the regolith can be seen connecting the Project-related drawdown to the drawdown impacts at Peak Downs, south of the Project (**Figure 3-14**). For the Leichhardt and Vermont coal seams, there was no drawdown interaction between the Project and the neighbouring mines that both target the Rangal Coal Measures which are not present in the CVM area (**Figure 3-15** and **Figure 3-16**).

Figure 3-17 to **Figure 3-20** show the maximum predicted cumulative drawdown in Q, P, H and D seams in the Moranbah Coal Measures. As shown in the figures the cumulative drawdown is predicted to interact with zone of impact from the Peak Downs open pits, Saraji open cut, Eagle Downs and Grosvenor underground operations. The extents of maximum predicted incremental drawdown in the Moranbah coal seams are approximately 13 km to the East and 10 km to the north of the Project mining lease.



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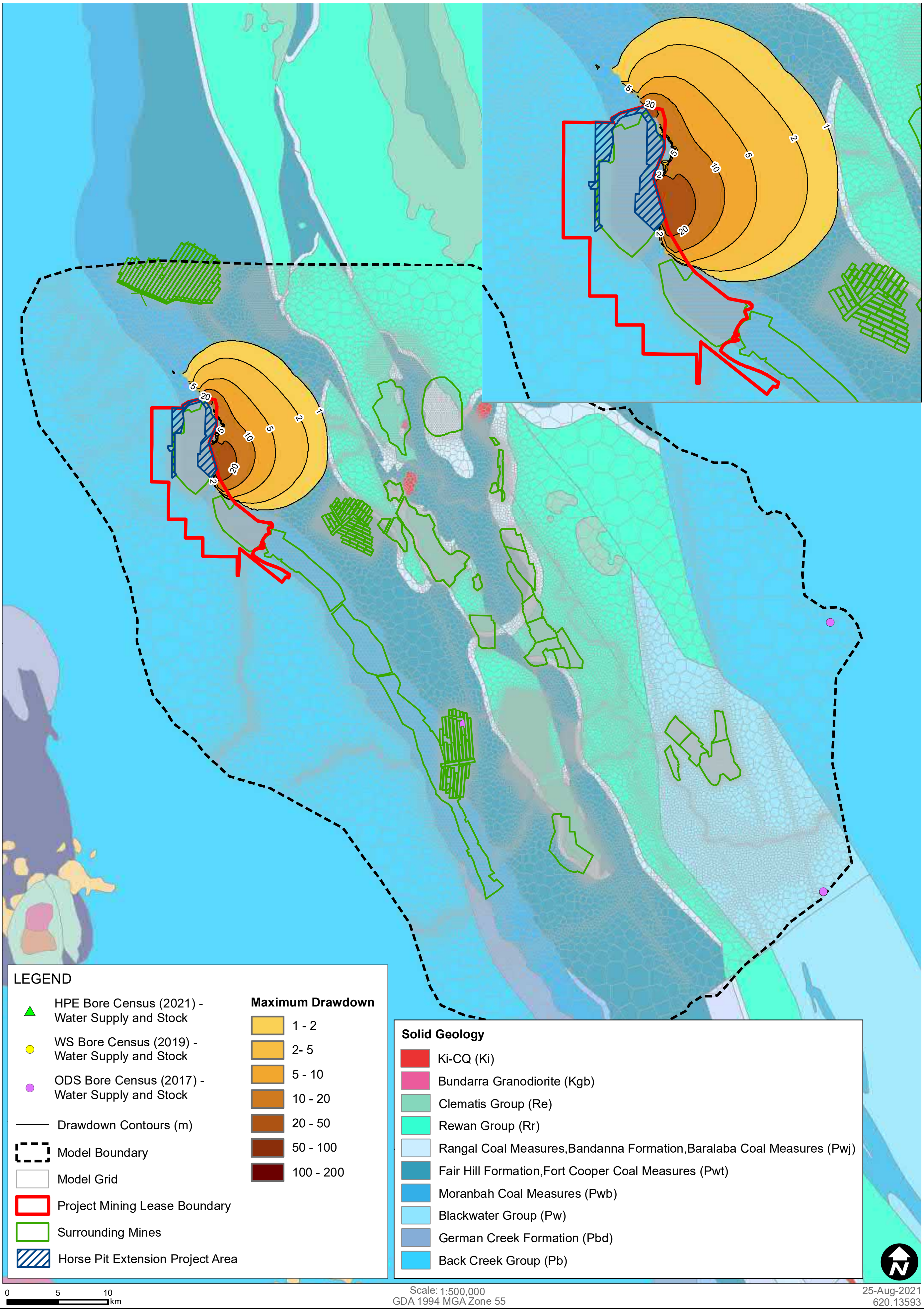
Maximum Incremental Drawdown in Regolith (Layer 2)

FIGURE 3-8

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\62013593 F 3-9 Maximum Incremental Drawdown in Q Seam (Layer 12).mxd



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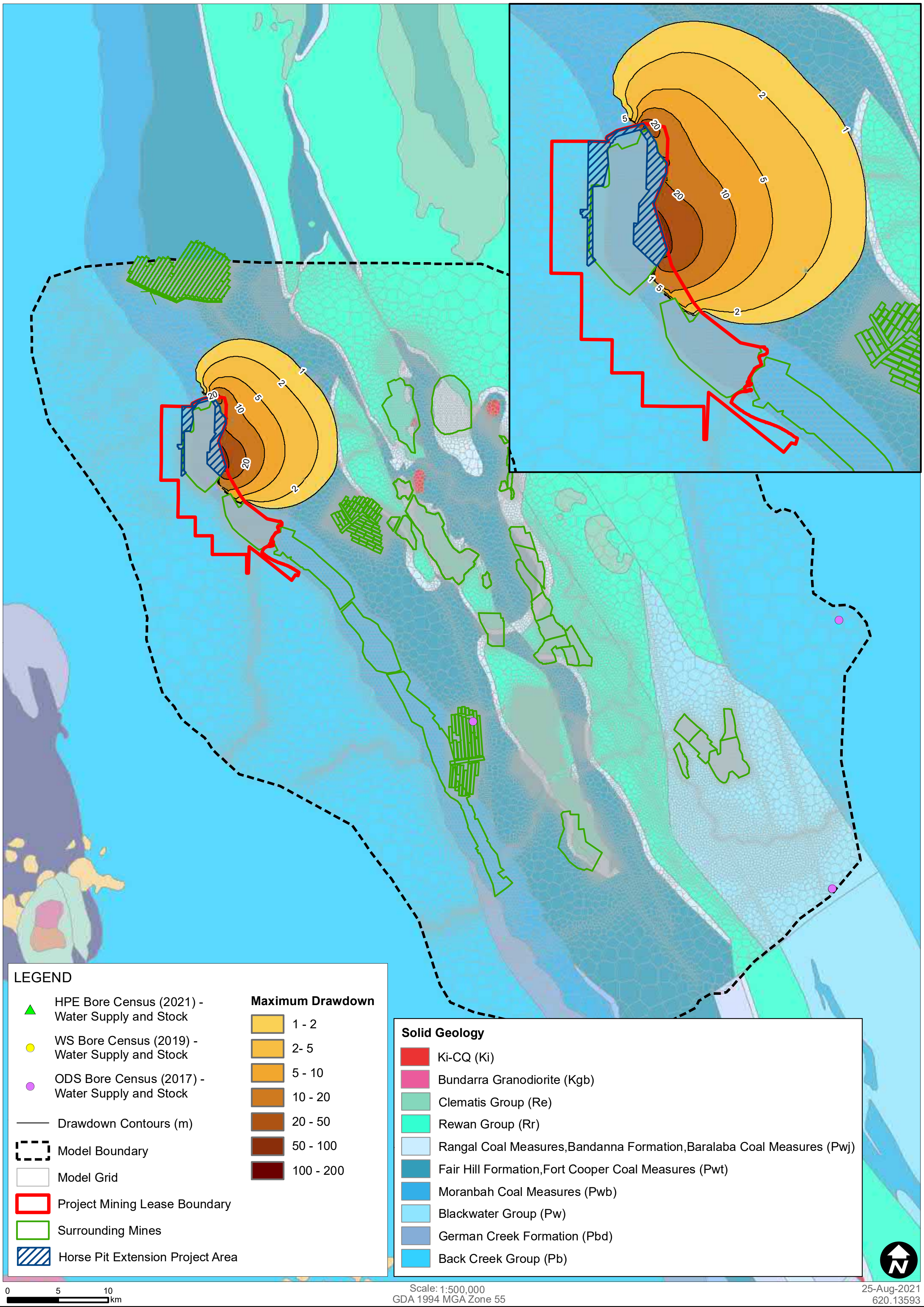
Maximum Incremental Drawdown in Q Seam (Layer 12)

FIGURE 3-9



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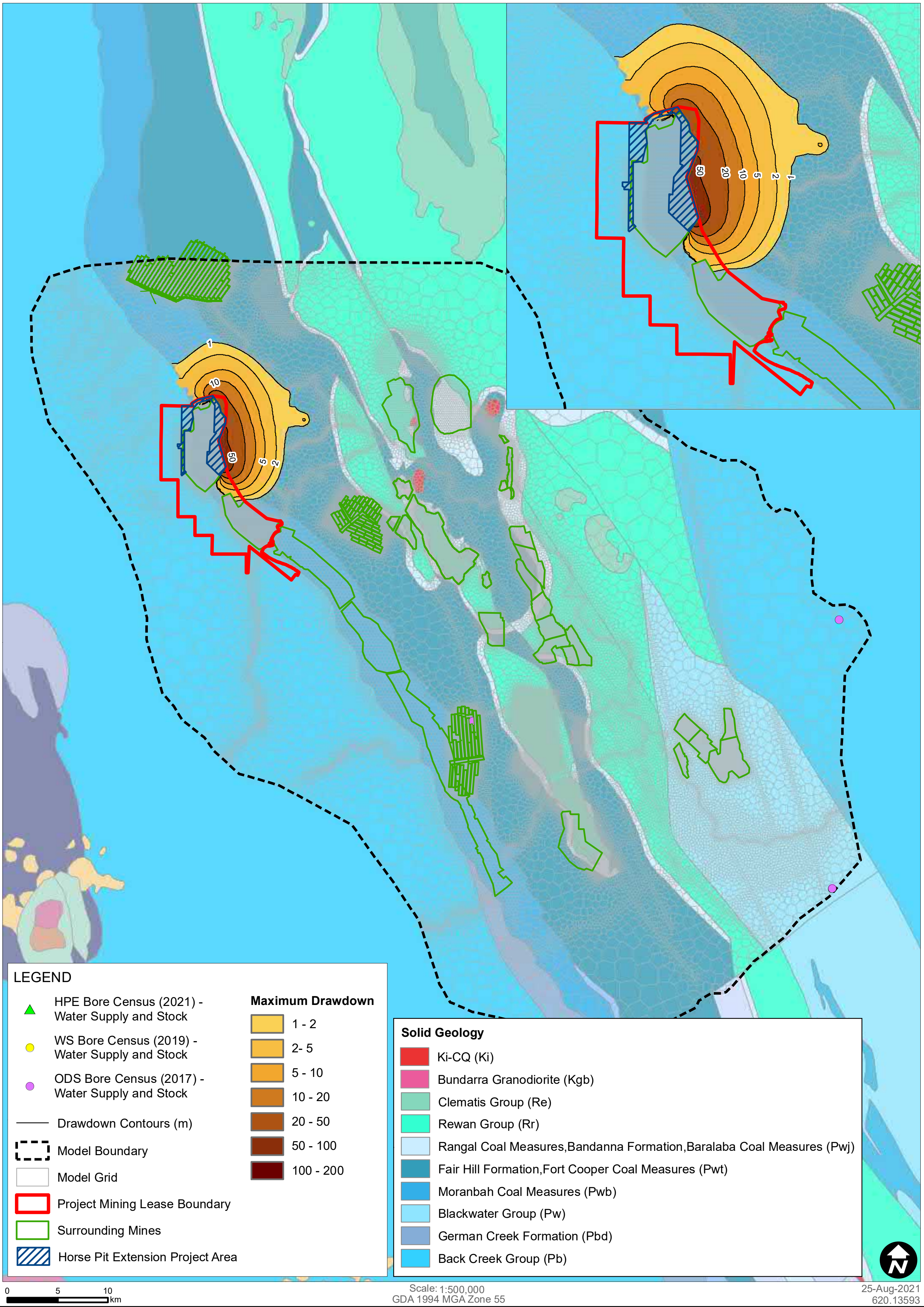
SLR

Maximum Incremental Drawdown in P Seam (Layer 14)

FIGURE 3-10



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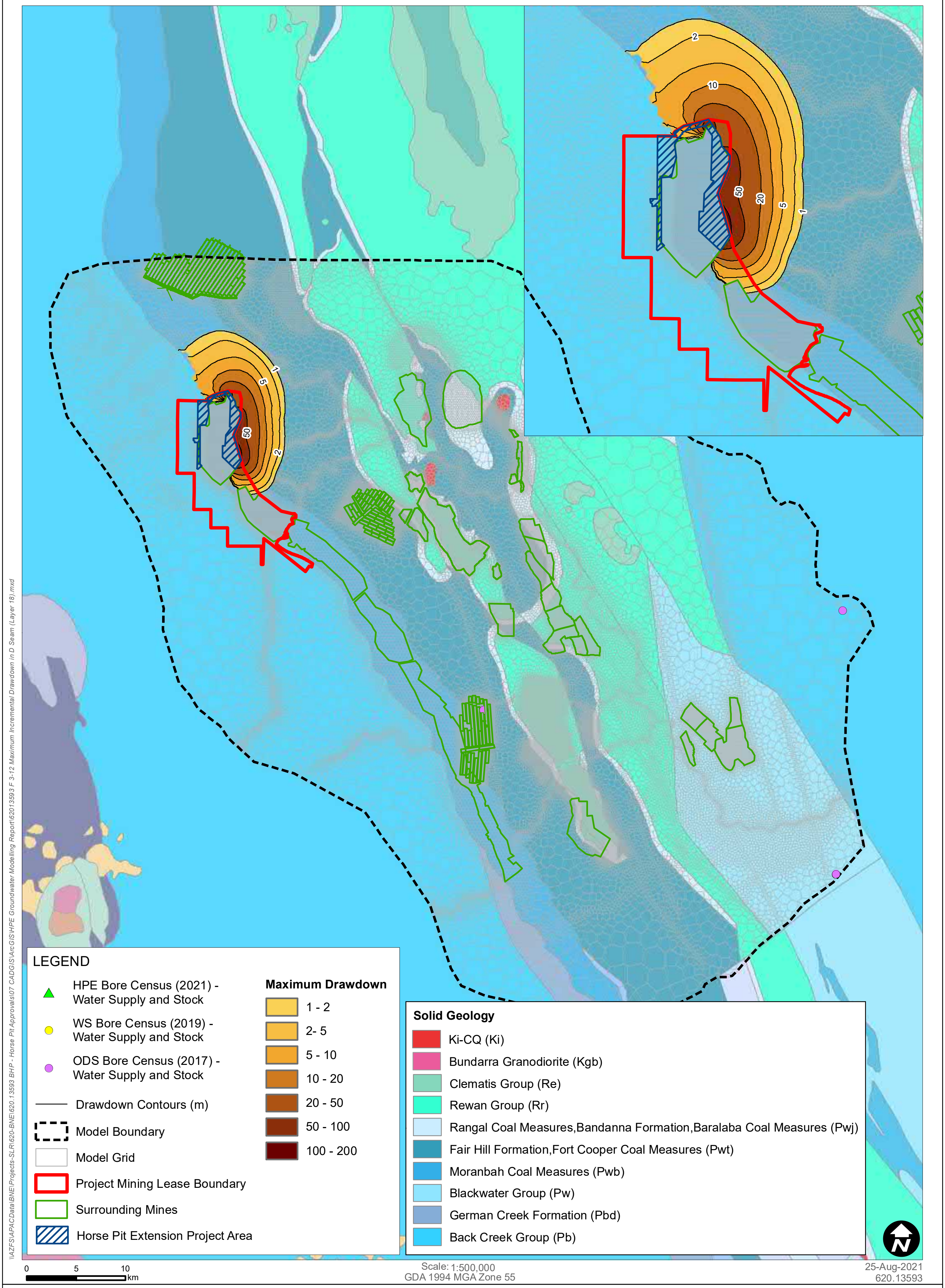
Maximum Incremental Drawdown in H Seam (Layer 16)

FIGURE 3-11



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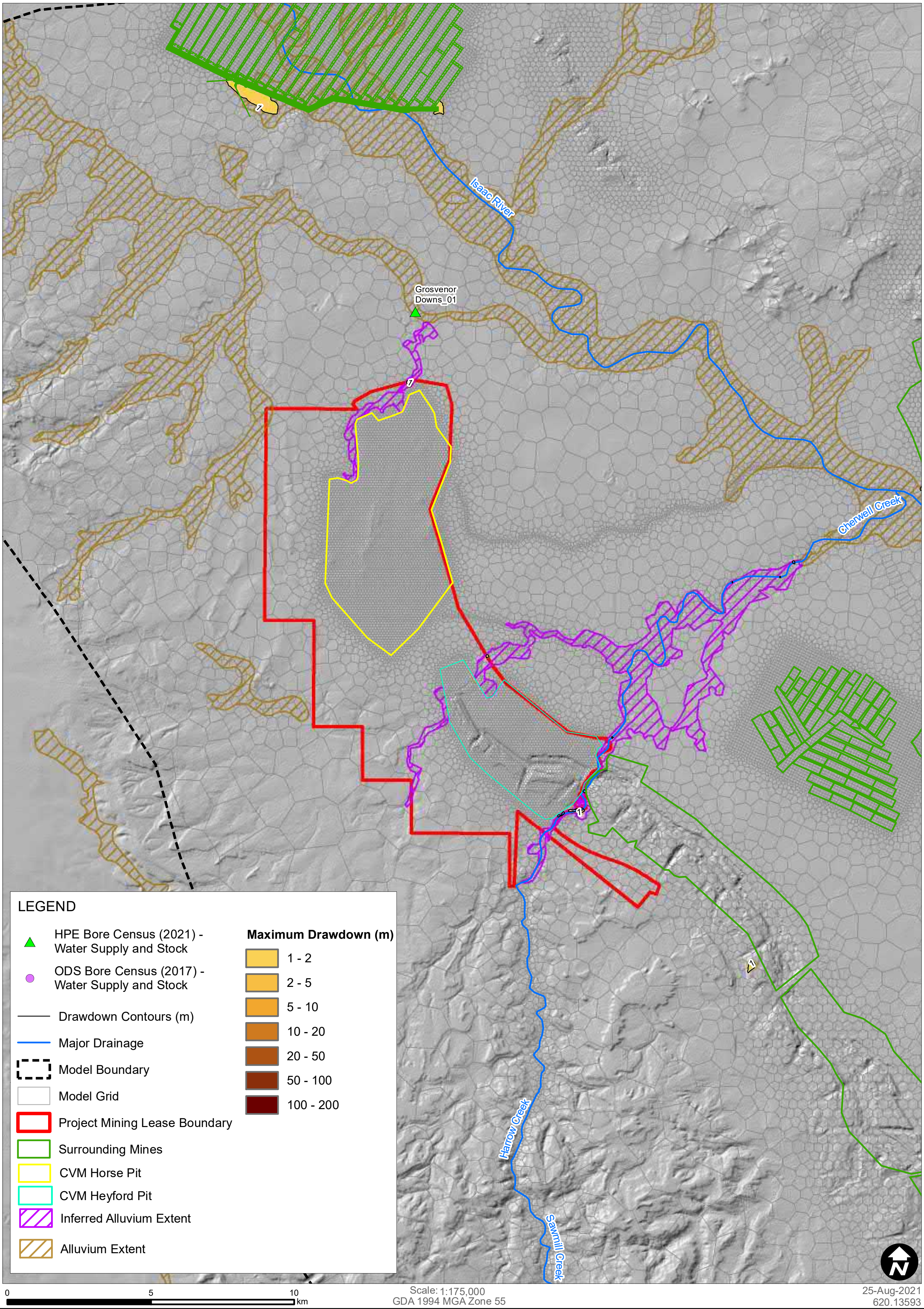
SLR

Maximum Incremental Drawdown in D Seam (Layer 18)

FIGURE 3-12



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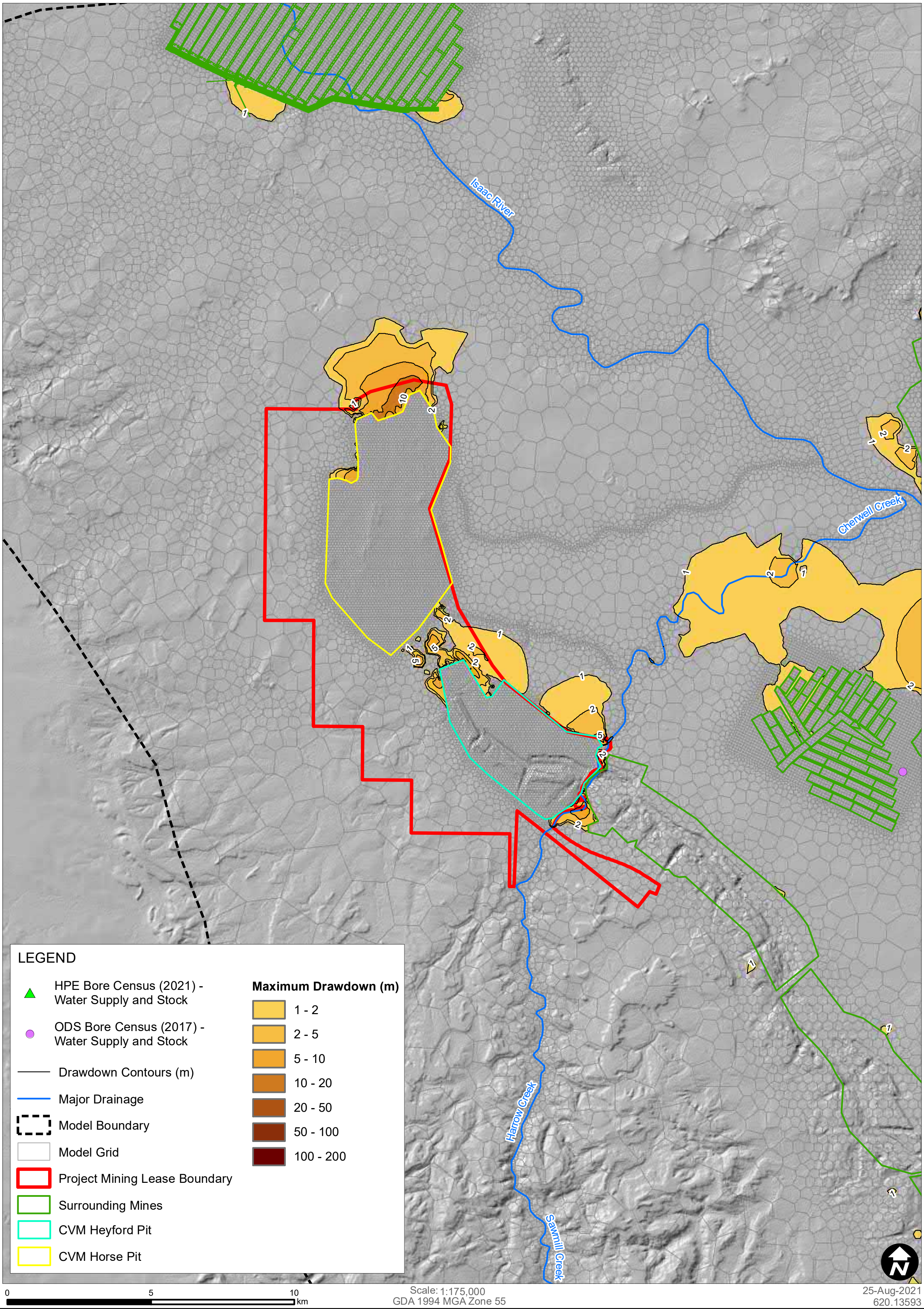
\AZFS\APACData\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\62013593 F 3-13 Maximum Cumulative Drawdown in Quaternary Alluvium (Layer 1).mxd

SLR

Maximum Cumulative Drawdown in Quaternary Alluvium (Layer 1)

FIGURE 3-13



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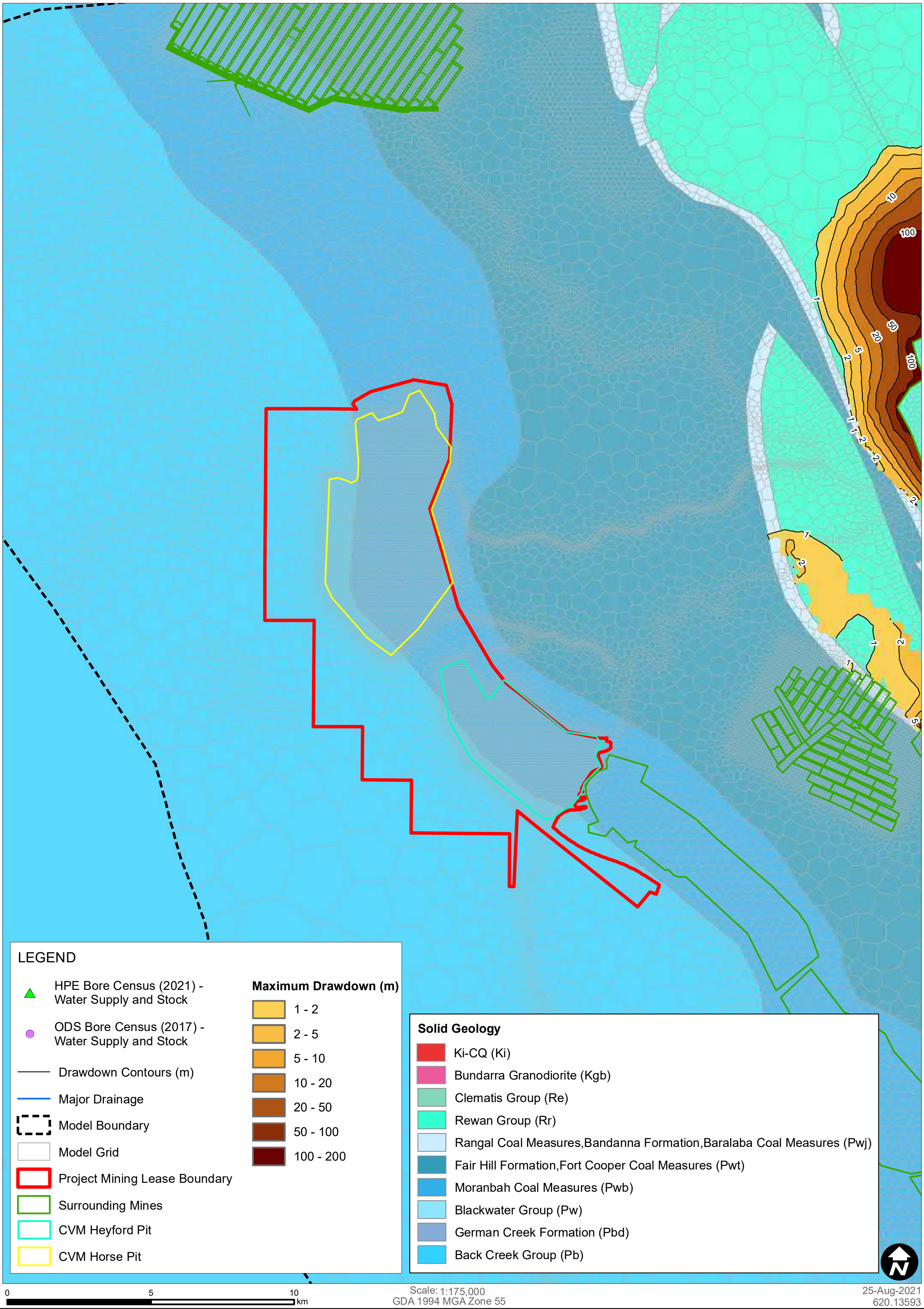
\\AZFS\APACData\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\62013593 F 3-14 Maximum Cumulative Drawdown in Regolith (Layer 2).mxd

SLR

Maximum Cumulative Drawdown in Regolith (Layer 2)

FIGURE 3-14



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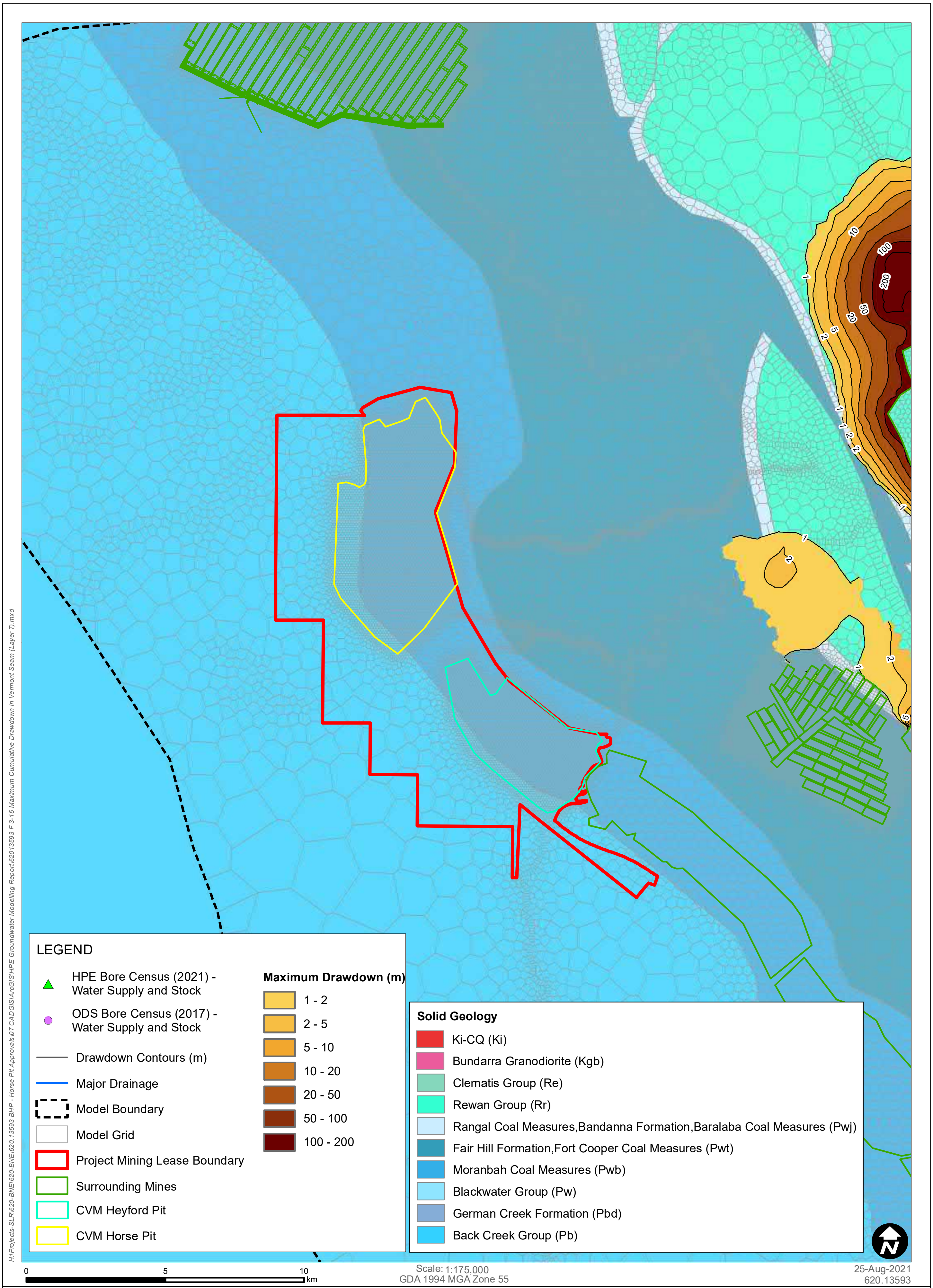
SLR

Maximum Cumulative Drawdown in Leichhardt Seam (Layer 5)

FIGURE 3-15



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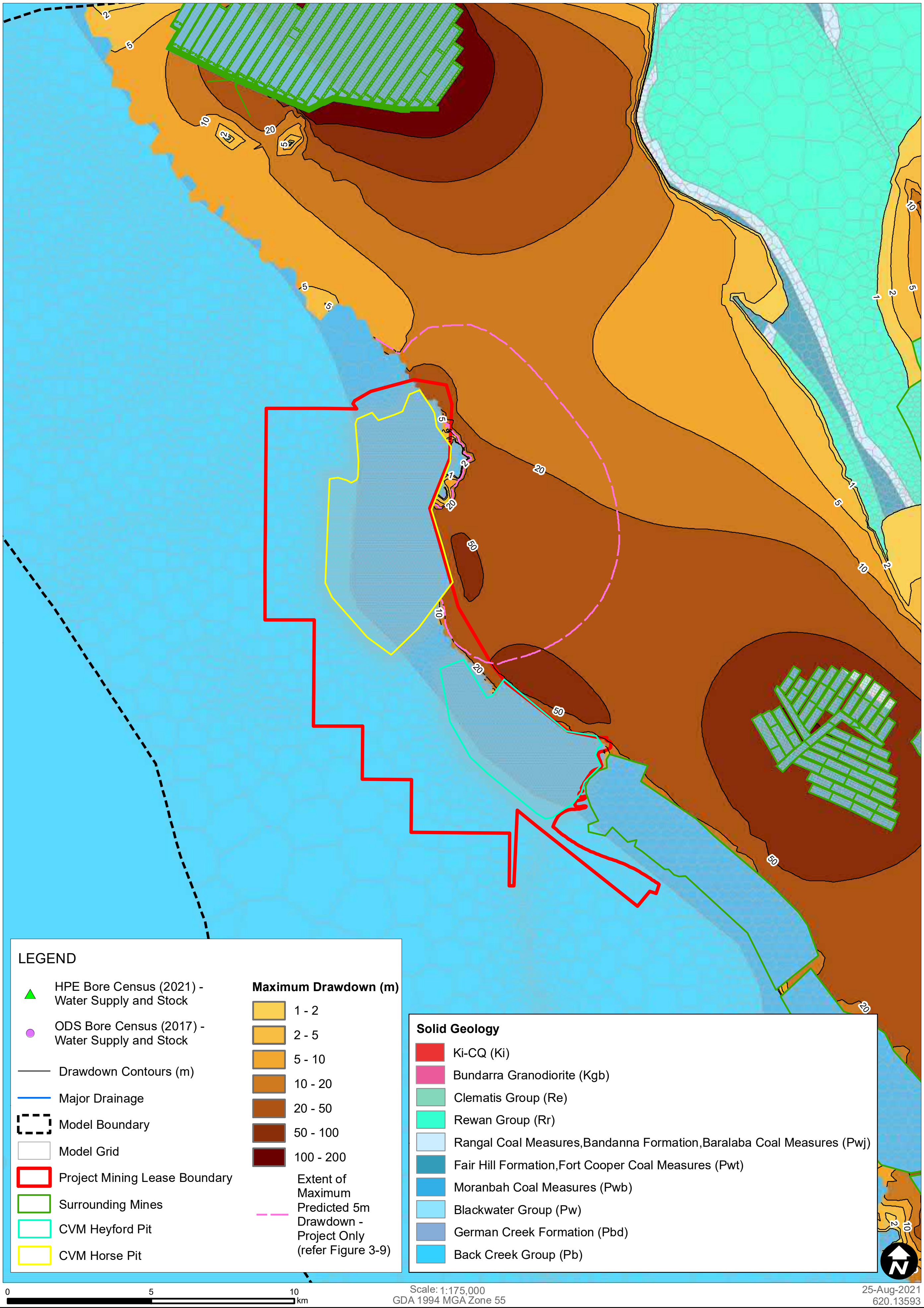
Maximum Cumulative Drawdown in Vermont Seam (Layer 7)

FIGURE 3-16



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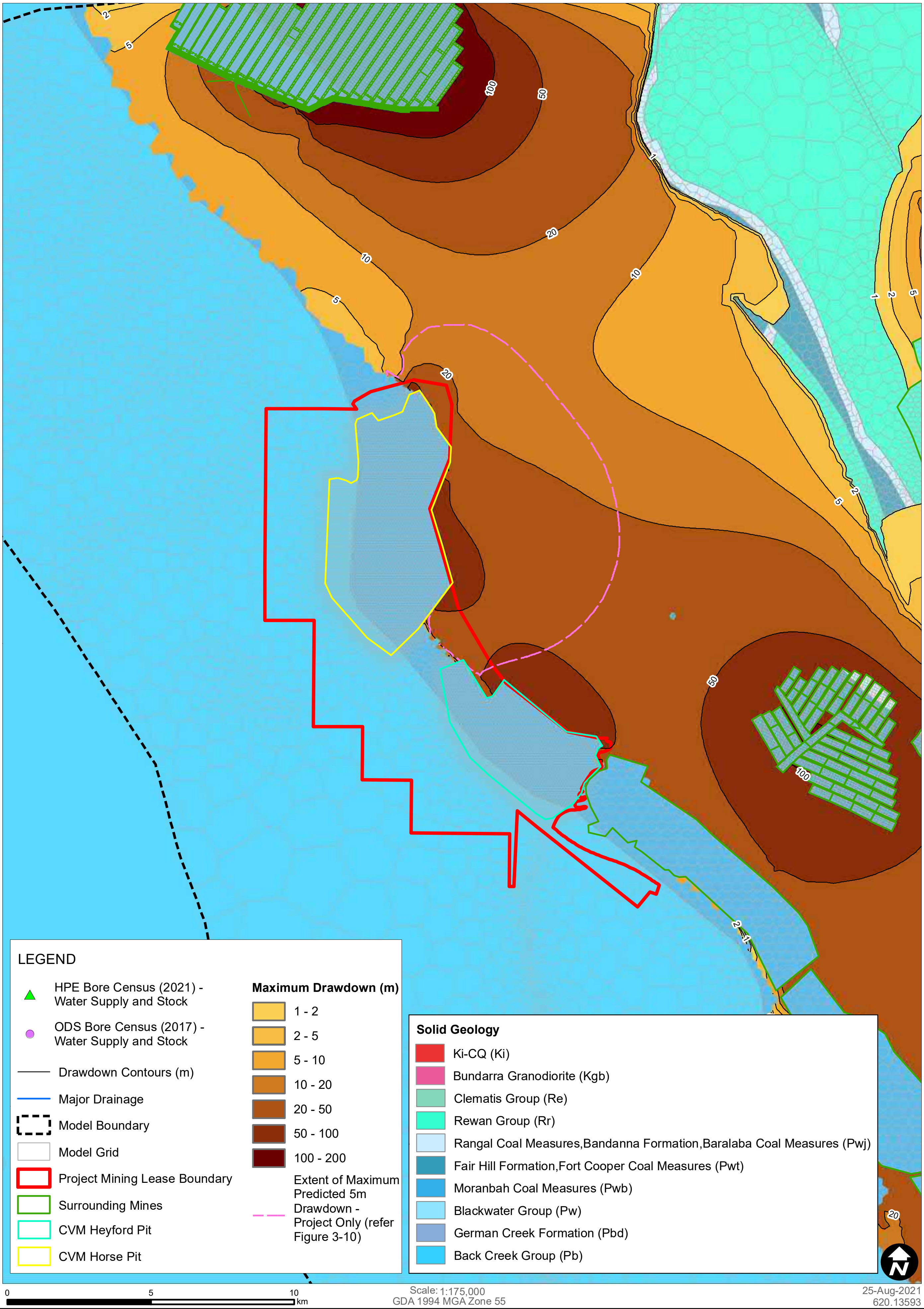
SLR

Maximum Cumulative Drawdown in Q Seam (Layer 12)

FIGURE 3-17



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GDA 1994 MGA Zone 55

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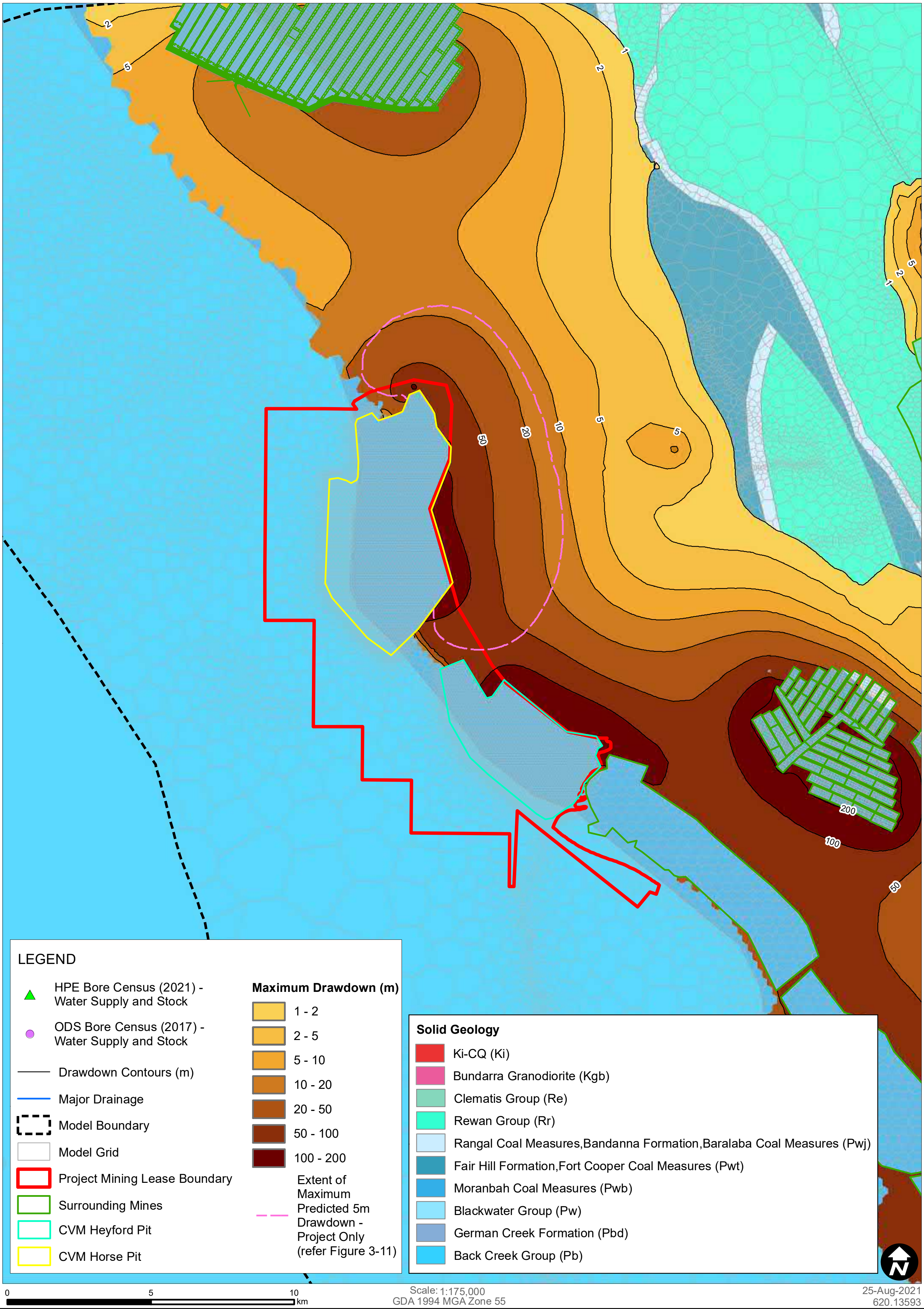
SLR

Maximum Cumulative Drawdown in P Seam (Layer 14)

FIGURE 3-18



Scale: 1:175,000
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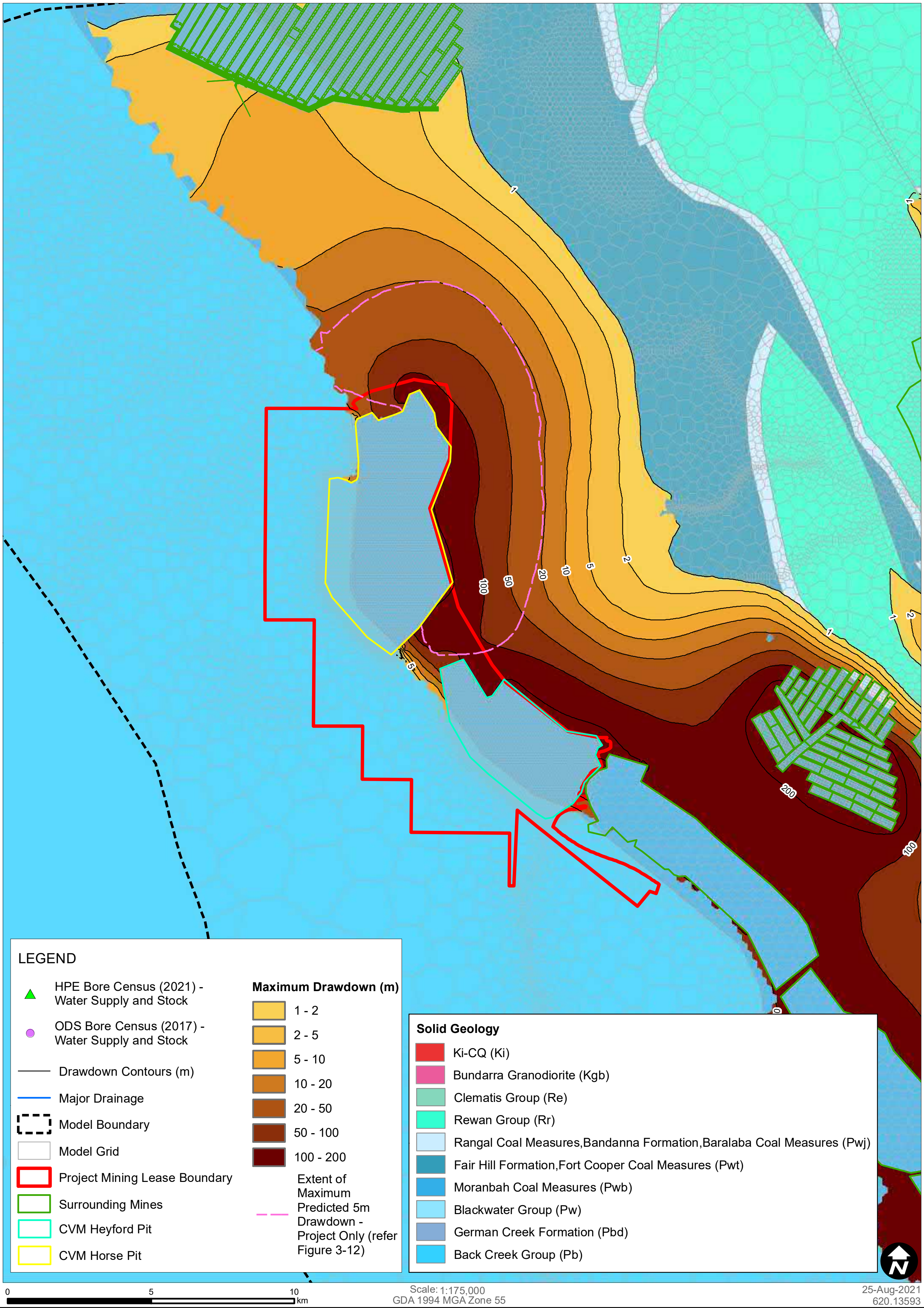
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\62013593 F 3-19 Maximum Cumulative Drawdown in H Seam (Layer 16)_revC.mxd

SLR

Maximum Cumulative Drawdown in H Seam (Layer 16)

FIGURE 3-19



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SLR

Maximum Cumulative Drawdown in D Seam (Layer 18)

FIGURE 3-20

3.5 Predicted Groundwater Interception

Project mine pit inflow volumes have been calculated as time weighted averages of the outflow reported by ZoneBudget software for Project drain cells. The predicted inflows for Approved mining at Horse Pit and the Project, and the total combined (Approved + Project) inflows are presented in **Figure 3-21**. The predicted average future total Horse Pit inflow rate over the duration of mining (Approved + Project) is 198.1 ML/year (0.55 ML/day). For reference, as reported in the Groundwater Impact Assessment Report (SLR, 2021a) BMA’s annual Associated Water Take reporting for CVM reported an annual groundwater inflow estimate to Horse Pit of 865 ML/year (2.4 ML/day) for 2018/2019, using a simpler and more conservative water balance approach.

As shown in **Figure 3-21**, inflows due to the Project are predicted to reach a maximum peak in year 2044, with 275.2 ML inflow predicted for the year (0.75 ML/day). The average inflow rate due to the Project is 133.9 ML/year (0.36 ML/day).

The GHD (2017) model for CVM predicted an average inflow of 1,461 ML/year (4.0 ML/day) which is higher than the predicted inflows in the current model. The difference in the predicted inflows may relate to updates to the model structure from site geological information, the updates to the calibrated hydraulic properties based on more recent observation data and the implementation of the coal depth dependence function in the current model (see **Section 2.7**).

The Water Plan (Fitzroy Basin) 2011 groundwater area consists of the following:

- Groundwater Unit 1 (containing aquifers of the Quaternary alluvium); and
- Groundwater Unit 2 (sub-artesian aquifers).

Planned mining operations at the Project will not intercept Quaternary alluvium at any of the proposed pits. As such, all direct groundwater take predicted by the model is from Groundwater Unit 2.

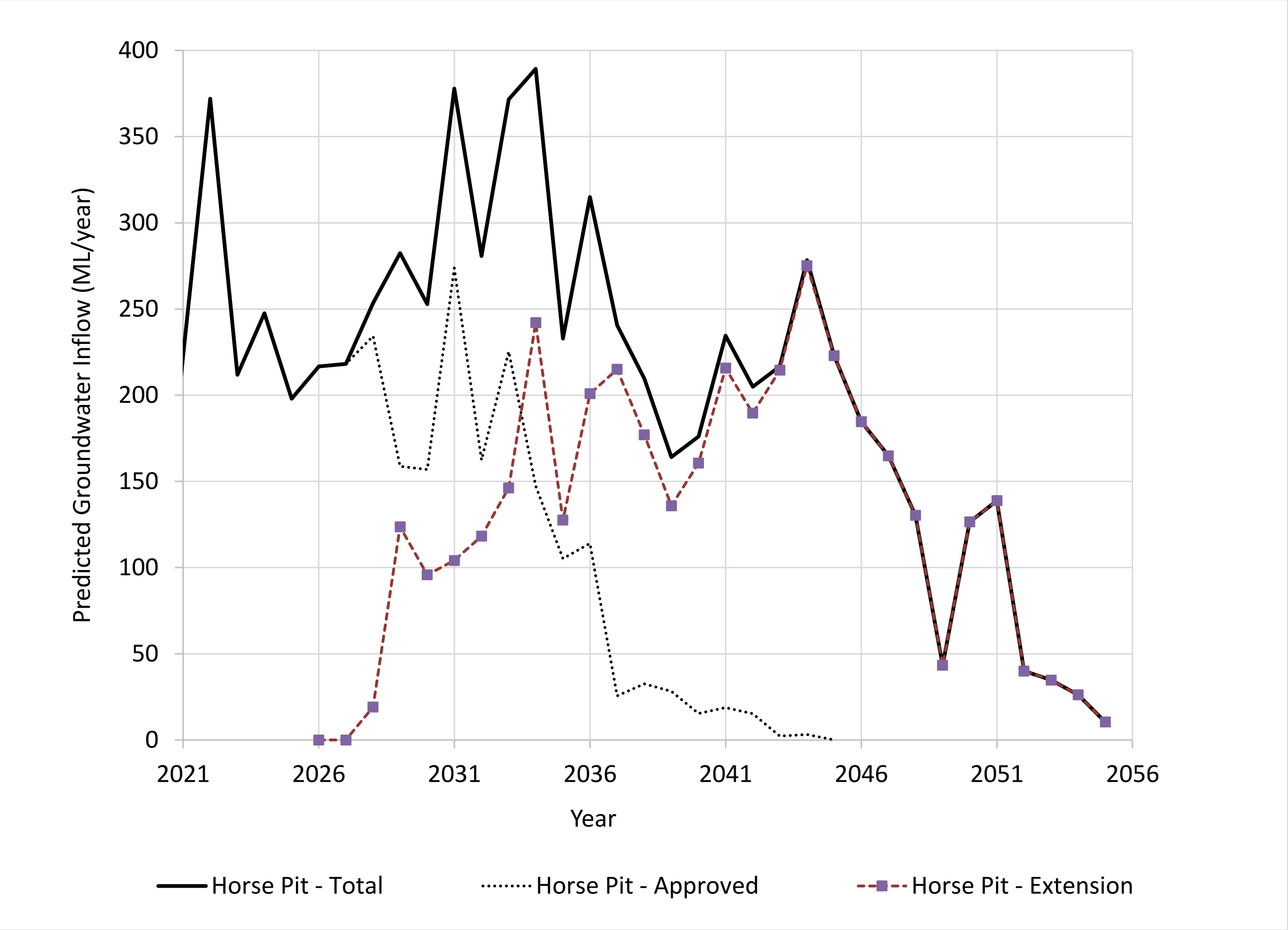


Figure 3-21 Predicted Horse Pit Groundwater Inflows

3.6 Incidental Water Impacts

3.6.1 Influence on Alluvium

The change in alluvial water resources was estimated by comparing water budgets for alluvial zones using the Approved and Cumulative scenarios of the predictive model that excluded and included the Project. Interference of the alluvial groundwater can occur due to increased leakage to the underlying Permian coal measures that are depressurised as a result of mining activities. Over the extent of Quaternary alluvium, there is an insignificant predicted loss of water from the alluvium as a result of the Project.

3.6.2 Groundwater – Surface Water Interaction

The change in river leakage due to the Project was calculated by comparing the river flow budgets for Isaac River in the Cumulative scenario against the Approved scenario. This calculation showed that over the life of mine, the change in the Isaac River to the alluvium is insignificant which is consistent with the predicted water balance in **Section 3.2.**

As discussed in **Section 2.4.2**, Harrow Creek and Cherwell Creek located within the Project area are both set up with a stage height of 0.0 which means they are simulated as gaining systems (i.e., negative net flow). Comparing the river flow budgets for Harrow Creek and Cherwell Creek in the Cumulative against the Approved Case indicated no change in the net flow in these two creeks due to the Project.

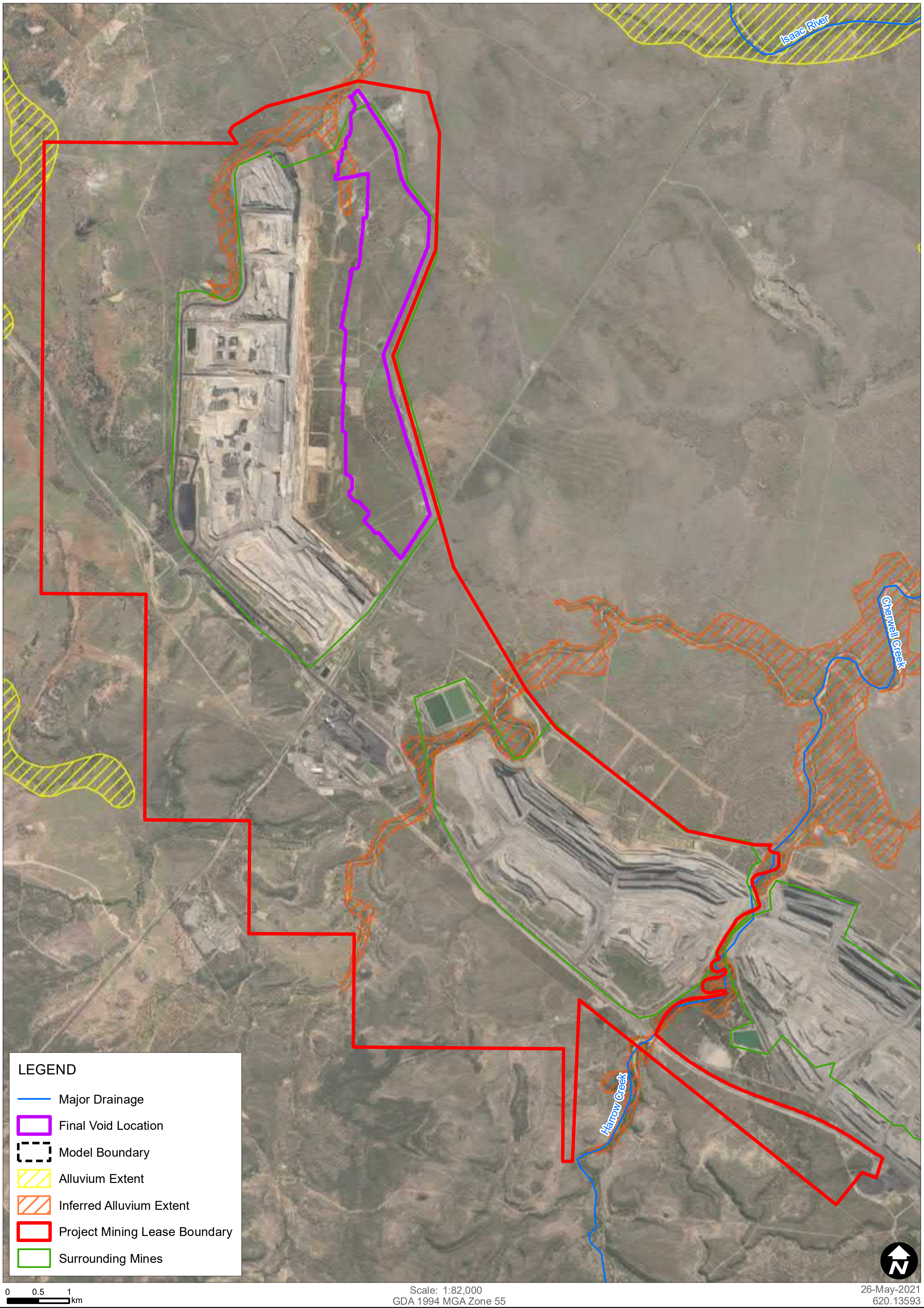
4 Recovery Model

The potential post mining impacts of the Project were investigated with a recovery model, commencing at the end of mining at the Project and run for 200 years. A transient model was created to ascertain post-mining inflows, with all predictive model drain cells removed. All drain cells in the Study Area were removed at the start of the recovery period to allow groundwater levels to equilibrate. At the end of mining at the Project, the properties of the final void cells were converted to values representative of a void. The void cells were assigned high horizontal and vertical hydraulic conductivities (1000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, storage coefficient of 5.0 x 10^{-6} m^{-1}), to simulate free water movement within the final void. This approach is often referred to as a 'high-K' lake. The location of the final void at the Project is provided in **Figure 4-1**.

Groundwater inflows to the final void during recovery were incorporated in the site water balance model for the Project's Surface Water Assessment (SLR, 2021b). The pit lake recovery level and timings were predicted by the surface water balance modelling. These elevation and recovery timing derived from the surface water modelling was replicated within the numerical groundwater model using the time variant constant head boundary condition. This recovery model was then re-run for 200 years to maintain consistency with the Surface Water and Flooding Assessment prepared for the Project. Predictions from the re-run recovery model are presented within the main Groundwater Impact Assessment report (SLR, 2021a). A hydrograph for pit water level is provided as **Figure 4-2**. As shown in the figure, the average predicted equilibrated final void water level in Horse Pit final void was 120 mAHD. The post-mining recovery model was then run and results presented for up to 500 years with the predicted final groundwater inflows and lake stage elevations presented in **Table 4-1**.

Table 4-1 Final Model Predicted Stage Groundwater Inflows to the Void

Post-Mining Recovery Year	Lake Stage (mAHD)	Average Groundwater Flow to the Void (ML/day)
After 20 Years	105	0.52
After 40 Years	110	0.32
After 60 Years	113	0.25
After 80 Years	115	0.20
After 100 Years	118	0.18
After 140 Years	119	0.18
After 200 Years	120	0.18



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H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Horse Pit Modelling Report\62013593 F 4-1 Final Void Locations2.mxd

SLR

Final Void Location

FIGURE 4-1

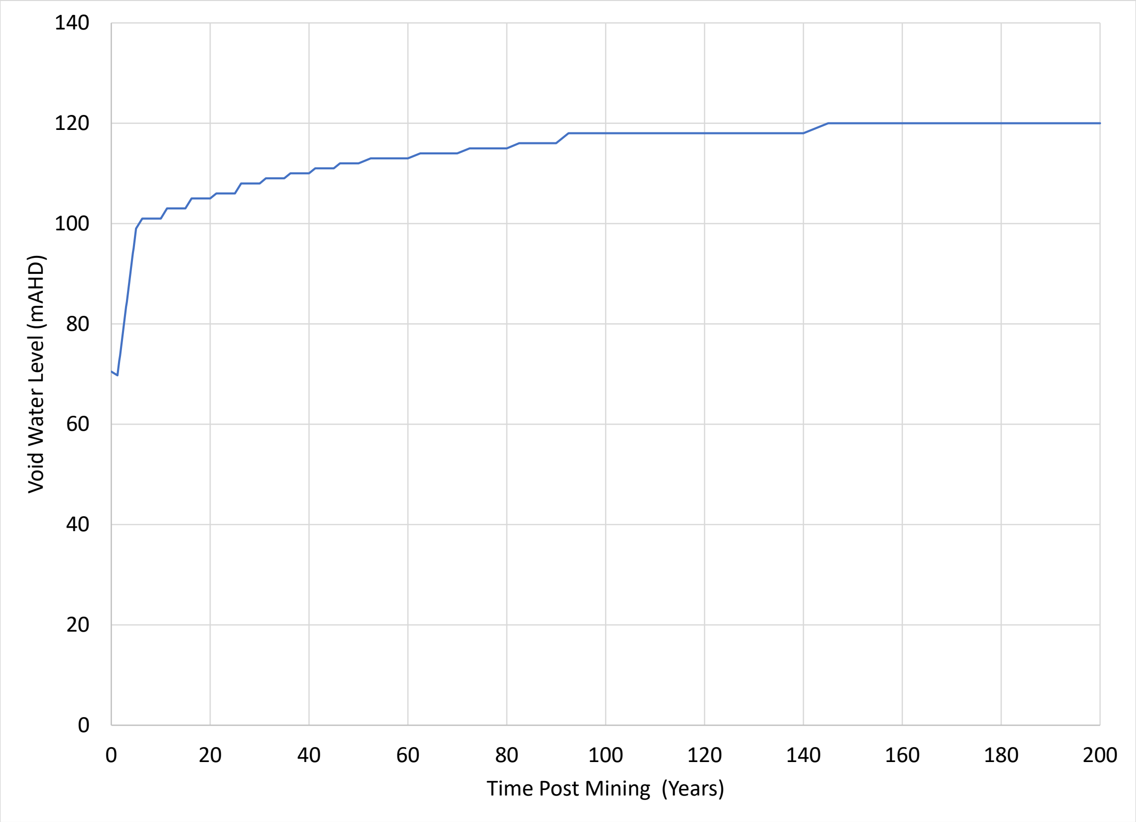


Figure 4-2 Predicted Final Void Recovery

5 Sensitivity Analysis

5.1 Sensitivity Analysis

5.1.1 Calibration Sensitivity

As an additional step in the calibration process, a parameter sensitivity file containing the "composite sensitivity" of each parameter with respect to all observations was generated. The Relative Composite Sensitivity (RCS) of a parameter is obtained by multiplying its composite sensitivity by the magnitude of the value of the parameter. Therefore, RCS is a measure of the composite changes in model outputs that are incurred by a fractional change in the value of the parameter (PEST Manual, Doherty 2010).

Composite parameter sensitivities are used in identifying those parameters that may be degrading the performance of the parameter estimation process through lack of sensitivity to model outcomes. Relative Composite Sensitivity is a measure of the composite changes in the model outputs that have resulted by a change in the value of the parameter. RCS also show how much the model calibration is sensitive to an input parameter. The groundwater model is more sensitive to the parameters that have high RCS value. Where parameters have low RCS (<1), the model calibration is less sensitive to those which indicates a greater uncertainty associated with them.

The composite sensitivity values were calculated during the PEST calibration and are presented in **Figure 5-1** and **Figure 5-2**. **Figure 5-1** shows the RCS for the horizontal conductivity, anisotropy (KZ/Kx) and the slope used in the depth dependence equations used in the model (**Section 2.7**). **Figure 5-2** shows the RCS for the specific yield, specific storage, and recharge.

Most parameters shown in **Figure 5-1** have RCS of less than 1. The only exception is the slope in depth dependence equation for Q Seam that shows the calibration is highly sensitive to this parameter. In **Figure 5-2**, all the storage and recharge parameters have an RCS of less than 1 indicating the model has a relatively low sensitivity to these parameters.

As discussed in **Section 6**, the uncertainty analysis is guided by the results of this sensitivity analysis to explore more extreme values within the constraints of the model calibration statistics.

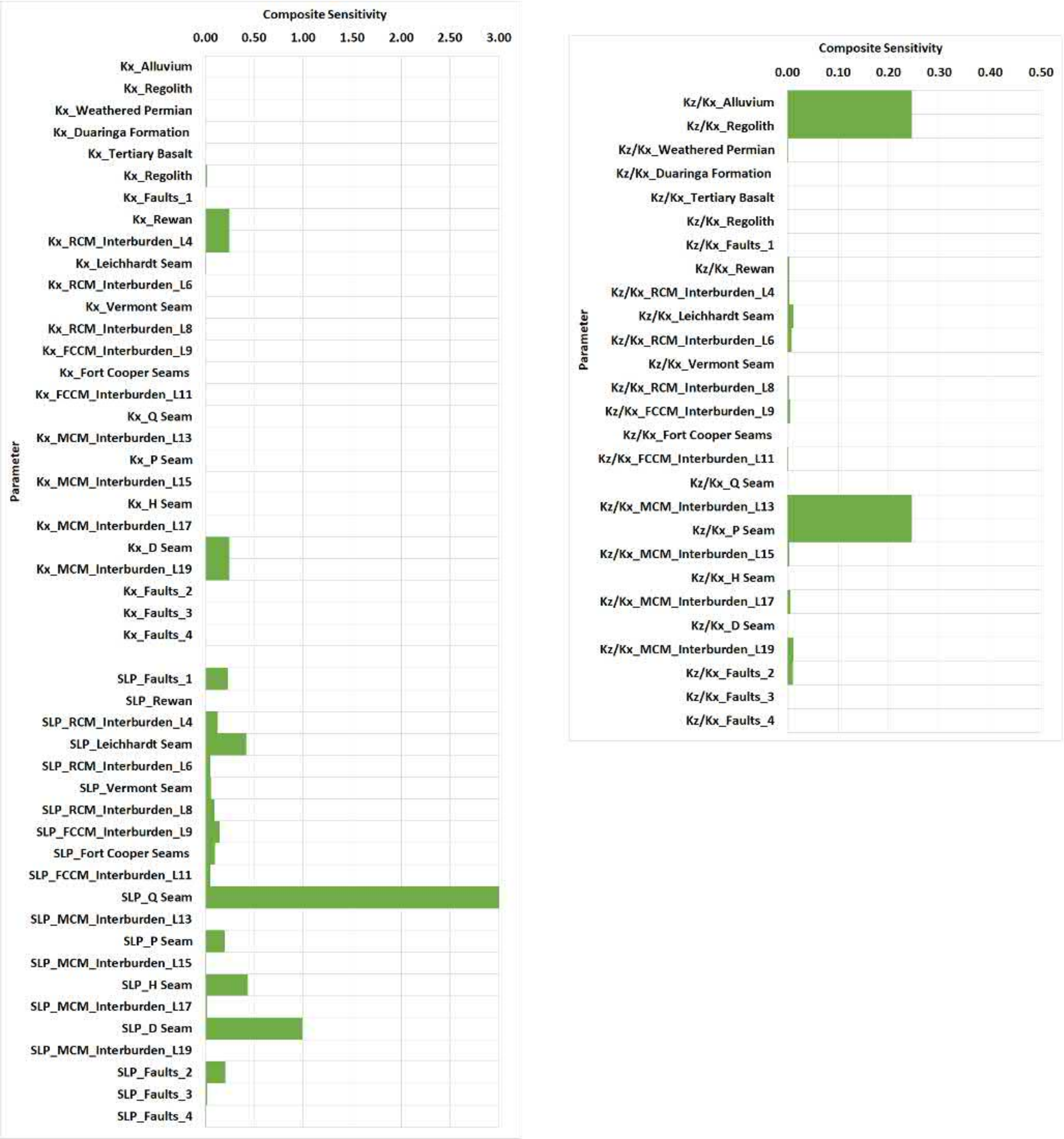


Figure 5-1 Composite Sensitivity – Kx, Kz/Kx and Slope

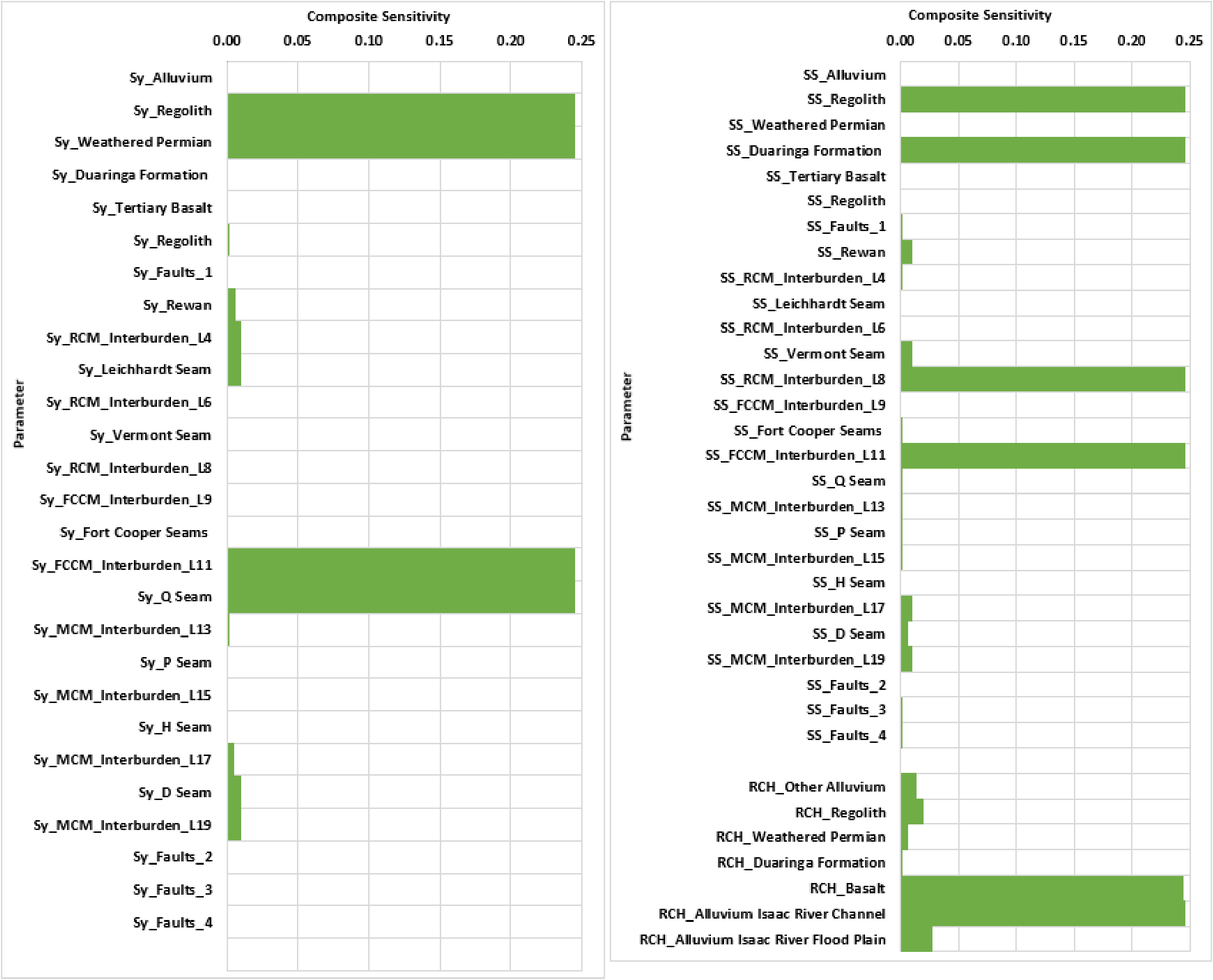


Figure 5-2 Composite Sensitivity – Sy, SS and Recharge

5.1.2 Calibration Identifiability

Identifiability describes a parameters capability to be constrained by the model calibration. Identifiability values range from zero to one. As identifiability approaches one, the parameter is increasingly able to be constrained. Likewise, as values approach zero the parameter is increasingly unable to be constrained by the calibration and uncertainty of model results is not reduced through calibration.

The PEST utility GENLINPRED was used to provide an estimate of parameter identifiability for each of the model parameters. Estimated identifiability values for the calibrated parameters horizontal hydraulic conductivity, Anisotropy, Specific yield and recharge are summarised in **Figure 5-3** through **Figure 5-7**.

Figure 5-3 indicates that in general the calibration process was successful in constraining the horizonal conductivity. Notably, the conductivity of alluvium, Rewan Group, Leichhardt Seam, Vermont Seam, D Seam and Q Seam units are well constrained by calibration (high identifiability values above 0.80). The horizontal hydraulic conductivity of most of the faults generally has not been able to be constrained well during calibration, relative to their surrounding unit. The exception to this is the Isaac fault zone, which has been constrained during the calibration.

Identifiability of hydraulic conductivity anisotropy for model zones is presented in **Figure 5-4**. Anisotropy in the weathered Permian, Moranbah Coal Measures interburden, Fort Cooper Coal Measures overburden and Moranbah Coal Measures overburden have high identifiability values indicating these can be constrained and contribute to reducing model uncertainty. All other zones feature low values (equal to and below 0.40) and are less constrained by calibration.

In general, specific yield and specific storage of other zones in the model domain has low identifiability (**Figure 5-5** and **Figure 5-6**). **Figure 5-6** shows except in the D Seam and the interburden unit above the D seam, the calibration was not able to constrain this variable in the other layers.

The recharge zones for all the zone except the Isaac River Channel Alluvium, are highly constrained by the calibration. The other zones have low identifiability (**Figure 5-7**). Note that the stream channel alluvium represents a narrow zone along the Isaac River, with a small area relative to the other recharge zones. It is, therefore, considered less impactful to model predictions.

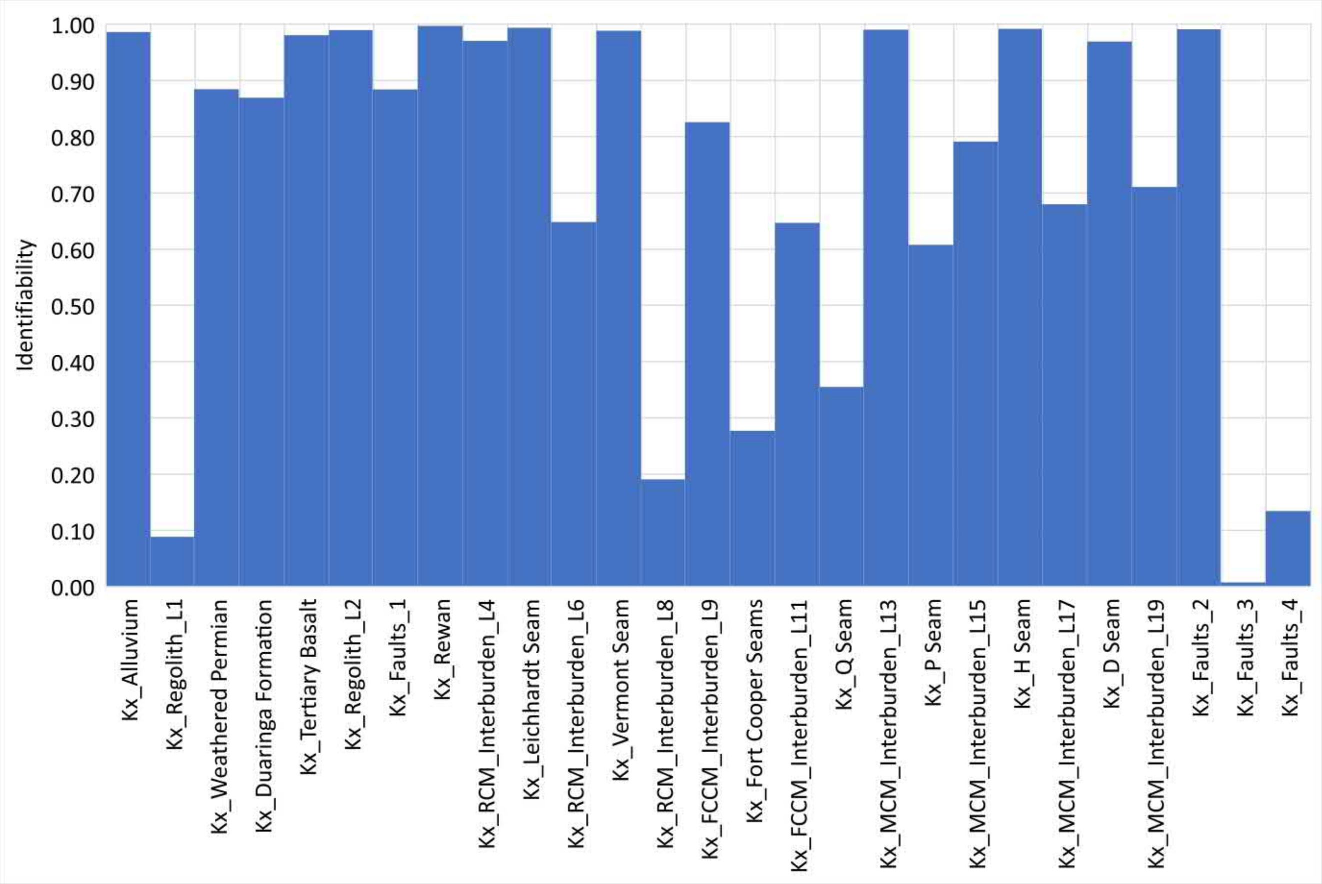


Figure 5-3 Identifiability – Horizontal Hydraulic Conductivity (Kx)

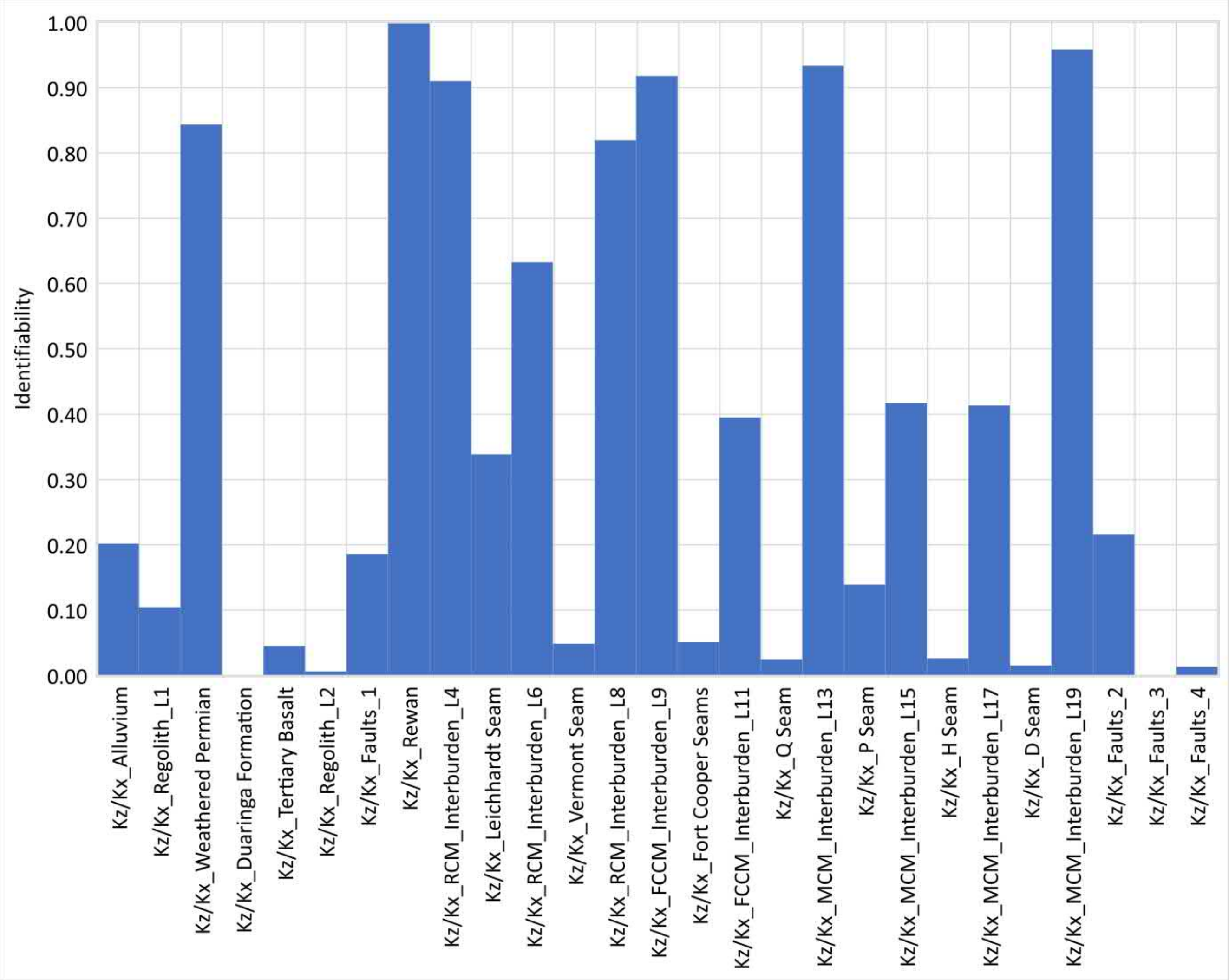


Figure 5-4 Identifiability – Anisotropy (Kz/Kx)

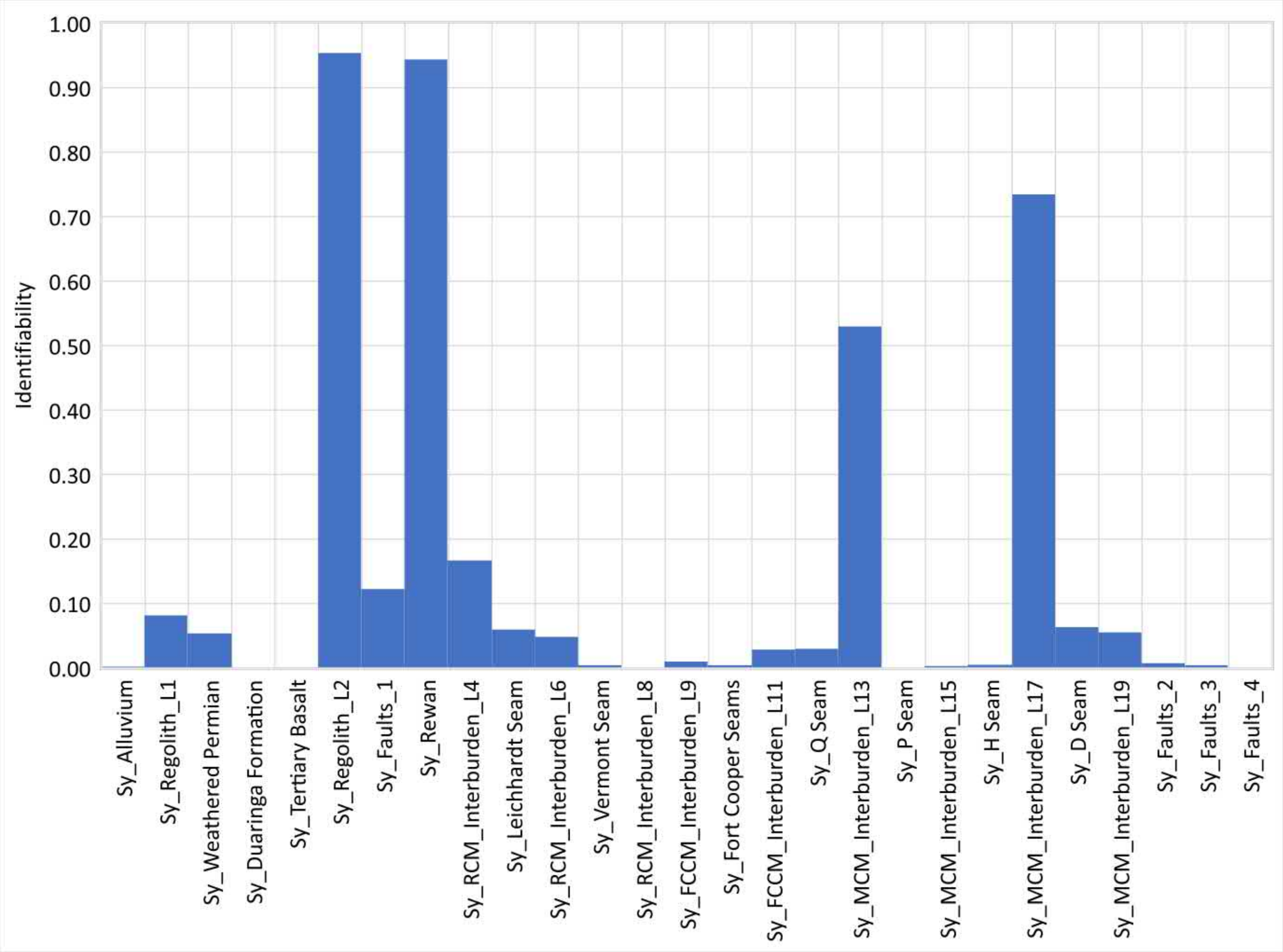


Figure 5-5 Identifiability – Specific Yield (Sy)

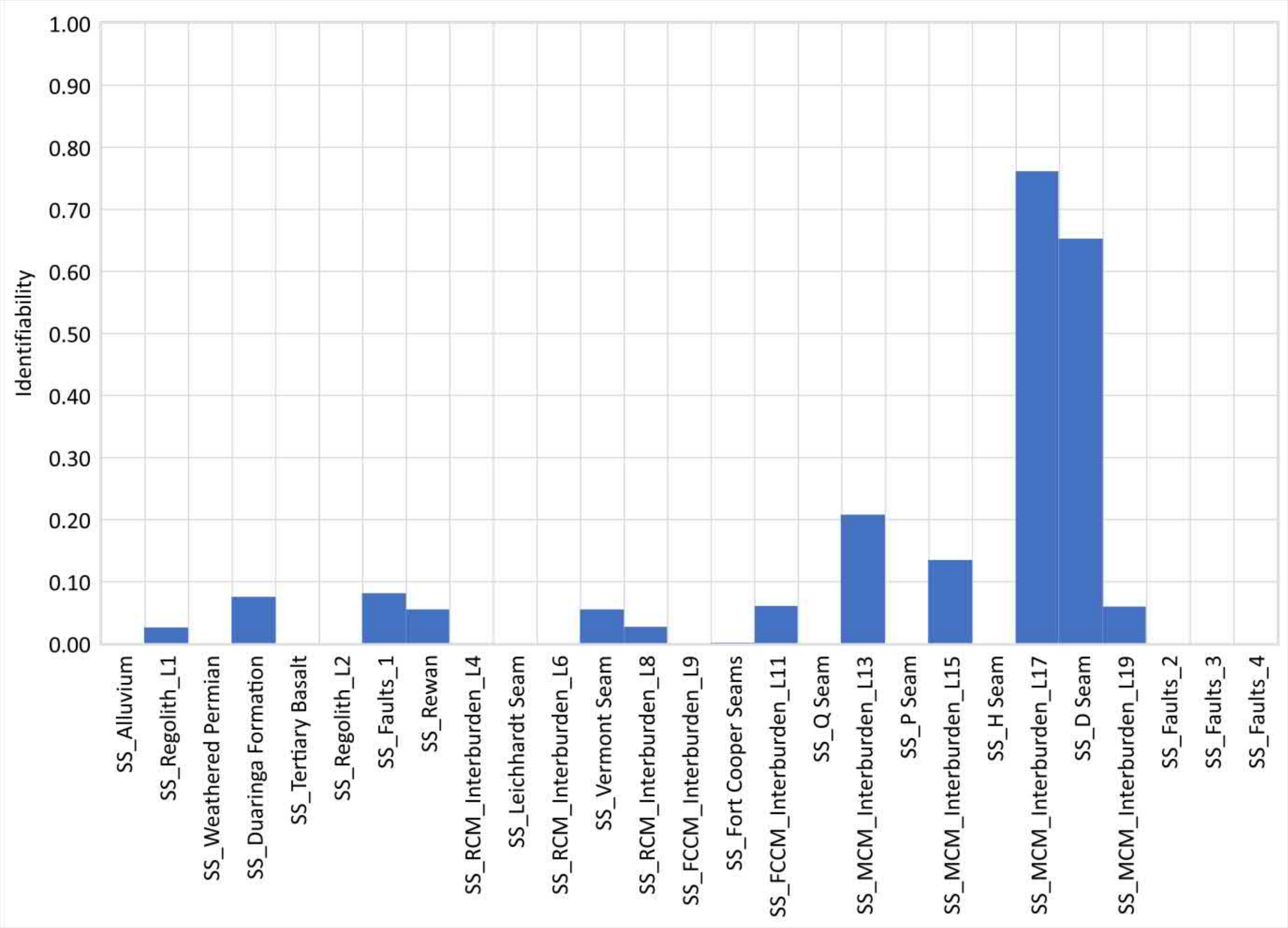


Figure 5-6 Identifiability – Specific Storage (SS)

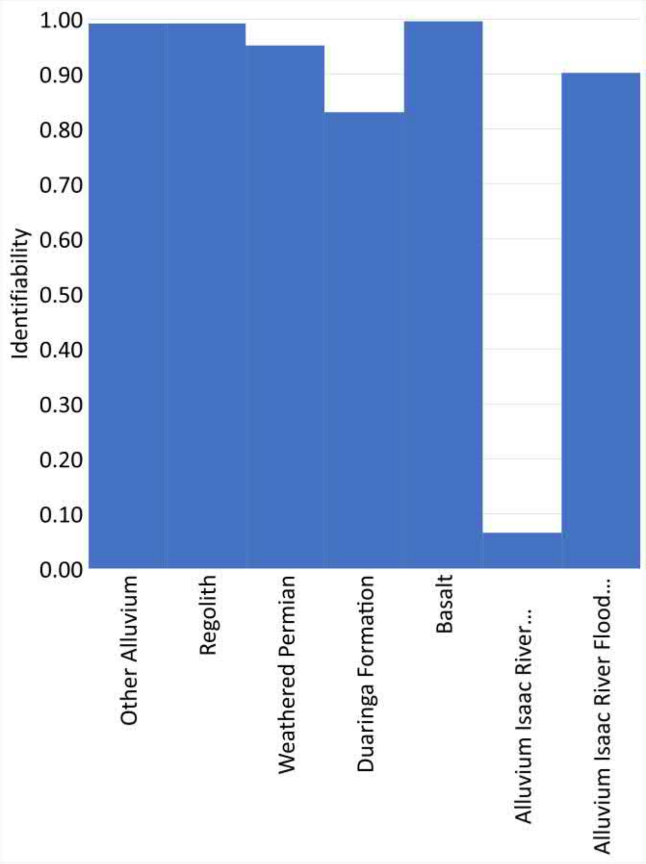


Figure 5-7 Identifiability – Recharge (RCH)

5.1.3 Prediction Identifiability

Prediction identifiability describes parameters capability on impacting the model predictions. To calculate the prediction identifiability the groundwater model is run once per each parameter. The predictions included in the analysis were the project only inflows and maximum cumulative drawdown. The analysis then utilised the GENLINPRED utility to provide an estimate of parameter identifiability for each of the model parameters.

As identifiability approaches one, the parameter is increasingly able to change model predictions. On the contrary, as values approach zero the parameter is increasingly unable to change model predictions.

The Murray Darling Basin Modelling Guidelines (MDBC, 2000) recommends classifying sensitivity by the resultant changes (or contribution) to the model calibration and predictions. According to this process models can be classified as one of the four main types:

- Type I: Insignificant changes to calibration (low identifiability) and prediction (low uncertainty contribution);
- Type II: Significant changes to calibration (high identifiability) – insignificant changes to predictions (low uncertainty contribution);
- Type III: Significant changes to calibration (high identifiability) –significant changes to predictions (high uncertainty contribution); and
- Type IV: Insignificant changes to calibration (low identifiability) –significant changes to predictions (high uncertainty contribution).

Types I-III are of less concern, as these Types have an insignificant impact on model predictions or constrained by calibration. Type IV is classed as ‘a cause for concern’ as non-uniqueness in a model input might allow a range of valid calibrations but the choice of value impacts significantly on a prediction (MDBC, 2000).

To classify the sensitivity contribution to the model calibration and predictions for each model parameter, the calibration and prediction Identifiability were compared against each other for each parameter.

Figure 5-8 presents the relationship between the identifiability of the predicted Project only inflow and the identifiability of the calibration. Sensitivity classifications for the sensitivity types have been assigned using judgement based on the range of the identifiability. The results show that the key parameters that require further work to reduce their influence on predictive uncertainty in relation to Permian groundwater inflows include the specific yield of the Moranbah Coal Measures interburden (Layer 15).

As shown in **Figure 5-8**, for the inflow predictions most parameters are classified as Type I or Type II which indicates they have low uncertainty contribution in inflow predictions.

Figure 5-9 presents the relationship between identifiability of the maximum predicted drawdown within the alluvium and the identifiability of the calibration. Sensitivity classifications for the sensitivity types have been assigned using judgement based on the range of the posterior predictions. The results show that the key parameter that require further work to reduce its influence on predictive uncertainty in relation to the maximum drawdown extent is specific storage of the Moranbah Coal Measures interburden (Layer 11).

Figure 5-9 shows horizontal conductivity parameters in the model are mostly classified as Type II indicating they significantly impact the model calibration but have insignificant contribution in reducing uncertainty of the maximum drawdown.

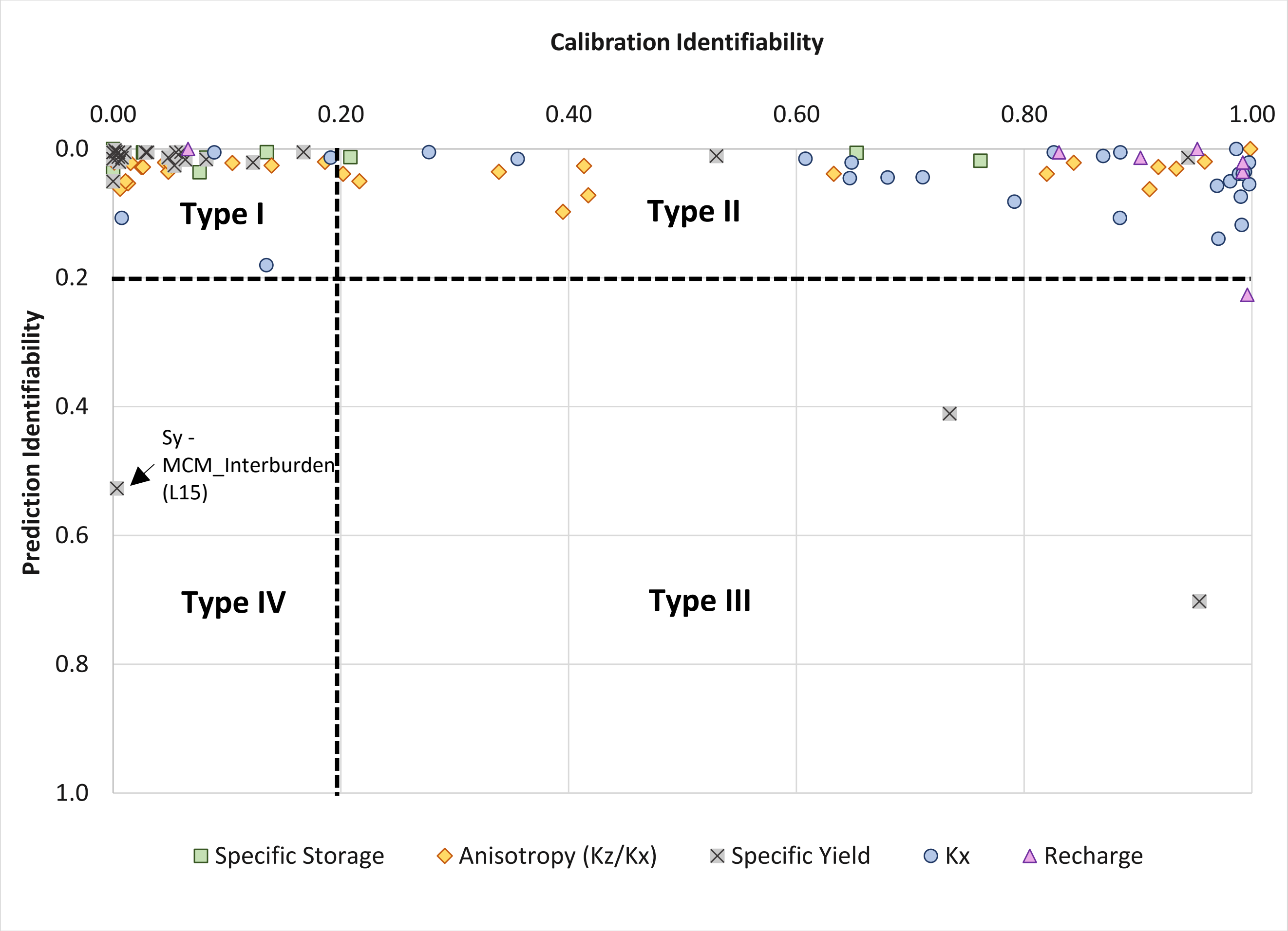


Figure 5-8 Uncertainty contribution (predicted mine inflow) versus identifiability

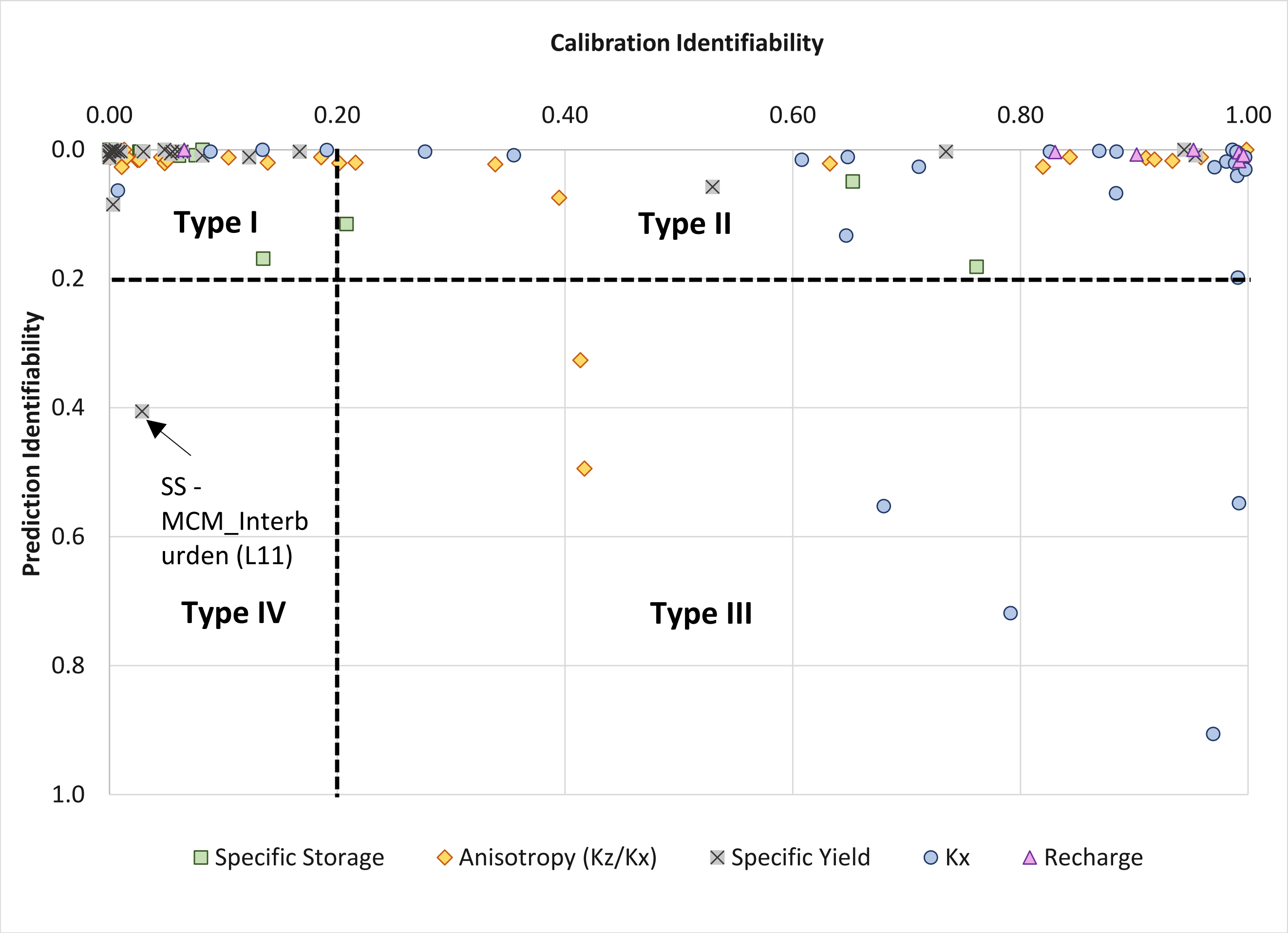


Figure 5-9 Uncertainty contribution (maximum cumulative drawdown) versus identifiability

6 Uncertainty Analysis

A Type 3 Monte Carlo uncertainty analysis (IESC, 2018) was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis.

The first step in Monte Carlo analysis is to define the parameter distribution and range. For this project, the parameters are assumed to be log-normally distributed around the optimum value derived from the calibration and the standard deviation attributed to the log (base 10) of parameter is 0.5. The distribution for each parameter were checked and constrained such that upper or lower ranges do not go beyond ranges in literature for physical constraints. 1100 model realisations were generated, each having differing values of key parameters. The realisations were run, and calibration quality was assessed. In this case, models were considered to have an acceptable calibration if they achieved an SRMS less or equal to calibration SRMS of 5.4 %. Of the 1100 model runs, 250 model runs were found to be meet the above criteria. These were used in all model scenarios (calibration, Cumulative Mining, Approved Mining, and No Mining) and statistically analysed for uncertainty analysis.

6.1 Parameter Distribution

Table 6-1 to **Table 6-5** show the parameter ranges explored during the sensitivity and uncertainty analysis simulation.

Parameters were assumed to possess a log-Normal distribution. Instead of simple random sampling, the Latin Hypercube Sampling (LHS) method was used to create random realisations from parameter distribution. LHS aims to spread the sample points evenly across all possible values. In doing so, it divides parameter space into N intervals of equal probability and chooses one sample from each interval. The generated random numbers derived from LHS approach is distributed sufficiently across the parameter space even at the small sample size. The main advantage of LHS over simple random sampling is that a lower number of realisations are needed to obtain a reasonable convergence of the uncertainty results. The parameter distribution for the converged and calibrated model runs are provided as **Appendix E**.

Table 6-1 Uncertainty Parameter Range for Horizontal Hydraulic Conductivity

Zone	Layer - Unit	Horizontal Hydraulic Conductivity (m/day)	
		Mean (Log10)	Constraint
1	Layer 1 - Alluvium	1.08	No constraint
2	Layer 1 - Regolith	0.00	< Kx_Alluvium
3	Layer 1 - Weathered Permian	-0.19	< Kx_Alluvium
4	Layer 1 - Duaringa Formation	-0.30	< Kx_Alluvium
5	Layer 1/2 - Tertiary Basalt	0.51	No constraint
6	Layer 2 - Regolith	0.00	= L1 regolith
7	Layer 3-19- Faults_zone1	-0.91	No constraint
8	Layer 3-Rewan	-2.63	< Kx_Alluvium, Regolith, Weathered Permian, Duaringa, Basalt

Zone	Layer - Unit	Horizontal Hydraulic Conductivity (m/day)	
		Mean (Log10)	Constraint
9	Layer 4 - RCM O/B	-2.16	< Kx_Alluvium,L5
10	Layer 5 - Leichhardt Seam	-1.02	< Kx_Alluvium
11	Layer 6 - RCM I/B	-2.93	< Kx_Alluvium,L5
12	Layer 7 - Vermont Seam	-1.96	< Kx_Alluvium
13	Layer 8 - RCM U/B	-3.00	< Kx_Alluvium,L7
14	Layer 9 - FCCM O/B	-3.00	< Kx_Alluvium,L10
15	Layer 10 - FCCM Seam	-2.94	< Kx_Alluvium
16	Layer 11 - FCCM U/B	-0.39	< Kx_Alluvium,L10
17	Layer 12 - Q Seam	-1.00	< Kx_Alluvium
18	Layer 13 - MCM U/B	0.69	< Kx_Alluvium,L12
19	Layer 14 - P Seam	0.69	< Kx_Alluvium
20	Layer 15 -MCM I/B	-0.52	< Kx_Alluvium,L14
21	Layer 16 - H Seam	-0.98	< Kx_Alluvium
22	Layer 17 - MCM I/B	-0.65	< Kx_Alluvium,L16
23	Layer 18 - D Seam	-1.00	< Kx_Alluvium
24	Layer 19 - MCM U/B	-0.56	< Kx_Alluvium,L18
25	Layer 3-19 - Faults zone 2	-0.46	No constraint
26	Layer 7 - Faults zone 3	-0.32	No constraint
27	Layer 8 - Faults zone 4	-0.40	No constraint
28	Layer 2 - Regolith under alluvium	0.00	= L1 regolith

Standard deviation = 0.5 order of magnitude for all units.
O/B = Overburden.
I/B = Interburden.
U/B = Underburden.
RCM = Rangal Coal Measures.
FCCM = Fort Cooper Coal Measures.
MCM = Moranbah Coal Measures.

Table 6-2 Uncertainty Parameter Range for Vertical to Horizontal Conductivity (Kz/Kx)

Zone	Layer - Unit	Anisotropy (Kv/Kx)	
		Mean (Log10)	Constraint
1	Layer 1 - Alluvium	-0.70	< 0.5
2	Layer 1 - Regolith	-1.00	< 0.5
3	Layer 1 - Weathered Permian	-1.18	< 0.5
4	Layer 1 - Duaringa Formation	-1.25	< 0.5
5	Layer 1/2 - Tertiary Basalt	-1.00	< 0.5
6	Layer 2 - Regolith	-1.52	< 0.5
7	Layer 3-19- Faults zone1	-1.02	No constraint
8	Layer 3-Rewan	-1.11	< 0.5
9	Layer 4 - RCM O/B	-1.01	< 0.5
10	Layer 5 - Leichhardt Seam	-2.66	< 0.5
11	Layer 6 - RCM I/B	-0.97	< 0.5
12	Layer 7 - Vermont Seam	-1.43	< 0.5
13	Layer 8 - RCM U/B	-2.65	< 0.5
14	Layer 9 - FCCM O/B	-1.00	< 0.5
15	Layer 10 - FCCM Seam	-0.79	< 0.5
16	Layer 11 - FCCM U/B	-2.33	< 0.5
17	Layer 12 - Q Seam	-0.70	< 0.5
18	Layer 13 - MCM U/B	-0.70	< 0.5
19	Layer 14 - P Seam	-1.29	< 0.5
20	Layer 15 -MCM I/B	-1.33	< 0.5
21	Layer 16 - H Seam	-2.14	< 0.5
22	Layer 17 - MCM I/B	-1.21	< 0.5
23	Layer 18 - D Seam	-1.42	< 0.5
24	Layer 19 - MCM U/B	-2.23	< 0.5
25	Layer 3-19 - Faults zone 2	-1.02	< 0.5
26	Layer 7 - Faults zone 3	-2.99	< 0.5
27	Layer 8 - Faults zone 4	-2.21	< 0.5
28	Layer 2 - Regolith under alluvium	-2.11	< 0.5

Standard deviation = 0.5 order of magnitude for all units.

Table 6-3 Uncertainty Parameter Range for Specific Yield

Zone	Layer - Unit	Specific Yield (Sy)	
		Mean (Log10)	Constraint
1	Layer 1 - Alluvium	-1.60	No constraint
2	Layer 1 - Regolith	-1.67	< Sy_Alluvium; < 0.15
3	Layer 1 - Weathered Permian	-2.73	< Sy_Alluvium; < 0.15
4	Layer 1 - Duaringa Formation	-1.71	< Sy_Alluvium; < 0.05
5	Layer 1/2 - Tertiary Basalt	-1.74	< Sy_Alluvium; < 0.1
6	Layer 2 - Regolith	-1.30	< Sy_Alluvium; < 0.15
7	Layer 3-19- Faults_zone 1	-2.09	< Sy_Alluvium; < 0.05
8	Layer 3-Rewan	-2.02	< Sy_Alluvium; < 0.1
9	Layer 4 - RCM O/B	-2.00	< Sy_Alluvium; < 0.05
10	Layer 5 - Leichhardt Seam	-3.00	< Sy_Alluvium; < 0.05
11	Layer 6 - RCM I/B	-2.00	< Sy_Alluvium; < 0.05
12	Layer 7 - Vermont Seam	-2.68	< Sy_Alluvium; < 0.05
13	Layer 8 - RCM U/B	-2.40	< Sy_Alluvium; < 0.05
14	Layer 9 - FCCM O/B	-2.98	< Sy_Alluvium; < 0.05
15	Layer 10 - FCCM Seam	-2.46	< Sy_Alluvium; < 0.05
16	Layer 11 - FCCM U/B	-2.34	< Sy_Alluvium; < 0.05
17	Layer 12 - Q Seam	-3.00	< Sy_Alluvium; < 0.05
18	Layer 13 - MCM U/B	-2.76	< Sy_Alluvium; < 0.05
19	Layer 14 - P Seam	-2.80	< Sy_Alluvium; < 0.05
20	Layer 15 -MCM I/B	-2.57	< Sy_Alluvium; < 0.05
21	Layer 16 - H Seam	-2.74	< Sy_Alluvium; < 0.05
22	Layer 17 - MCM I/B	-2.99	< Sy_Alluvium; < 0.05
23	Layer 18 - D Seam	-3.00	< Sy_Alluvium; < 0.05
24	Layer 19 - MCM U/B	-2.42	< Sy_Alluvium; < 0.05
25	Layer 3-19 - Faults zone 2	-2.59	< Sy_Alluvium; < 0.05
26	Layer 7 - Faults zone 3	-2.22	< Sy_Alluvium; < 0.05
27	Layer 8 - Faults zone 4	-2.67	< Sy_Alluvium; < 0.05
28	Layer 2 - Regolith under alluvium	-2.77	< Sy_Alluvium; < 0.15

Standard deviation = 0.5 order of magnitude for all units.

Table 6-4 Uncertainty Parameter Range for Specific Storage (1/m)

Zone	Layer - Unit	Specific Storage (SS) 1/m	
		Mean (Log10)	Constraint
1	Layer 1 - Alluvium	-5.83	No constraint
2	Layer 1 - Regolith	-5.55	< SS_Alluvium
3	Layer 1 - Weathered Permian	-6.99	< SS_Alluvium
4	Layer 1 - Duaringa Formation	-6.49	< SS_Alluvium
5	Layer 1/2 - Tertiary Basalt	-6.17	< SS_Alluvium
6	Layer 2 - Regolith	-6.75	< SS_Alluvium
7	Layer 3-19- Faults zone1	-5.52	< SS_Alluvium
8	Layer 3-Rewan	-6.25	< SS_Alluvium;< 5 x 10^{-5}
9	Layer 4 - RCM O/B	-5.48	< SS_Alluvium;< 5 x 10^{-5}
10	Layer 5 - Leichhardt Seam	-6.30	< SS_Alluvium;< 5 x 10^{-5}
11	Layer 6 - RCM I/B	-6.30	< SS_Alluvium;< 5 x 10^{-5}
12	Layer 7 - Vermont Seam	-6.30	< SS_Alluvium;< 5 x 10^{-5}
13	Layer 8 - RCM U/B	-5.89	< SS_Alluvium;< 5 x 10^{-5}
14	Layer 9 - FCCM O/B	-6.28	< SS_Alluvium;< 5 x 10^{-5}
15	Layer 10 - FCCM Seam	-5.64	< SS_Alluvium;< 5 x 10^{-5}
16	Layer 11 - FCCM U/B	-5.66	< SS_Alluvium;< 5 x 10^{-5}
17	Layer 12 - Q Seam	-5.60	< SS_Alluvium;< 5 x 10^{-5}
18	Layer 13 - MCM U/B	-5.43	< SS_Alluvium;< 5 x 10^{-5}
19	Layer 14 - P Seam	-5.64	< SS_Alluvium;< 5 x 10^{-5}
20	Layer 15 -MCM I/B	-5.30	< SS_Alluvium;< 5 x 10^{-5}
21	Layer 16 - H Seam	-6.16	< SS_Alluvium;< 5 x 10^{-5}
22	Layer 17 - MCM I/B	-5.87	< SS_Alluvium;< 5 x 10^{-5}
23	Layer 18 - D Seam	-5.32	< SS_Alluvium;< 5 x 10^{-5}
24	Layer 19 - MCM U/B	-6.15	< SS_Alluvium;< 5 x 10^{-5}
25	Layer 3-19 - Faults zone 2	-6.24	< SS_Alluvium
26	Layer 7 - Faults zone 3	-5.42	< SS_Alluvium
27	Layer 8 - Faults zone 4	-6.13	< SS_Alluvium
28	Layer 2 - Regolith under alluvium	-5.03	< SS_Alluvium

Standard deviation = 0.5 order of magnitude for all units.

Table 6-5 Uncertainty Ranges for Recharge Rates

Zone	Unit	Mean % of rainfall	Constraints
1	Other Alluvium	0.23	>Regolith >Weathered Permian >Duaringa Formation
2	Regolith	0.01	
3	Weathered Permian	0.01	
4	Duaringa Formation	0.01	
5	Tertiary Basalt	0.30	
6	Alluvium Isaac River Channel	0.52	>Regolith >Weathered Permian >Duaringa Formation
7	Alluvium Isaac River	0.23	>Regolith >Weathered Permian >Duaringa Formation

Standard deviation = 0.5 order of magnitude for all units.

6.2 Uncertainty Results

6.2.1 Uncertainty of Mine Inflows

Figure 6-1 presents the uncertainty of groundwater inflow into the mine due to the Project from start of the Project (January 2025) that is, four years after the start of cumulative prediction modelling to the end of the prediction model (January 2056). The figure shows the predicted inflows for the base case model and different percentiles including 5th, 33th, 50th, 66th and 95th prediction bounds. Based on the IESC (2018) guidelines these represent:

- 5th percentile indicates it is very likely the outcome is larger than this value,
- 5th – 33th indicates it is likely that the outcome is larger than this value,
- 33th - 66th indicate it is as likely as not that the outcome is larger or smaller than this value,
- 67th - 95th indicates it is unlikely that the outcome is larger than this value, and
- 95th percentile indicates it is very unlikely the outcome is larger than this value.

The bounds in the figure demonstrate the uncertainty within the predicted inflow rate. The bounds show that the calibrated base case model is below the 50th percentile.

Figure 6-1 shows that, while the realisations created in uncertainty analysis provide a reasonable fit to calibration datasets, they generally predict higher inflows than what is reported for the base case (**Section 3.5**). This can be seen in the figure by comparing the predicted inflow in the base case and the 50th percentile predicted inflow. The difference between the base case inflow and the 50th percentile is likely due to specific yield values in the basecase. The specific yield values in the calibrated model were generally at the lower end of the parameter range (0.1 %). While the value of 0.1 % for specific yield for coal seam and interburden is reasonable and consistent with the literature, there were no measured inflow data available to constrain this parameter during the calibration. Therefore, the uncertainty analysis has tested the model with higher values for specific yield and this resulted in higher 50th percentile inflow comparing to the base case (see **Appendix E**).

As shown in **Figure 6-1**, The maximum mine inflow in the uncertainty analysis was 1,800 ML/year (4.92 ML/day) (very unlikely outcome is larger than this value). The 5th to 95th range in mine inflows for the 2025 to 2056 period was 14.7 ML/year (0.04 ML/day) to 589.11 ML/year (1.61 ML/day).

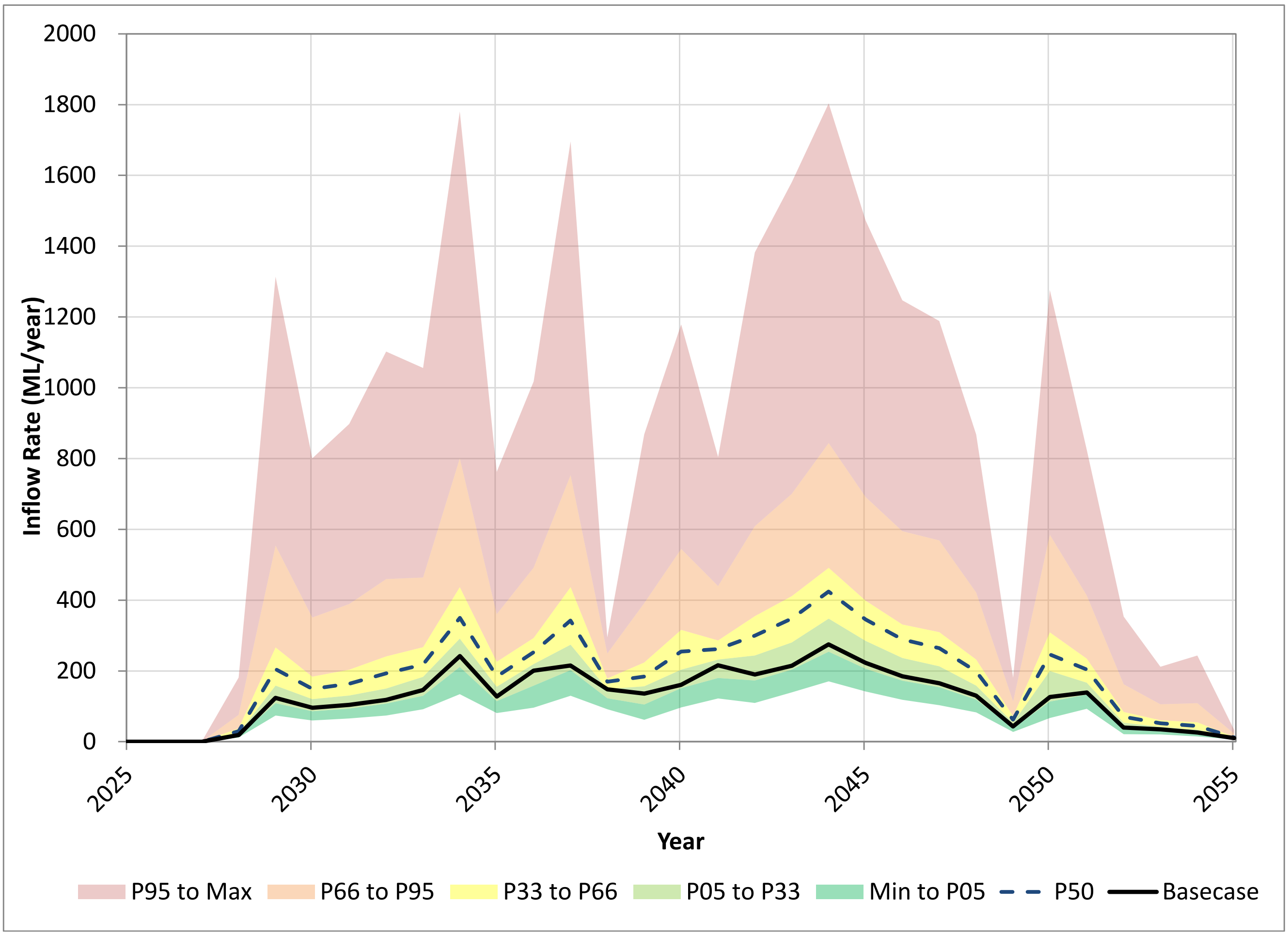


Figure 6-1 Mine Inflow Uncertainty

6.2.2 Groundwater Drawdowns

To illustrate the level of uncertainty in the extent of predicted drawdown, the base case maximum drawdown and the 50th percentile maximum drawdown extent were compared to the maximum drawdown extent for the 5th and 95th percentiles.

The uncertainty analysis results did not show any incremental drawdown impacts greater than 1 m for the Quaternary alluvium as a result of mining at the Project.

Figure 6-2 shows the uncertainty in the extent of predicted 1 m maximum incremental drawdown in regolith. As shown in this figure, the 5th, 50th and 95th percentile maximum drawdowns in the regolith are localised in the northern boundary of the Project area.

Figure 6-3 and **Figure 6-4** show the uncertainty in the extent of predicted 1 m maximum incremental drawdown in the Q Seam and H Seam. The figures show that the 95th percentile drawdown in Q Seam and H Seam extends between 10 and 12 km to the north and east of the Project area (down-dip).

6.2.3 Uncertainty of Drawdown at Water Supply Bores

As discussed in **Section 3.4.1**, the 2020 bore census identified three active water supply and stock bores near to the Project. These bores are Grosvenor Downs 1, Coolibah Downs 01 and Winchester Downs 01 located less than 7 km to the east of the Project area (SLR, 2021a). Grosvenor Downs 1 is installed in the alluvium while the other two bores access the Fort Cooper Coal Measures. None of these bores are predicted to be impacted as a result of mining activities at the Project.

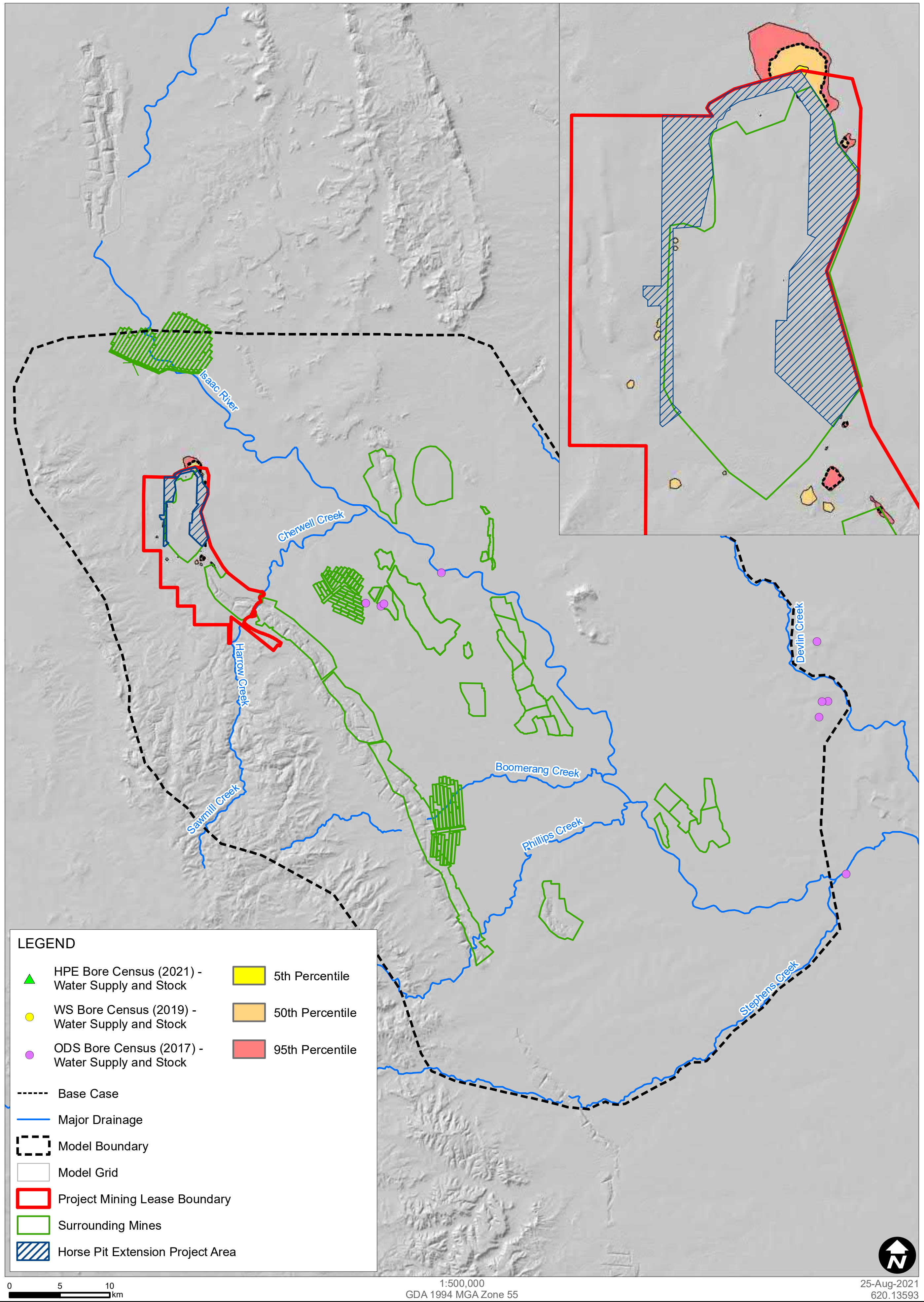
The 95th percentile (very unlikely) maximum drawdown calculated from the uncertainty analysis did show drawdowns greater than 1 m due to the Project in two of the Fort Cooper Coal Measures bores. **Table 6-6** summarises the 95th percentile maximum drawdown at the two water supply bores predicted to be impacted during mining to 2056. Both bores have screen elevations that correspond to the layer representing the underburden of the Fort Cooper Coal Measures in the model (i.e. layer 11). The locations of the two Fort Cooper Coal Measures bores that may be impacted are shown in **Figure 6-5** along with the model drawdown predictions for layer 11.

Table 6-6 Predicted Drawdown at Water Supply Bores

Bore	Easting	Northing	Model Layer	Geology	Baseline Water Level (mbgl)*	Simulated pre-mining Water Level (mAHD)	95th percentile Maximum Drawdown Due to Project (m)	95th percentile Maximum Cumulative Drawdown (m)
Coolibah Downs 01	617388	617388	11	FCCM	191.5	205.6	1.5	6.4
Winchester Downs 01	618483	618483	11	FCCM	195.7	202.5	1.3	8.7

Note: Coordinates in GDA94 Z55
Baseline water level from SLR (2021a)

The uncertainty results showed no water supply bores in the alluvium are predicted to experience drawdowns greater than 1 m due to the Project.



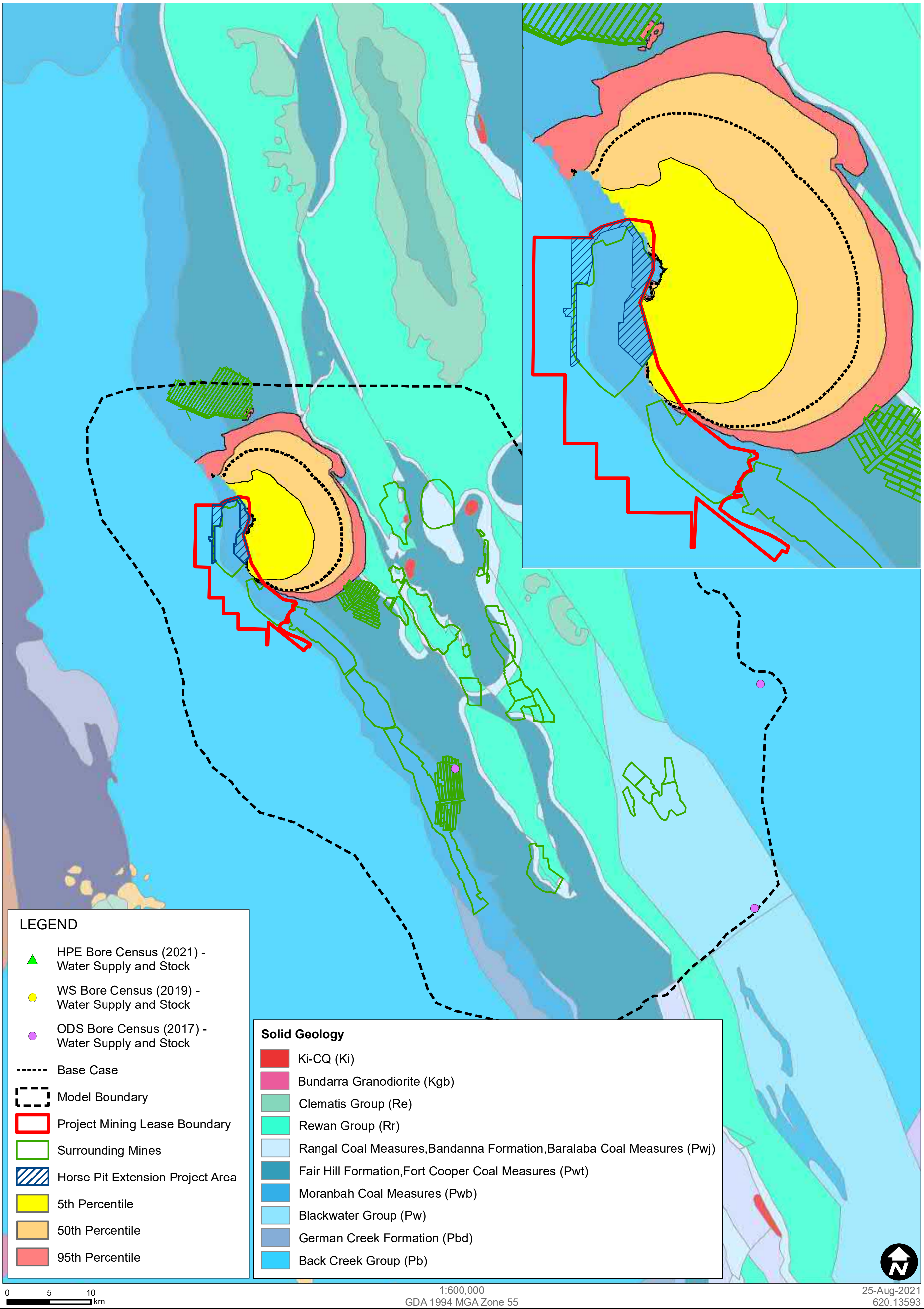
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\62013593 F6-2 Uncertainty in Predicted 1 m Maximum Incremental Drawdown in Regolith.mxd

25-Aug-2021
620.13593

SLR

Uncertainty in Predicted 1m Maximum Incremental Drawdown in Regolith

FIGURE 6-2



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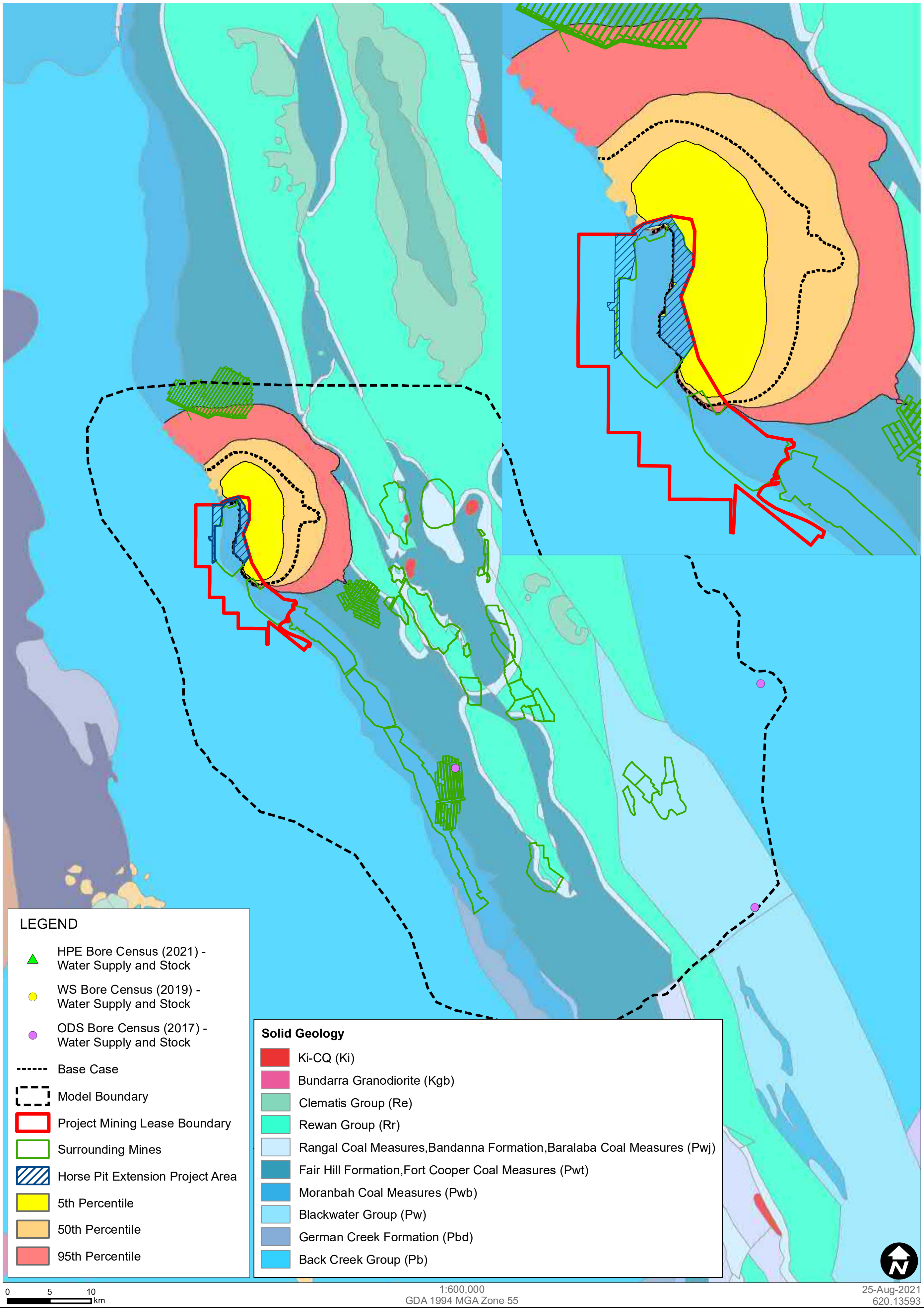
H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\62013593 F6-3 Uncertainty in Predicted 1 m Maximum Incremental Drawdown in Q Seam (Layer 12).mxd

SLR

Uncertainty in Predicted 1m Maximum Incremental Drawdown in Q Seam (Layer 12)

FIGURE 6-3



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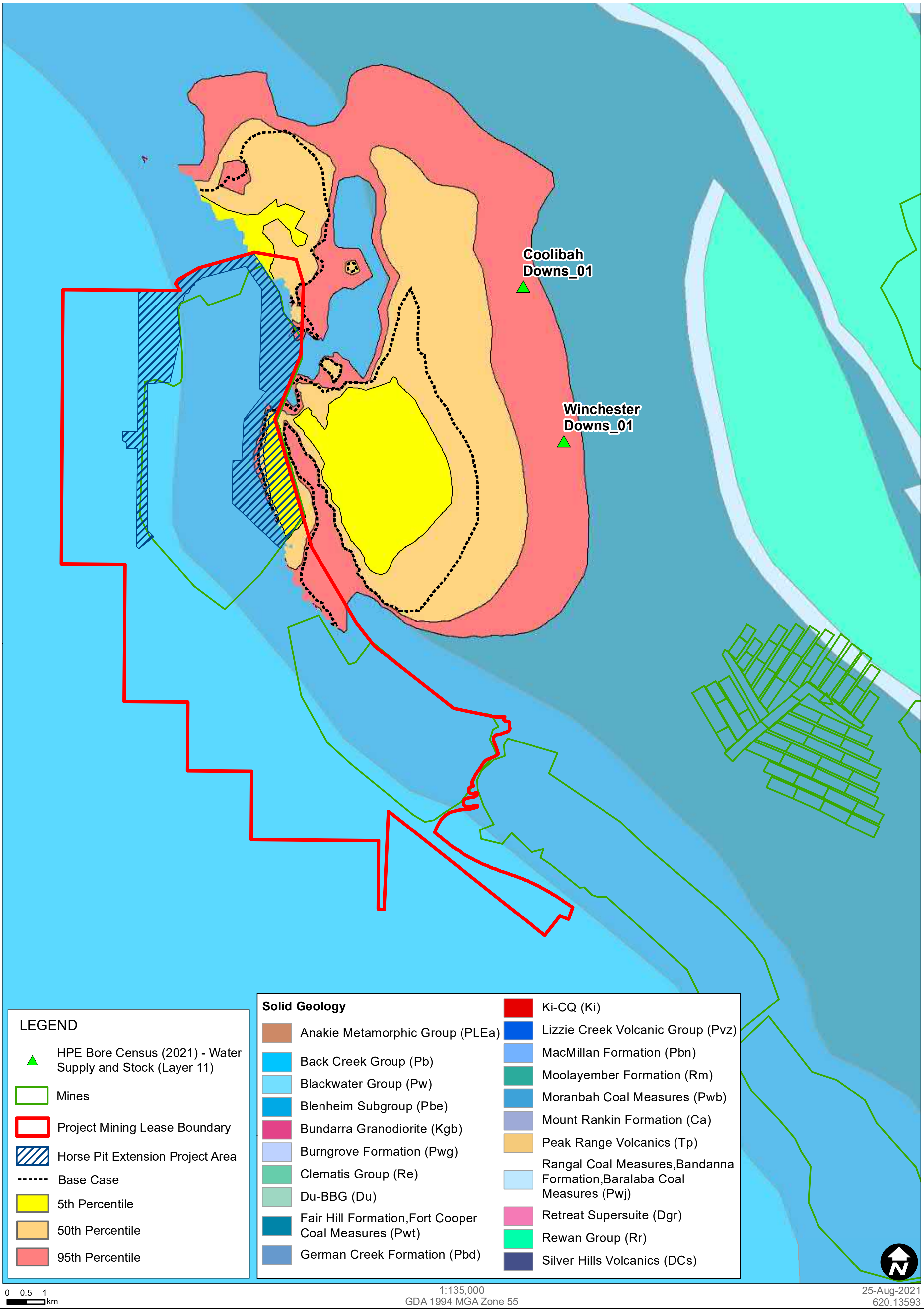
SLR

Uncertainty in Predicted 1m Maximum Incremental Drawdown in H Seam (Layer 16)

FIGURE 6-4



SLR

Location of Water Supply Bores that may be Impacted and Uncertainty in Predicted 1m Maximum Incremental Drawdown in lower FCCM (Layer 11)

FIGURE 6-5

6.2.4 Number of realisations

As discussed above, 250 realisations met the calibration criteria and were selected as calibrated realisations. The predictive model was run using the 250 parameters sets. The results from the predictive model were used to conduct statistical analyses to assess if additional realisations were likely to provide results that would significantly change the reported predictive results. The 95 % confidence interval was calculated for the mine inflows and the maximum drawdown.

Figure 6-6 and **Figure 6-7** show the 95 % confidence intervals of the median and maximum drawdown and predicted inflows, as well as the variance of the median and maximum drawdown and predicted inflows as more realisations are added to the uncertainty analysis. For example, the 95% confidence interval for the maximum drawdown is calculated by first estimating the maximum drawdown for each realisation and then calculating the 95 % confidence interval of the maximum drawdowns as each realisation is added to the dataset. As shown in **Figure 6-6** and **Figure 6-7**, additional realisations are unlikely to significantly increase or decrease the confidence intervals of predictions of mine inflows and maximum drawdowns. Therefore, the results from the 250 realisations are considered representative and used for predicted drawdown and indirect water take (alluvium and surface water).

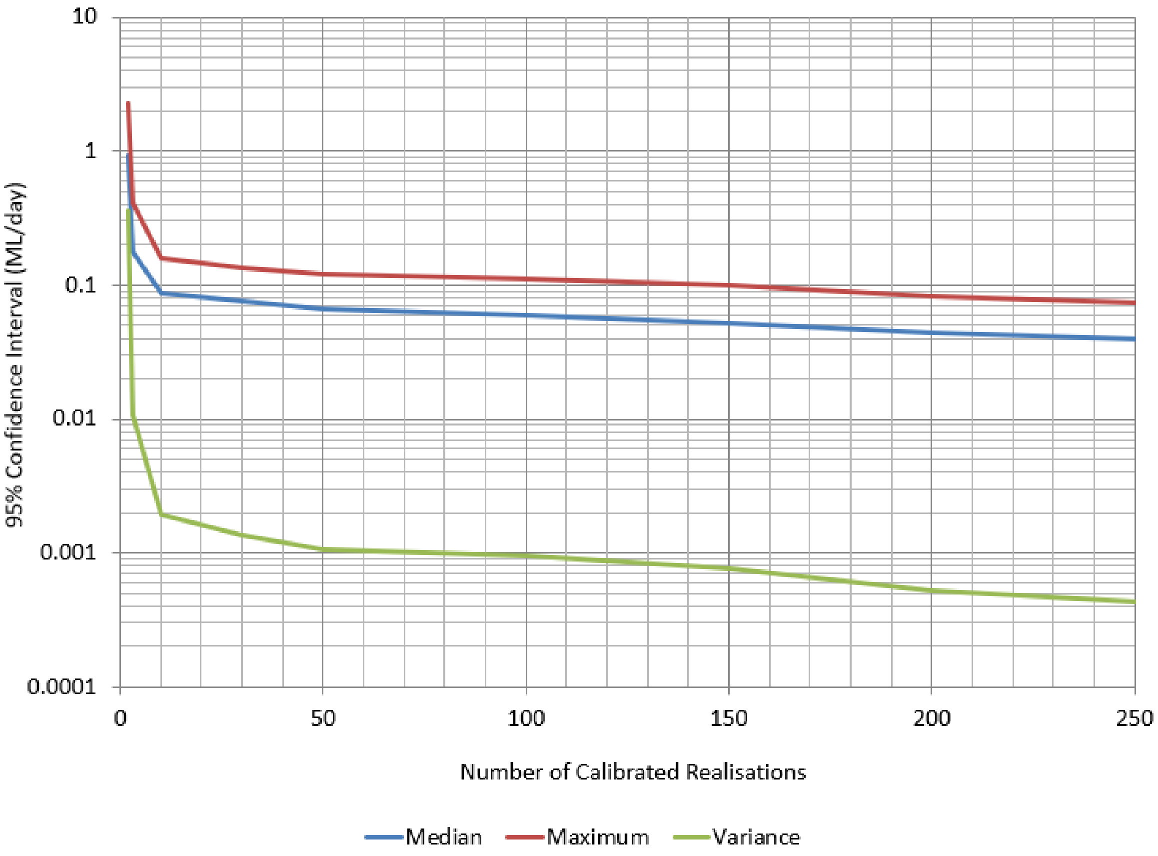


Figure 6-6 95 % Confidence Interval for Pit Inflows

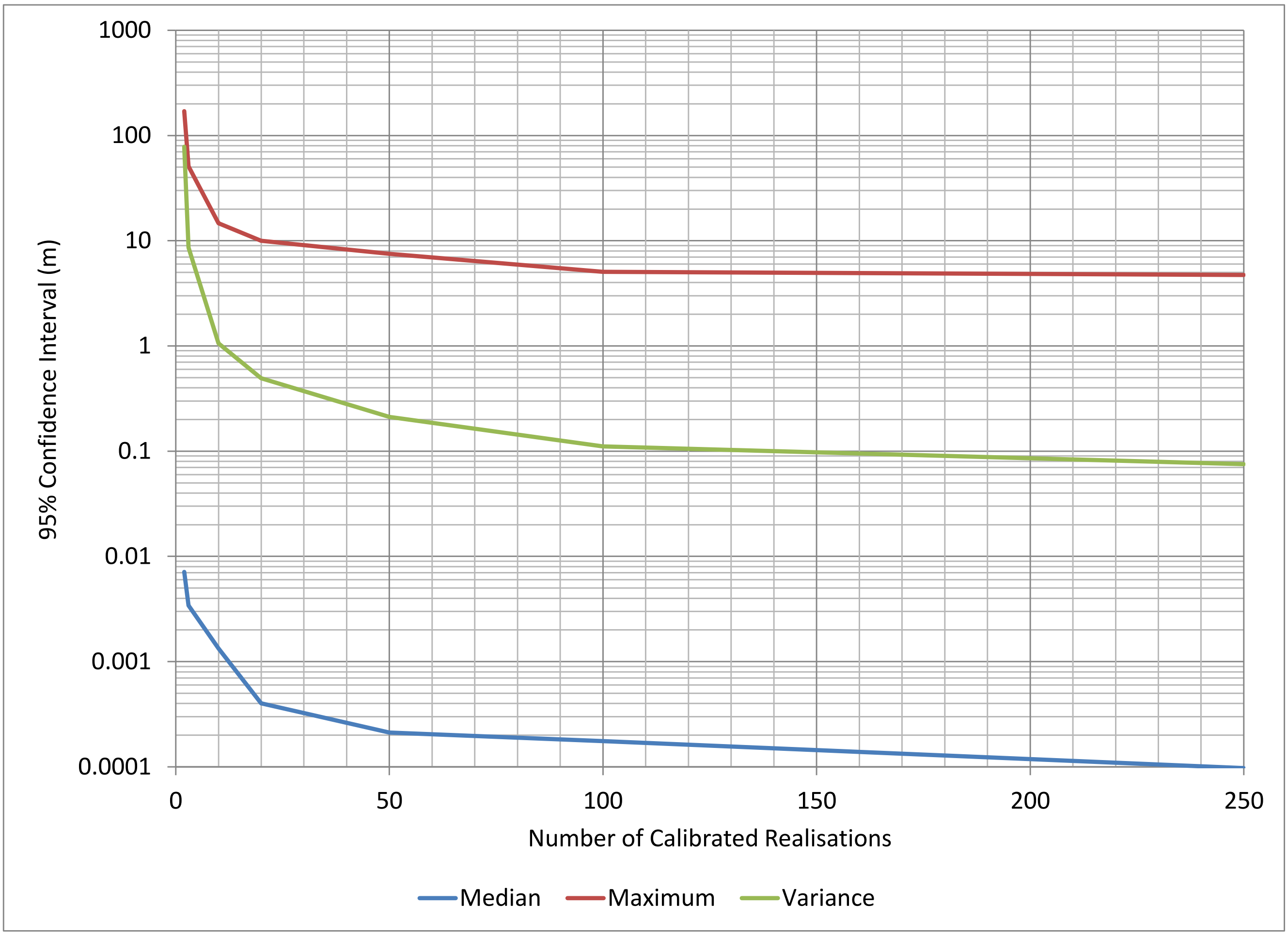


Figure 6-7 95 % Confidence Interval for Maximum Drawdowns

6.2.5 Uncertainty of Influence on Alluvium and Surface Water Flow

The uncertainty analysis results showed that even for the 95th percentile prediction, which is a very unlikely outcome, the indirect take from the alluvium and the change in Isaac River flow loss due to the Project were insignificant.

7 Model Confidence Level Classification

The groundwater modelling was conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al. 2012), the MDBC Groundwater Flow Modelling Guideline (MDBC 2001) and the released IESC Explanatory Note for Uncertainty Analysis (IESC 2018). These are mostly generic guides and do not include specific guidelines on special applications, such as underground coal mine modelling.

The Australian Groundwater Modelling Guidelines has replaced the model complexity classification of the previous MDBC Groundwater Flow Modelling Guideline by a "model confidence level" (Class 1, Class 2 or Class 3 in order of increasing confidence) typically depending on:

- Available data (and the accuracy of that data) for the conceptualisation, design and construction.
- Calibration procedures that are undertaken during model development.
- Consistency between the calibration and predictive analysis.
- Level of stresses applied in predictive models.

It is generally expected that a model confidence level of Class 2 is required for mining environmental impact assessment. **Table 7-1** (based on Table 2.1, Barnett et al. 2012) summarises the classification criteria and shows a scoring system allowing model classification. The groundwater model developed for this Groundwater Assessment may be classified as primarily Class 2 (effectively “medium confidence”) with some items meeting the higher Class 3 criteria, and therefore the model is considered fit for purpose for this Project context.

Table 7-1 Groundwater Model Classification Table

Class	Data	Calibration	Prediction	Indicators	Total
1	Not much. Spares. **Not metered usage.** Remote climate data.	Not Possible. Large error statistics. Inadequate data spread. Targets incompatible with model purpose.	Timeframe>>calibration. Long stress periods. Transient prediction but steady state calibration. Bad verification.	Timeframe>10x. Stresses>5x. Mass balance>1% (or single 5%). Properties<>Field. Bad discretisation. No review.	
Count	1	0	0	0	**1**
2	**Some.** **Poor coverage**. Some usage info. Baseflow estimates.	**Partial performance.** Long-term trends wrong. Short time record. **Weak seasonal replication.** No use of targets compatible with model purpose.	**Timeframe>calibration.** **Long stress periods.** New stresses not in calibration. Poor verification.	**Timeframe=3-10x.** **Stresses=2-5x.** **Mass balance<1%.** **Properties<>Field measurements.** **Some key coarse discretisation.** **Reviewed by hydrogeo.**	
Count	2	2	2	6	**12**
3	Lots. Good aquifer geometry. Good usage info. **Local climate info.** **K measurements** **Hi –res DEM.**	Good performance stats. Long-term trends replicated. Seasonal fluctuations OK. **Present day data targets.** **Head and flux targets.**	Timeframe~calibration. Similar stress periods. Similar stresses to those in calibration. Steady state prediction consistent with steady state calibration. Good verification.	Timeframe<3x. Stresses<2x. **Mass balance<0.5%** Properties~Field measurements. Some key coarse discretisation. **Reviewed by modeller.**	
Count	3	1	0	2	**6**

8 Groundwater Model and Data Limitations

The IESC *Uncertainty analysis – Guidance for groundwater modelling within a risk management framework* (2018) identifies four key sources of scientific uncertainty affecting groundwater model simulations:

- Structural/conceptual.
- Parameterisation.
- Measurement error.
- Scenario uncertainties.

These four sources of scientific uncertainty have been qualitatively assessed with regards key aspects of the CVM groundwater model, as presented in **Table 8-1**.

Overall, the model captures depressurisation due to active mining. The model is numerically stable with no mass balance error. The model shows a good fit between observed and modelled groundwater levels (**Section 2.6.1**). A depth dependence function was used for hydraulic conductivity, with the calibrated values showing a good fit to observed data as presented in **Section 2.7**. Overall, the model is considered fit for purpose to achieve the objectives outlined in **Section 1** based on the data provided and the project timeframe.

In case of future use of the model, updates could be conducted to further refine the model if it was deemed that an increase in model confidence level was required, but the applicability of this would be dependent on the purpose of the future modelling and availability of data to inform future changes. As it stands, the current model is deemed fit for purpose for the Project impact assessment.

Table 8-1 Groundwater Model and Data Limitations

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	The model has an unstructured Voronoi grid that includes detailed cell refinement around site, neighbouring mines and along drainage features.
	Layers	Fit for purpose	Top of layer 1 incorporates site LiDAR data
		Fit for purpose	Representation of alluvium based on CSIRO (2015) regolith mapping and refined based on site drill data.
	Conceptualisation – Geological Structure	Fit for purpose	The local structure of the geology is based on detailed data at site (CVM Mine geology model), and regional model geometry (outside of site) interpolated based on neighbouring mines geology models (Winchester South, Lake Vermont, Moorvale South and Olive Downs South) and geological mapping. Geophysical surveys across the Project Area have identified minor faulting in the CVM area. Faulting is typically confined to the coal seams of the Moranbah Coal Measures. Thrust faults are the dominant structural feature in the Project Area and show throws range between 3 and 15m and average 6.6m. Therefore, no geological structures (i.e. faults) have been included within the Project area in the model other than through layer displacements from the site geological model. The most significant geological structures in the area is the Jellinbah Fault Zone which is located remote from the site and will not be intersected by mining. Therefore, its influence on the groundwater regime in the CVM area is likely to be very limited.
	Conceptualisation – GDEs	Fit for purpose, future improvements possible if new data collected	Ecological Service Professionals (ESP, 2020) undertook an environment assessment of the condition of the aquatic ecosystems in the vicinity of the Project Area in April 2020. This data on known GDEs (location and interaction) have been considered and incorporated.
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose	The Permian coal measures outcrop along the western edge of the site. Therefore, how this is captured within the model influences the model predictions. The structure of the coal seams was checked to ensure it matches observed and mapped geology. The predictions of drawdown adjacent to mining was checked and the model shows a good fit between modelled and observed trends.

Type	Part	Status	Comment
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose	Site monitoring network includes 4 bores mapped within alluvium that were used to inform saturated extent of alluvium locally at site and for calibration targets. The model slightly under or over-predicts groundwater levels in alluvium, but generally within 5 m of observed levels. For the extent alluvium in the vicinity of the Project Area (i.e., alluvium along Harrow Creek and Cherwell Creek) a slope analysis and Google satellite imagines were used. Any additional data or study on alluvium extent and thickness at CVM should be reviewed and captured (where relevant) in future updates of the model. Such improvements are not deemed required for the Project impact assessment however.
Parameterisation	Hydraulic Conductivity – Depth Dependence	Fit for purpose, future improvements possible	Field testing of hydraulic conductivity (horizontal and to a lesser extent vertical) has been conducted in the area. Hydraulic conductivity test results from the other sites within the model domain were also considered. The data shows a general decline in hydraulic conductivity with depth that is replicated in the model. Further conductivity tests and measurements of storage properties can improve model calibration and refine model predictions, but are not deemed required for the Project impact assessment.
	Spoil Properties	Fit for purpose, future improvements possible	Limited site-specific data is available for the spoil. Spoil properties were adopted using the previous studies.
	Rivers	Fit for purpose, future improvements possible	Isaac River stage height is changed temporally in the historical calibration model based on observed levels from government stream gauges, and long term annual average level assumed in the predictive model. Watercourses within and in the vicinity of the Project Area such as Harrow Creek and Cherwell Creek are ephemeral and only flow briefly after rainfall. Therefore, river stage height of zero was assigned to these watercourses in the model. Measurements of flow rates and stage height in the rivers can help with improving the model calibration and refining the model predictions, but are not deemed required for the Project impact assessment.
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and calibrated recharge rates.

Type	Part	Status	Comment
Measurement Error	Observation Data Quality	Fit for purpose	Bore logs and construction details available for most site bores, and long-term site water level data available for various units.
	Landholder Bore Data Quality	Fit for purpose	Impacts on registered landholder bores are influenced by the assumptions of the bore design, target geology and use.
	Temporal spread	Fit for purpose	Timeseries water level data from the site as well as the neighbouring mines (Winchester South, Moorvale South, Olive Downs South and Lake Vermont, Peak Downs, Moranbah South) for the alluvium and Permian coal measures.
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose	Transient warm-up (1988-2008) and transient (2008 to 2020) calibration model set up and a depth dependence function used and calibration to water levels conducted using automated (PEST) and manual methods.
	Predictive	Fit for purpose	Model captures approved and proposed open cut mining at CVM. The model also includes future mining at Sarajii, Peak Downs and Grosvenor mainly based on publicly available data. The actual future mine progression for these sites may vary.
	Sensitivity and uncertainty	Fit for purpose	Uncertainty analysis has been conducted by stochastic modelling using an adapted Monte Carlo method with modern software packages. The Latin Hypercube Sampling (LHS) method was used to create random realisations from parameter and PEST++ was used to orchestrate the model runs. The uncertainty analysis quantified the variability in predictions with changes in maximum predicted drawdowns, mine inflows, impact on alluvium flow and impacts on surface water flow.

9 Conclusions

The numerical groundwater model developed for the Project successfully achieved the modelling objectives, as outlined in **Section 1**. Model calibration statistics are within suggested guidelines (Middlemis et al., 2001) and mass balance errors remain low, through the model calibration and predictive modelling. Model construction considers all available data, including the current site mine plan and site geological model for the Project Area. The uncertainty analysis has demonstrated a low likelihood for the Project to impact on alluvial water levels, with drawdown to layers mostly contained within the Project Area. The model serves as a suitable representation of possible transient groundwater conditions within the Study Area, over the life of the Project, however, the uncertainty in predictions should be acknowledged.

Limited site-specific information on aquifer storage and specific yield parameters were available during calibration. As more site-specific hydraulic data becomes available, new data should be compared with the calibrated parameters achieved and the validity of the model calibration should be assessed. Additional site-specific data is expected to “tighten” uncertainty bounds for model prediction results. Predictive sensitivity indicates that mine inflows are most sensitive to the specific yield values of the Permian units. However, calibration sensitivity to these parameters is relatively low. Future work should consider opportunities to further constrain values of these parameters. However, as it stands, the model is deemed fit for purpose for the Project impact assessment without such improvements.

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APPENDIX A

Calibration Residuals

ID	Easting	Northing	Layer	Average Residual	Min	Max
8	623790.2	7552348.9	1	11.3	11.3	11.3
11	627177.2	7546881.1	2	6.8	6.8	6.8
13	627219.4	7546972.0	2	7.5	7.5	7.5
14	628779.2	7546673.0	2	9.7	9.7	9.7
15	629073.7	7546802.0	8	8.1	8.1	8.1
16	628425.3	7544023.0	12	7.8	7.8	7.8
7978	629633.4	7556463.5	5	-1.8	-1.8	-1.8
7979	629633.4	7559234.5	7	11.7	11.7	11.7
7987	629633.4	7559234.5	4	11.6	11.6	11.6
7998	629633.4	7556463.5	7	-1.9	-1.9	-1.9
37861	649695.8	7505004.6	10	-27.0	-27.0	-27.0
38418	607829.6	7540275.4	1	-22.6	-22.6	-22.6
43305	647097.6	7516801.5	8	-30.9	-30.9	-30.9
43639	639103.3	7511121.5	14	29.4	29.4	29.4
44053	660370.1	7501087.5	1	-21.5	-21.5	-21.5
44161	647409.4	7540369.3	1	-1.0	-1.0	-1.0
44164	647977.5	7540860.5	2	-3.5	-3.5	-3.5
44625	650488.2	7509533.8	9	-32.1	-32.1	-32.1
67216	655389.1	7526202.6	1	7.4	7.4	7.4
67217	656736.8	7522643.0	1	1.5	1.5	1.5
67218	658631.7	7521477.3	1	3.3	3.3	3.3
88525	671181.5	7521895.5	2	-20.9	-20.9	-20.9
88526	671831.6	7519720.8	2	-21.9	-21.9	-21.9
88527	665168.1	7516140.8	1	-17.4	-17.4	-17.4
88528	664074.0	7516803.1	9	-23.6	-23.6	-23.6
89454	653205.5	7513829.3	9	-35.0	-35.0	-35.0
89469	648324.8	7504929.1	12	-21.2	-21.2	-21.2
89470	647480.7	7503867.5	1	10.3	10.3	10.3
90015	643693.1	7503665.0	1	13.3	13.3	13.3
90074	671494.7	7510763.1	12	-17.1	-17.1	-17.1
90076	672363.0	7515470.4	15	-13.3	-13.3	-13.3
90480	652589.0	7519704.0	8	-31.8	-31.8	-31.8
97180	654589.0	7527206.3	1	-4.0	-4.0	-4.0
97181	656420.9	7524049.7	1	-2.8	-2.8	-2.8
97182	657134.9	7522439.1	1	-10.4	-10.4	-10.4
97183	657439.9	7522249.8	1	-10.3	-10.3	-10.3
97184	659035.3	7519506.0	1	-15.7	-15.7	-15.7

ID	Easting	Northing	Layer	Average Residual	Min	Max
97185	659228.7	7519277.0	1	-15.3	-15.3	-15.3
105427	630296.9	7570136.8	1	15.9	15.9	15.9
105435	616912.6	7570594.3	1	1.0	1.0	1.0
105677	621977.3	7573484.3	1	-0.4	-0.4	-0.4
122458	644983.0	7526770.0	8	-16.8	-16.8	-16.8
132627	649608.9	7525155.5	2	-12.7	-12.7	-12.7
136090	647449.5	7540132.3	2	-1.9	-1.9	-1.9
136689	635867.6	7528211.2	2	-11.1	-11.1	-11.1
141382	628342.1	7542223.0	12	3.7	3.7	3.7
141383	627298.9	7549948.3	1	-15.7	-26.4	-15.0
141457	621977.3	7573484.3	1	-0.4	-0.4	-0.4
141458	622157.5	7572706.2	1	-11.6	-11.6	-11.6
141655	659112.1	7554720.1	7	-47.9	-47.9	-47.9
141656	659112.1	7554720.1	2	15.7	15.7	15.7
141661	661637.3	7552900.8	2	-4.9	-4.9	-4.9
141662	662958.1	7552840.0	2	-4.6	-4.6	-4.6
141685	631548.7	7557652.0	1	-4.0	-6.7	-1.7
141807	621938.0	7573812.1	1	-10.5	-12.5	-9.3
141808	621457.8	7572382.5	1	5.3	5.3	5.3
141864	622157.5	7572706.2	1	-14.4	-22.0	-7.3
141865	622157.5	7572706.2	1	-6.3	-6.3	-6.3
141942	607476.6	7570034.7	1	-7.0	-7.0	-7.0
141943	606865.4	7570053.5	1	-5.6	-5.6	-5.6
141944	611199.6	7567224.3	1	-10.1	-10.1	-10.1
141945	604828.7	7569831.1	1	1.2	1.2	1.2
141950	608807.5	7570968.8	1	-3.9	-3.9	-3.9
141974	633658.8	7559660.0	1	-30.5	-30.5	-30.5
141975	632758.8	7558447.5	5	3.1	3.1	3.1
141976	632758.8	7558447.5	5	-8.1	-8.1	-8.1
141977	634258.8	7559660.0	1	-28.7	-28.7	-28.7
141978	632358.8	7558447.5	5	-8.8	-8.8	-8.8
141981	621977.3	7573484.3	1	2.3	2.3	2.3
158010	642598.4	7519951.8	9	-4.8	-4.8	-4.8
158011	639841.3	7514207.2	12	4.5	4.5	4.5
158484	648056.4	7523971.3	2	-9.4	-9.4	-9.4
158485	643191.0	7521957.0	9	-5.9	-5.9	-5.9
161572	672413.8	7537992.6	2	-15.2	-15.2	-15.2

ID	Easting	Northing	Layer	Average Residual	Min	Max
161573	672413.8	7537992.6	2	-14.4	-14.4	-14.4
161578	672024.2	7534618.9	2	-16.5	-16.5	-16.5
162011	622157.5	7572706.2	1	4.1	4.1	4.1
162012	622157.5	7572706.2	1	1.8	1.8	1.8
162013	622186.9	7571874.5	3	-5.4	-14.2	-2.7
162014	622157.5	7572706.2	1	1.1	1.1	1.1
162016	621457.8	7572382.5	2	2.7	2.7	2.7
162017	621457.8	7572382.5	2	2.5	2.5	2.5
162020	621977.3	7573484.3	2	-1.0	-1.0	-1.0
162041	621977.3	7573484.3	3	-19.3	-27.6	-13.2
162043	613588.7	7559886.1	2	7.2	7.2	7.2
162044	615579.5	7560524.4	2	-5.6	-5.6	-5.6
162046	618307.7	7557682.1	10	-0.3	-0.3	-0.3
162068	606007.8	7571075.3	1	-11.0	-11.0	-11.0
162070	606007.8	7571075.3	1	-11.6	-11.6	-11.6
162071	605947.6	7570995.5	1	-11.3	-11.3	-11.3
162138	620223.4	7547524.7	12	2.6	2.6	2.6
162141	613923.6	7562122.8	1	0.8	0.8	0.8
162145	614939.2	7550983.9	10	3.0	3.0	3.0
162163	609750.7	7560104.5	15	-5.3	-8.6	13.6
162164	608381.8	7558287.5	1	0.5	-4.1	14.0
162165	608881.8	7556728.5	2	-1.5	-6.8	2.7
162166	608881.8	7556728.5	17	-7.4	-9.3	-0.7
162167	610681.8	7555343.0	13	-1.5	-2.2	-0.9
162168	608881.8	7554130.5	2	-1.2	-1.5	-0.9
162169	611045.8	7551706.5	2	5.3	5.0	5.9
162170	611045.8	7551706.5	13	1.4	1.3	1.4
162171	612345.4	7550593.3	1	2.6	2.6	2.7
162172	612345.4	7550593.3	13	2.7	1.7	4.2
162173	611258.8	7549492.5	1	3.5	1.1	5.2
162174	611258.8	7549492.5	17	-7.8	-9.2	-6.7
162175	614308.8	7548886.5	13	-4.9	-13.2	-1.3
162177	616874.8	7547722.0	12	-2.3	-10.5	1.9
162234	629633.4	7559234.5	5	16.3	16.3	16.3
162235	629633.4	7559234.5	5	12.6	12.6	12.6
162236	629633.4	7556463.5	5	-1.8	-1.8	-1.8
162237	629633.4	7556463.5	5	-1.8	-1.8	-1.8

ID	Easting	Northing	Layer	Average Residual	Min	Max
162439	631965.8	7553593.0	1	-5.4	-5.4	-5.4
162469	632558.8	7561911.5	10	-5.0	-8.8	-3.9
162470	635358.8	7560179.5	4	-14.0	-18.1	-10.2
162471	632258.8	7558274.0	6	-13.2	-14.9	-3.5
162472	635699.4	7554944.4	10	-15.8	-16.1	-15.0
162504	610681.8	7557248.0	1	3.7	3.3	4.7
162505	610731.8	7557161.5	1	2.0	0.8	4.1
162527	632558.8	7561911.5	19	-0.6	-0.8	-0.4
162528	631758.8	7561218.5	9	-7.4	-10.7	-5.5
162547	618426.4	7570661.4	3	-8.4	-8.7	-8.1
162548	619273.9	7568558.3	3	2.6	2.3	2.9
162549	619280.6	7567287.0	1	9.4	8.2	9.9
162550	620379.5	7567546.5	2	6.4	5.8	6.7
162551	619004.7	7572915.2	3	-0.9	-1.3	-0.2
162552	618855.2	7571993.7	3	-5.1	-5.7	-4.6
162565	617475.5	7568865.6	10	-63.8	-75.0	-59.1
162682	641132.5	7546549.5	1	-7.0	-7.5	-6.8
162684	642541.9	7547447.5	1	-3.4	-3.7	-3.1
162806	611126.2	7562863.9	1	9.8	9.8	9.8
162810	620314.7	7573518.7	1	-1.5	-2.3	-0.8
162811	621651.4	7568874.3	1	9.1	8.0	10.1
162812	621651.4	7568874.3	1	10.5	9.5	10.7
162839	631184.4	7564729.5	1	-4.3	-4.3	-4.3
162841	639766.9	7558393.5	1	-11.3	-15.7	-6.9
162992	631629.4	7559452.0	19	-8.2	-8.7	-7.5
165325	640164.7	7515922.0	12	1.4	1.4	1.4
182077	619119.6	7571315.4	3	-9.7	-9.9	-9.4
182078	619978.6	7568093.1	2	-0.3	-9.0	4.7
182079	619978.6	7568093.1	2	5.3	4.8	5.7
182080	619863.6	7567330.7	2	6.2	6.0	6.3
182390	616511.8	7571966.5	1	-20.4	-24.7	-9.9
182391	616511.8	7571966.5	1	-46.3	-49.2	-34.5
182392	616511.8	7571966.5	1	-22.4	-25.8	-19.8
13040180	667814.0	7516270.0	1	-17.4	-19.2	-16.1
13040181	668052.0	7516020.9	1	-15.9	-15.9	-15.9
13040183	668871.5	7514836.3	1	-17.4	-17.4	-17.4
13040184	669622.7	7514341.8	1	-17.9	-17.9	-17.9

ID	Easting	Northing	Layer	Average Residual	Min	Max
13040282	605198.6	7546183.1	1	4.3	3.9	4.6
13040283	628059.5	7527241.5	1	-17.4	-19.7	-14.8
13040284	620258.8	7566342.2	1	13.7	12.2	14.4
13040286	660153.0	7536920.6	2	-27.3	-28.0	-26.9
1235C-VWP1	650028.0	7522291.5	4	-17.2	-18.2	-9.8
1235C-VWP2	650028.0	7522291.5	5	-19.5	-23.1	-18.7
1235C-VWP3	650028.0	7522291.5	6	-21.1	-22.8	-19.9
1235C-VWP4	650028.0	7522291.5	7	-35.1	-38.8	-20.7
1238-MB1	651084.9	7523115.5	2	-10.7	-10.8	-10.5
1238-MB2	651084.9	7523115.5	7	-18.0	-18.2	-17.7
2183-VWP1	644147.6	7520525.5	4	-23.0	-23.1	-22.9
2183-VWP2	644147.6	7520525.5	5	-14.6	-16.4	-12.4
2183-VWP3	644147.6	7520525.5	6	-33.5	-34.6	-32.3
2183-VWP4	644147.6	7520525.5	7	-26.0	-28.2	-22.9
2218-MB2	645582.8	7522925.3	3	-12.1	-12.9	-11.2
2218-MB3	645582.8	7522925.3	5	-12.3	-12.7	-11.9
2218-VWP1	645582.8	7522925.3	5	-13.6	-14.9	-13.1
2218-VWP2	645582.8	7522925.3	6	-16.7	-17.1	-16.4
2218-VWP3	645582.8	7522925.3	7	-15.8	-17.3	-15.1
2218-VWP4	645582.8	7522925.3	7	-11.6	-12.6	-10.6
2226-MB2	643155.5	7522152.0	3	-5.9	-6.5	-5.3
2226-MB3	643155.5	7522152.0	5	-8.9	-9.2	-8.7
2226-VWP1	643155.5	7522152.0	4	-4.5	-4.8	-4.2
2226-VWP2	643155.5	7522152.0	5	-9.9	-11.1	-9.0
2226-VWP3	643155.5	7522152.0	6	-11.3	-11.9	-10.7
2226-VWP4	643155.5	7522152.0	7	-13.2	-13.3	-13.0
2372-MB1	647627.7	7526233.0	2	-14.3	-14.5	-14.1
2372-MB2	647627.7	7526233.0	3	-14.5	-19.8	-13.8
2372-MB3	647627.7	7526233.0	7	-13.5	-15.1	-13.2
2372-VWP1	647627.7	7526233.0	6	-12.6	-13.8	-10.8
2372-VWP2	647627.7	7526233.0	7	-13.7	-15.0	-12.7
2372-VWP3	647627.7	7526233.0	8	-15.8	-17.2	-12.8
2372-VWP4	647627.7	7526233.0	8	-14.6	-15.1	-12.4
2375-MB2	648272.6	7524055.9	7	-17.1	-17.3	-17.0
2375-VWP1	648056.4	7523971.3	6	-17.7	-18.2	-15.7
2375-VWP2	648056.4	7523971.3	7	-19.3	-20.5	-18.9
2375-VWP3	648056.4	7523971.3	8	-20.4	-20.8	-20.2

ID	Easting	Northing	Layer	Average Residual	Min	Max
2393-MB1	645820.4	7523264.1	2	-9.1	-9.7	-8.8
2393-MB2	645820.4	7523264.1	5	-11.5	-11.8	-11.1
2393-MB3	645820.4	7523264.1	7	-11.6	-12.1	-10.8
2394-MB1	645024.3	7523114.7	1	-14.3	-14.4	-14.2
2394-MB2	645024.3	7523114.7	3	-12.1	-13.4	-9.6
BMB	639590.5	7560206.8	7	-17.9	-155.1	1.9
Bore2	634878.9	7550015.4	1	-5.6	-5.6	-5.6
Bore3	634878.9	7550015.4	10	-5.7	-5.7	-5.7
Bore7	637698.0	7552820.4	9	-5.9	-5.9	-5.9
Bullock_P	636076.7	7528132.0	10	-3.4	-3.4	-3.4
C2105	634696.8	7541900.5	5	-7.2	-8.6	-7.0
C2105R	634646.8	7541814.0	5	-7.5	-7.5	-7.5
C2136	631696.8	7547270.0	5	-13.7	-14.0	-13.5
Cattle_CG	670715.1	7536720.3	17	4.7	4.7	4.7
DauniaPZ02	635358.8	7560179.5	7	-25.6	-152.6	-11.9
DauniaPZ04	635699.4	7554944.4	7	-19.7	-158.9	-12.6
G2304	633246.8	7543199.5	7	-13.2	-13.2	-13.2
G2304R	633246.8	7543199.5	7	-13.1	-13.1	-13.1
G2307	630846.8	7547876.0	7	-12.7	-12.7	-12.4
GW01d_p1	642541.9	7547447.5	7	-7.8	-8.9	-6.4
GW01d_p2	642541.9	7547447.5	5	-11.6	-12.4	-10.2
GW01d_p3	642541.9	7547447.5	3	-6.1	-6.4	-5.6
GW01d_p4	642541.9	7547447.5	3	-4.0	-4.1	-3.2
GW01s	642541.9	7547447.5	1	-2.7	-2.9	-2.4
GW02d	641132.5	7546549.5	7	-7.0	-7.2	-7.0
GW02s	641132.5	7546549.5	1	-7.1	-7.1	-7.0
GW06d_p1	639273.5	7542068.1	11	8.7	8.3	9.0
GW06d_p2	639273.5	7542068.1	10	-0.3	-0.9	0.1
GW06d_p3	639273.5	7542068.1	10	-0.8	-1.0	-0.6
GW06d_p4	639273.5	7542068.1	9	-5.2	-5.9	-3.0
GW08d_p1	645324.1	7539903.3	5	-12.1	-14.9	-10.5
GW08d_p2	645324.1	7539903.3	4	-6.5	-6.7	-6.3
GW08d_p3	645324.1	7539903.3	3	0.1	0.1	0.2
GW08d_p4	645324.1	7539903.3	3	-32.1	-38.1	-24.2
GW12d_p1	641732.7	7532894.0	5	-2.7	-3.8	1.8
GW12d_p2	641732.7	7532894.0	5	-7.6	-8.4	-6.2
GW12d_p3	641732.7	7532894.0	4	10.8	7.9	12.0

ID	Easting	Northing	Layer	Average Residual	Min	Max
GW12d_p4	641732.7	7532894.0	3	30.3	29.3	32.1
GW12s	641732.7	7532894.0	2	-6.5	-6.6	-6.5
GW16d_p1	660840.1	7525340.5	7	-26.9	-28.3	-23.0
GW16d_p2	660840.1	7525340.5	5	-14.9	-15.0	-14.8
GW16d_p3	660840.1	7525340.5	3	-14.6	-14.8	-14.3
GW16d_p4	660840.1	7525340.5	3	-13.9	-14.0	-13.7
GW18d	656866.6	7522819.5	7	-8.1	-8.2	-8.1
GW18s	656866.6	7522819.5	1	-7.6	-7.7	-7.5
GW21d	661694.6	7521666.9	9	-17.8	-17.8	-17.7
GW21s	661694.6	7521666.9	2	2.8	2.7	2.9
GW8S	645324.1	7539903.3	1	-3.5	-3.6	-3.4
KnobHill1	631021.0	7553963.0	1	-3.9	-4.1	-3.7
KnobHill2	630446.4	7554123.5	1	-0.5	-1.0	0.7
LakeV3	648056.4	7523971.3	2	-1.1	-1.1	-1.1
LH13	627219.4	7546972.0	2	9.2	5.4	10.2
LV2370W	648272.6	7524055.9	2	-7.7	-9.6	8.0
LV2371W	643155.5	7522152.0	2	-3.3	-4.0	-2.4
MB08PZ1	615892.5	7559621.0	14	-12.0	-12.0	-12.0
MB08PZ2	615892.5	7559621.0	14	-12.1	-12.1	-12.1
MB08PZ3	615892.5	7559621.0	14	-13.5	-13.5	-13.5
MB08PZ4	615892.5	7559621.0	14	-14.0	-14.0	-14.0
MB1	623291.3	7551562.0	13	-0.8	-2.8	1.7
MB13PZ1	615290.2	7551152.6	14	-7.7	-7.7	-7.7
MB13PZ2	615290.2	7551152.6	14	-6.9	-6.9	-6.9
MB13PZ3	615290.2	7551152.6	14	-6.9	-6.9	-6.9
MB13PZ4	615290.2	7551152.6	14	-9.3	-9.3	-9.3
MB15PZ1	620223.4	7547524.7	14	-3.6	-3.6	-3.6
MB15PZ2	620223.4	7547524.7	14	-5.6	-5.6	-5.6
MB15PZ3	620223.4	7547524.7	14	-6.3	-6.3	-6.3
MB15PZ4	620223.4	7547524.7	14	-3.4	-3.4	-3.4
MB19CVM01A	610442.3	7548263.7	1	-6.5	-6.8	-6.0
MB19CVM03T	610213.3	7551337.7	2	4.6	3.8	5.4
MB19CVM04P	610214.3	7551343.7	17	-18.3	-18.3	-18.3
MB19CVM05T	611081.3	7551427.7	2	-4.6	-6.4	-2.3
MB19CVM06P	611074.3	7551428.7	13	-8.2	-10.7	-5.2
MB19CVM07T	611577.3	7552536.7	2	8.4	8.1	8.8
MB19CVM08P	611578.3	7552525.7	16	22.5	22.0	23.3

ID	Easting	Northing	Layer	Average Residual	Min	Max
MB19CVM09A	612559.3	7550878.7	1	7.2	6.9	7.9
MB19CVM10P	613293.3	7549947.7	12	-6.7	-7.8	-4.1
MB19SRM01A	639911.6	7515595.9	1	13.4	13.4	13.4
MB19SRM02T	639891.2	7515766.0	2	3.4	3.4	3.4
MB19SRM03P	639891.2	7515766.0	18	8.6	8.6	8.6
MB19SRM04P	637053.3	7511150.3	2	-9.5	-9.5	-9.5
MB2	623708.7	7549381.3	13	6.0	4.6	6.5
MB20CVM01A	610028.3	7560467.7	1	0.5	0.0	1.5
MB20CVM04T	608307.3	7559830.7	2	2.6	2.2	3.3
MB20CVM05P	608312.3	7559825.7	17	-16.2	-17.6	-14.4
MB20CVM06T	610921.3	7549068.7	2	-1.7	-3.3	-1.3
MB20PDM03P	621377.3	7547930.5	2	-11.3	-11.3	-11.3
MB20PDM05P	630142.3	7532676.4	11	-91.4	-91.4	-91.4
MB20PDM06T	628778.3	7532642.0	2	64.3	64.3	64.3
MB20SRM02T	635918.1	7527713.9	2	-5.1	-5.1	-5.1
MB20SRM03P	635918.1	7527713.9	18	5.5	5.5	5.5
MB20SRM06A	636616.5	7519935.1	2	17.2	17.2	17.2
MB20SRM07P	641517.0	7508438.2	18	0.5	0.5	0.5
MB3	627298.9	7549948.3	3	-15.4	-16.9	-14.3
MB33	636608.9	7520518.6	17	4.7	4.7	4.7
MB34	638204.5	7518375.8	17	-38.7	-38.7	-38.7
MB35	642713.1	7520289.2	17	-1.5	-1.5	-1.5
MB36	640051.7	7514430.7	17	4.6	4.6	4.6
MB37	632499.0	7515493.2	19	5.7	5.7	5.7
MB4	626534.6	7544131.9	13	9.4	8.7	10.1
MB5	628342.1	7542223.0	13	10.2	-2.8	11.0
MOS_MB01	610501.7	7562777.0	2	5.2	5.2	5.2
MOS_MB02	612012.5	7562219.2	12	-16.8	-16.8	-16.8
MOS_MB04	614038.0	7562394.1	2	0.9	0.9	0.9
MOS_MB05	615192.8	7563121.5	2	4.4	4.4	4.4
MOS_MB06	616114.7	7561371.3	2	3.5	3.5	3.5
MOS_MB07	615579.5	7560524.4	2	-5.6	-5.6	-5.6
MOS_MB08b	615892.5	7559621.0	10	-5.5	-5.5	-5.5
MOS_MB09b	618119.9	7558372.9	10	-1.3	-1.3	-1.3
MOS_MB11	611597.0	7558392.4	12	-2.9	-2.9	-2.9
MOS_MB12	613875.4	7557129.4	2	-2.5	-2.5	-2.5
MOS_MB14	615290.2	7551152.6	10	3.3	3.3	3.3

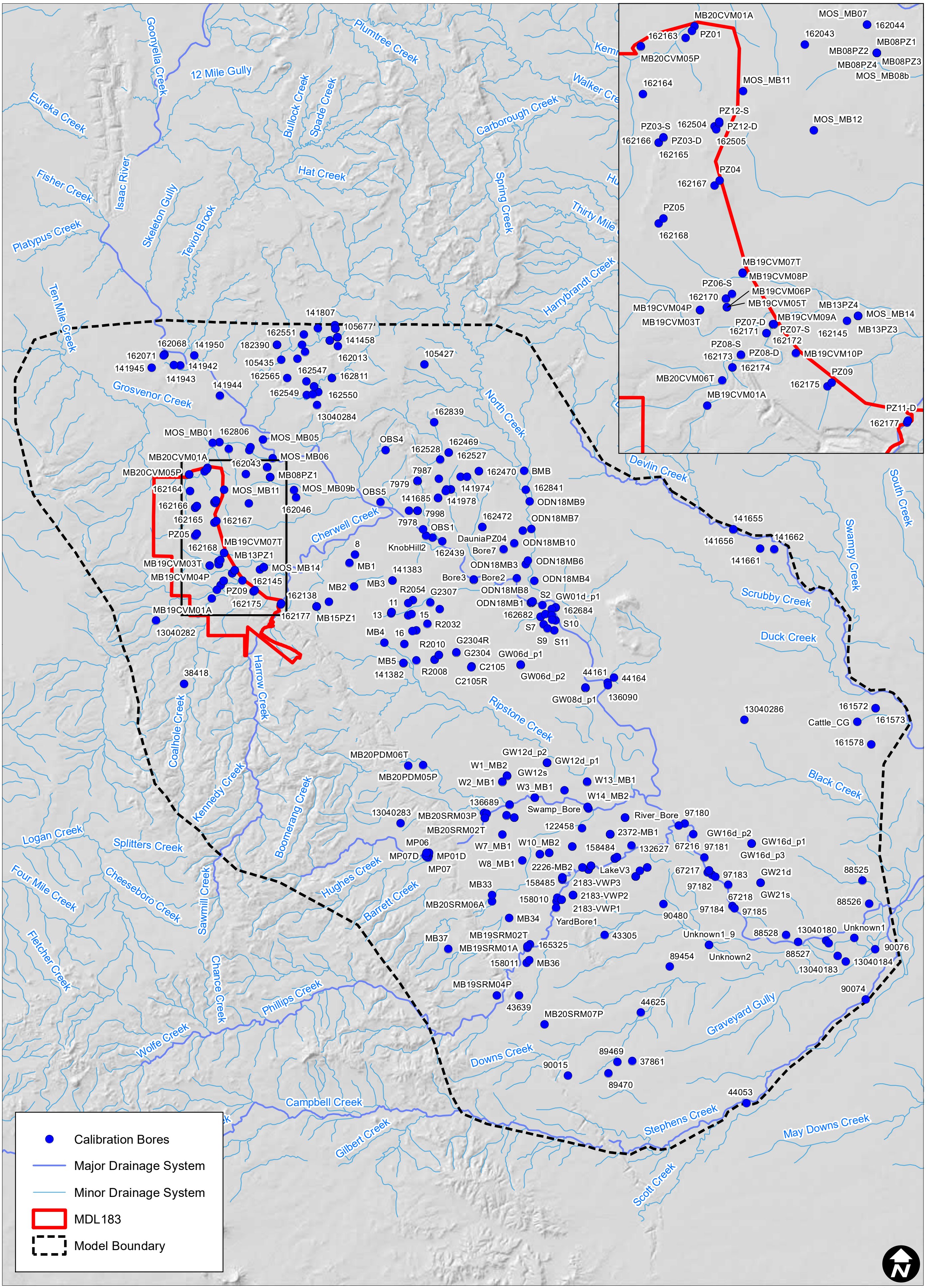
ID	Easting	Northing	Layer	Average Residual	Min	Max
MOS_MB16	620223.4	7547524.7	12	2.1	2.1	2.1
MP01D	630685.3	7524218.0	1	6.6	6.6	6.6
MP02D	630685.3	7524218.0	1	6.4	6.4	6.4
MP03D	630685.3	7524218.0	1	6.1	6.1	6.1
MP04D	630685.3	7524218.0	1	6.0	6.0	6.0
MP05D	630589.6	7524245.0	1	6.5	6.5	6.5
MP06	630703.3	7524458.0	1	8.3	8.3	8.3
MP07	630651.0	7524026.4	1	6.1	6.1	6.1
MP07D	630494.9	7524468.6	1	7.0	7.0	7.0
MP08	630483.3	7524093.9	1	3.7	3.7	3.7
MP09	630395.9	7524227.0	1	4.9	4.9	4.9
MP10	630494.9	7524468.6	1	6.3	6.3	6.3
OBS1	630153.6	7554713.2	4	-5.5	-6.2	-4.4
OBS2	631548.7	7557652.0	9	-1.5	-2.1	-0.2
OBS4	626659.2	7562129.0	4	-6.5	-9.1	-5.8
OBS5	626162.3	7557241.9	1	-4.8	-8.8	-4.1
OBS6	628833.4	7556463.5	5	8.6	8.1	9.2
ODN18MB1	640309.8	7547851.0	5	-8.7	-8.8	-8.6
ODN18MB10	639463.5	7554574.0	9	-13.3	-13.3	-13.3
ODN18MB11	638684.1	7553398.2	9	-7.2	-7.2	-7.2
ODN18MB12	640214.9	7547881.0	7	-1.0	-1.3	-0.7
ODN18MB2	640214.9	7547881.0	1	1.5	1.5	1.5
ODN18MB3	639763.5	7551456.0	5	-11.6	-11.6	-11.6
ODN18MB4	640563.6	7549899.8	1	-10.1	-10.5	-9.7
ODN18MB6	639963.5	7551802.5	5	-10.3	-10.3	-10.3
ODN18MB7	640263.5	7554747.0	1	-5.2	-5.2	-5.2
ODN18MB8	638907.4	7550142.9	1	-3.4	-3.5	-3.4
ODN18MB9	640105.8	7557334.2	5	-3.3	-3.3	-3.3
ODN18TB1	640381.2	7547984.1	5	-7.6	-7.9	-7.3
ODN18TB2	640309.8	7547851.0	1	3.6	3.4	3.9
ODN18VWP1	640381.2	7547984.1	7	-9.9	-9.9	-9.9
ODN18VWP2	640381.2	7547984.1	5	-11.2	-11.2	-11.2
ODN18VWP3	640381.2	7547984.1	4	-10.1	-10.1	-10.1
PZ01	609954.3	7560324.7	18	-1.4	-6.2	12.8
PZ03-D	609029.3	7556891.7	18	-7.0	-9.1	-2.1
PZ03-S	609028.3	7556895.7	1	-3.9	-9.7	0.1
PZ04	610844.3	7555505.7	13	-1.7	-2.4	-1.1

ID	Easting	Northing	Layer	Average Residual	Min	Max
PZ05	609030.3	7554297.7	18	-8.7	-11.9	0.8
PZ06-S	611237.3	7551855.7	1	5.9	5.1	9.2
PZ07-D	612578.3	7550883.7	16	3.1	1.6	4.1
PZ07-S	612584.3	7550882.7	1	6.6	6.3	7.5
PZ08-D	611526.3	7549892.7	18	-3.4	-9.6	5.6
PZ08-S	611524.3	7549888.7	1	6.1	3.0	7.7
PZ09	614439.3	7549001.7	13	-5.4	-15.3	-0.5
PZ11-D	616904.2	7547779.7	15	-2.9	-10.7	1.7
PZ12-D	610834.3	7557343.7	13	-0.4	-1.5	2.1
PZ12-S	610825.3	7557398.7	1	2.5	2.2	3.2
R2008	631248.8	7542520.0	7	1.0	0.1	1.2
R2009	631248.8	7542520.0	6	4.9	4.6	5.3
R2010	631643.7	7542970.3	7	-5.1	-6.5	-4.8
R2010R	631643.7	7542970.3	5	-5.4	-5.4	-5.4
R2032	630539.6	7545862.8	5	5.3	2.2	5.7
R2034	629523.2	7545279.0	8	-0.2	-1.0	0.8
R2035	629167.1	7545184.3	7	-5.0	-9.4	-3.1
R2054	629223.7	7548101.5	6	3.2	-1.9	4.3
R2055	628773.7	7547841.5	7	4.5	3.3	4.7
River_Bore	654039.4	7526997.0	3	-12.1	-12.1	-12.1
S10	642519.5	7546193.5	1	-3.5	-3.5	-3.5
S11	642428.0	7545276.4	1	-3.0	-3.0	-3.0
S2	641305.8	7547611.2	1	-4.4	-4.4	-4.4
S4	641582.5	7546809.0	1	-7.2	-8.8	-7.1
S5	642184.5	7547258.0	1	-5.7	-5.7	-5.7
S6	642170.1	7546664.5	1	-3.9	-4.0	-3.9
S7	641432.5	7545856.5	1	-7.1	-7.1	-7.0
S8	642224.1	7546257.8	1	-1.9	-2.1	-1.9
S9	641782.5	7545423.5	1	-5.8	-5.8	-5.8
Swamp_Bore	645603.3	7528594.1	9	-12.1	-12.1	-12.1
Unknown1	670435.8	7516502.4	1	-10.6	-10.6	-10.6
Unknown1_6	650407.4	7522800.9	6	-14.8	-14.8	-14.8
Unknown1_9	656842.6	7515864.0	9	-10.4	-10.4	-10.4
Unknown2	656842.6	7515864.0	2	-17.5	-17.5	-17.5
W1_MB1	638017.7	7531666.6	2	-4.7	-5.0	-4.4
W1_MB2	638017.7	7531666.6	5	-3.9	-3.9	-3.9
W1_MB3	638017.7	7531666.6	7	-3.9	-4.0	-3.9

ID	Easting	Northing	Layer	Average Residual	Min	Max
W10_MB2	641956.5	7524449.8	3	-25.3	-25.5	-25.0
W10_MB3	641956.5	7524449.8	8	-22.1	-22.2	-22.1
W11_MB1	644071.7	7525050.2	3	-22.7	-23.1	-22.3
W11_MB2	644071.7	7525050.2	5	-20.2	-20.4	-19.9
W12_MB1	643364.7	7530326.2	2	-15.5	-15.6	-15.4
W13_MB1	645471.9	7531129.0	9	-11.5	-11.6	-11.5
W13_MB2	645471.9	7531129.0	9	-12.0	-12.0	-12.0
W14_MB1	645525.9	7528779.5	2	-8.6	-8.7	-8.5
W14_MB2	645525.9	7528779.5	9	-11.3	-11.3	-11.3
W15_MB1	649018.5	7527774.9	2	3.9	3.9	3.9
W15_MB2	649018.5	7527774.9	7	3.8	3.8	3.8
W15_MB3	649018.5	7527774.9	8	3.4	3.3	3.5
W2_MB1	637568.5	7531128.7	2	-3.1	-3.2	-3.0
W2_MB2	637568.5	7531128.7	9	-3.4	-3.4	-3.4
W3_MB1	640587.6	7529633.2	1	4.1	3.6	4.7
W3_MB2	640587.6	7529633.2	2	-4.5	-4.5	-4.5
W4_MB1	638219.2	7528952.5	1	3.3	3.2	3.4
W4_MB2	638219.2	7528952.5	2	-4.0	-4.2	-3.8
W5_MB1	638695.5	7527785.2	3	-4.7	-4.7	-4.7
W5_MB2	638695.5	7527785.2	5	-3.6	-3.7	-3.6
W5_MB3	638695.5	7527785.2	7	-5.6	-5.6	-5.6
W6_MB1	637965.1	7527970.4	9	-6.6	-9.4	-3.8
W6_MB2	637965.1	7527970.4	9	-4.0	-4.0	-4.0
W7_MB1	637566.7	7526198.4	9	-5.5	-5.6	-5.5
W8_MB1	639428.1	7523760.1	9	-11.0	-11.0	-11.0
W9_MB2	641060.4	7524350.5	7	-19.4	-19.4	-19.3
W9_MB3	641060.4	7524350.5	8	-18.4	-18.4	-18.3
West-MB1	643089.8	7520088.8	2	-7.0	-7.7	-6.4
West-MB2	643089.8	7520088.8	9	-5.5	-7.0	-4.3
WhiteTank	629513.0	7542450.6	9	6.5	6.5	6.5
WinnetBore	634878.9	7550015.4	1	-5.3	-6.5	-4.8
YardBore1	642566.2	7519335.4	11	-7.1	-7.1	-7.1

APPENDIX B

Calibration Hydrographs



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07-May-2021
620.13593

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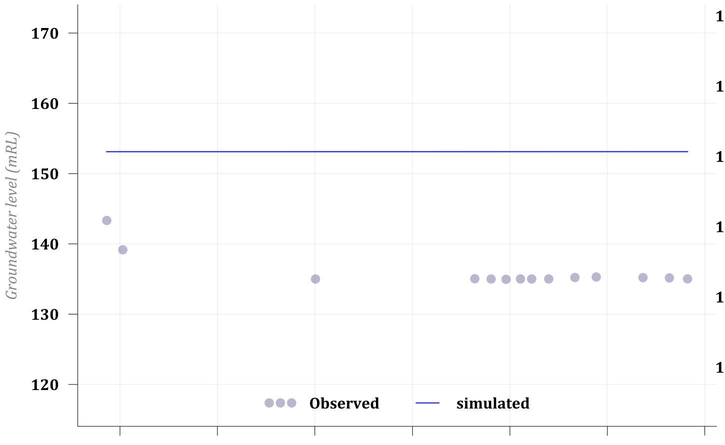
Sheet Size : A4

SLR
www.slrconsultingaustralia.com

0 5 10 15
Kilometers

Calibration Bores

APPENDIX B-1



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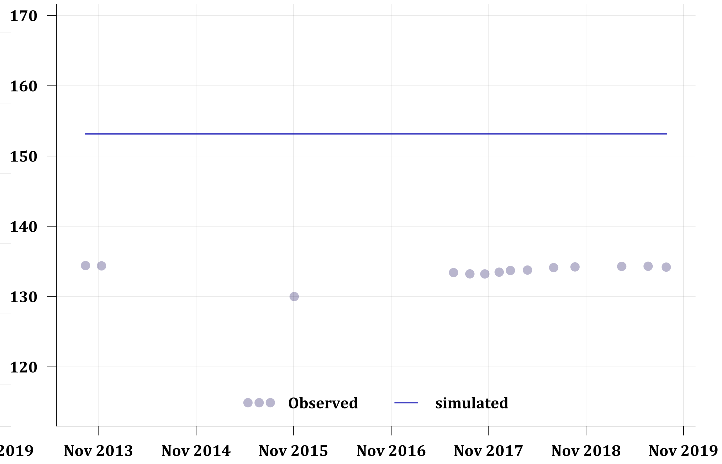

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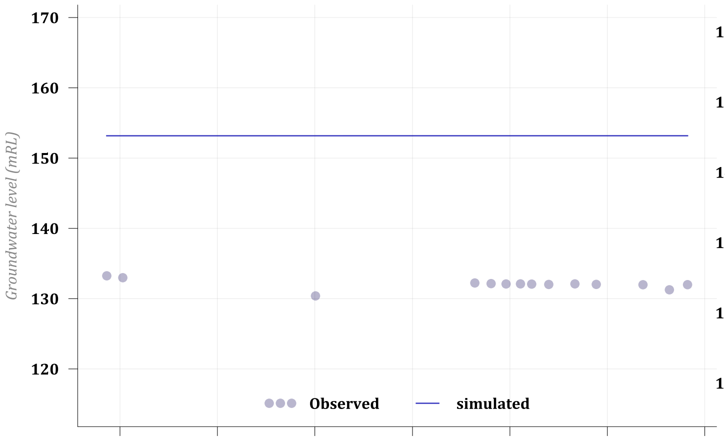

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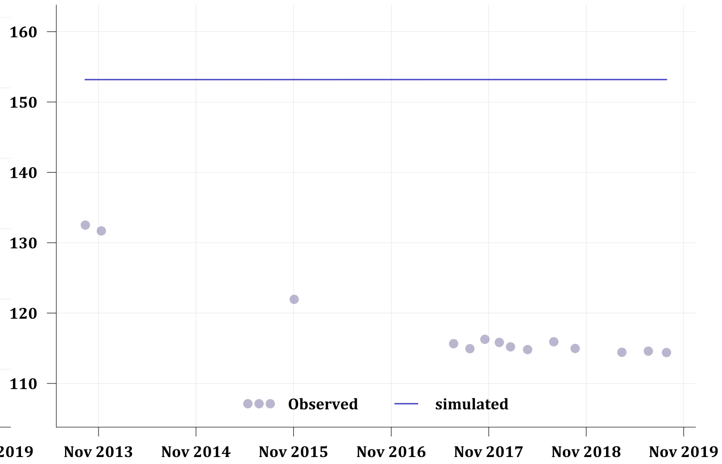

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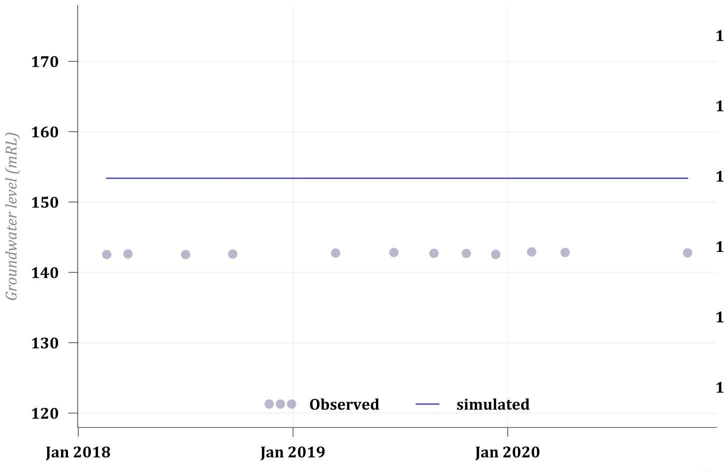

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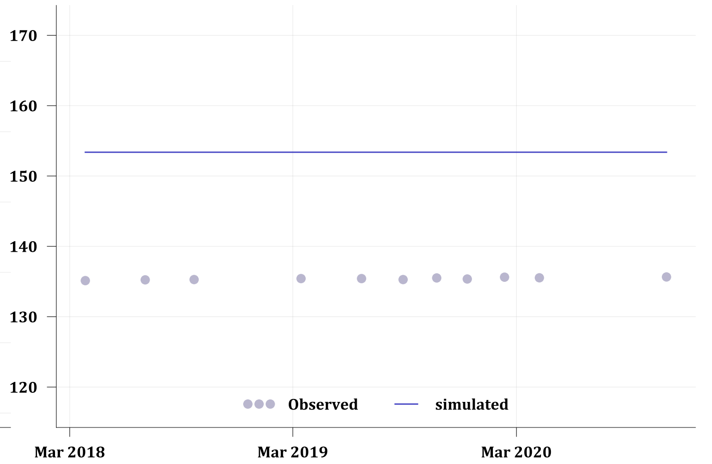

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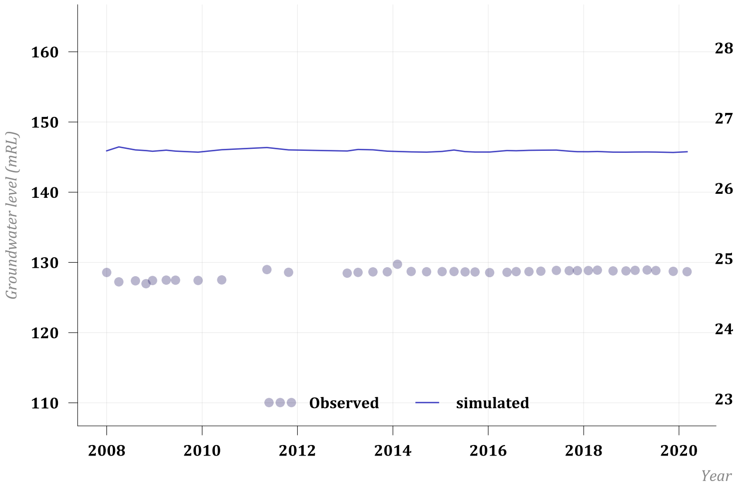

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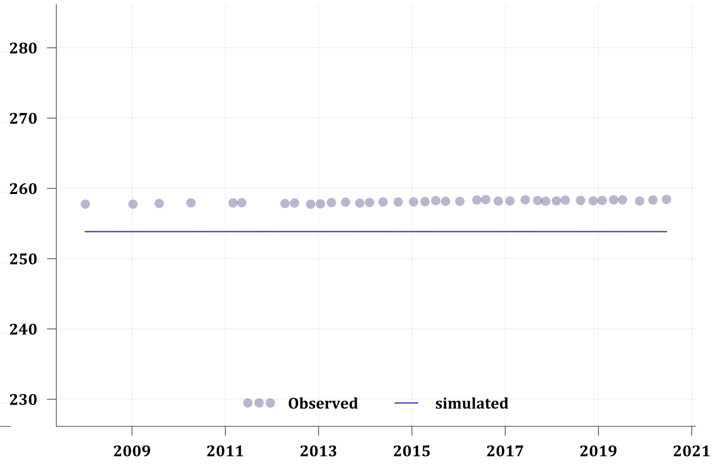

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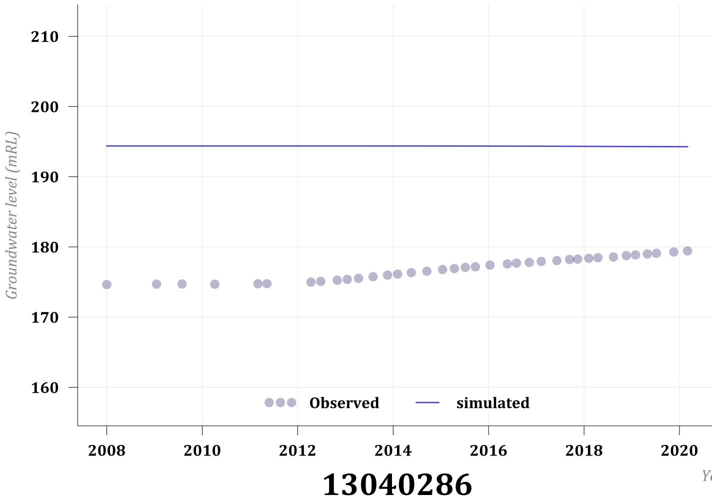

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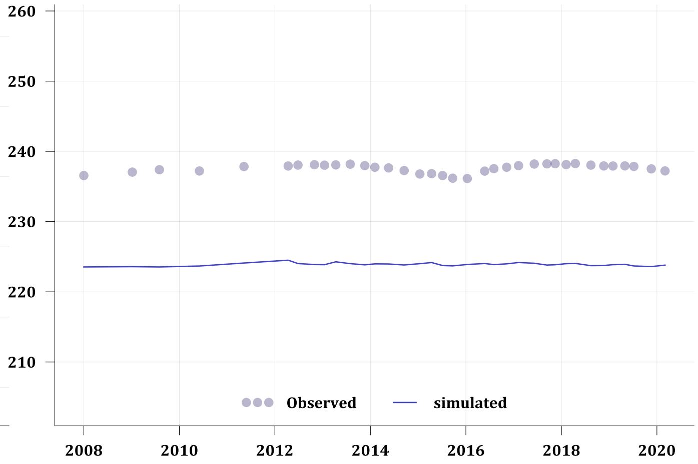

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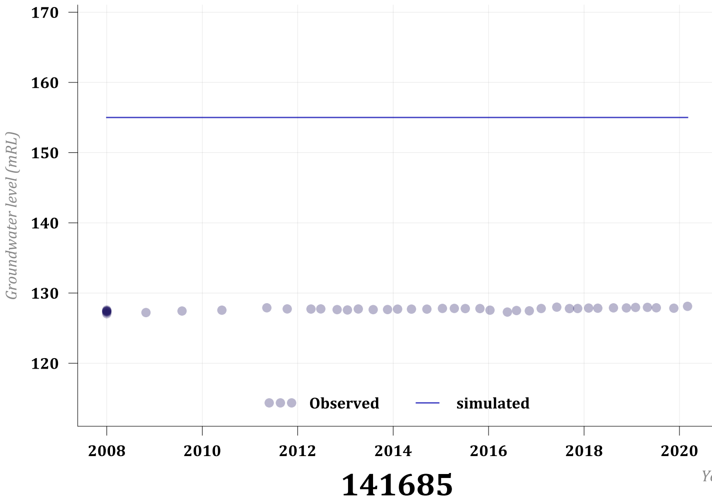

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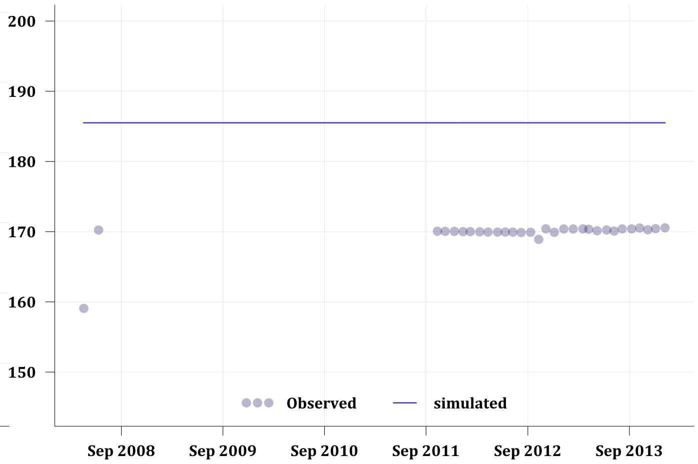

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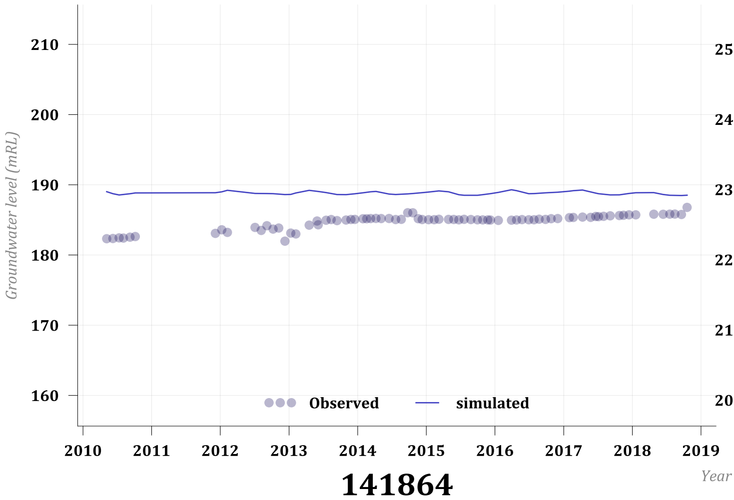

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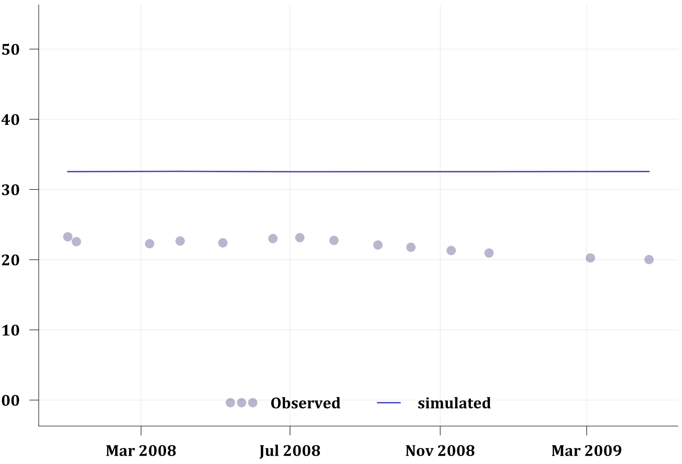

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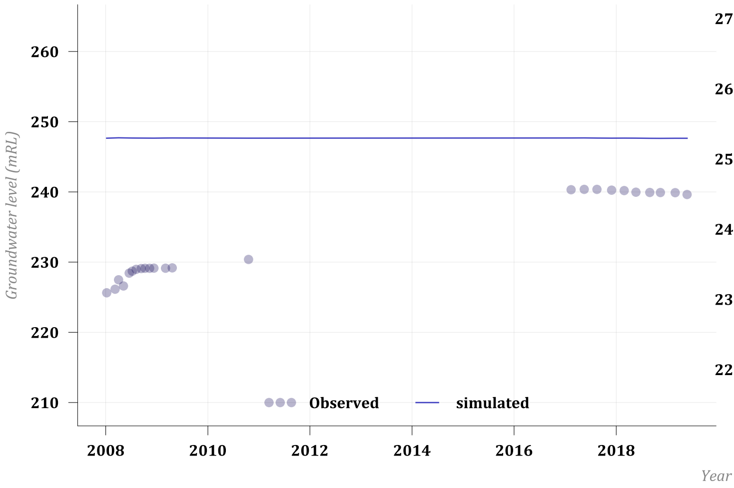

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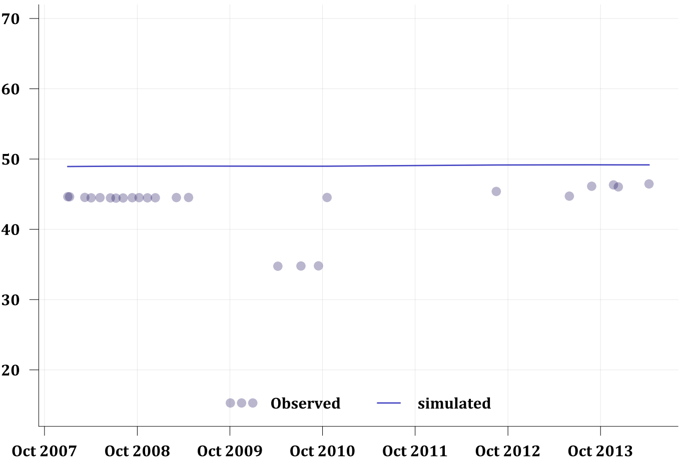

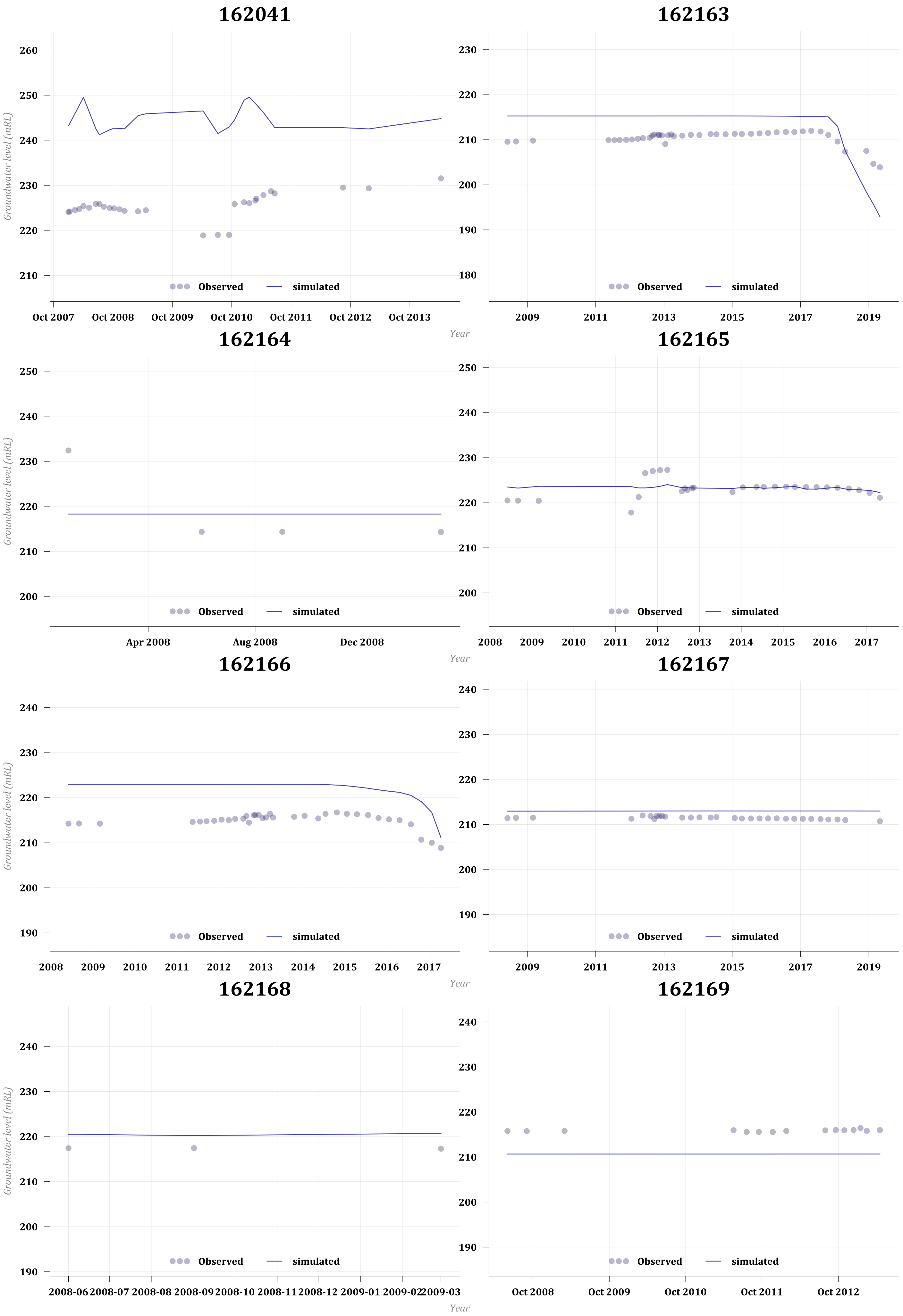
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2009-01
2009-02
2009-03
162169
240
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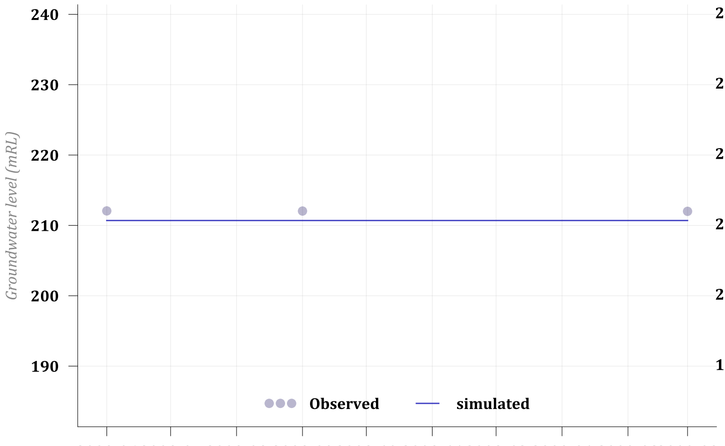
200
190
Oct 2008
Oct 2009
Oct 2010
Oct 2011
Oct 2012
Groundwater level (mRL)
Year
Observed
simulated

162170



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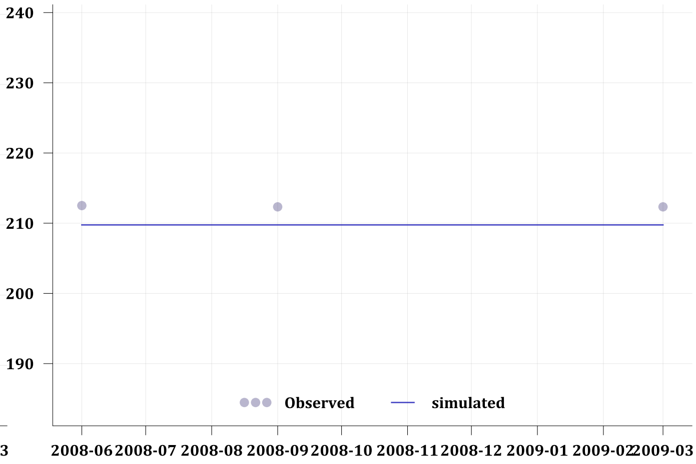

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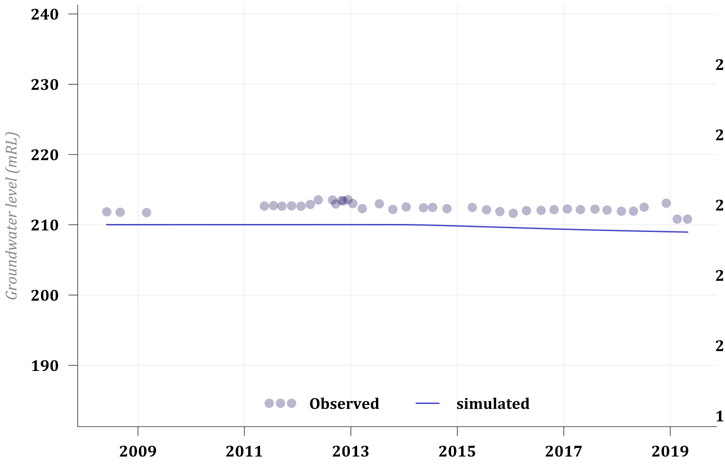

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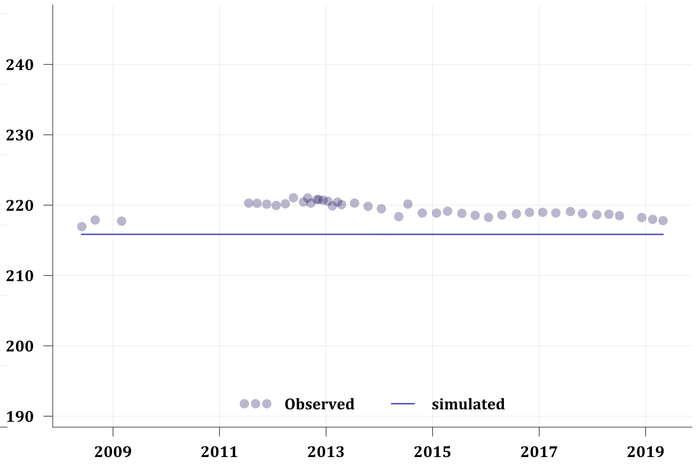

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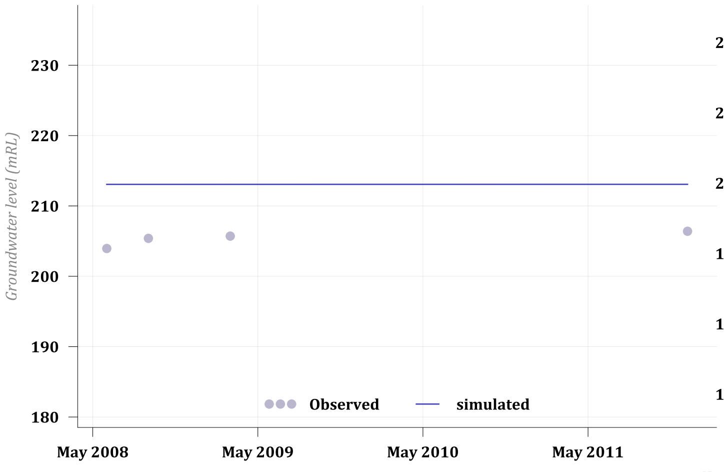

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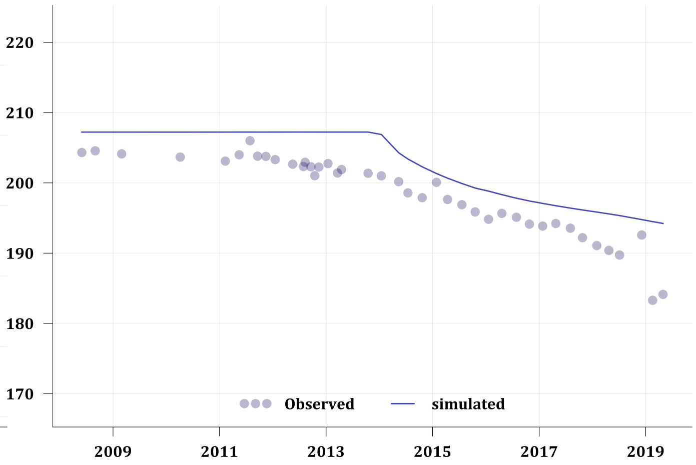

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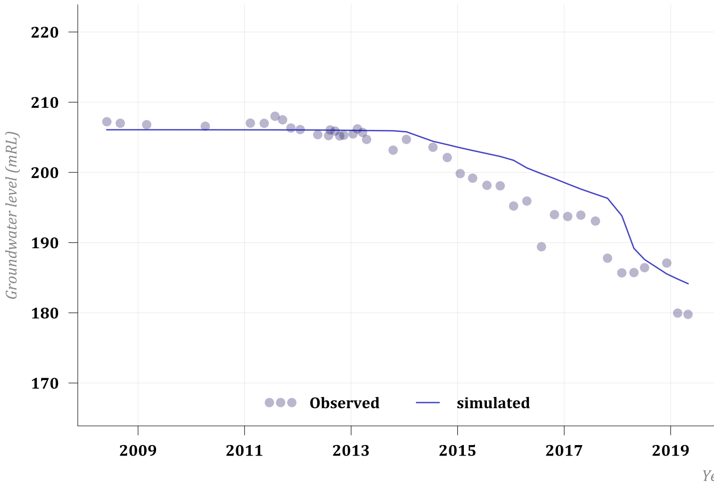

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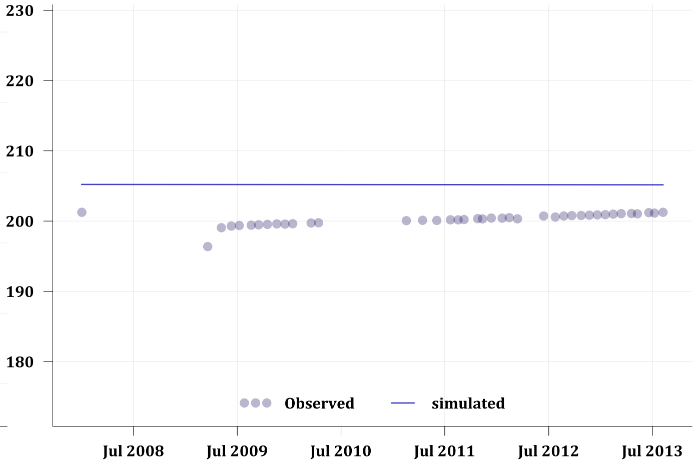

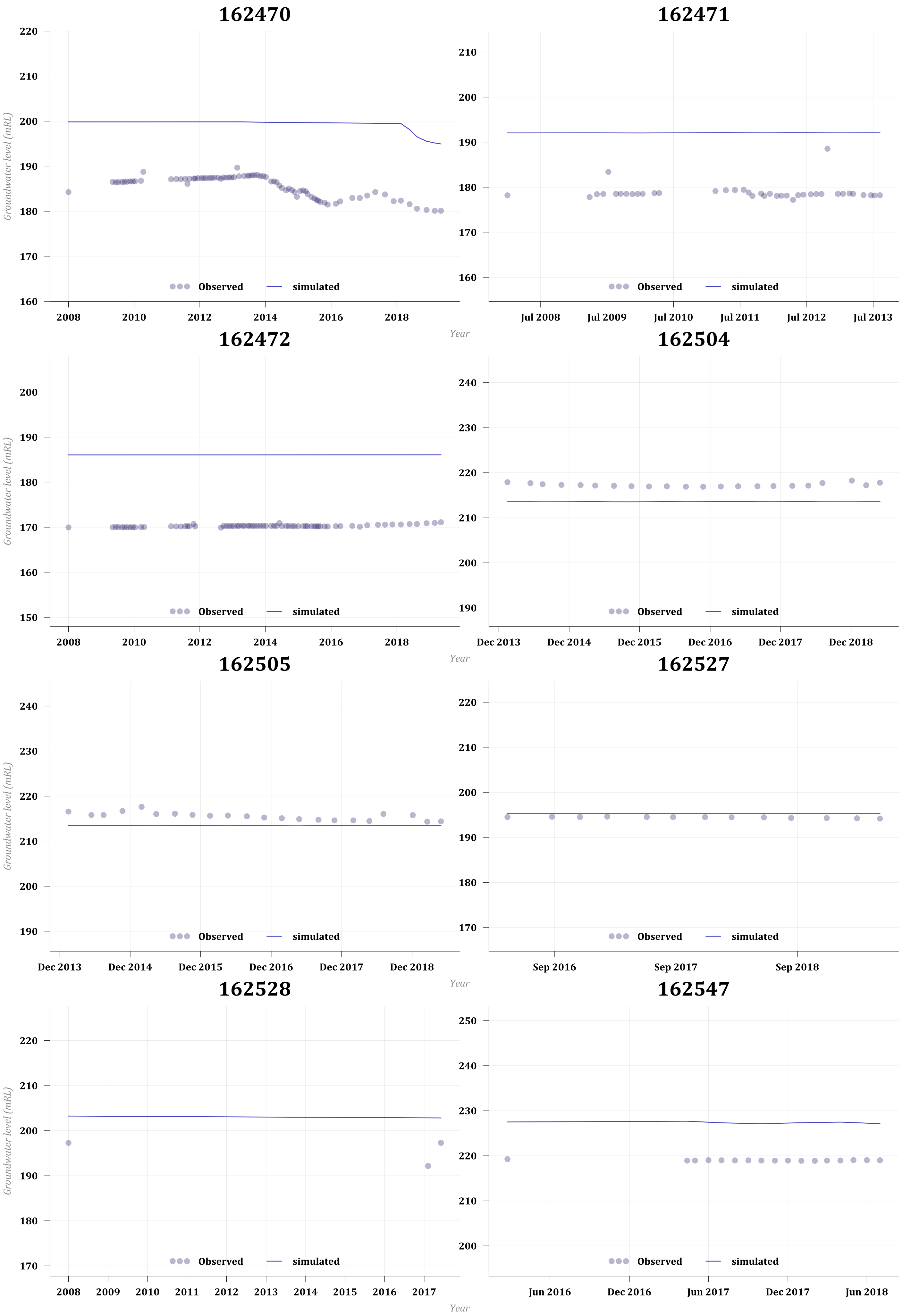
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Year
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simulated
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180
170
160
2008
2010
2012
2014
2016
2018
Jul 2008
Jul 2009
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Jul 2011
Jul 2012
Jul 2013
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Dec 2015
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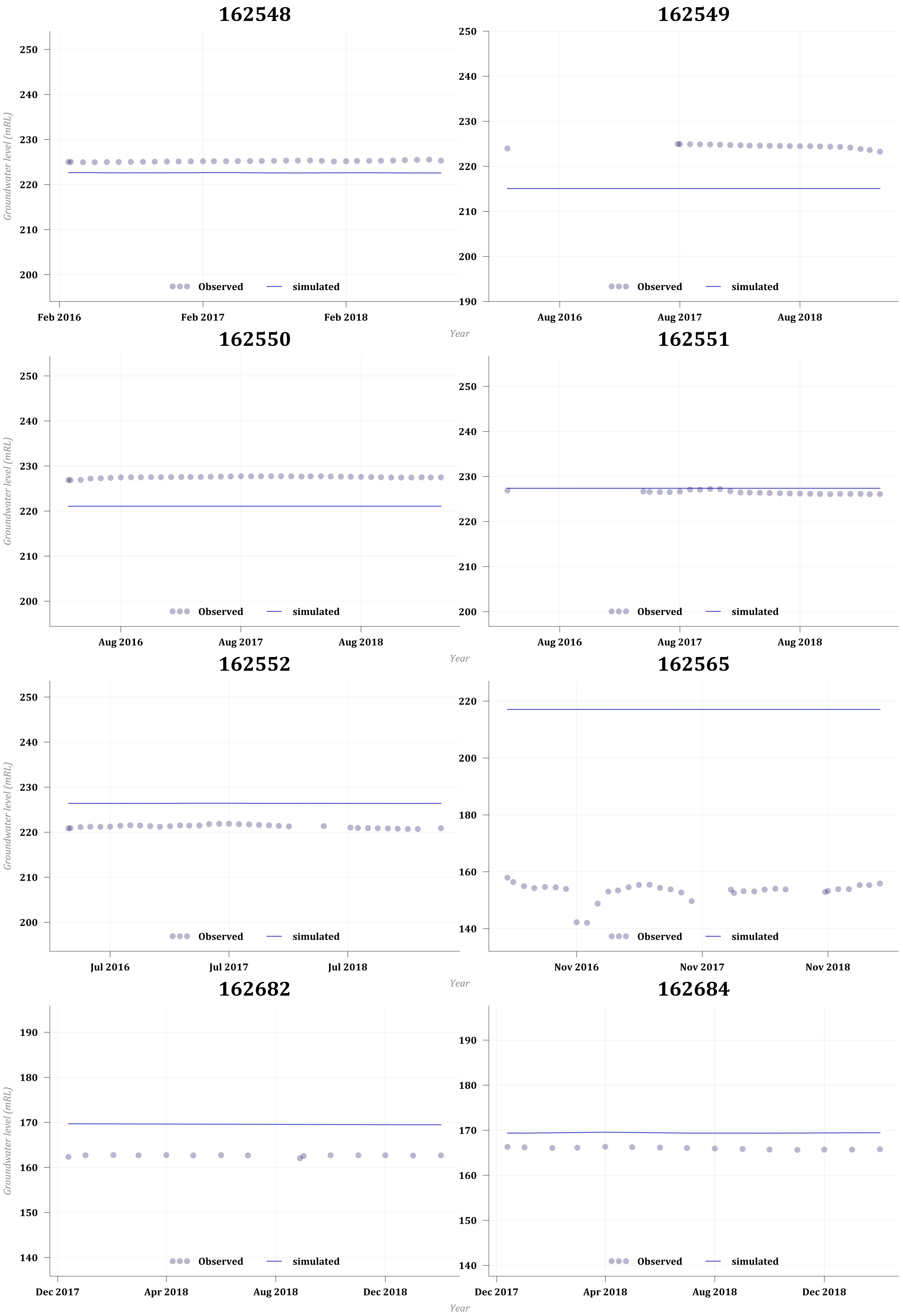
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Year
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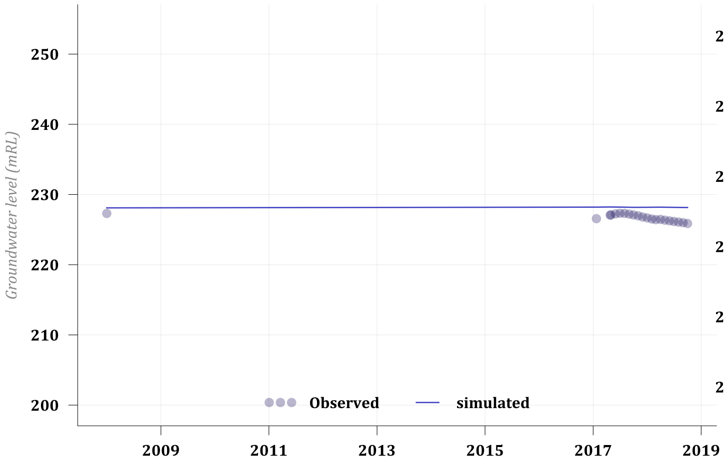

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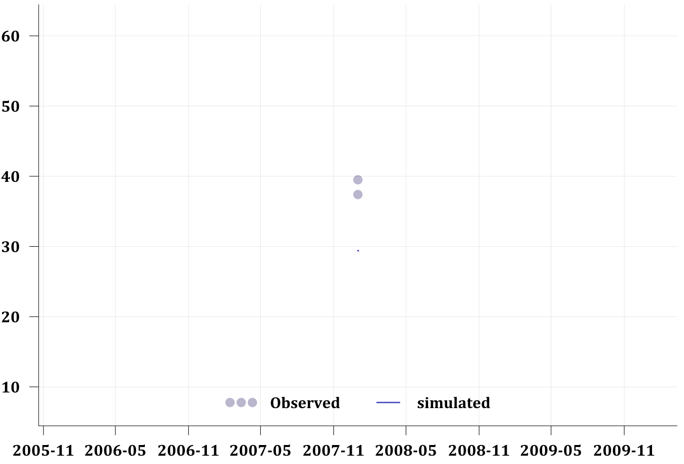

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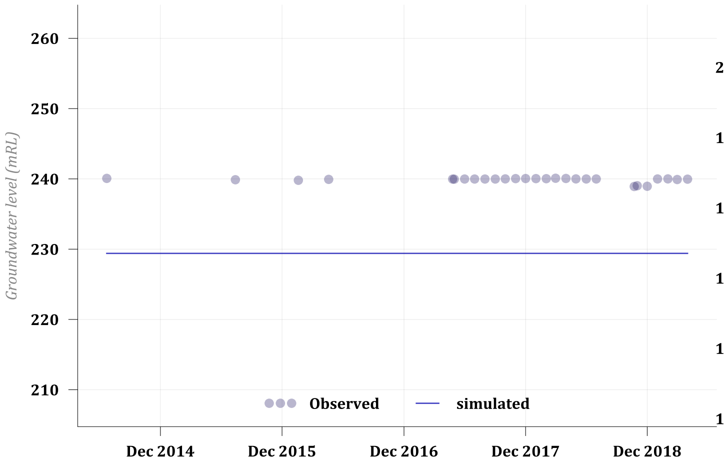

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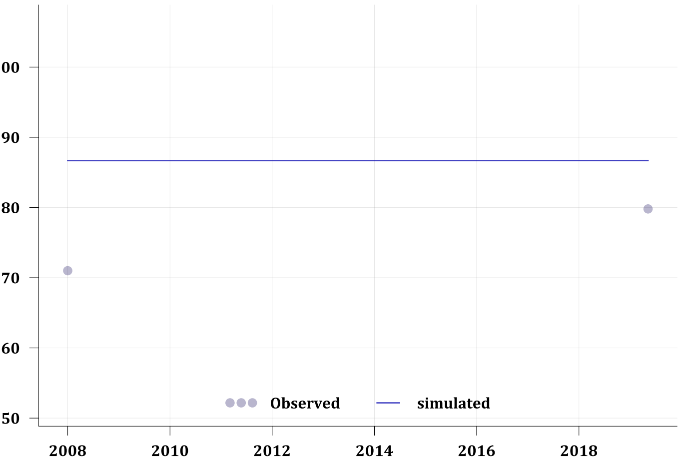
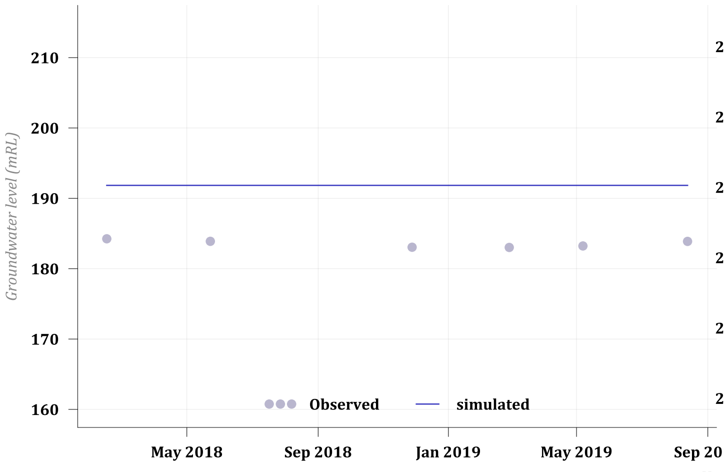
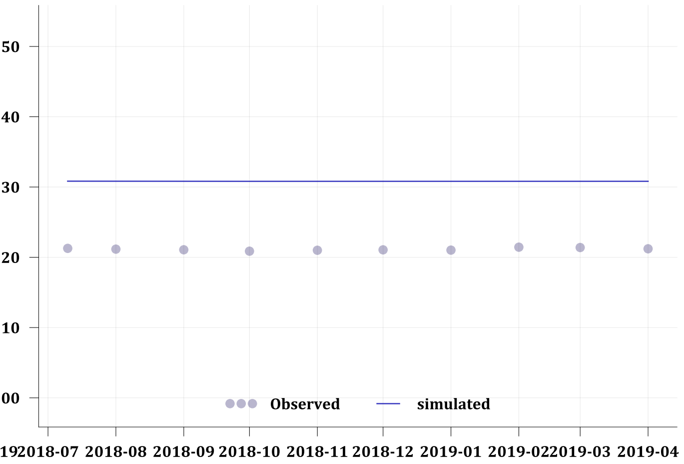


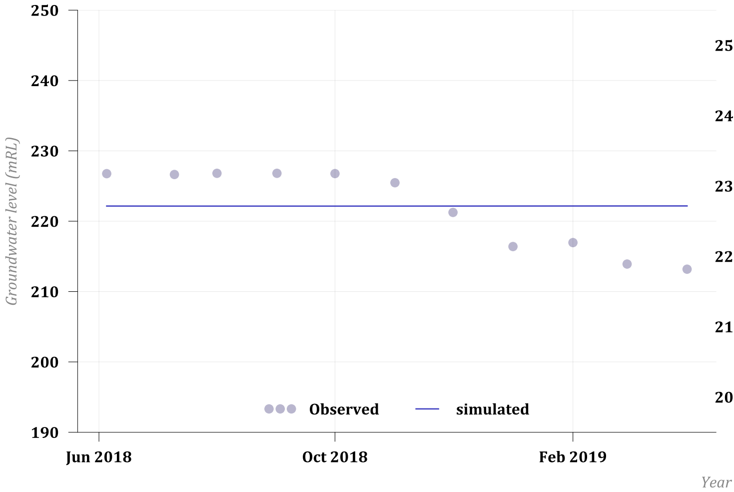
162992



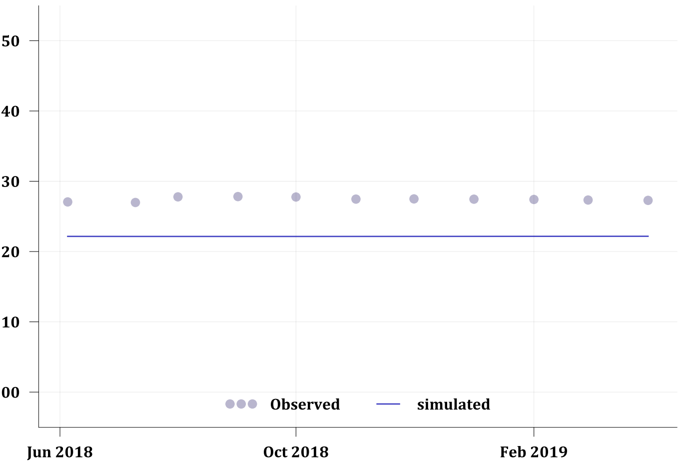
182077

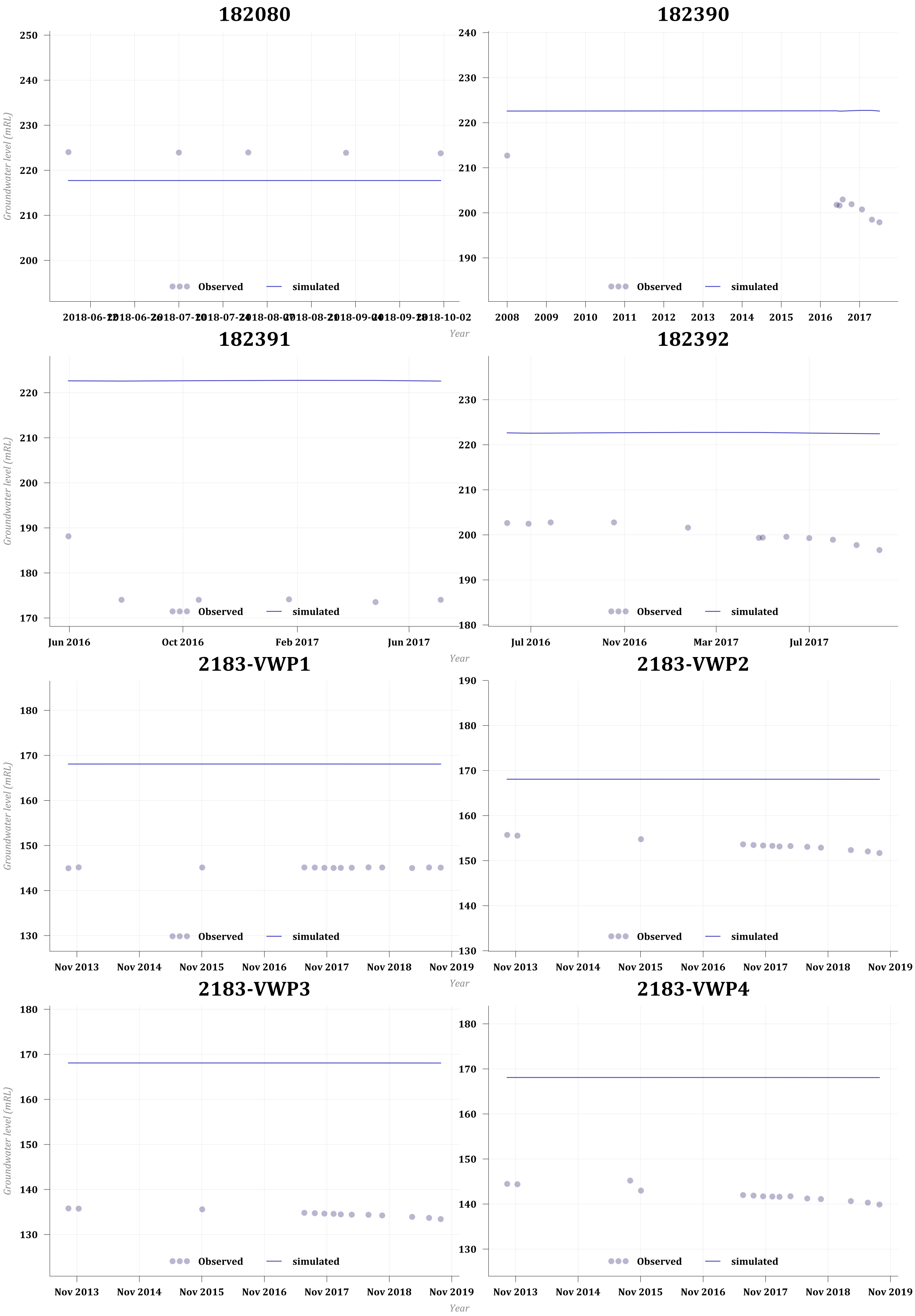


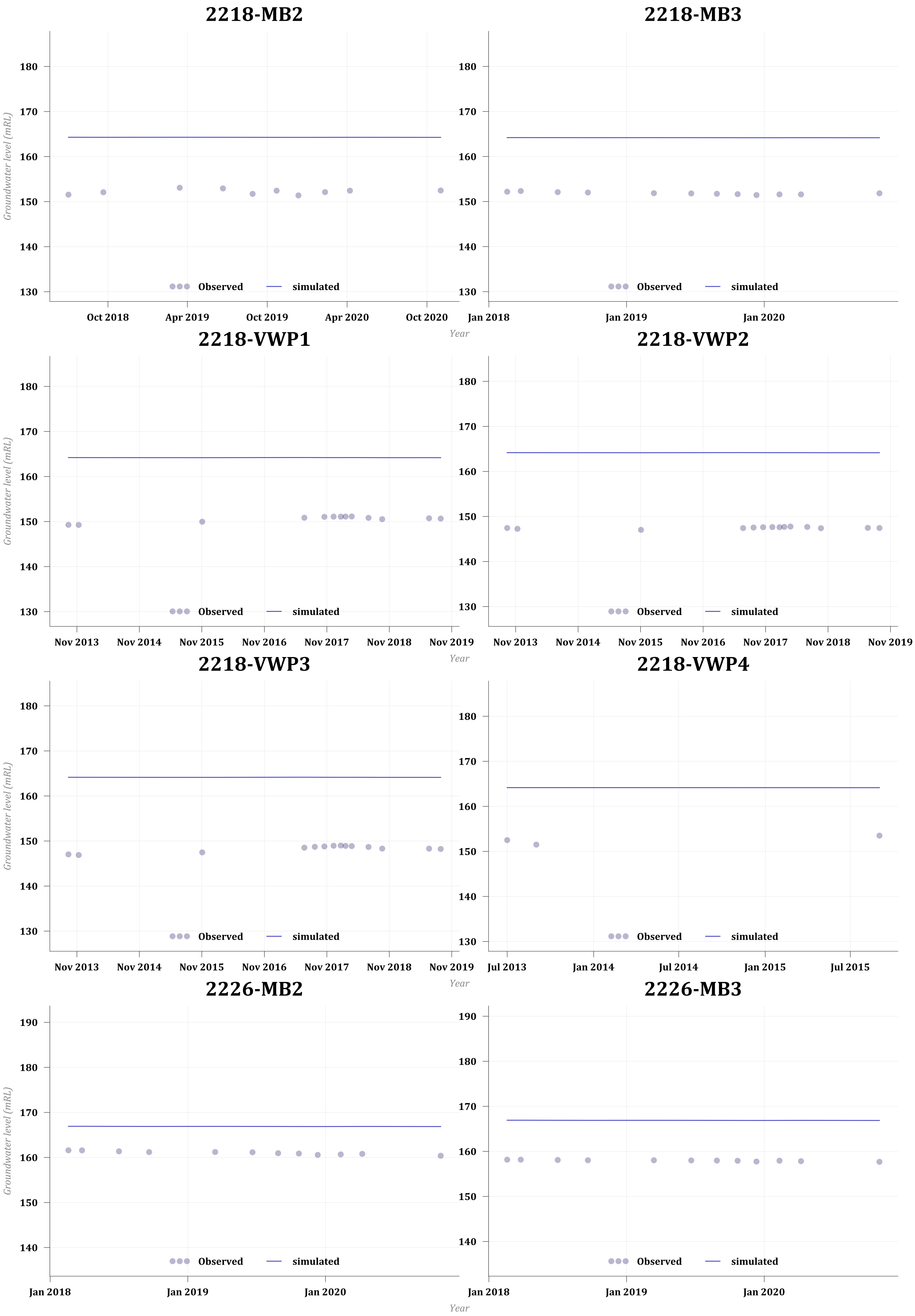
182078



182079




182080
250
240
230
220
210
200
Observed
simulated
2018-06-12
2018-06-26
2018-07-10
2018-07-24
2018-08-07
2018-08-21
2018-09-04
2018-09-18
2018-10-02
182390
240
230
220
210
200
190
Observed
simulated
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
182391
220
210
200
190
180
170
Observed
simulated
Jun 2016
Oct 2016
Feb 2017
Jun 2017
182392
230
220
210
200
190
180
Observed
simulated
Jul 2016
Nov 2016
Mar 2017
Jul 2017
Year
2183-VWP1
180
170
160
150
140
130
Observed
simulated
Nov 2013
Nov 2014
Nov 2015
Nov 2016
Nov 2017
Nov 2018
Nov 2019
2183-VWP2
190
180
170
160
150
140
130
Observed
simulated
Nov 2013
Nov 2014
Nov 2015
Nov 2016
Nov 2017
Nov 2018
Nov 2019
Year
2183-VWP3
180
170
160
150
140
130
Observed
simulated
Nov 2013
Nov 2014
Nov 2015
Nov 2016
Nov 2017
Nov 2018
Nov 2019
2183-VWP4
180
170
160
150
140
130
Observed
simulated
Nov 2013
Nov 2014
Nov 2015
Nov 2016
Nov 2017
Nov 2018
Nov 2019
Year
Groundwater level (mRL)


2218-MB2
2218-MB3
2218-VWP1
2218-VWP2
2218-VWP3
2218-VWP4
2226-MB2
2226-MB3
Groundwater level (mRL)
Year
Observed
simulated
130
140
150
160
170
180
190
Oct 2018
Apr 2019
Oct 2019
Apr 2020
Oct 2020
Jan 2018
Jan 2019
Jan 2020
Nov 2013
Nov 2014
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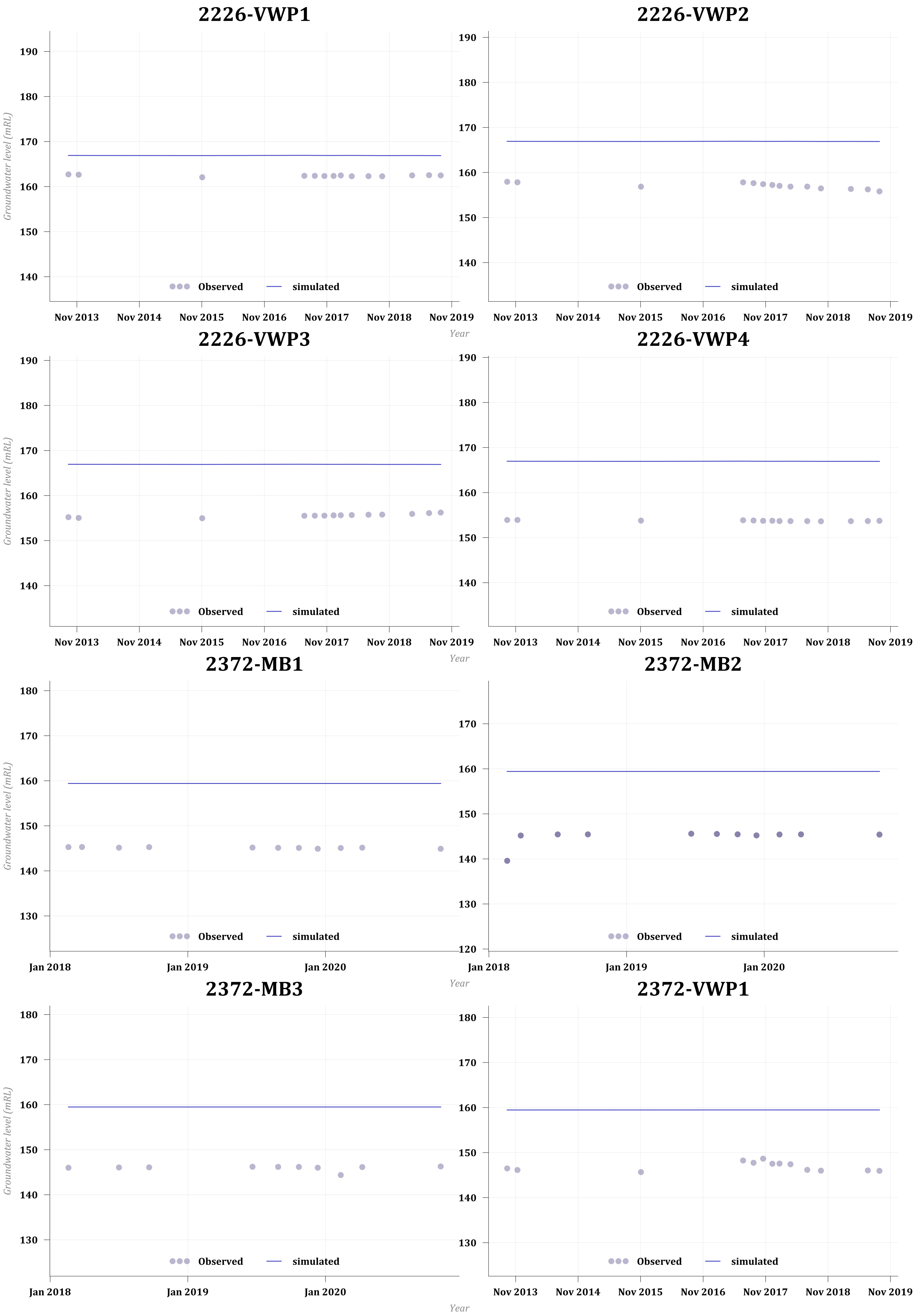
Nov 2019
Jul 2013
Jan 2014
Jul 2014
Jan 2015
Jul 2015


2226-VWP1
2226-VWP2
2226-VWP3
2226-VWP4
2372-MB1
2372-MB2
2372-MB3
2372-VWP1
Groundwater level (mRL)
Year
●●● Observed
— simulated
190
180
170
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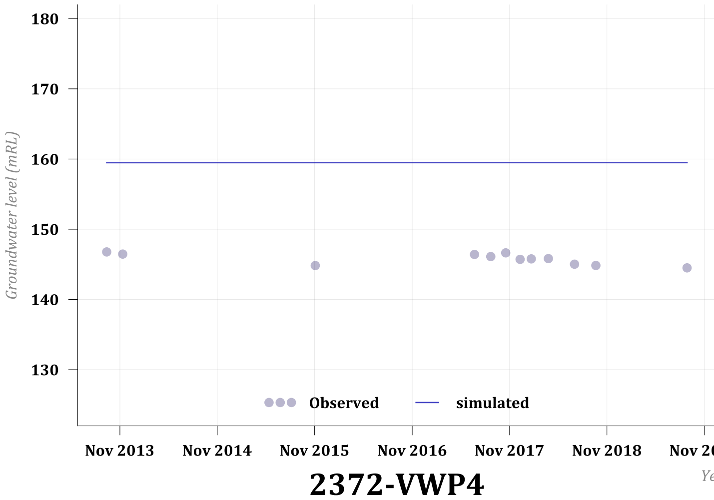
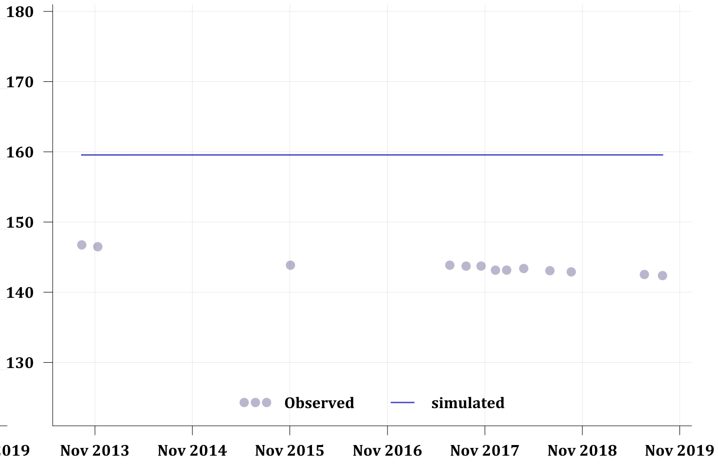
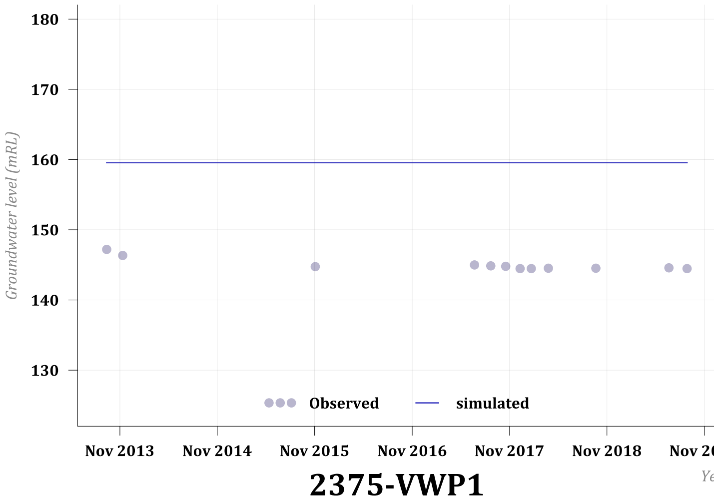
150
140
130
120
Nov 2013
Nov 2014
Nov 2015
Nov 2016
Nov 2017
Nov 2018
Nov 2019
Jan 2018
Jan 2019
Jan 2020



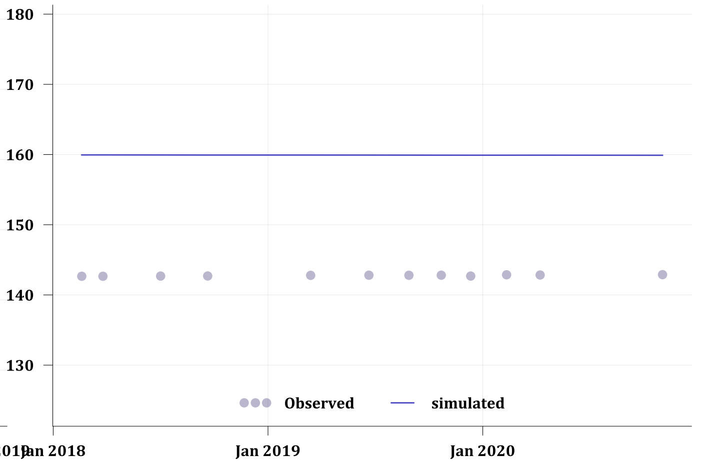
2372-VWP2



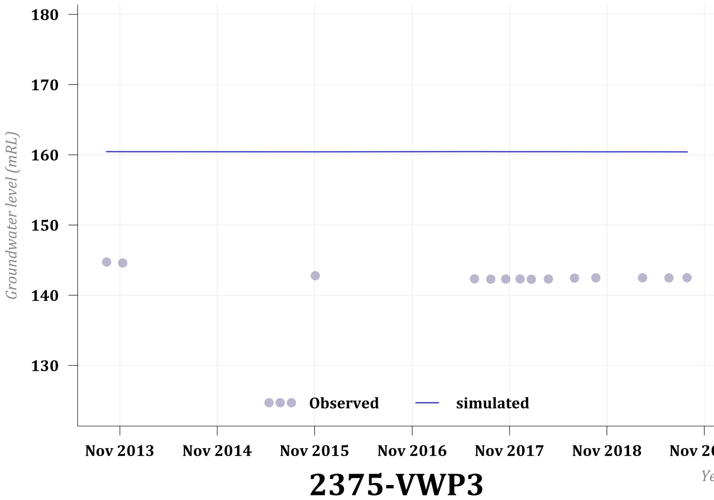
2372-VWP3



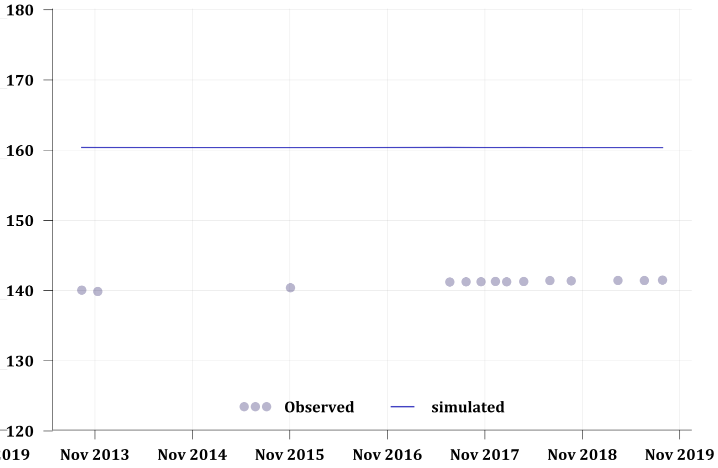
2372-VWP4



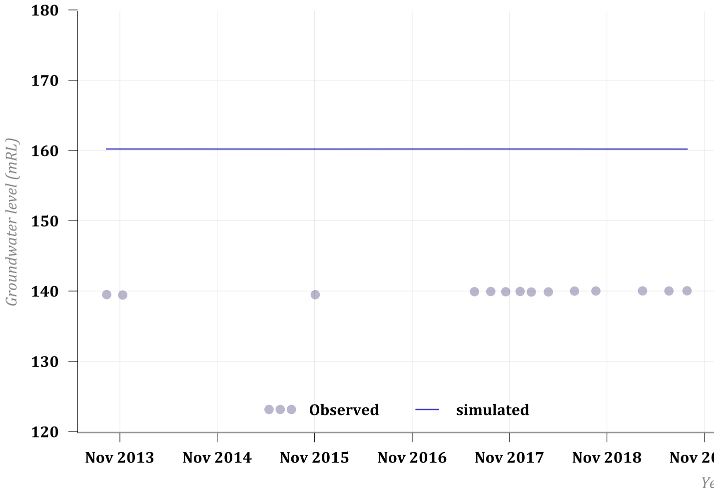
2375-MB2



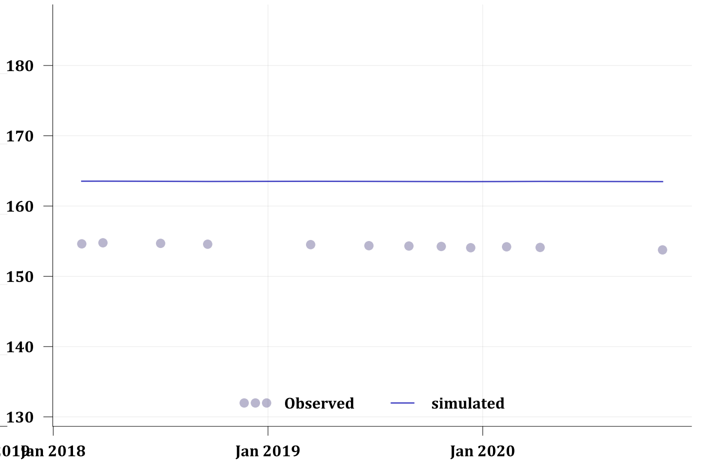
2375-VWP1



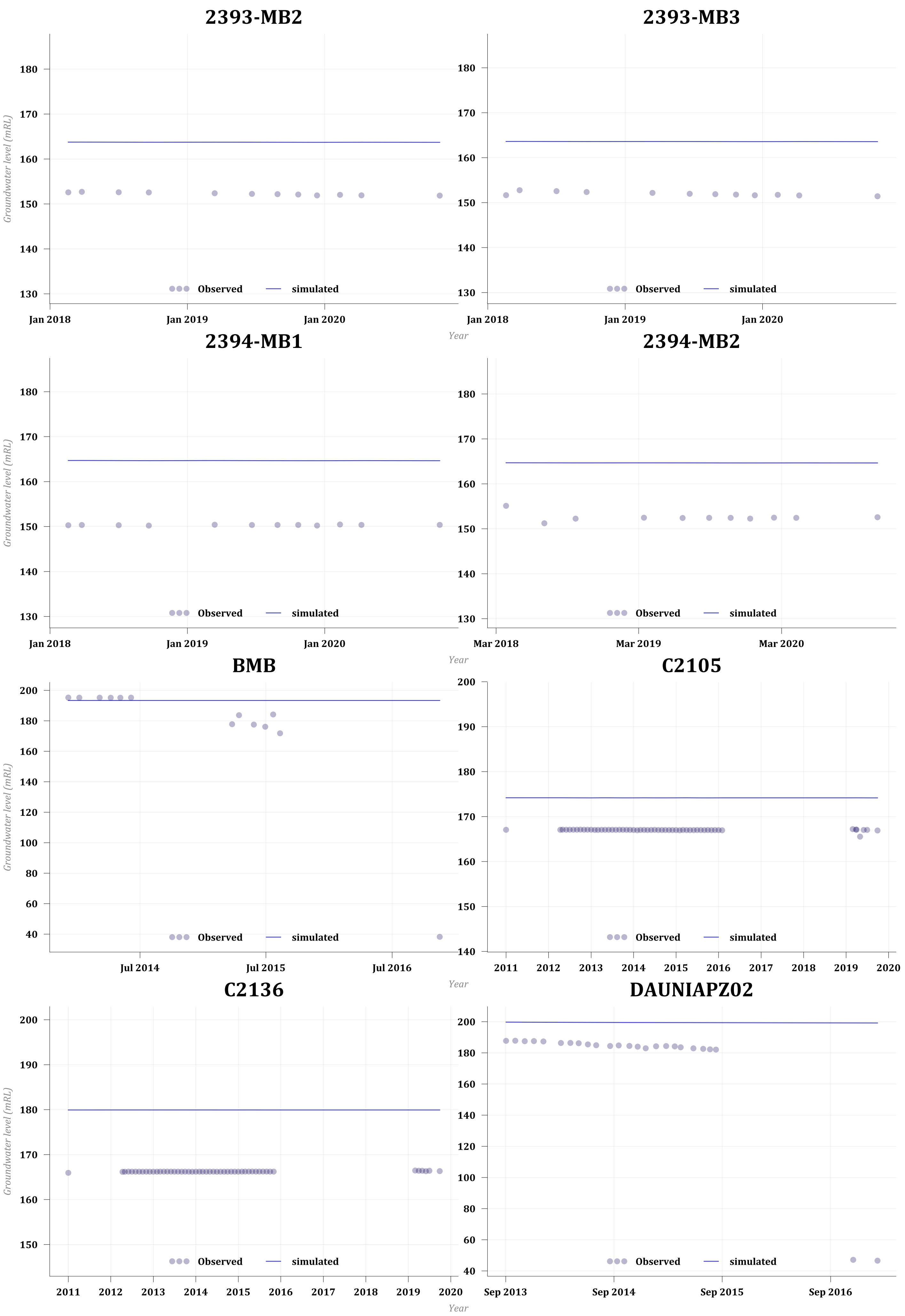
2375-VWP2

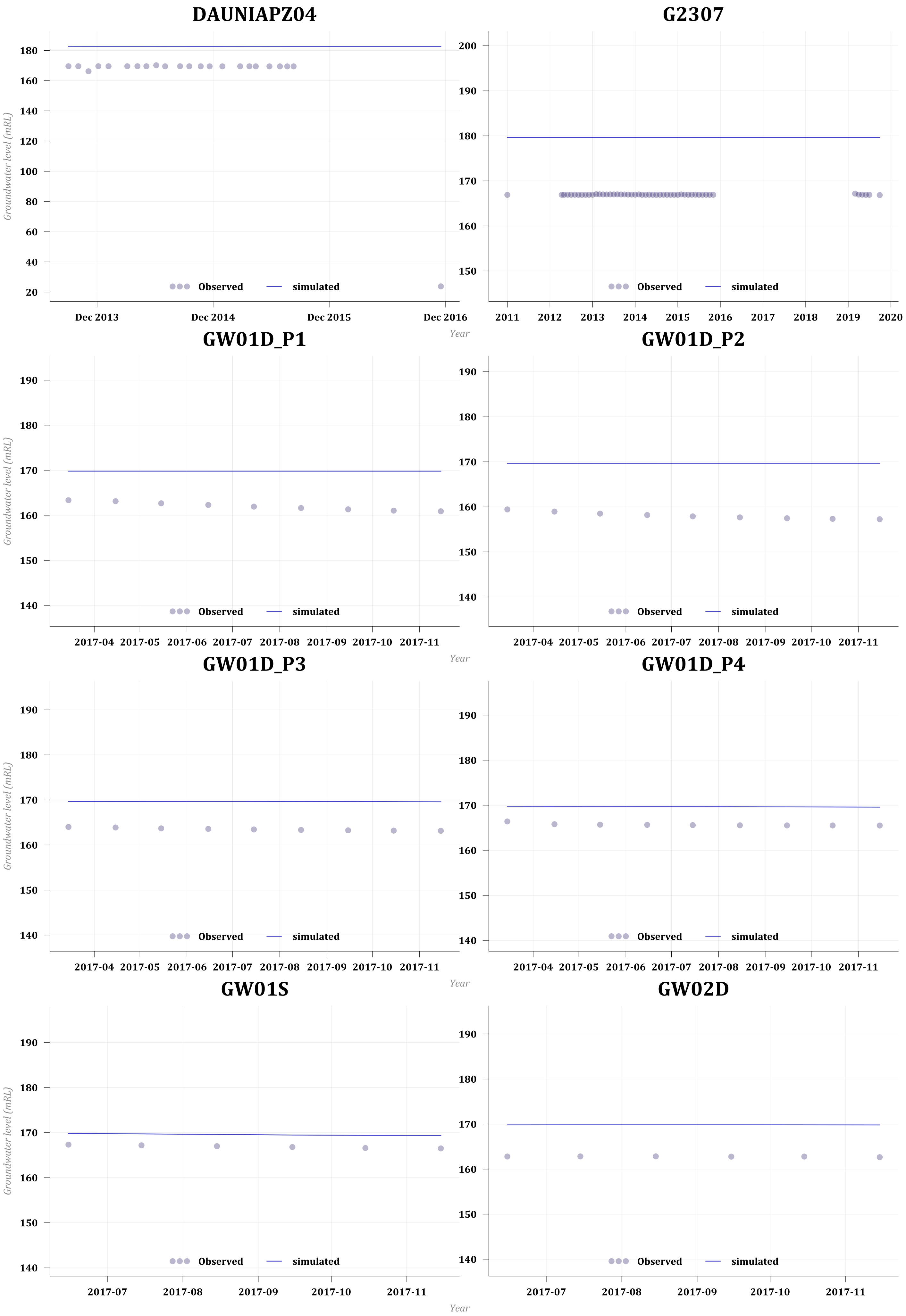


2375-VWP3



2393-MB1


2393-MB2
2393-MB3
2394-MB1
2394-MB2
BMB
C2105
C2136
DAUNIAPZ02
Groundwater level (mRL)
Year
Observed
simulated
180
170
160
150
140
130
200
190
120
100
80
60
40
Jan 2018
Jan 2019
Jan 2020
Mar 2018
Mar 2019
Mar 2020
Jul 2014
Jul 2015
Jul 2016
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Sep 2013
Sep 2014
Sep 2015
Sep 2016


DAUNIAPZ04
G2307
GW01D_P1
GW01D_P2
GW01D_P3
GW01D_P4
GW01S
GW02D
Groundwater level (mRL)
Year
Observed
simulated
180
160
140
120
100
80
60
40
20
Dec 2013
Dec 2014
Dec 2015
Dec 2016
200
190
180
170
160
150
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
190
180
170
160
150
140
2017-04
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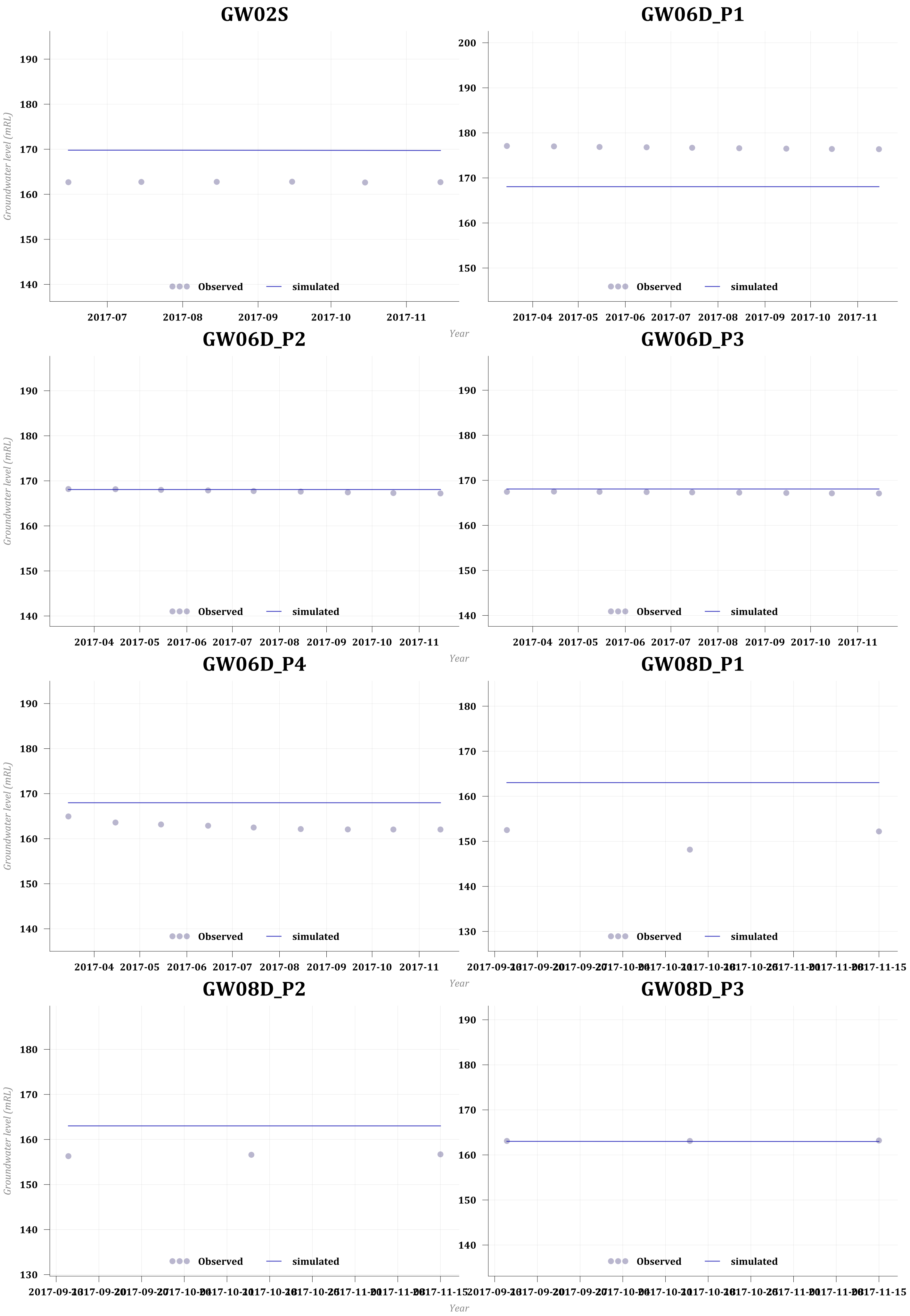
2017-09
2017-10
2017-11


GW02S
GW06D_P1
GW06D_P2
GW06D_P3
GW06D_P4
GW08D_P1
GW08D_P2
GW08D_P3
Groundwater level (mRL)
Year
Observed
simulated
130
140
150
160
170
180
190
200
2017-04
2017-05
2017-06
2017-07
2017-08
2017-09
2017-10
2017-11
2017-09-13
2017-09-20
2017-09-27
2017-10-04
2017-10-11
2017-10-18
2017-10-25
2017-11-01
2017-11-08
2017-11-15


GW08D_P4
Groundwater level (mRL)
170
160
150
140
130
120
2017-09-13
2017-09-20
2017-09-27
2017-10-04
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2017-10-18
2017-10-25
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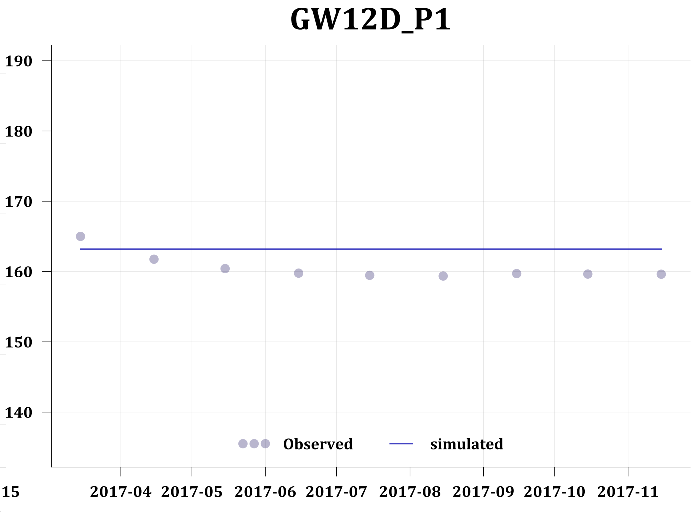
2017-11-08
2017-11-15
Observed
simulated
Year


GW12D_P1
190
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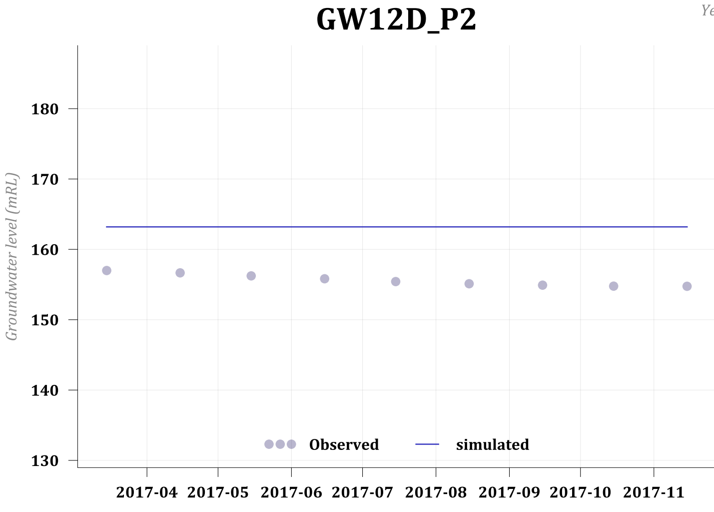
140
2017-04
2017-05
2017-06
2017-07
2017-08
2017-09
2017-10
2017-11
Observed
simulated


GW12D_P2
Groundwater level (mRL)
180
170
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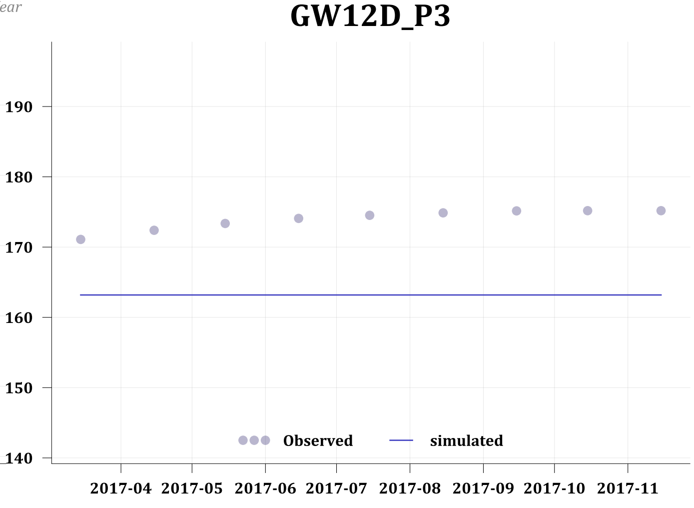
150
140
130
2017-04
2017-05
2017-06
2017-07
2017-08
2017-09
2017-10
2017-11
Observed
simulated
Year


GW12D_P3
190
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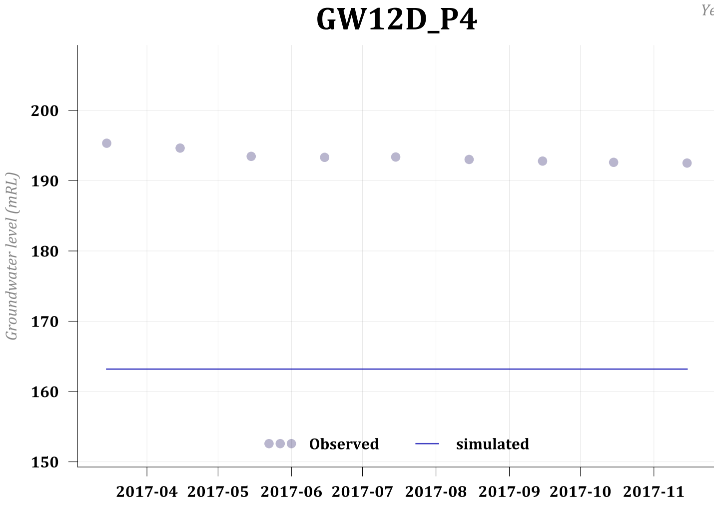
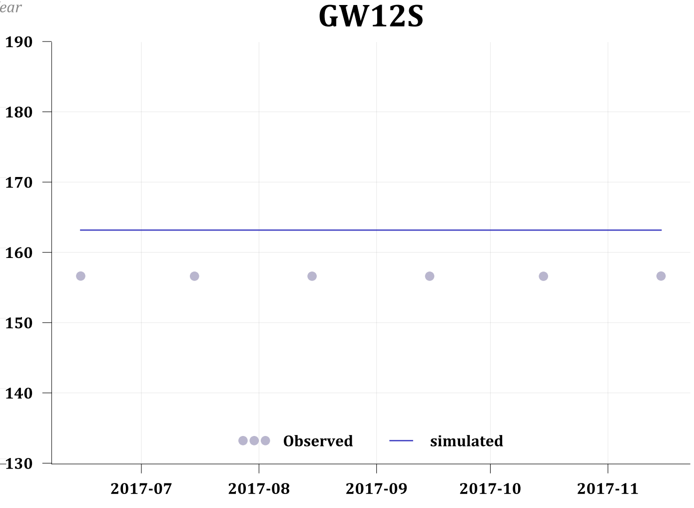
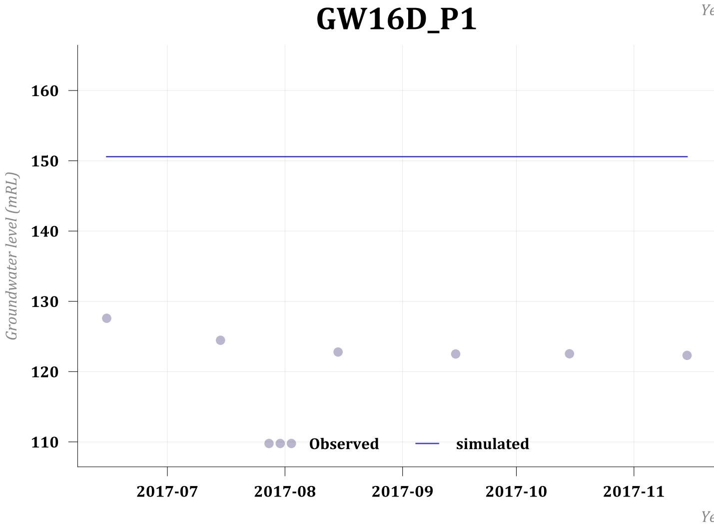
160
150
140
2017-04
2017-05
2017-06
2017-07
2017-08
2017-09
2017-10
2017-11
Observed
simulated


GW12D_P4
Groundwater level (mRL)
200
190
180
170
160
150
2017-04
2017-05
2017-06
2017-07
2017-08
2017-09
2017-10
2017-11
Observed
simulated
Year


GW12S
190
180
170
160
150
140
130
2017-07
2017-08
2017-09
2017-10
2017-11
Observed
simulated


GW16D_P1
Groundwater level (mRL)
160
150
140
130
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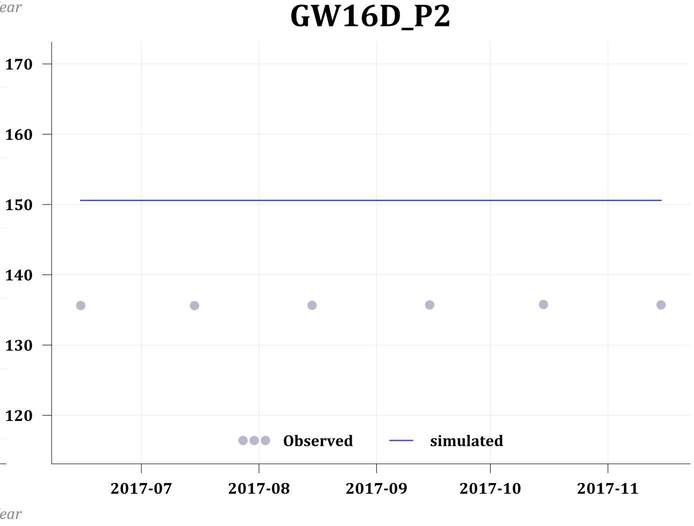
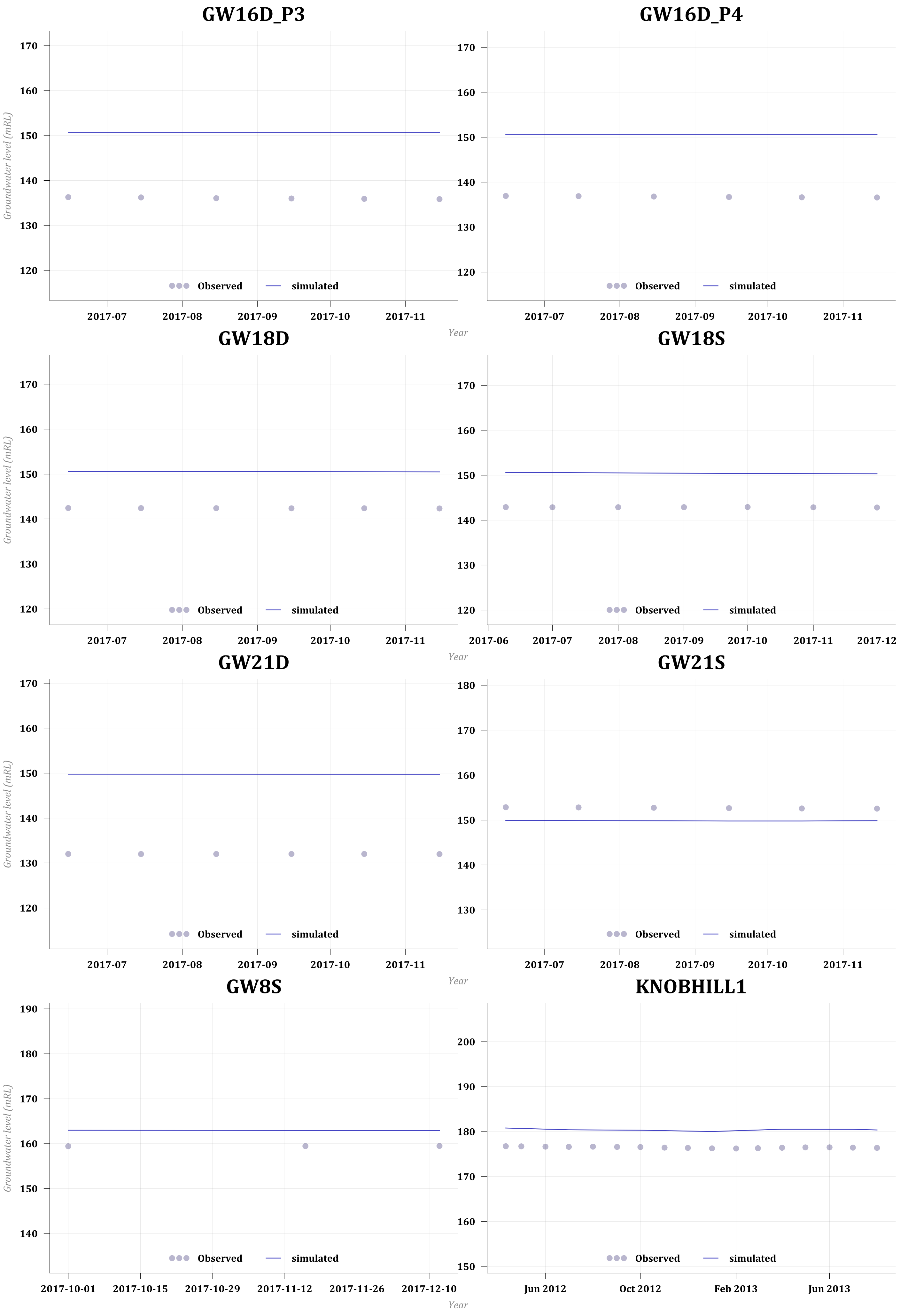
110
2017-07
2017-08
2017-09
2017-10
2017-11
Observed
simulated
Year


GW16D_P2
170
160
150
140
130
120
2017-07
2017-08
2017-09
2017-10
2017-11
Observed
simulated


GW16D_P3
GW16D_P4
GW18D
GW18S
GW21D
GW21S
GW8S
KNOBHILL1
Groundwater level (mRL)
Year
Observed
simulated
120
130
140
150
160
170
180
190
200
2017-06
2017-07
2017-08
2017-09
2017-10
2017-11
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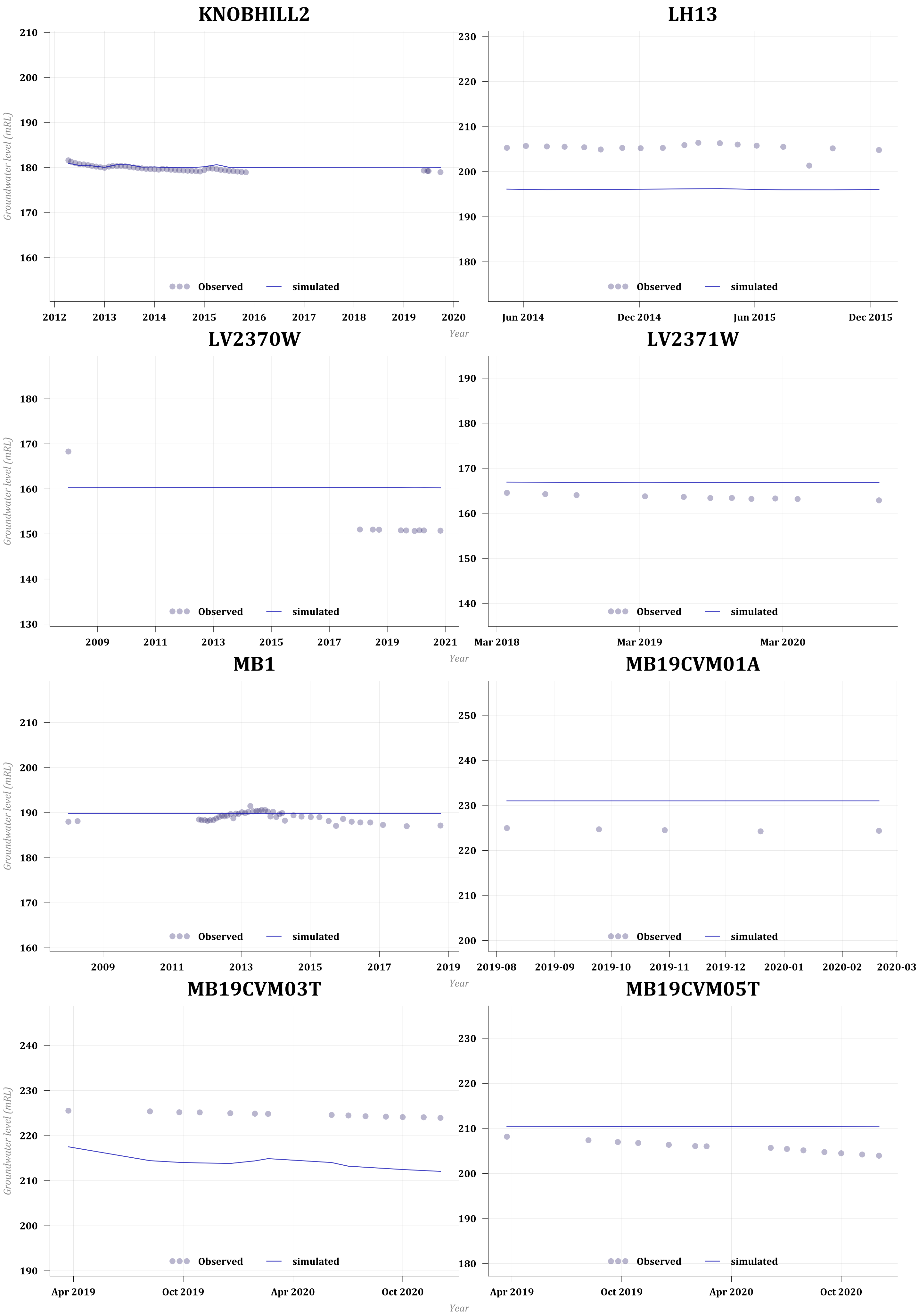
2017-12-10
Jun 2012
Oct 2012
Feb 2013
Jun 2013


KNOBHILL2
LH13
LV2370W
LV2371W
MB1
MB19CVM01A
MB19CVM03T
MB19CVM05T
Groundwater level (mRL)
Year
Observed
simulated
210
200
190
180
170
160
2012
2013
2014
2015
2016
2017
2018
2019
2020
230
220
210
200
190
180
Jun 2014
Dec 2014
Jun 2015
Dec 2015
180
170
160
150
140
130
2009
2011
2013
2015
2017
2019
2021
190
180
170
160
150
140
Mar 2018
Mar 2019
Mar 2020
210
200
190
180
170
160
2009
2011
2013
2015
2017
2019
250
240
230
220
210
200
2019-08
2019-09
2019-10
2019-11
2019-12
2020-01
2020-02
2020-03
240
230
220
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200
190
Apr 2019
Oct 2019
Apr 2020
Oct 2020
230
220
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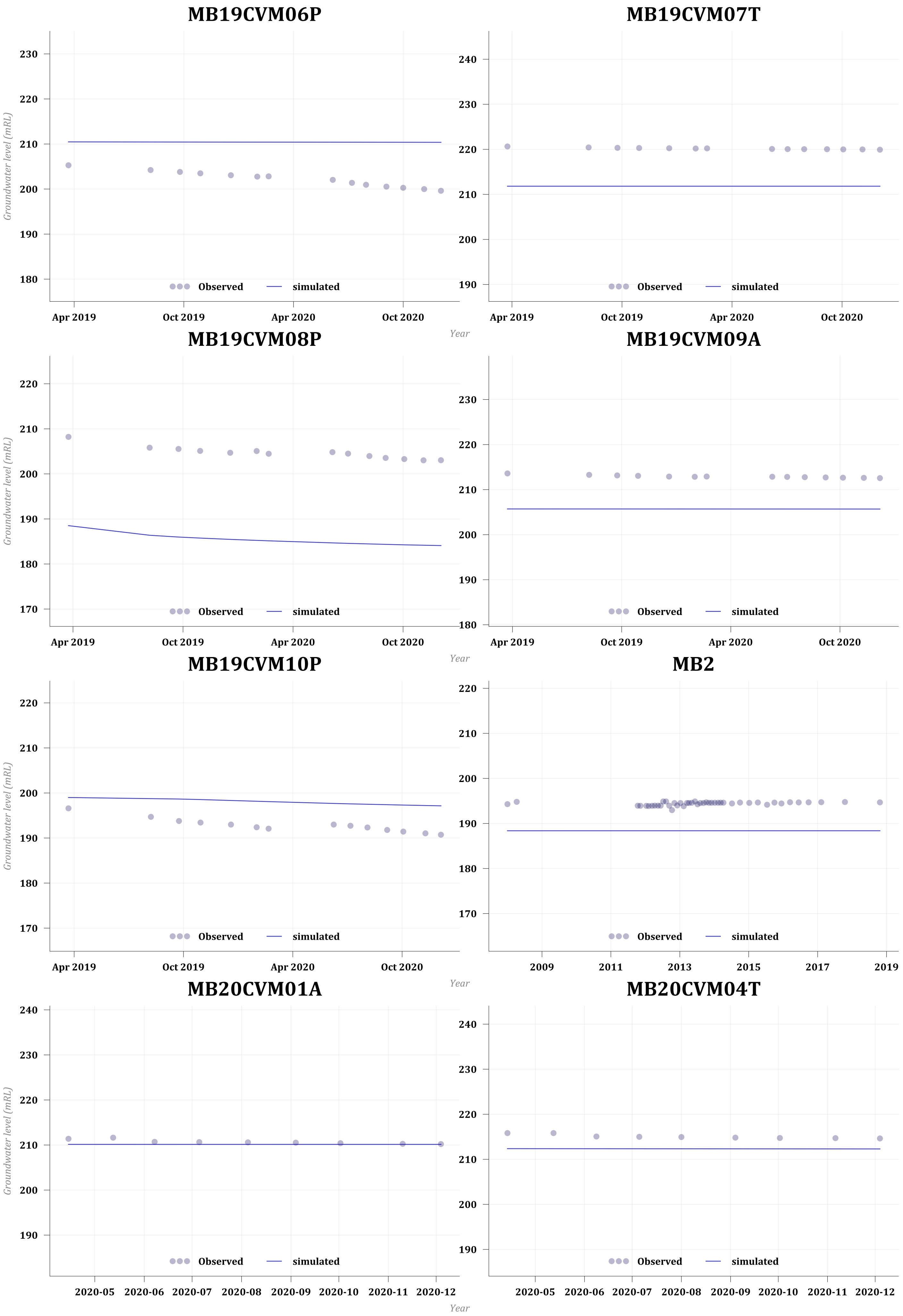
200
190
180
Apr 2019
Oct 2019
Apr 2020
Oct 2020


MB19CVM06P
230
220
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200
190
180
Groundwater level (mRL)
Observed
simulated
Apr 2019
Oct 2019
Apr 2020
Oct 2020
MB19CVM07T
240
230
220
210
200
190
Observed
simulated
Apr 2019
Oct 2019
Apr 2020
Oct 2020
Year
MB19CVM08P
220
210
200
190
180
170
Groundwater level (mRL)
Observed
simulated
Apr 2019
Oct 2019
Apr 2020
Oct 2020
MB19CVM09A
230
220
210
200
190
180
Observed
simulated
Apr 2019
Oct 2019
Apr 2020
Oct 2020
Year
MB19CVM10P
220
210
200
190
180
170
Groundwater level (mRL)
Observed
simulated
Apr 2019
Oct 2019
Apr 2020
Oct 2020
MB2
220
210
200
190
180
170
Observed
simulated
2009
2011
2013
2015
2017
2019
Year
MB20CVM01A
240
230
220
210
200
190
Groundwater level (mRL)
Observed
simulated
2020-05
2020-06
2020-07
2020-08
2020-09
2020-10
2020-11
2020-12
MB20CVM04T
240
230
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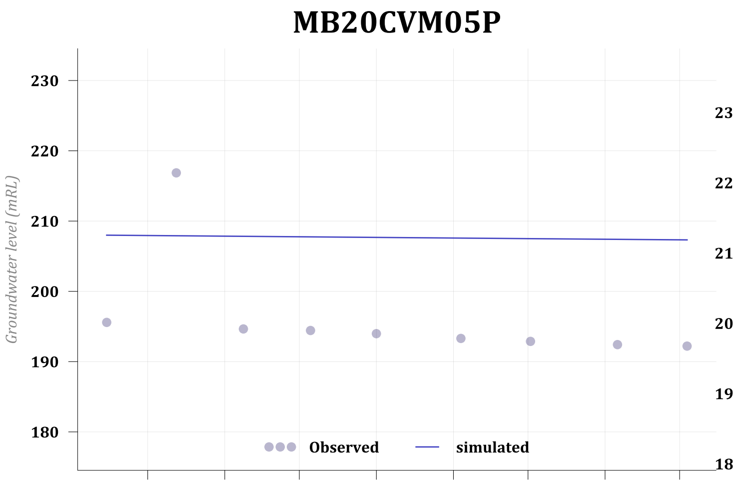
Observed
simulated
2020-05
2020-06
2020-07
2020-08
2020-09
2020-10
2020-11
2020-12
Year


MB20CVM05P
Groundwater level (mRL)
230
220
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200
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180
Observed
simulated
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2020-06
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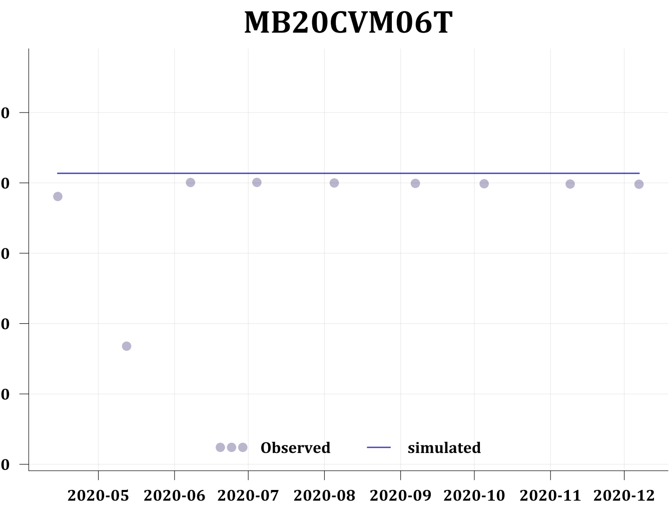
2020-10
2020-11
2020-12
Year


MB20CVM06T
230
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200
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Observed
simulated
2020-05
2020-06
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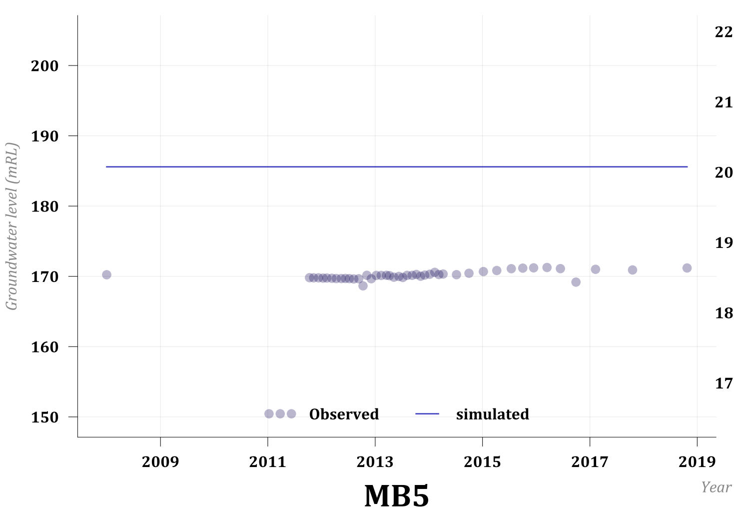
2020-09
2020-10
2020-11
2020-12


MB3
Groundwater level (mRL)
200
190
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160
150
Observed
simulated
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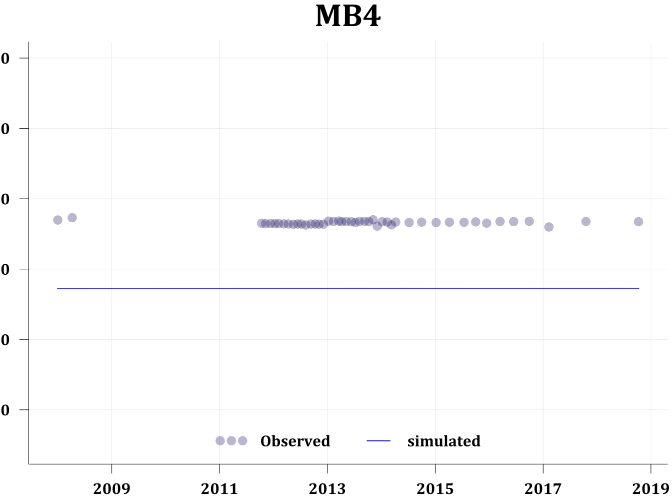
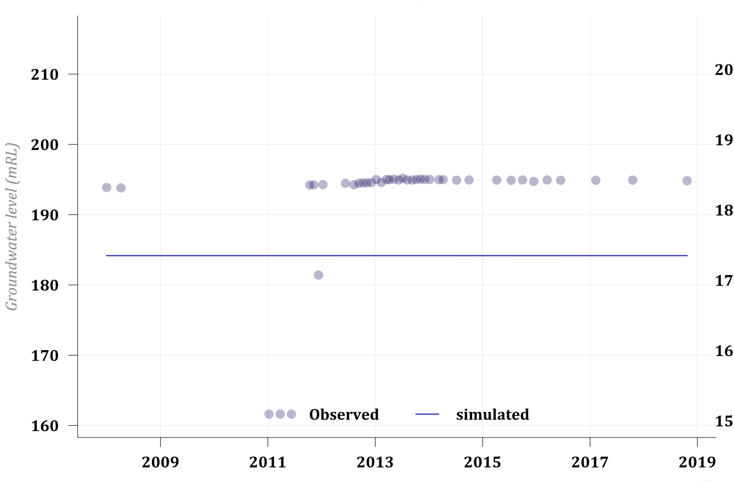
2011
2013
2015
2017
2019
Year


MB4
220
210
200
190
180
170
Observed
simulated
2009
2011
2013
2015
2017
2019


MB5
Groundwater level (mRL)
210
200
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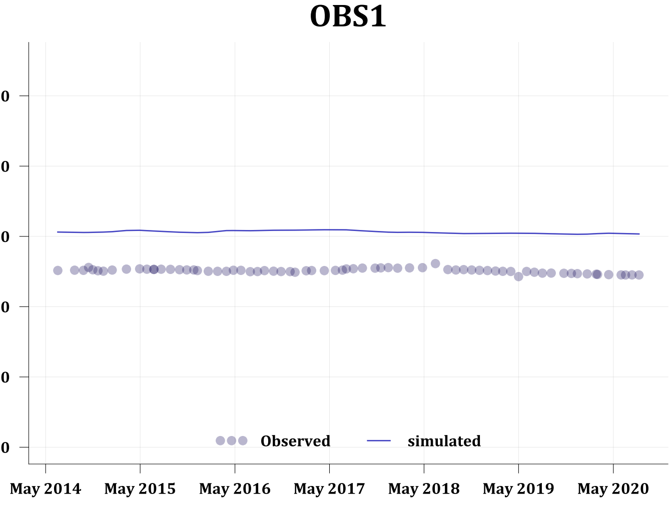
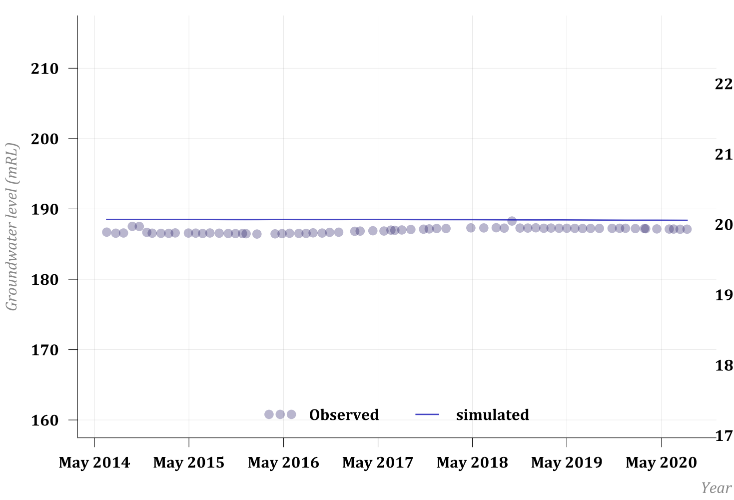
180
170
160
Observed
simulated
2009
2011
2013
2015
2017
2019
Year


OBS1
200
190
180
170
160
150
Observed
simulated
May 2014
May 2015
May 2016
May 2017
May 2018
May 2019
May 2020


OBS2
Groundwater level (mRL)
210
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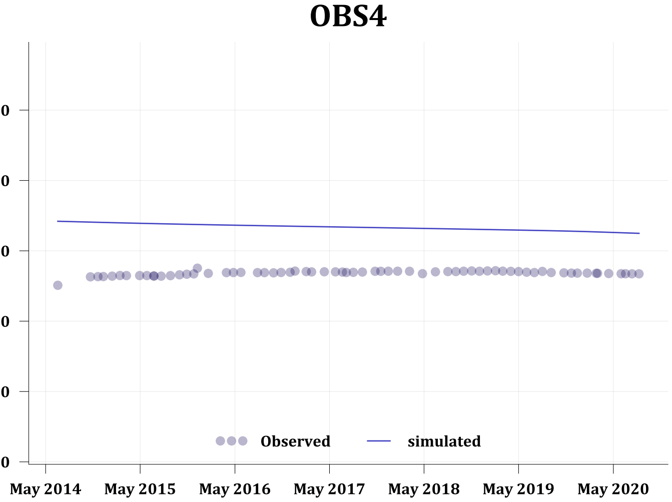
180
170
160
Observed
simulated
May 2014
May 2015
May 2016
May 2017
May 2018
May 2019
May 2020
Year


OBS4
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200
190
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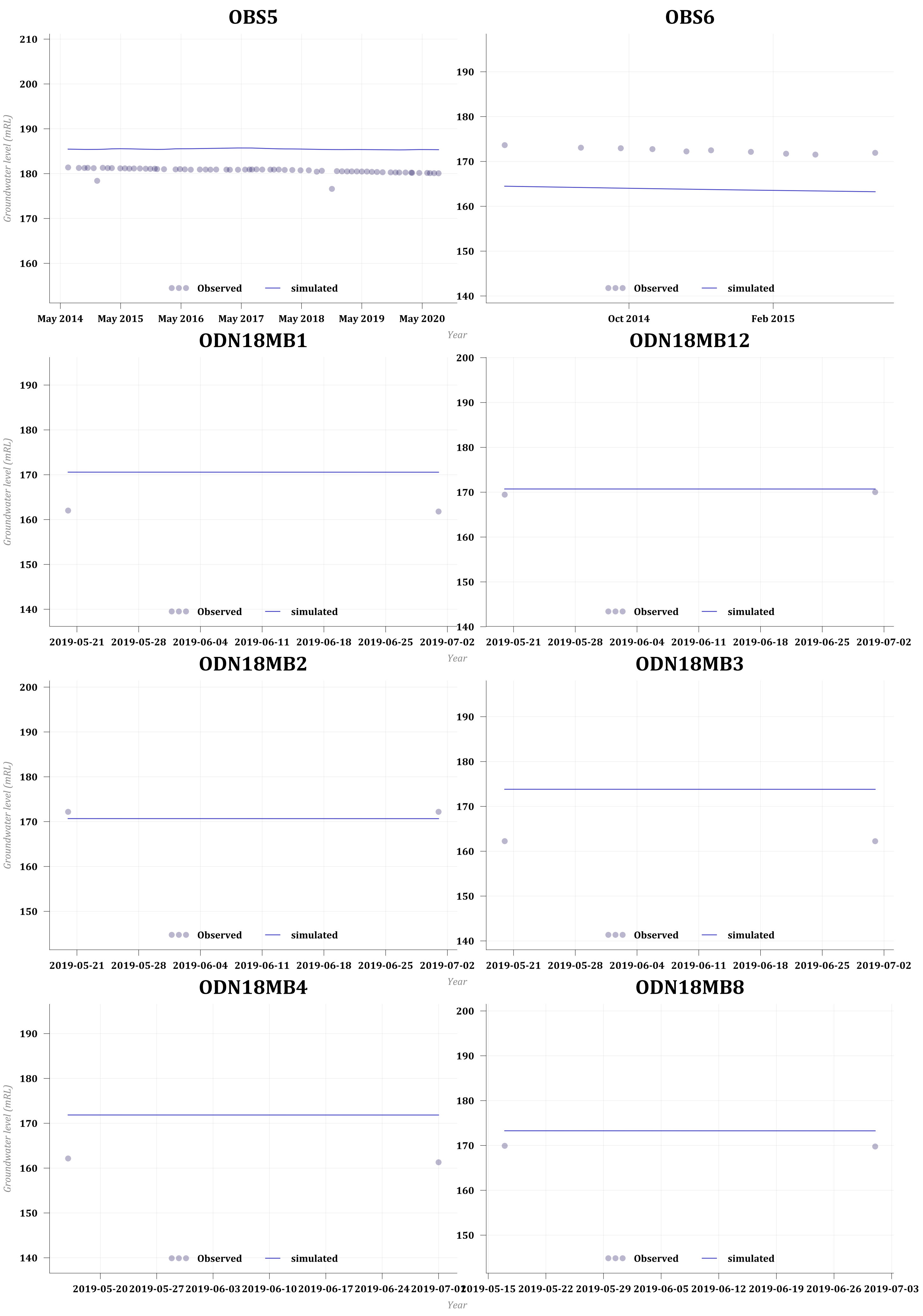
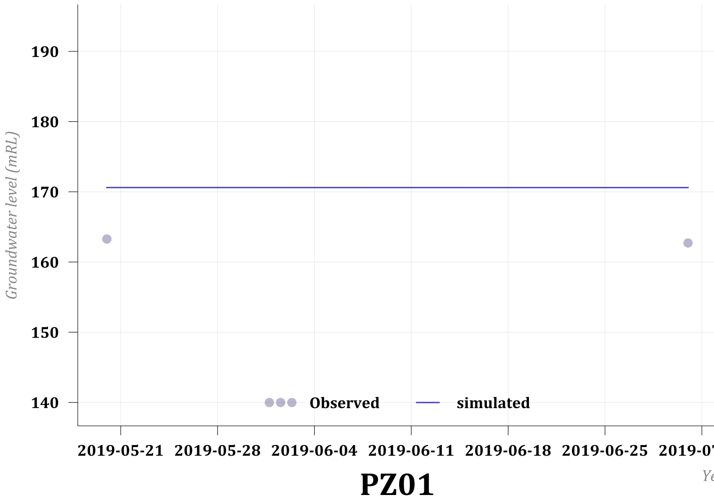
170
Observed
simulated
May 2014
May 2015
May 2016
May 2017
May 2018
May 2019
May 2020


OBS5
OBS6
ODN18MB1
ODN18MB12
ODN18MB2
ODN18MB3
ODN18MB4
ODN18MB8
Groundwater level (mRL)
Year
Observed
simulated
210
200
190
180
170
160
150
140
May 2014
May 2015
May 2016
May 2017
May 2018
May 2019
May 2020
Oct 2014
Feb 2015
2019-05-21
2019-05-28
2019-06-04
2019-06-11
2019-06-18
2019-06-25
2019-07-02
2019-05-20
2019-05-27
2019-06-03
2019-06-10
2019-06-17
2019-06-24
2019-07-01
2019-05-15
2019-05-22
2019-05-29
2019-06-05
2019-06-12
2019-06-19
2019-06-26
2019-07-03

ODN18TB1



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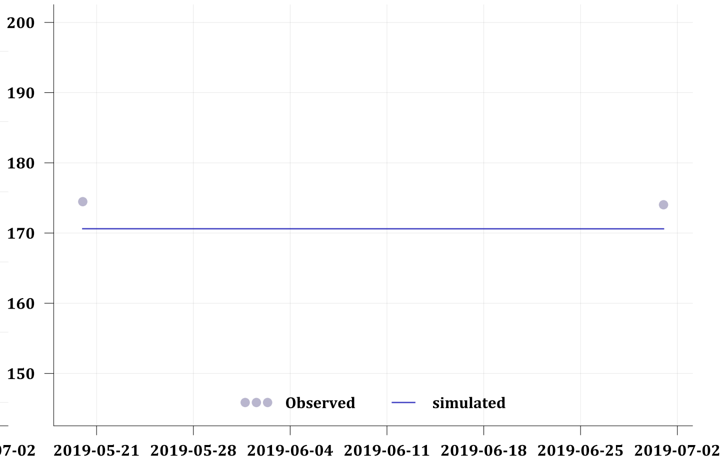

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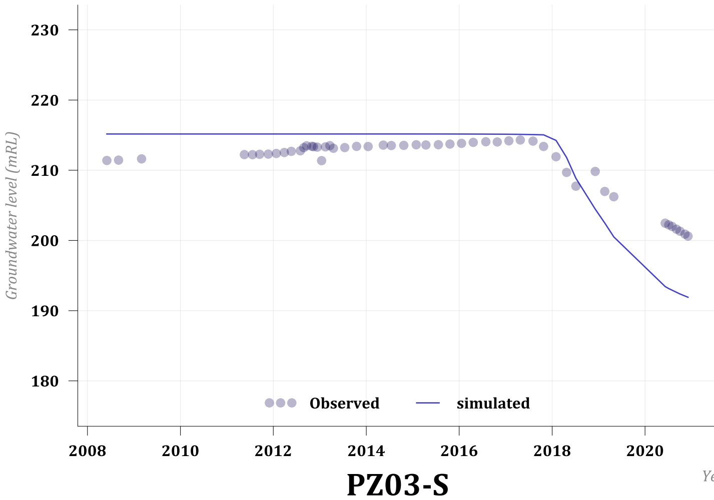

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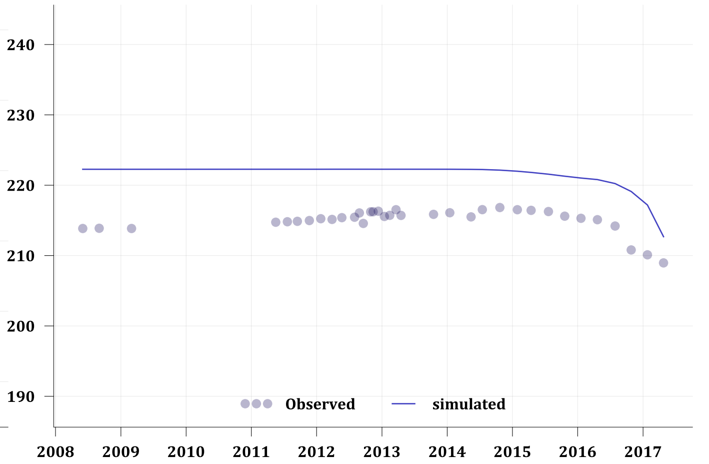

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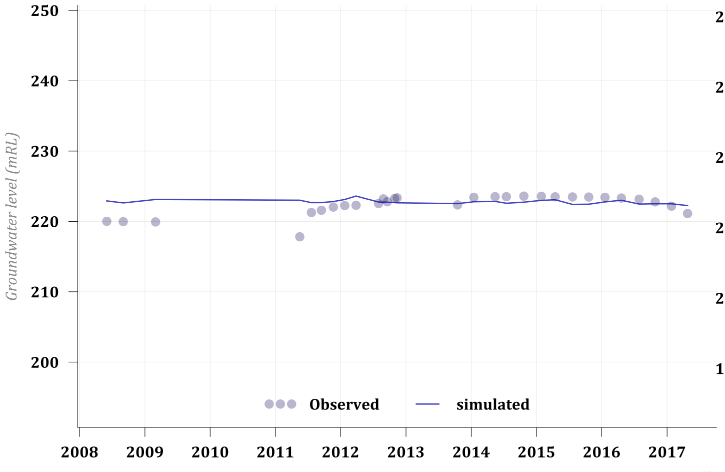

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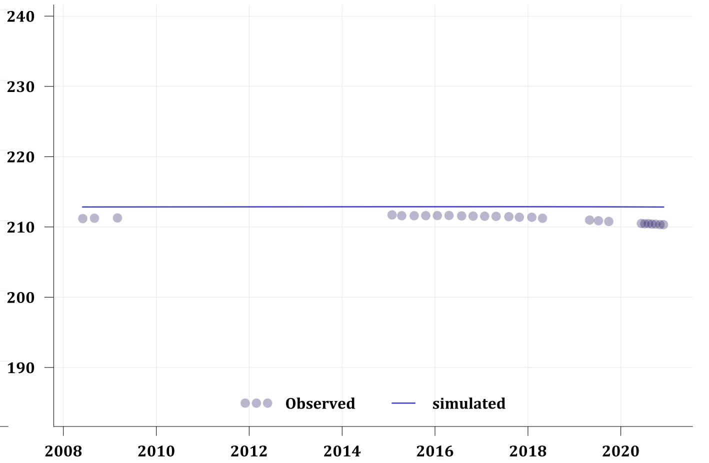

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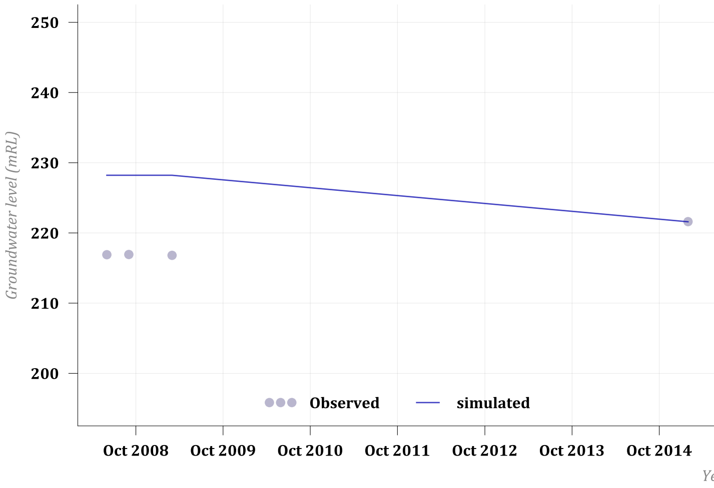

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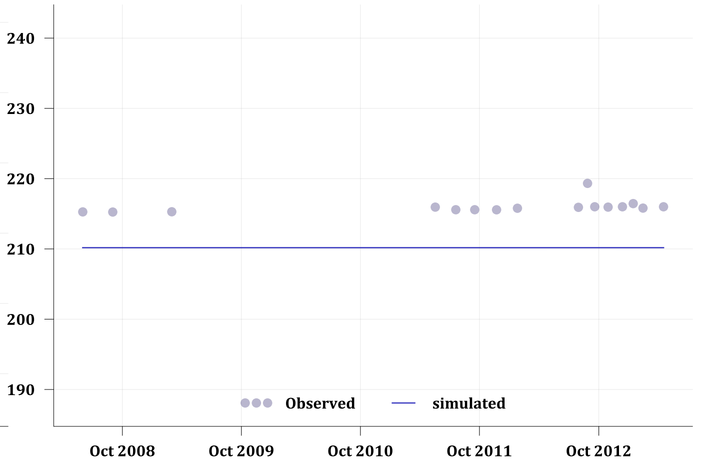

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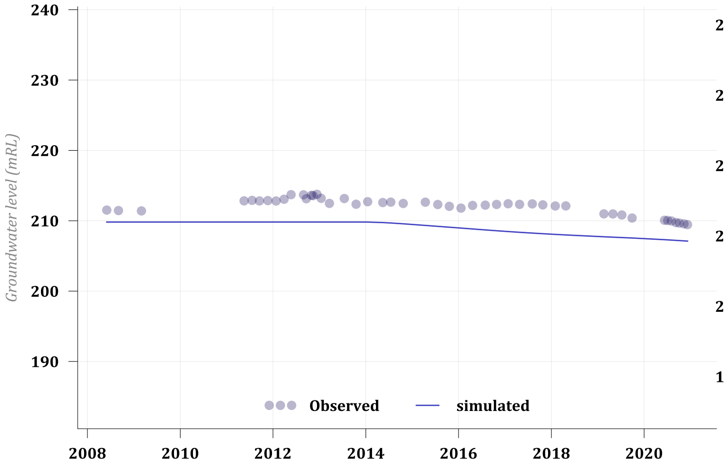

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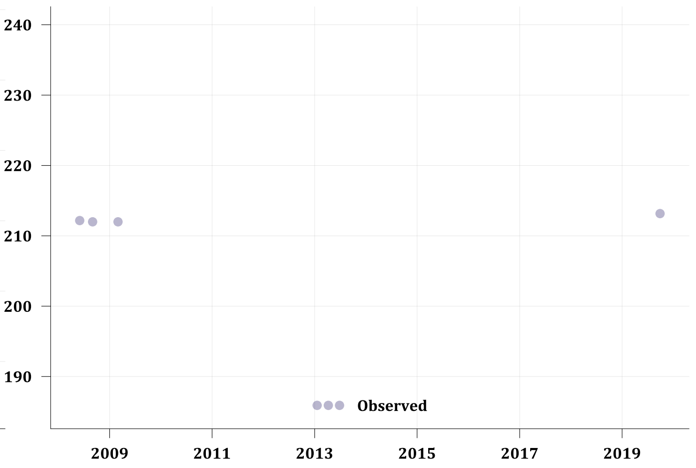

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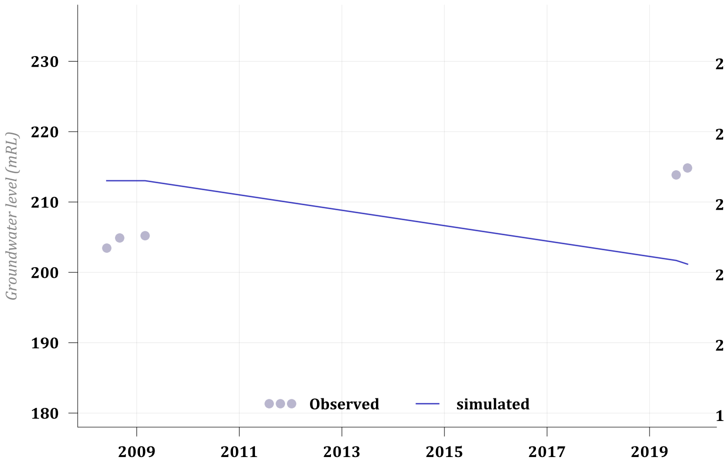

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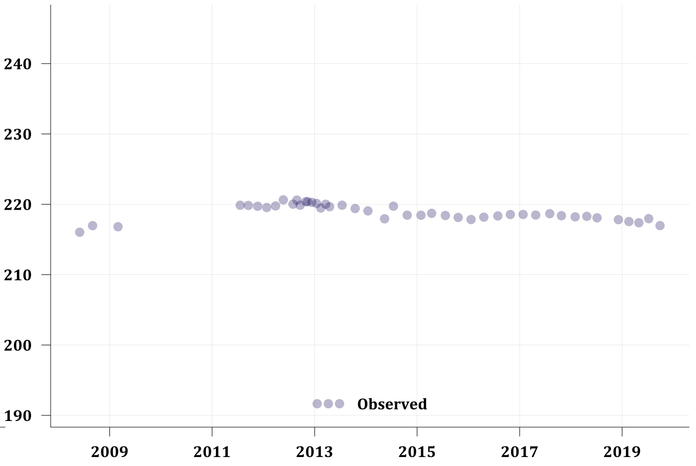

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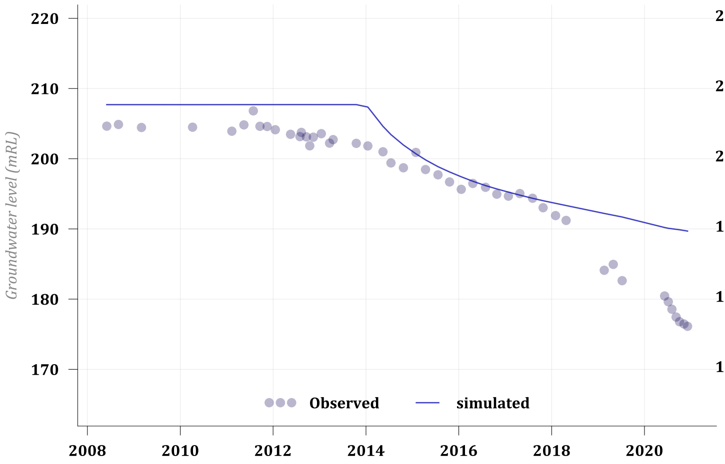

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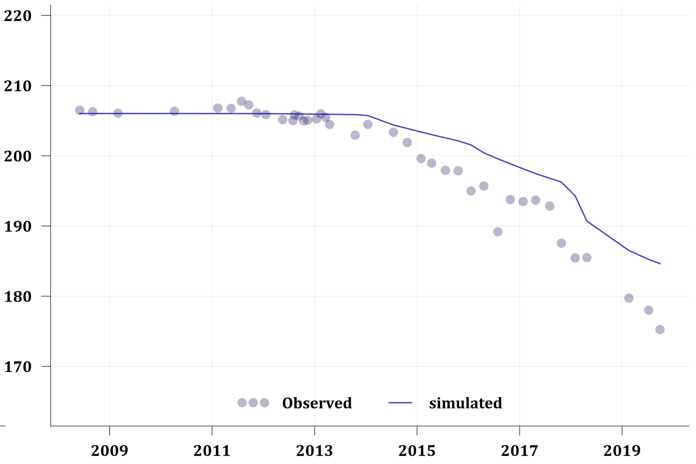

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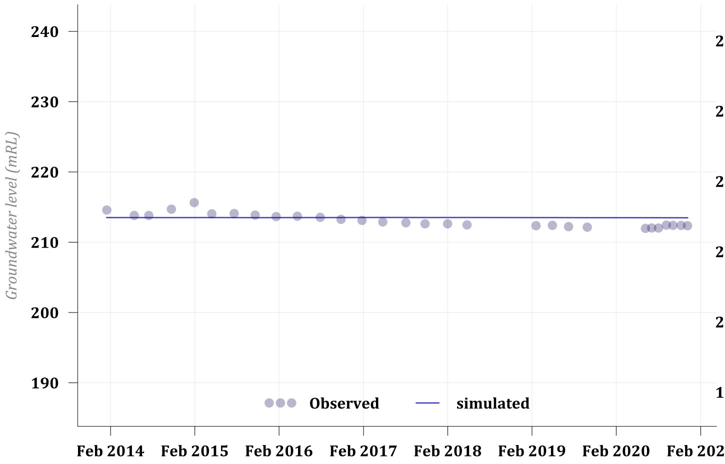

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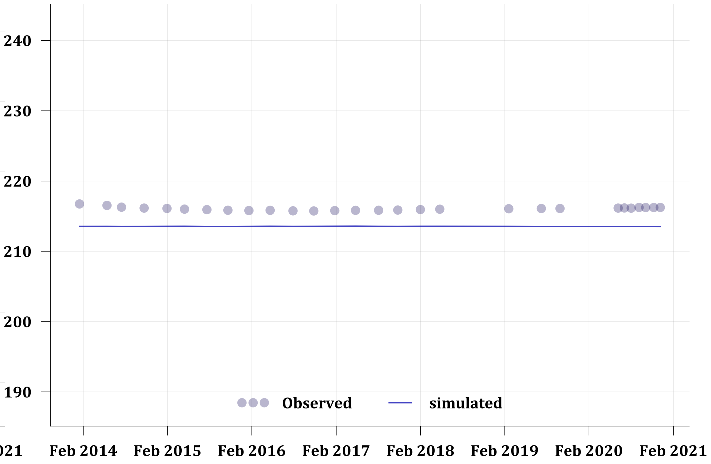
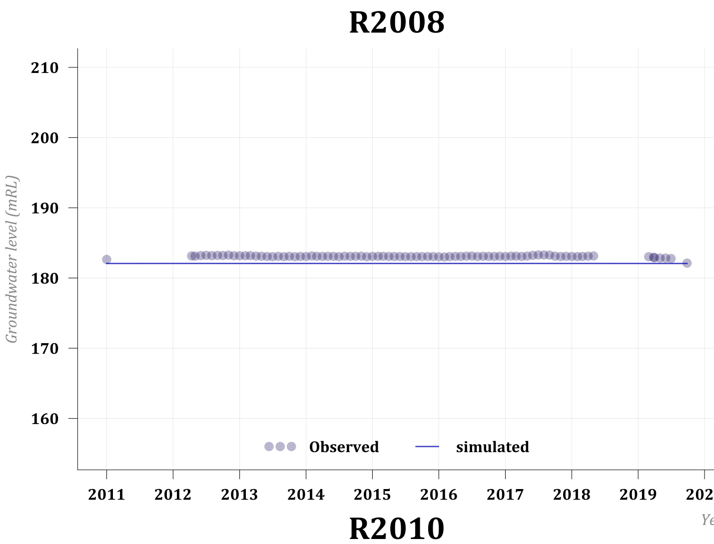
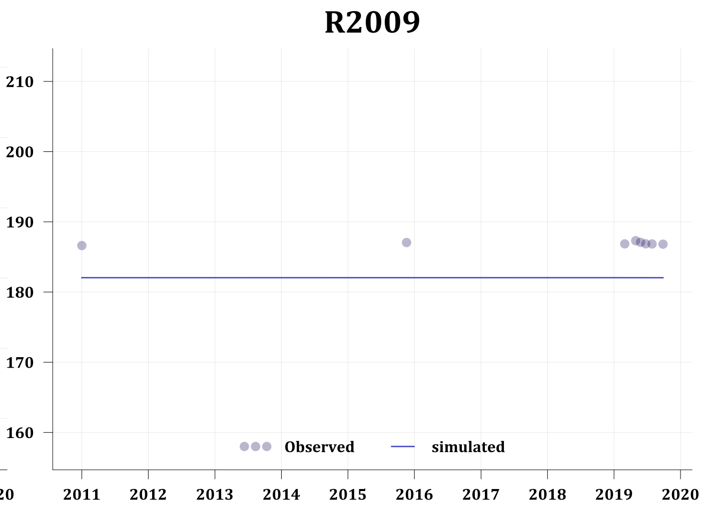



R2008
Groundwater level (mRL)
210
200
190
180
170
160
Observed
simulated
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year


R2009
210
200
190
180
170
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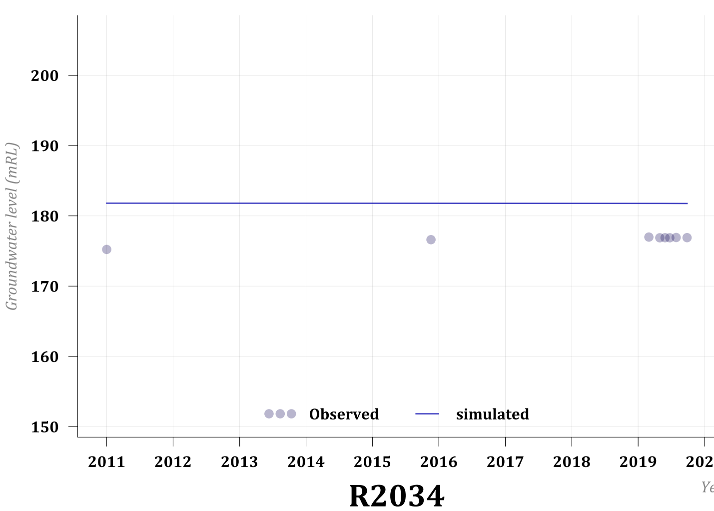
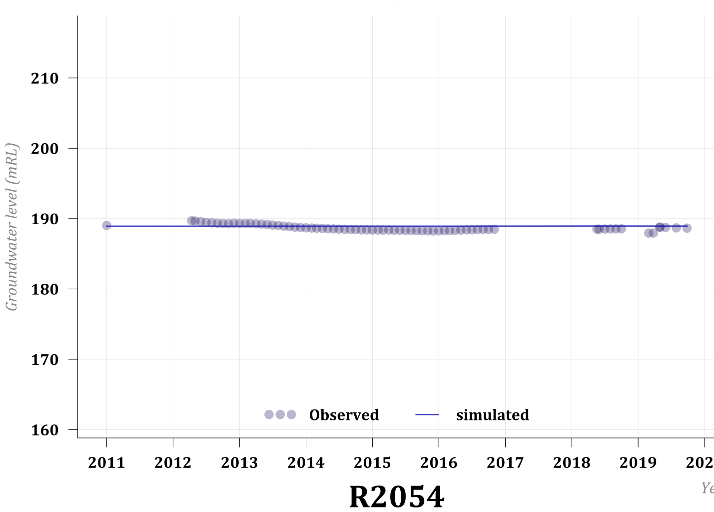
Observed
simulated
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020


R2010
Groundwater level (mRL)
200
190
180
170
160
150
Observed
simulated
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year


R2032
210
200
190
180
170
160
Observed
simulated
2011
2012
2013
2014
2015
2016
2017
2018
2019


R2034
Groundwater level (mRL)
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200
190
180
170
160
Observed
simulated
2011
2012
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2014
2015
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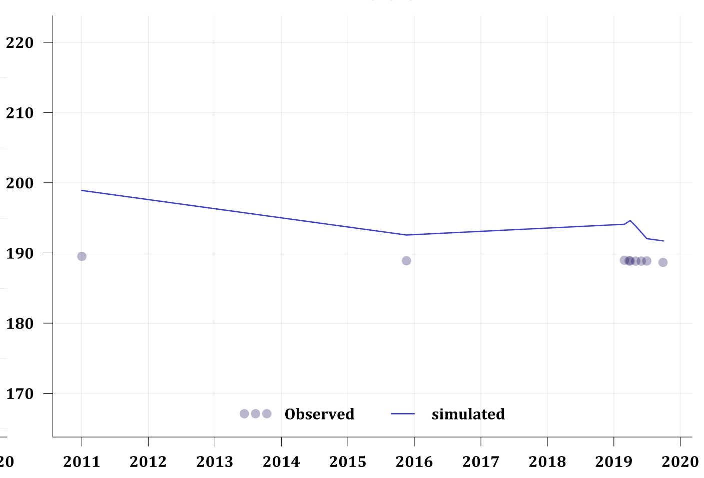
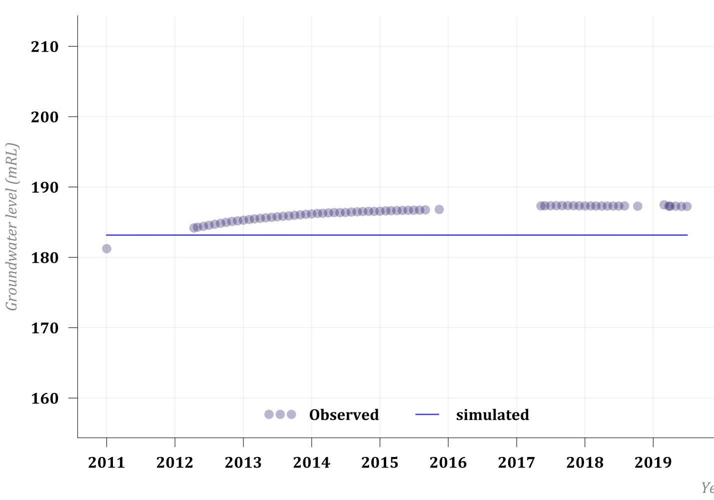
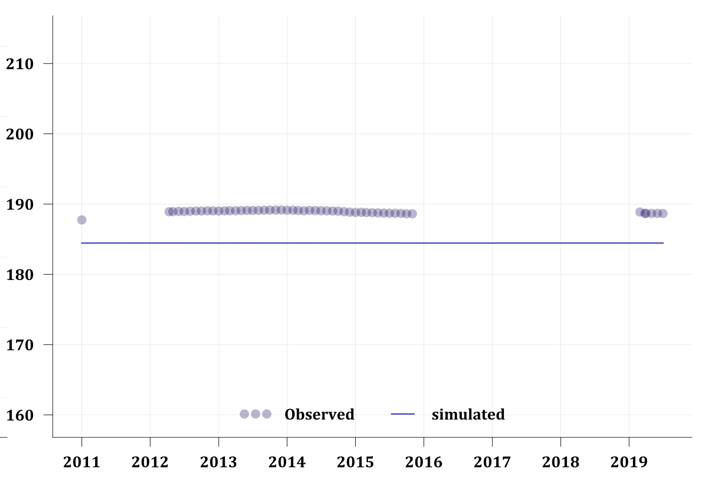
2017
2018
2019
2020
Year


R2035
220
210
200
190
180
170
Observed
simulated
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020


R2054
Groundwater level (mRL)
210
200
190
180
170
160
Observed
simulated
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year


R2055
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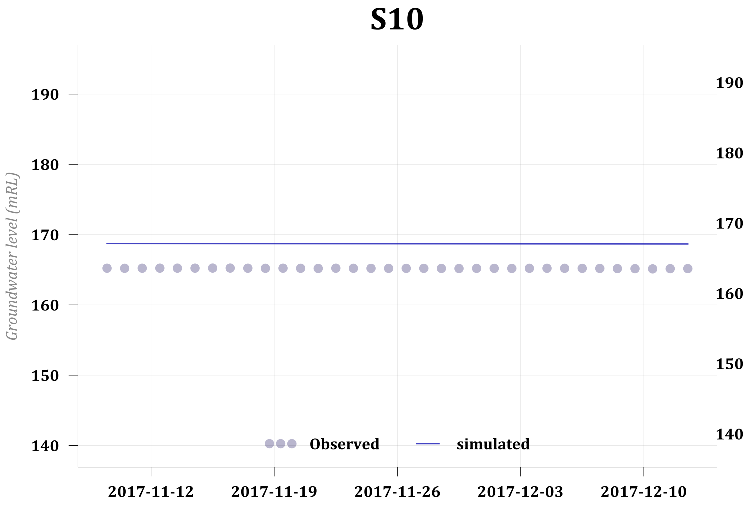
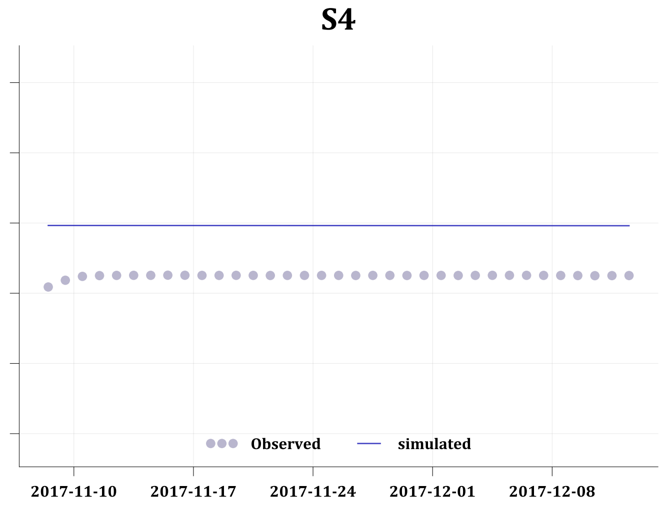
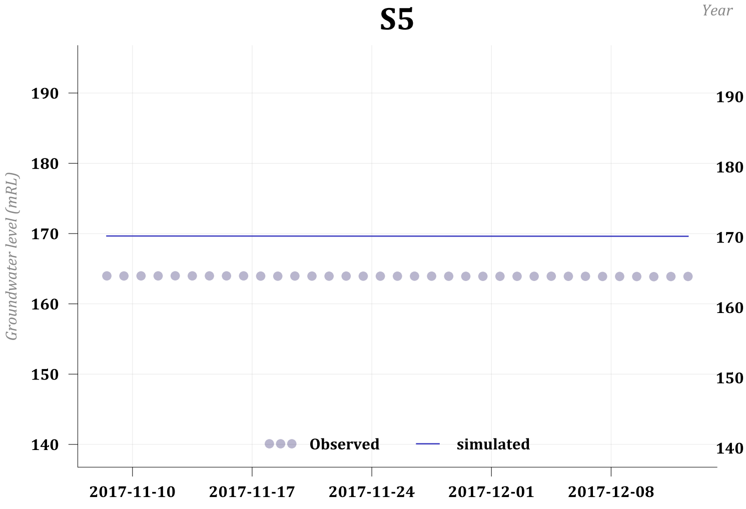
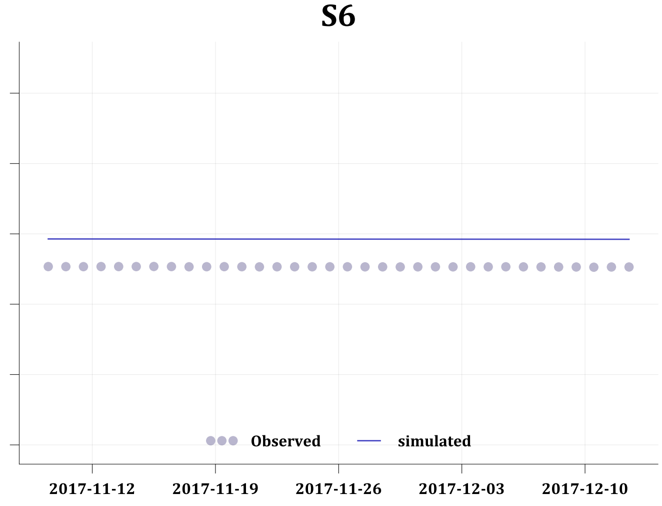
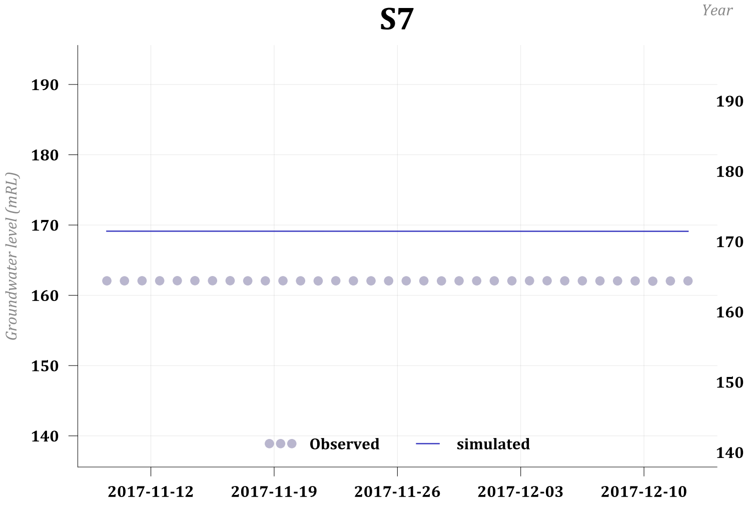
200
190
180
170
160
Observed
simulated
2011
2012
2013
2014
2015
2016
2017
2018
2019

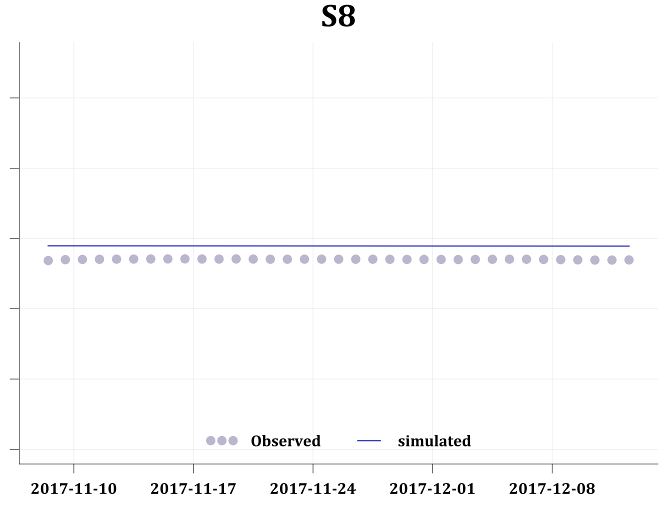

S10
Groundwater level (mRL)
190
180
170
160
150
140
Observed
simulated
2017-11-12
2017-11-19
2017-11-26
2017-12-03
2017-12-10
Year

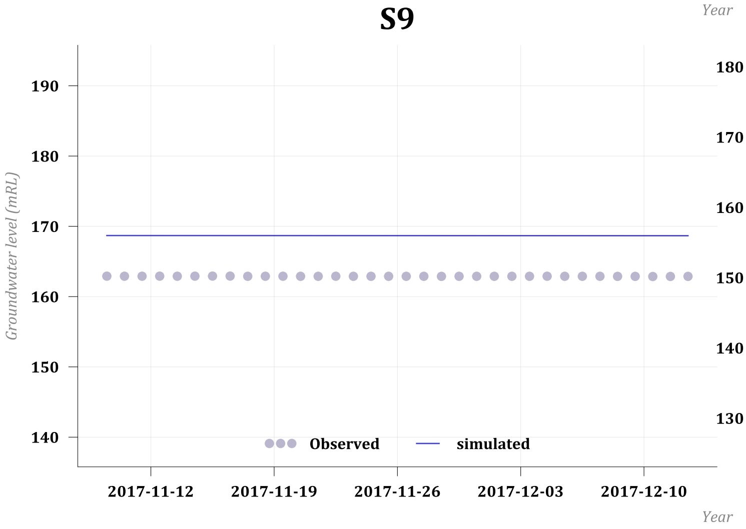

S4
190
180
170
160
150
140
Observed
simulated
2017-11-10
2017-11-17
2017-11-24
2017-12-01
2017-12-08

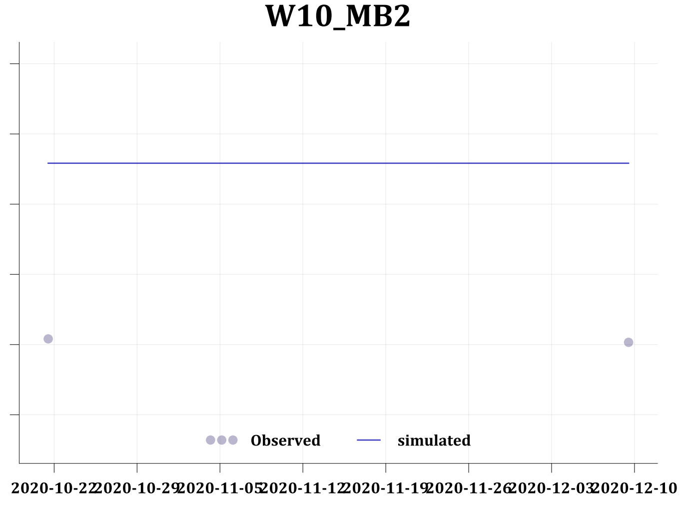

S5
Groundwater level (mRL)
190
180
170
160
150
140
Observed
simulated
2017-11-10
2017-11-17
2017-11-24
2017-12-01
2017-12-08
Year


S6
190
180
170
160
150
140
Observed
simulated
2017-11-12
2017-11-19
2017-11-26
2017-12-03
2017-12-10

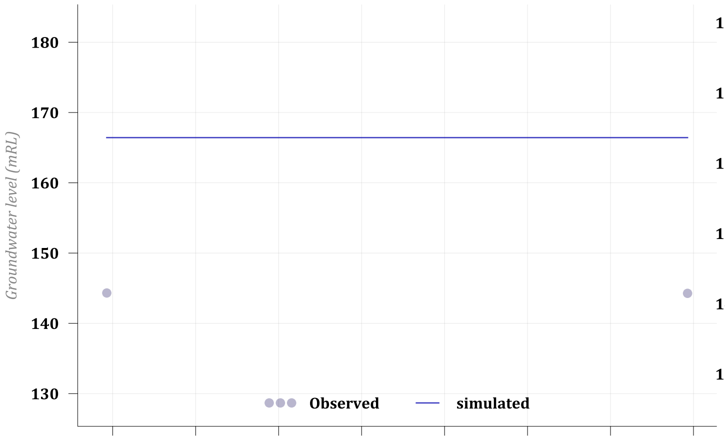

S7
Groundwater level (mRL)
190
180
170
160
150
140
Observed
simulated
2017-11-12
2017-11-19
2017-11-26
2017-12-03
2017-12-10
Year


S8
190
180
170
160
150
140
Observed
simulated
2017-11-10
2017-11-17
2017-11-24
2017-12-01
2017-12-08

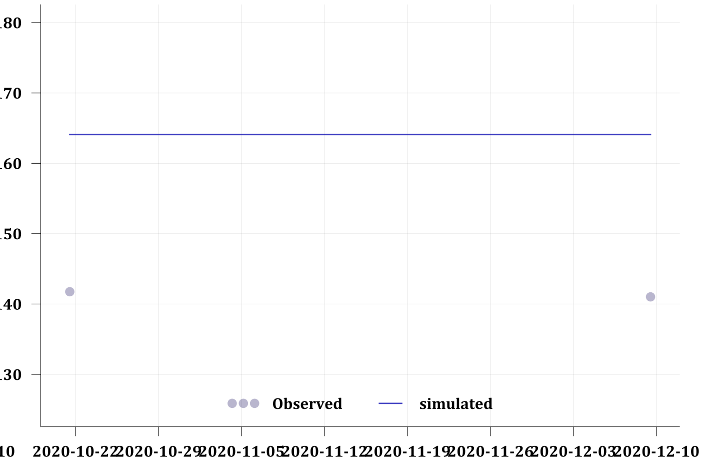

S9
Groundwater level (mRL)
190
180
170
160
150
140
Observed
simulated
2017-11-12
2017-11-19
2017-11-26
2017-12-03
2017-12-10
Year


W10_MB2
180
170
160
150
140
130
Observed
simulated
2020-10-22
2020-10-29
2020-11-05
2020-11-12
2020-11-19
2020-11-26
2020-12-03
2020-12-10

W10_MB3



W11_MB1



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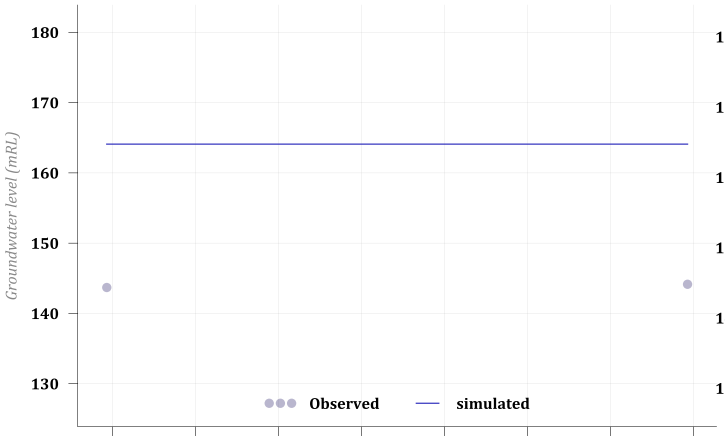

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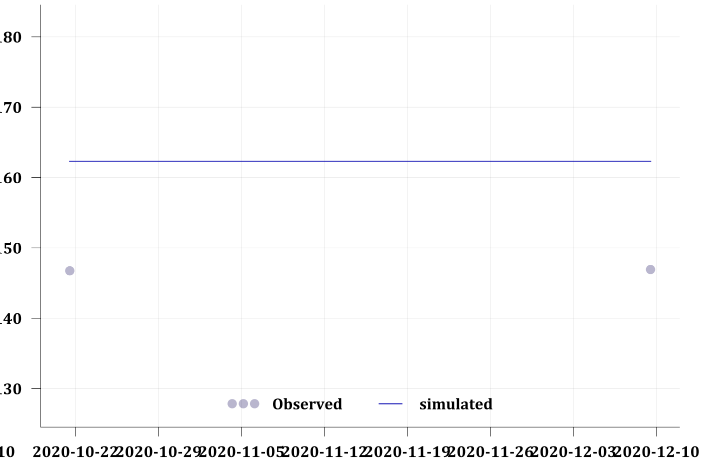
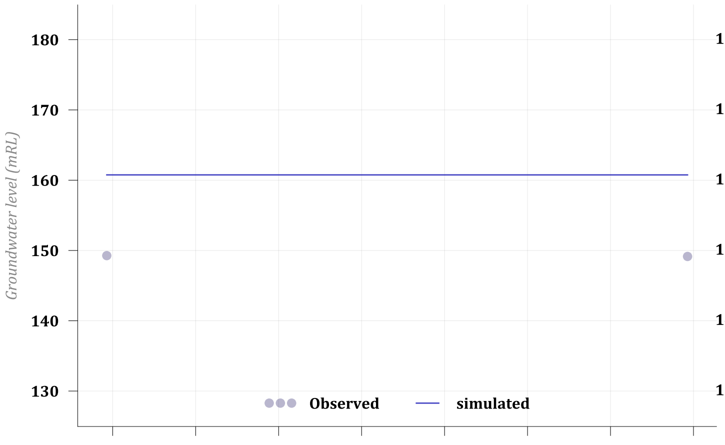


W13_MB1



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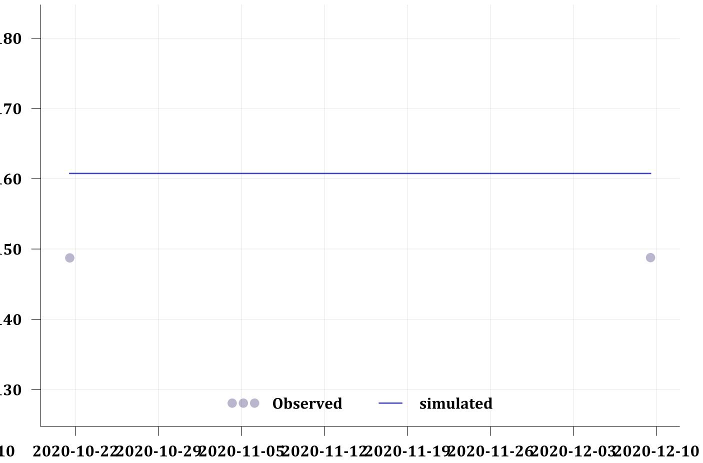

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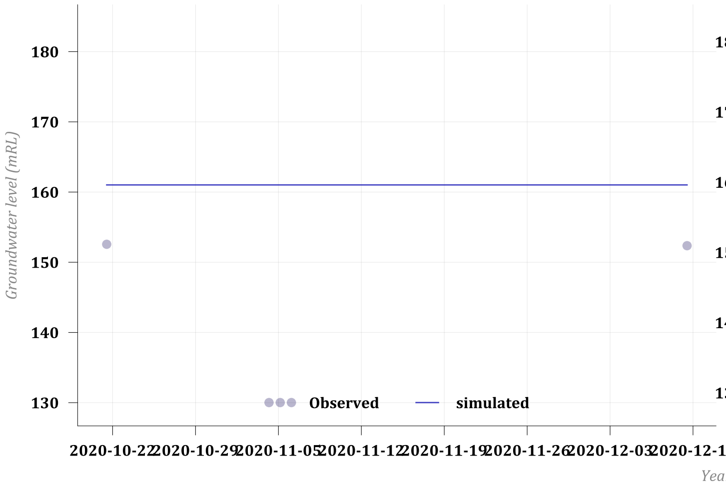
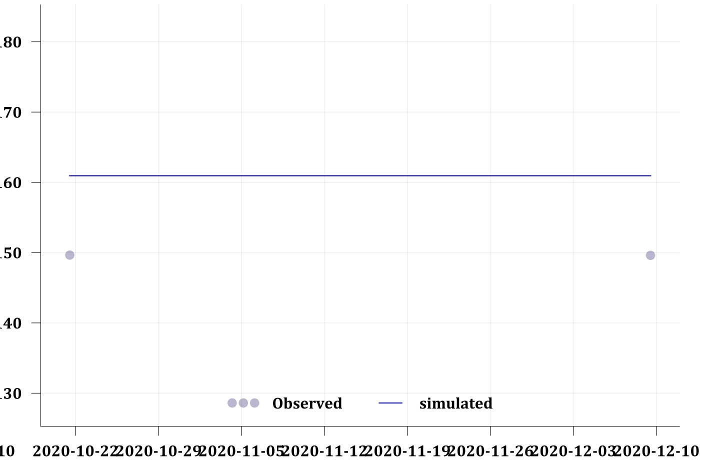


W14_MB2



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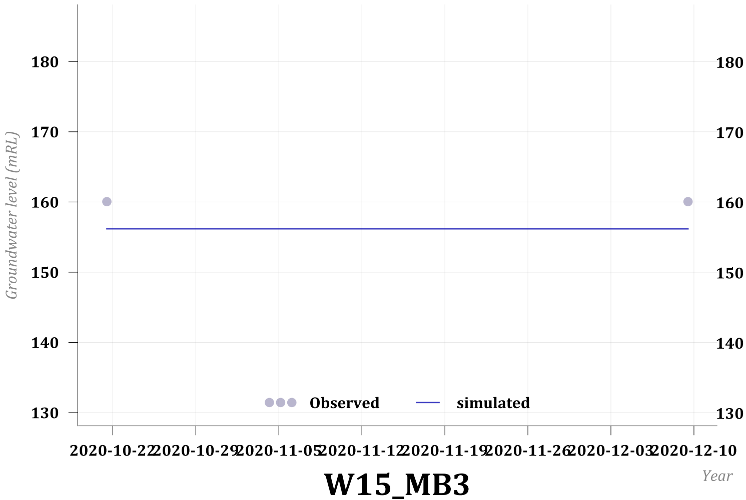
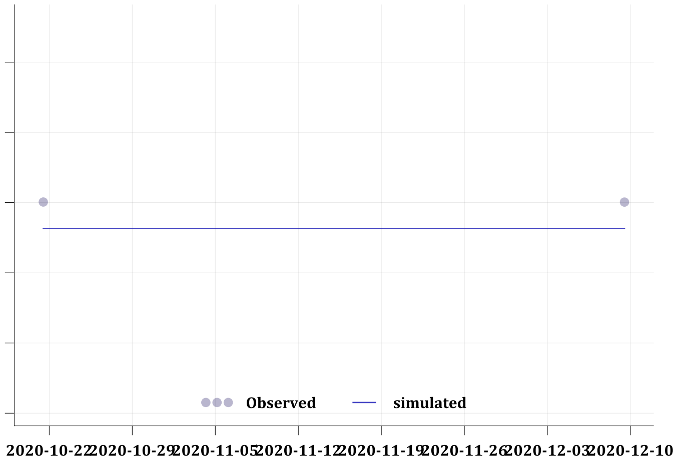
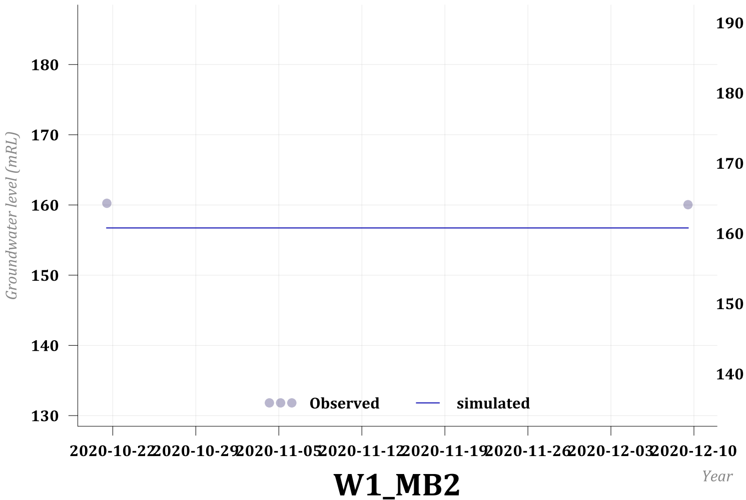


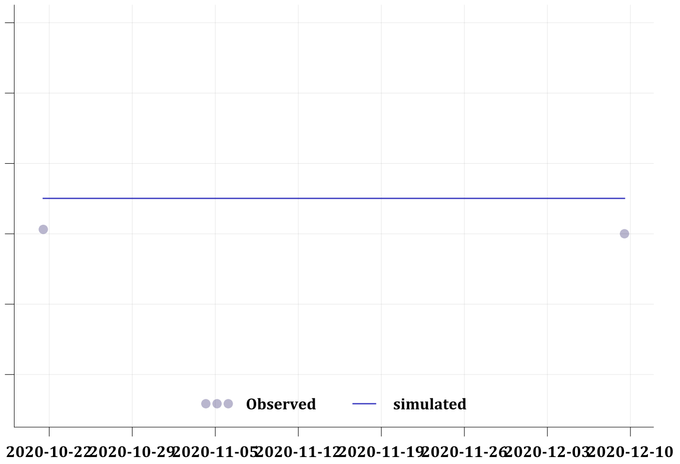
W15_MB2



W15_MB3



W1_MB1



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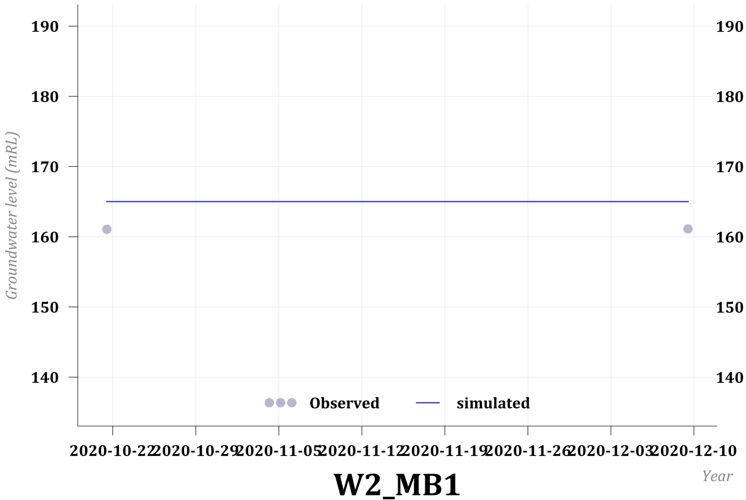
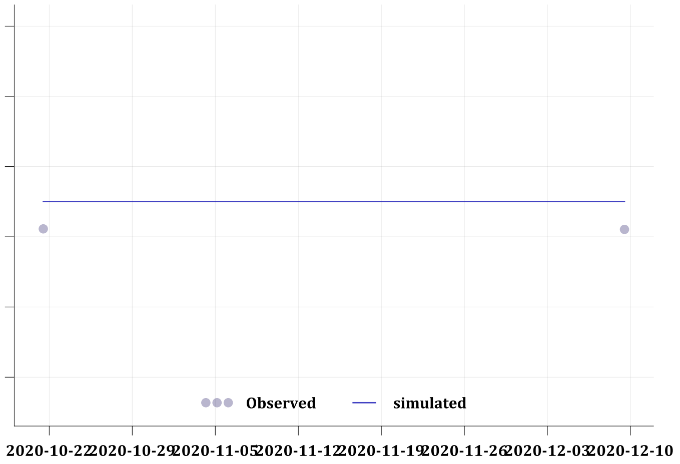
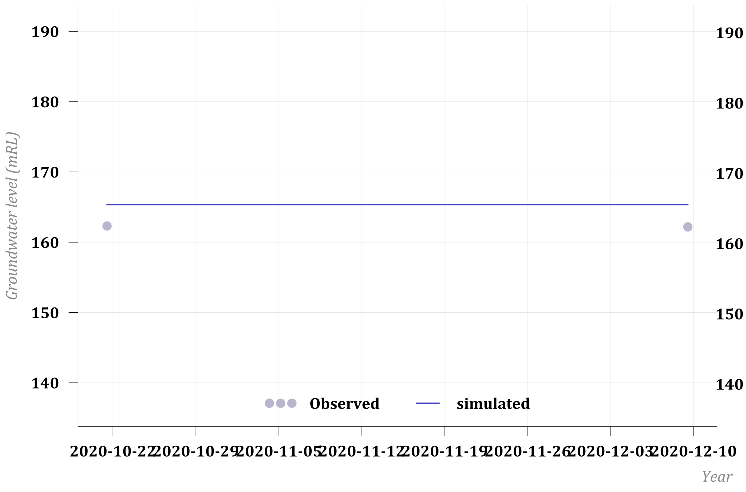


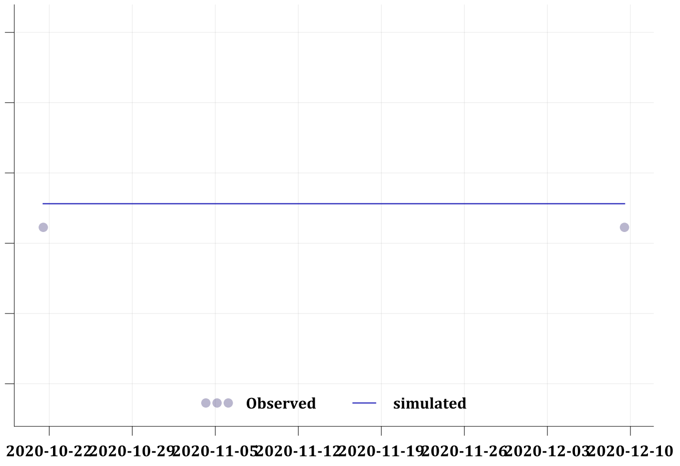
W1_MB3



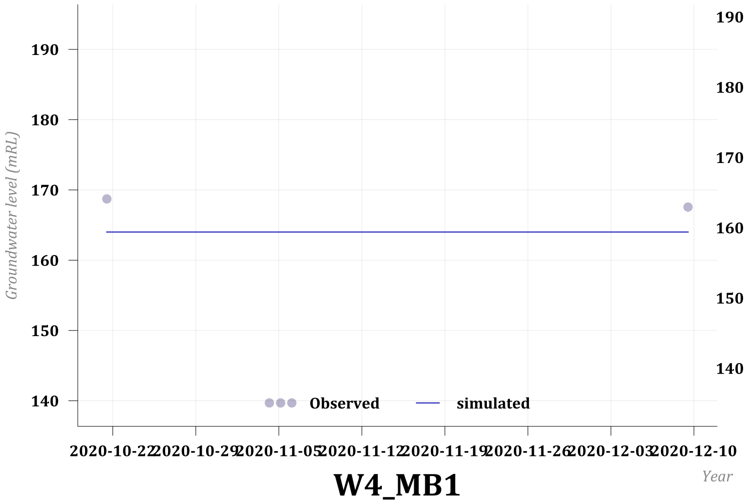
W2_MB1



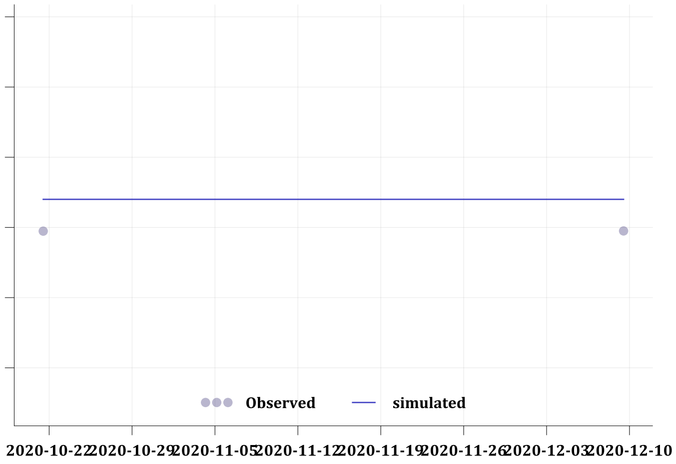
W2_MB2



W3_MB1



W3_MB2



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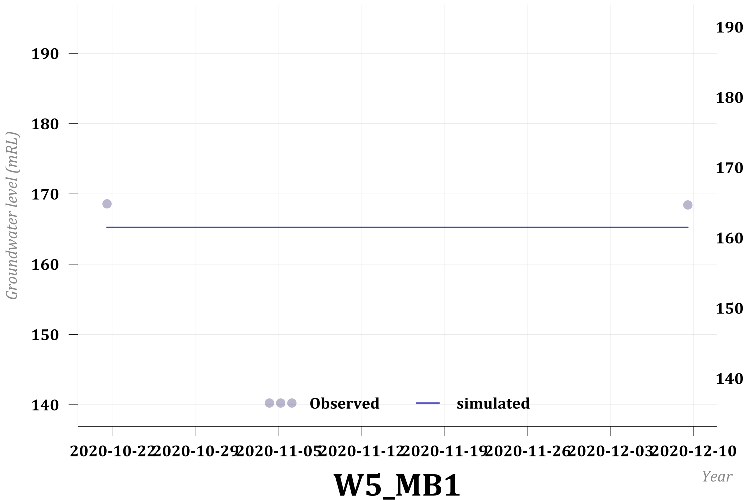

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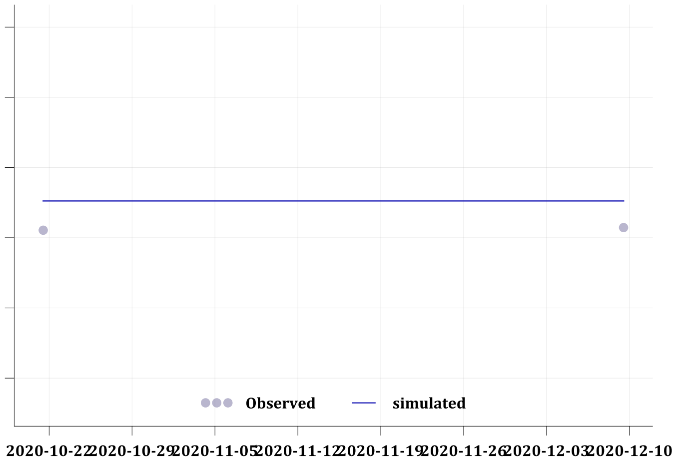

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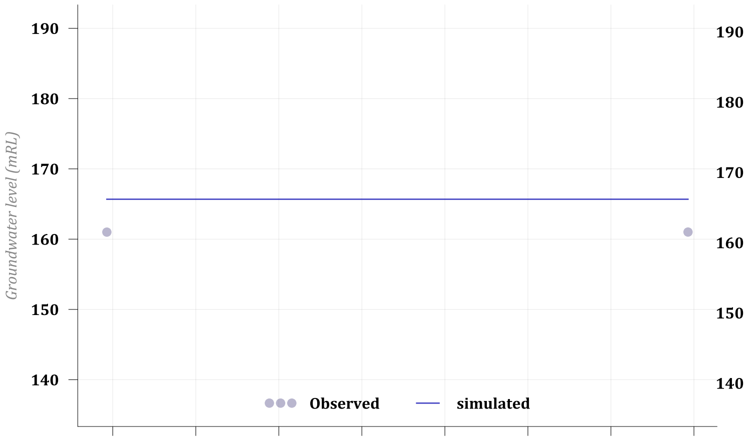

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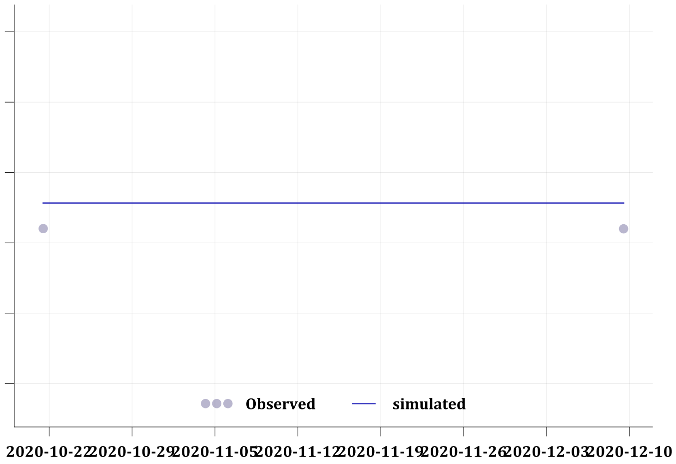
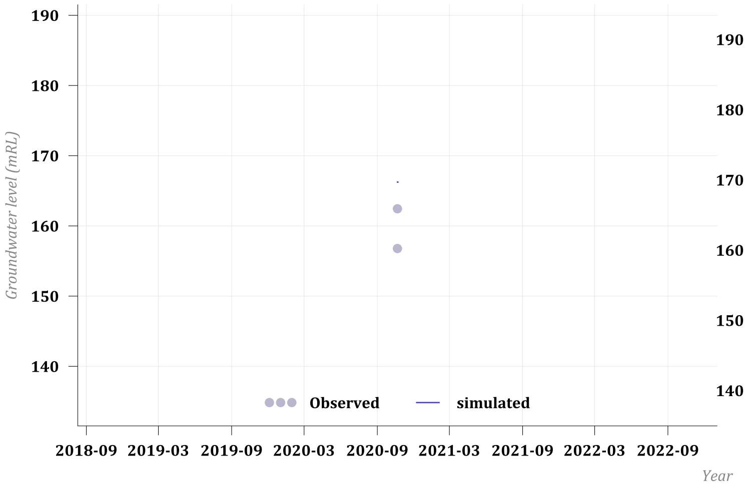
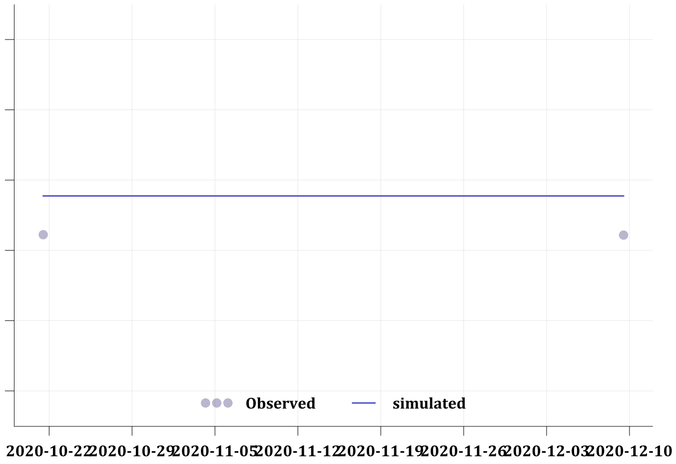
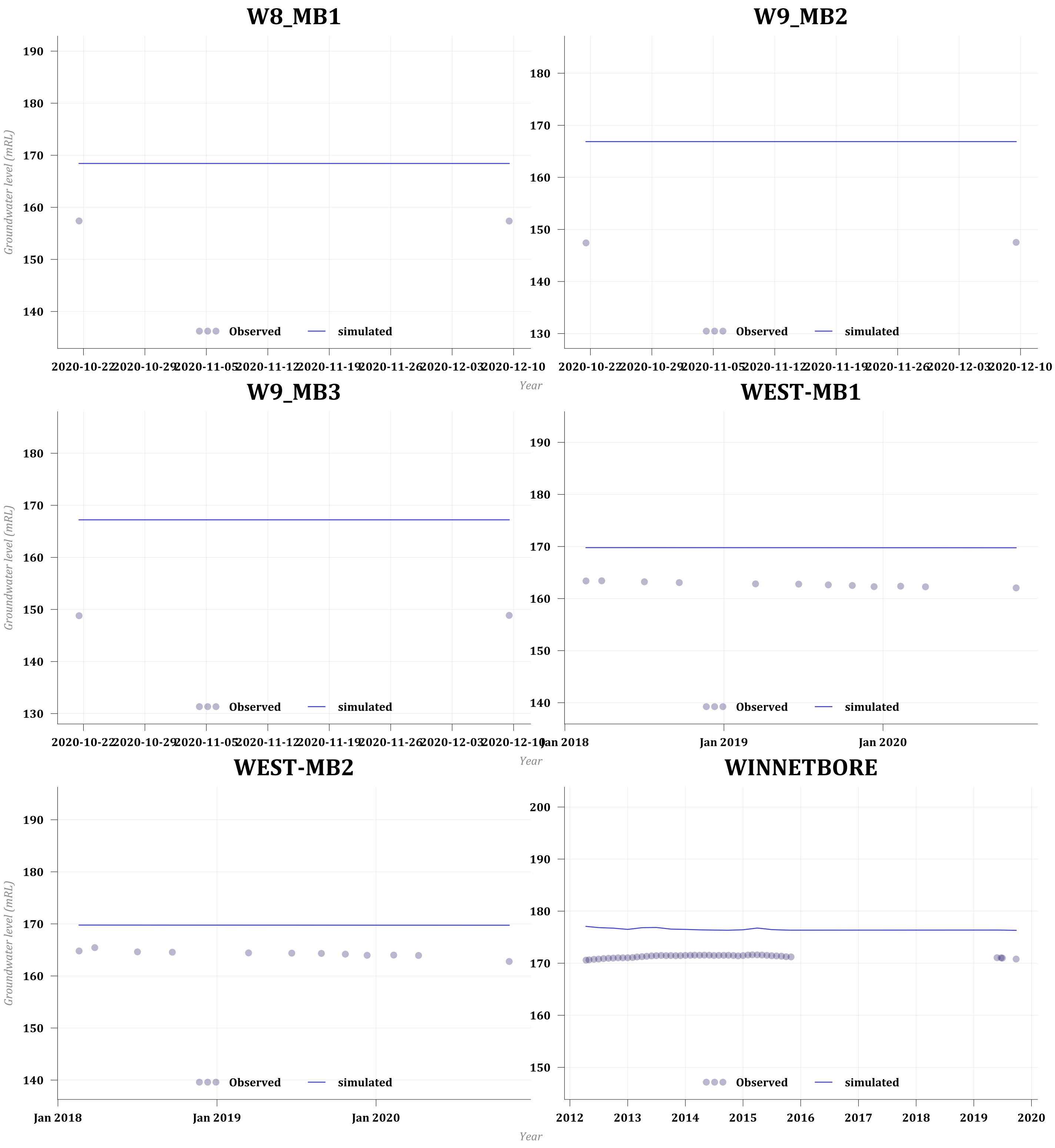


W6_MB1



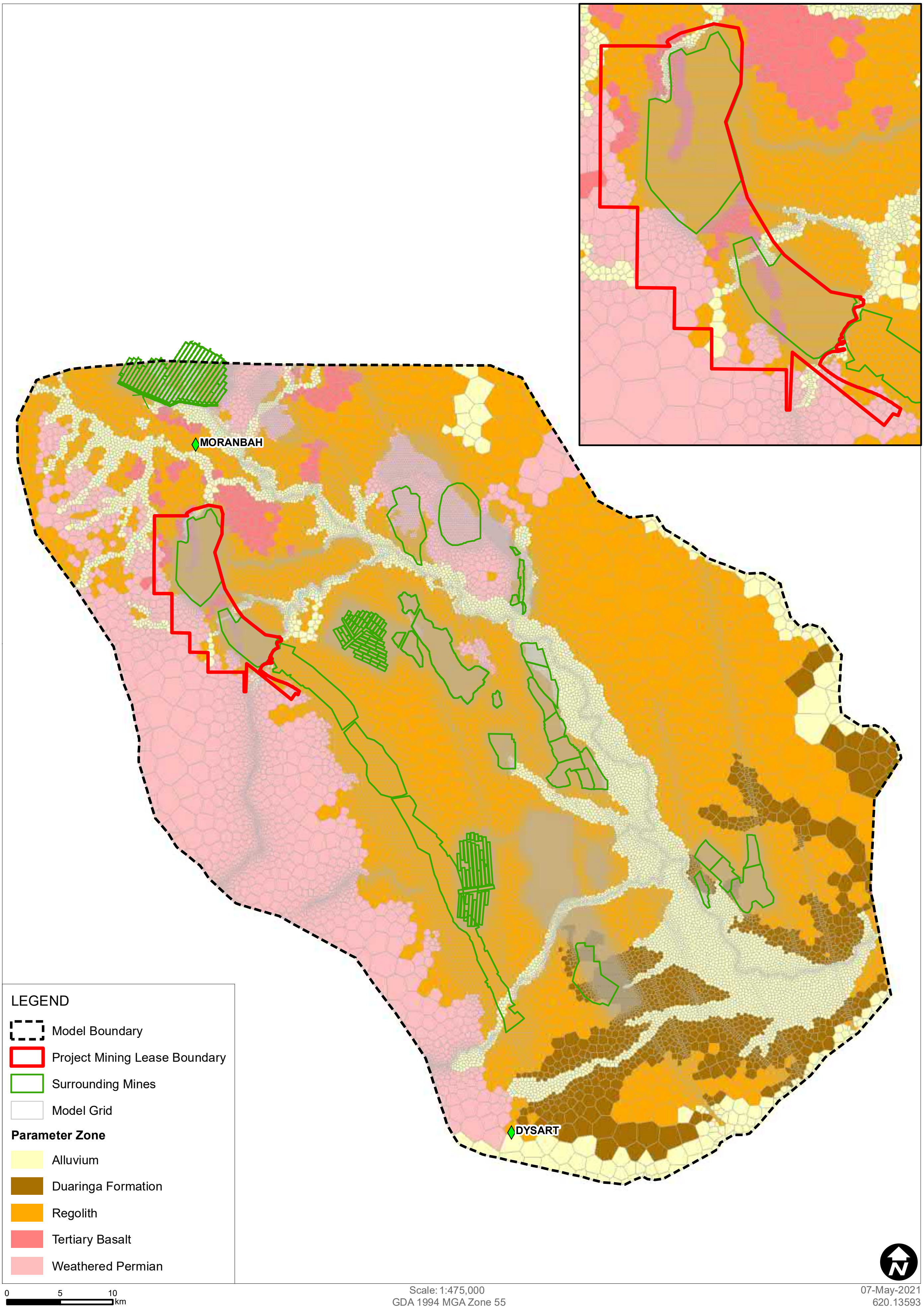
W7_MB1




W8_MB1
W9_MB2
W9_MB3
WEST-MB1
WEST-MB2
WINNETBORE
Groundwater level (mRL)
Year
190
180
170
160
150
140
130
200
2020-10-22
2020-10-29
2020-11-05
2020-11-12
2020-11-19
2020-11-26
2020-12-03
2020-12-10
Jan 2018
Jan 2019
Jan 2020
2012
2013
2014
2015
2016
2017
2018
2019
2020
●●● Observed
— simulated

APPENDIX C

Hydraulic Parameters and Recharge Zone Distribution



Scale: 1:475,000
GDA 1994 MGA Zone 55

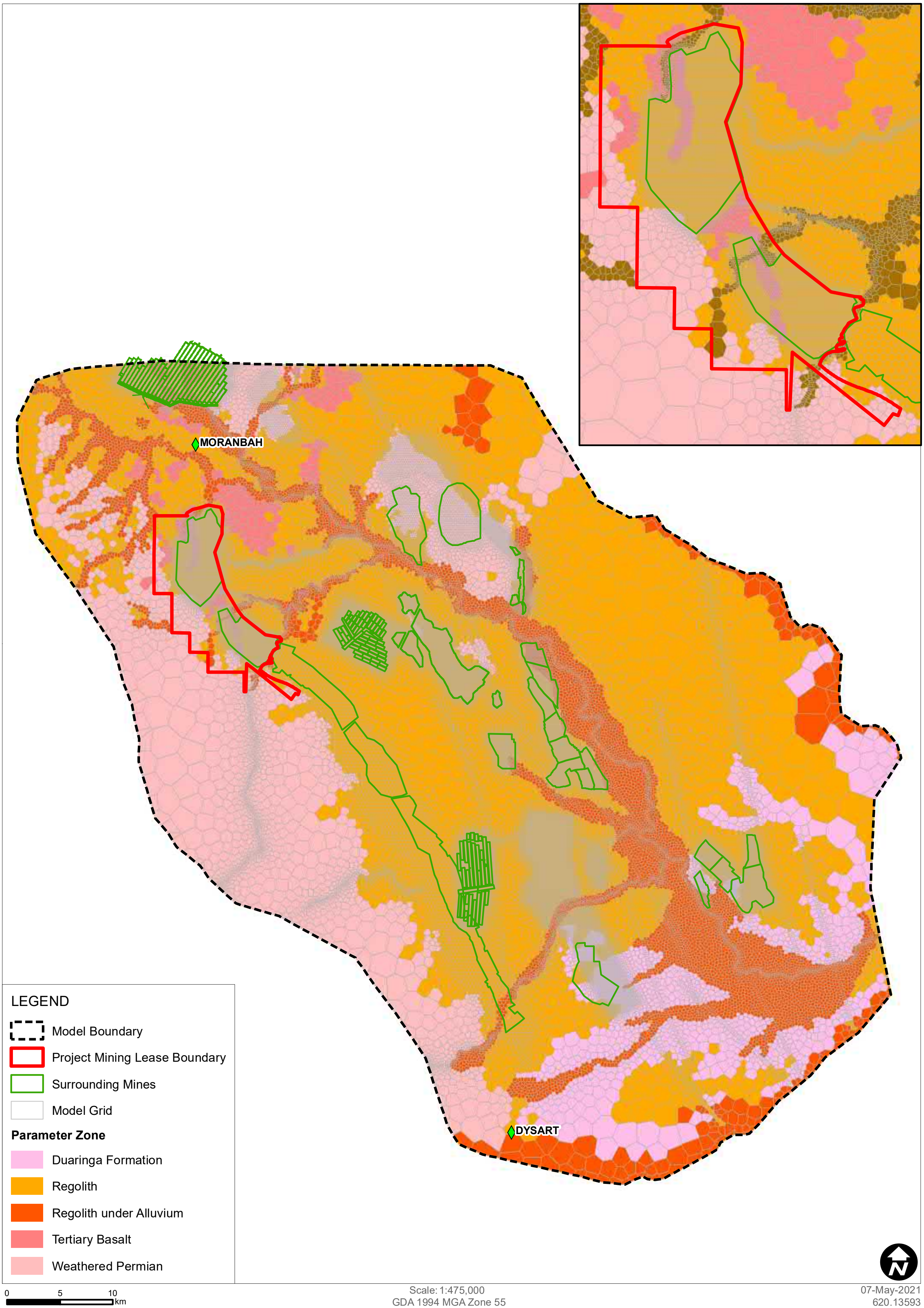
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-1 Hydraulic Zone Distribution (Layer 1).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 1

FIGURE C-1



Scale: 1:475,000
GDA 1994 MGA Zone 55

07-May-2021
620.13593

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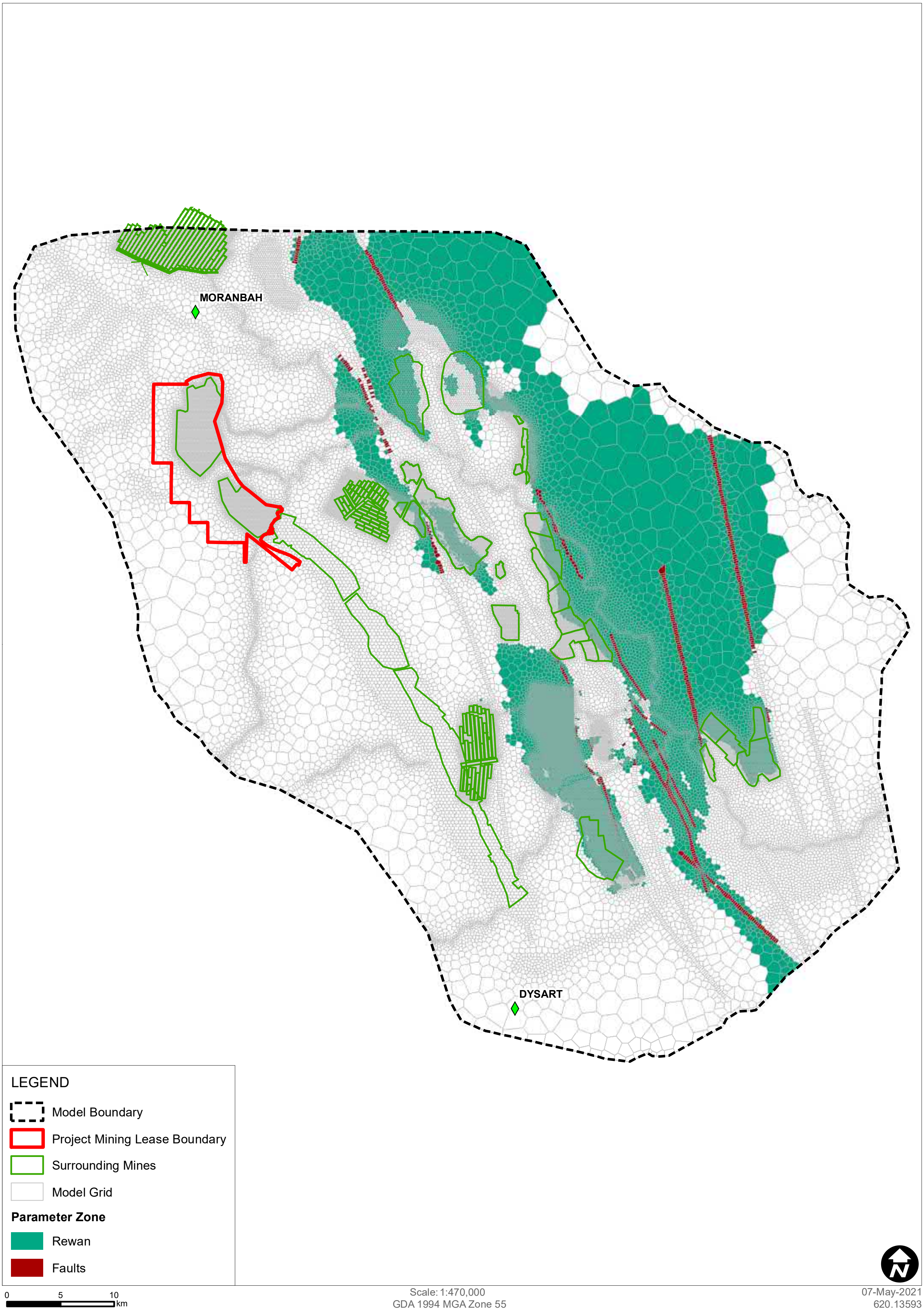
SLR

Hydraulic Parameter Zone Distribution Layer 2

FIGURE C-2



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GDA 1994 MGA Zone 55

07-May-2021
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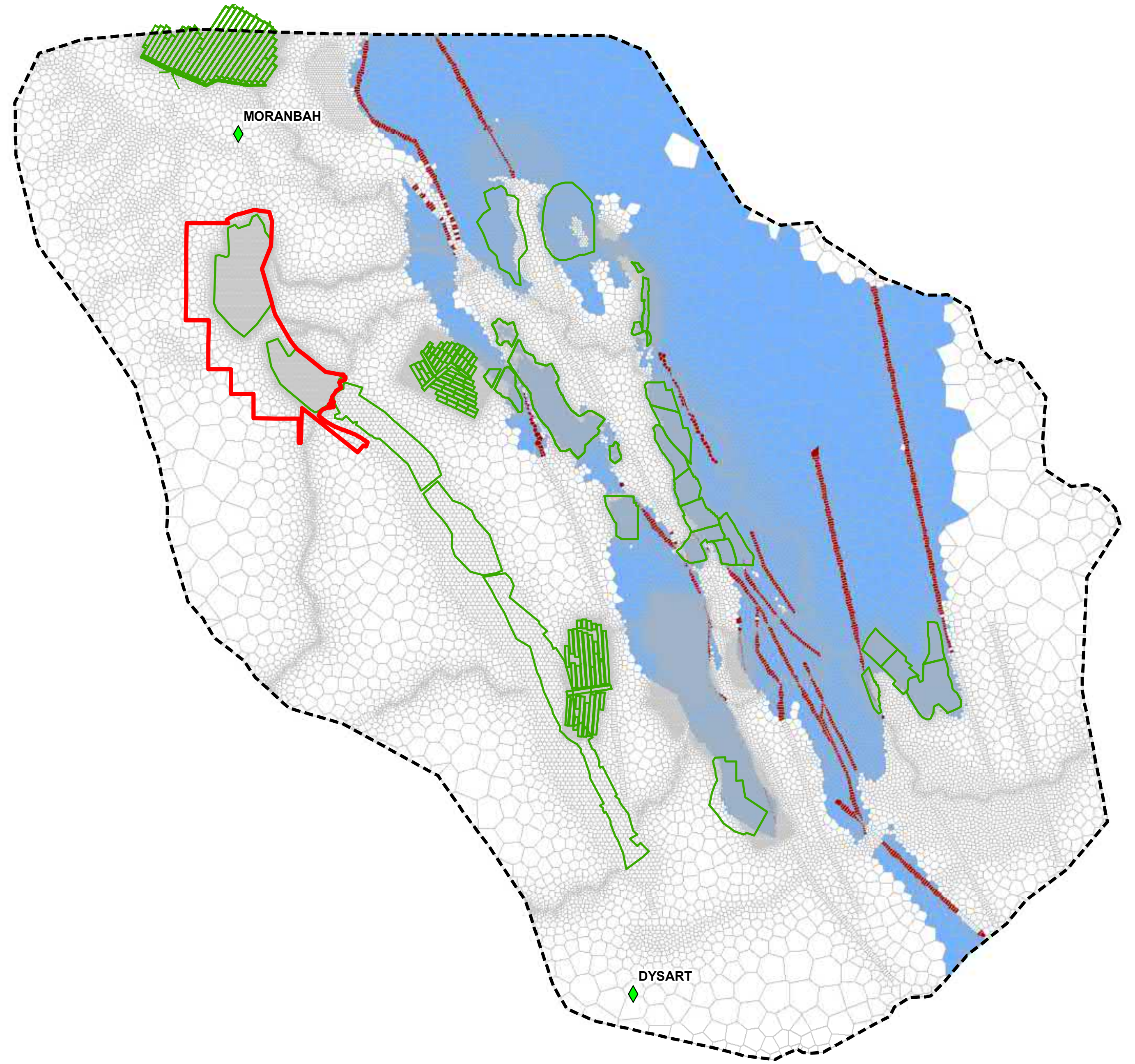
SLR

Hydraulic Parameter Zone Distribution Layer 3

FIGURE C-3



LEGEND

- ⬚ Model Boundary
- 🟥 Project Mining Lease Boundary
- 🟩 Surrounding Mines
- ⬜ Model Grid

Parameter Zone

- 🟦 RCM-Interburden
- 🟥 Faults

0 5 10 km

Scale: 1:470,000
GDA 1994 MGA Zone 55

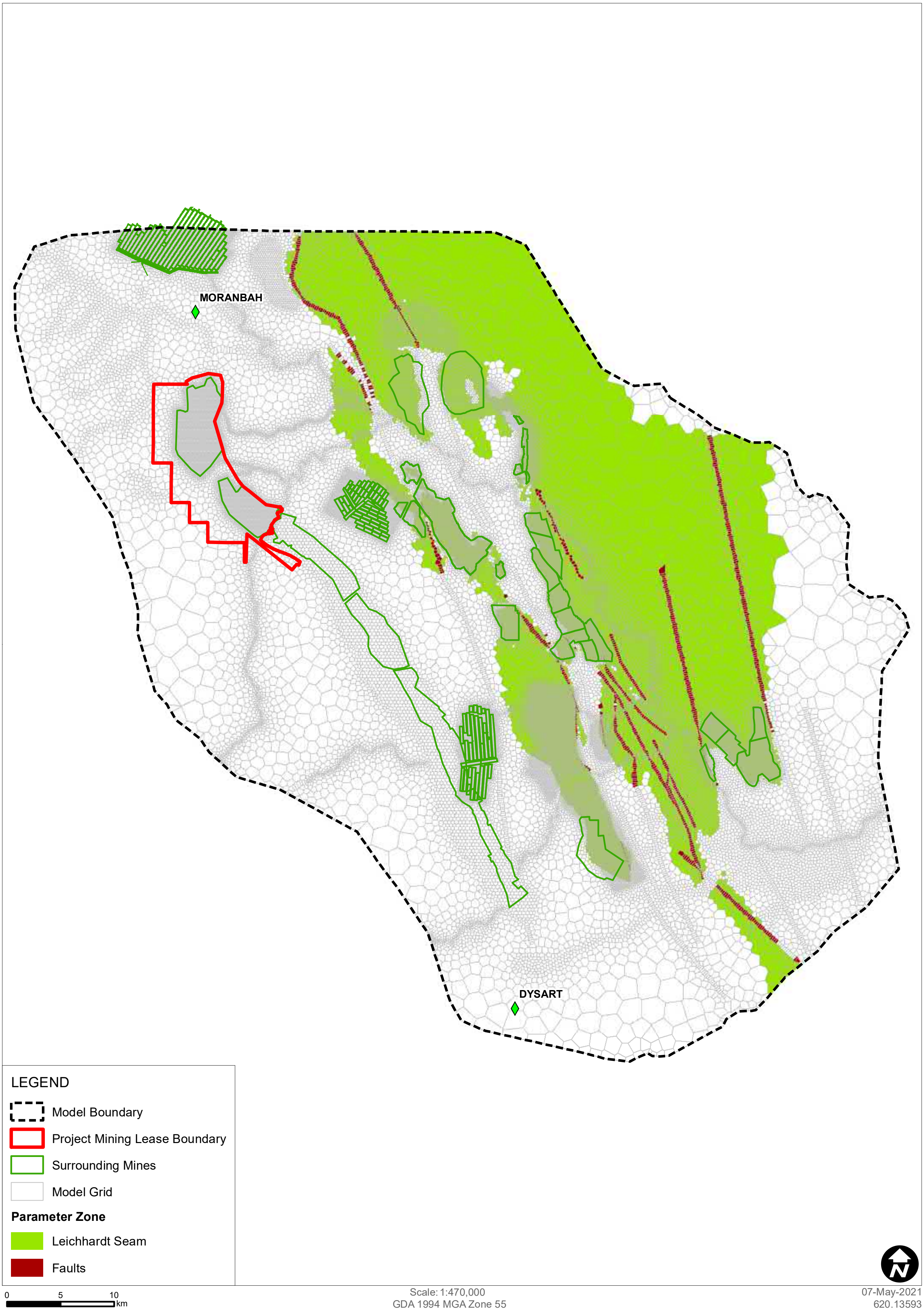
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-4 Hydraulic Zone Distribution (Layer 4).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 4

FIGURE C-4



LEGEND

- ⬚ Model Boundary
- 🟥 Project Mining Lease Boundary
- 🟩 Surrounding Mines
- ⬜ Model Grid

Parameter Zone

- 🟩 Leichhardt Seam
- 🟥 Faults

Scale: 1:470,000
GDA 1994 MGA Zone 55

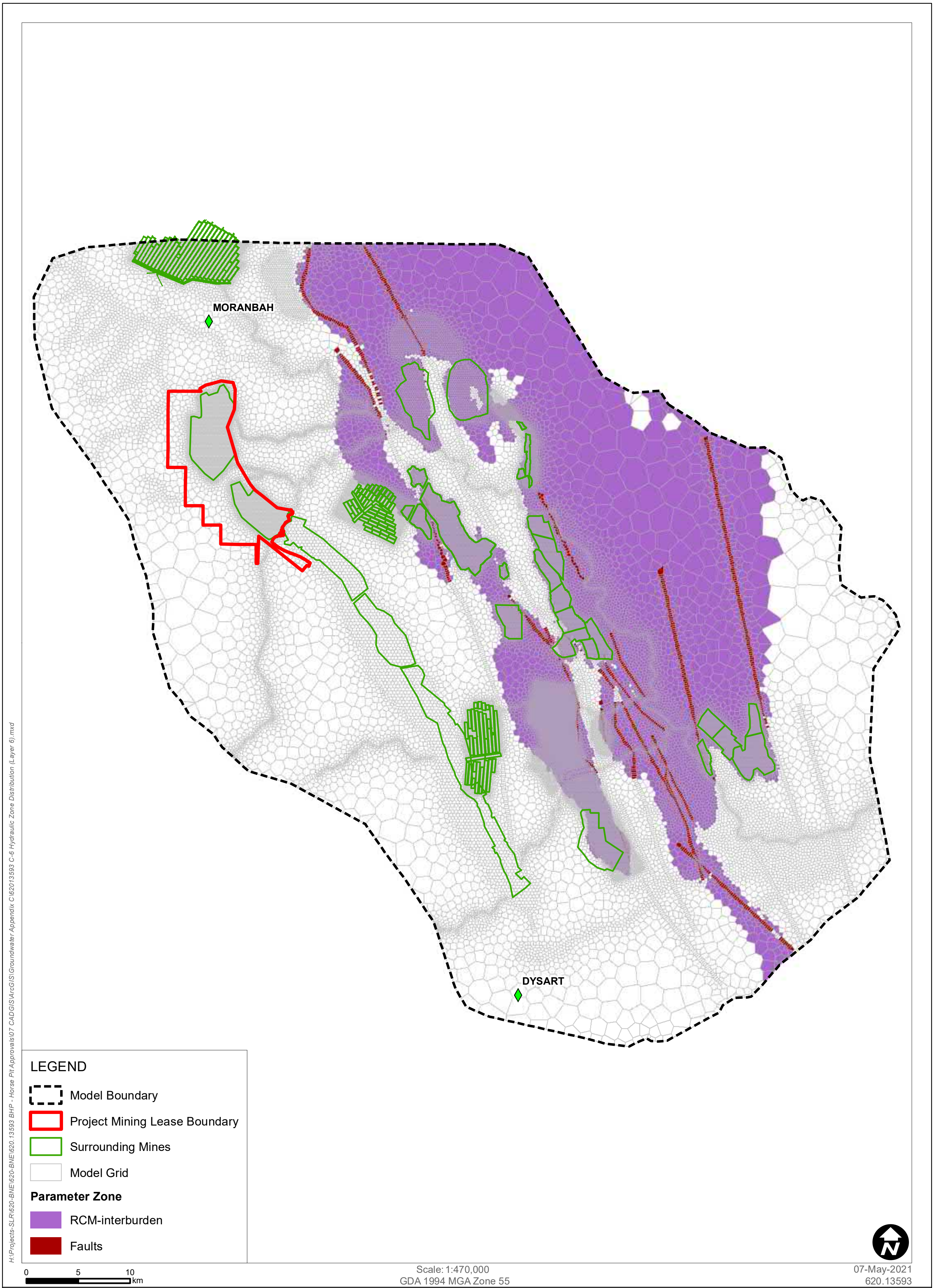
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-5 Hydraulic Zone Distribution (Layer 5).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 5

FIGURE C-5



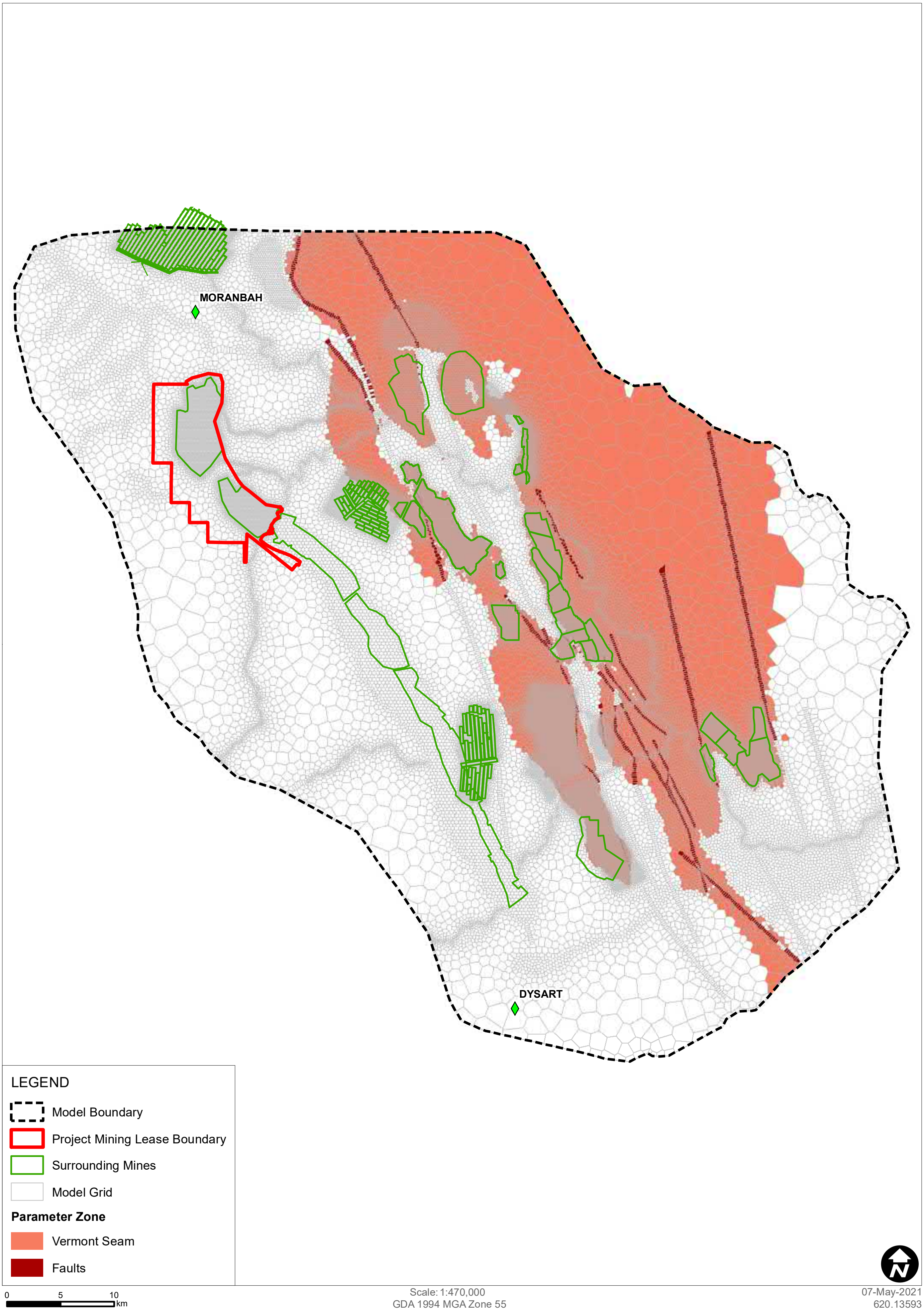
Scale: 1:470,000
GDA 1994 MGA Zone 55

07-May-2021
620.13593

SLR

Hydraulic Parameter Zone Distribution Layer 6

FIGURE C-6



Scale: 1:470,000
GDA 1994 MGA Zone 55

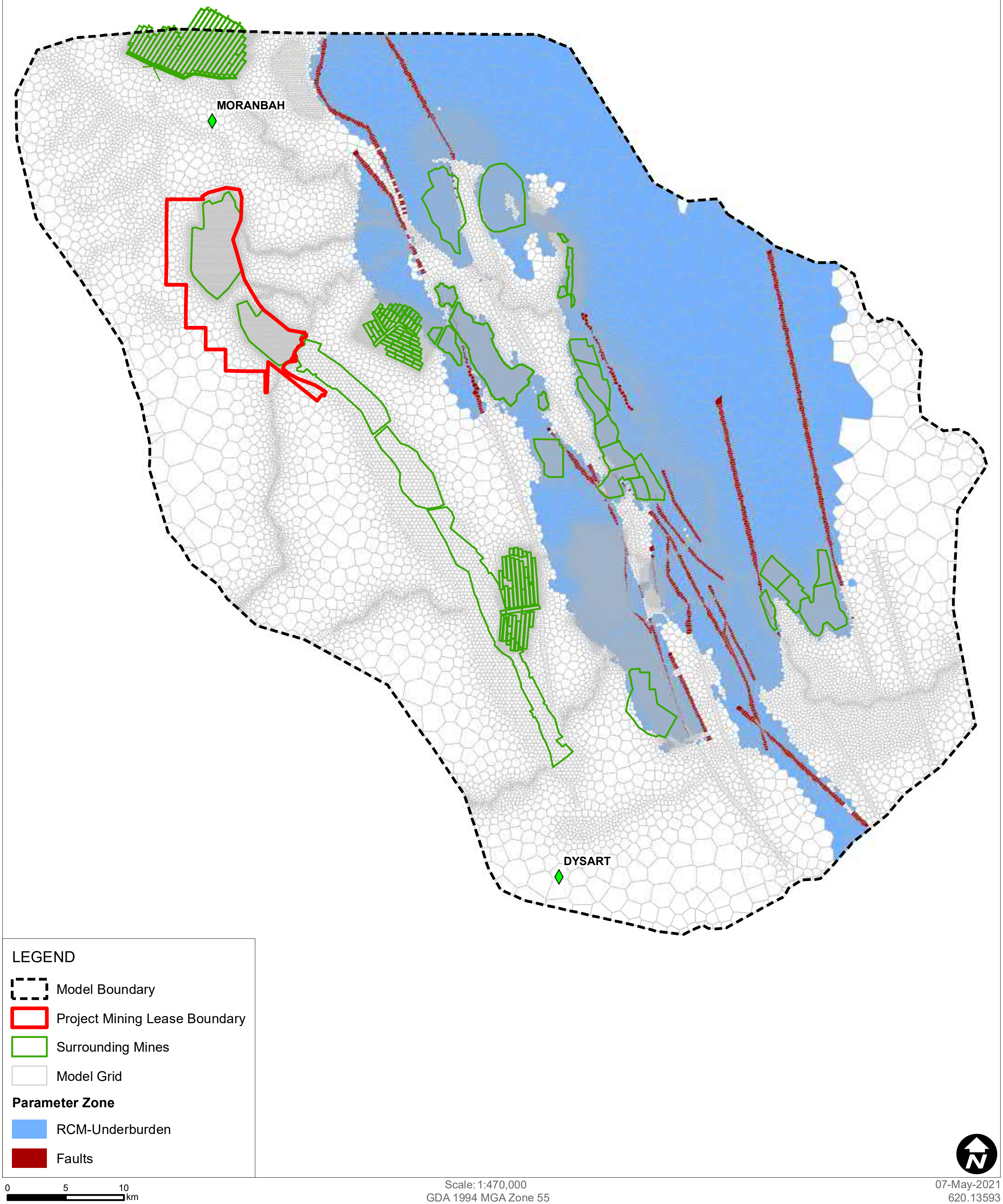
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-7 Hydraulic Zone Distribution (Layer 7).mxd

SLR

**Hydraulic Parameter
Zone Distribution
Layer 7**

FIGURE C-7



Scale: 1:470,000
GDA 1994 MGA Zone 55

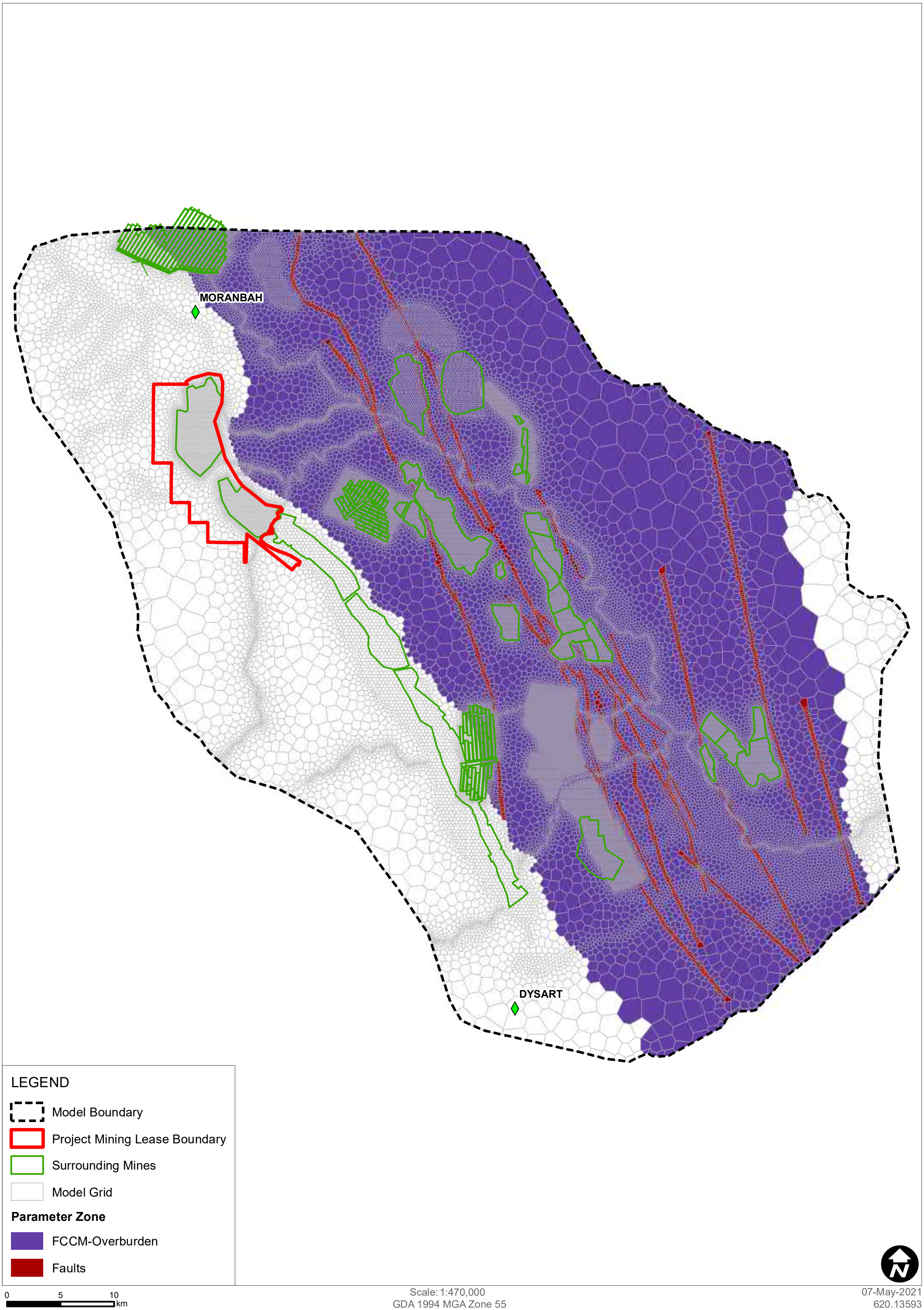
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-8 Hydraulic Zone Distribution (Layer 8).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 8

FIGURE C-8



Scale: 1:470,000
GDA 1994 MGA Zone 55

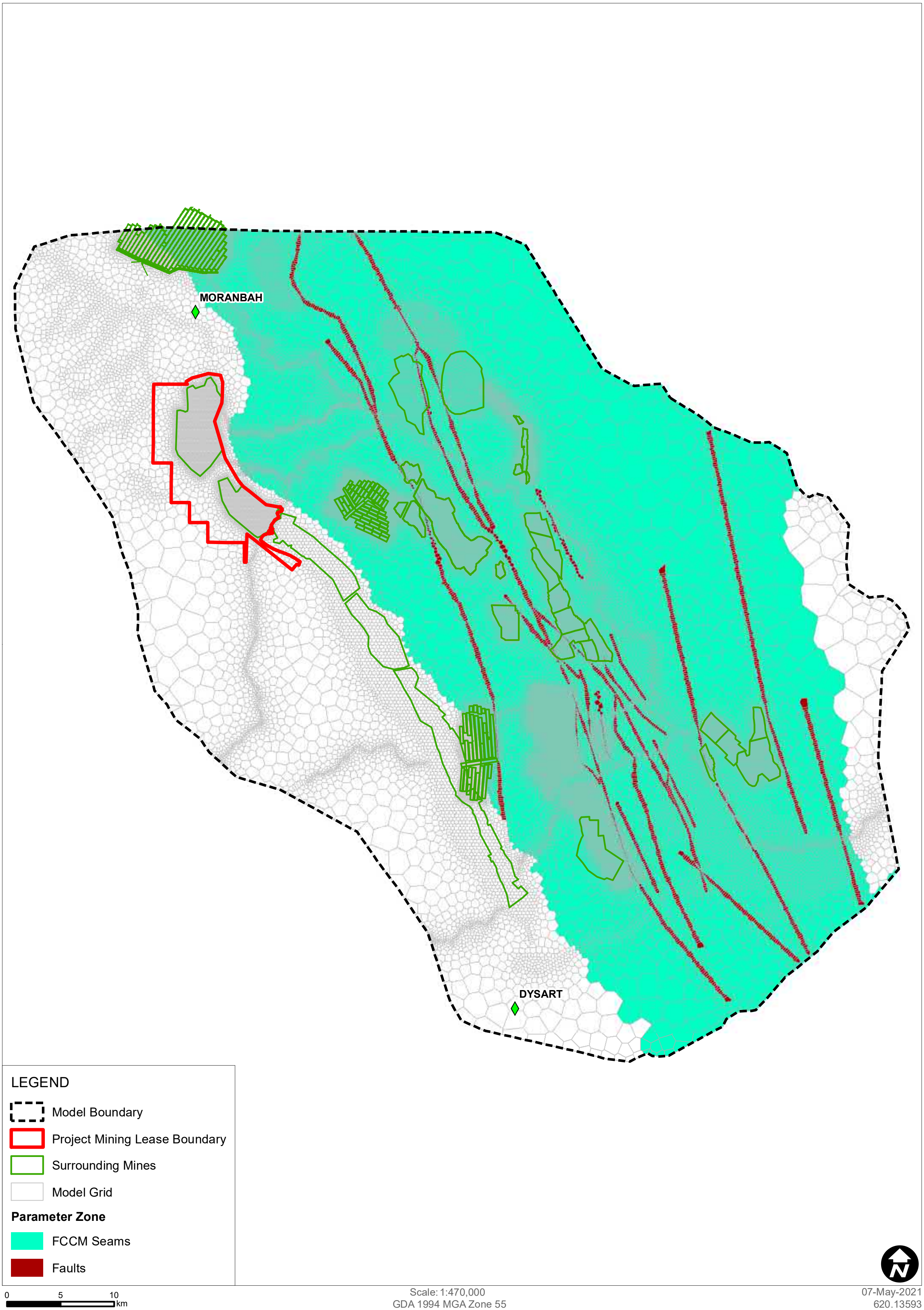
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-9 Hydraulic Zone Distribution (Layer 9).mxd

SLR

Hydraulic Parameter
Zone Distribution
Layer 9

FIGURE C-9



Scale: 1:470,000
GDA 1994 MGA Zone 55

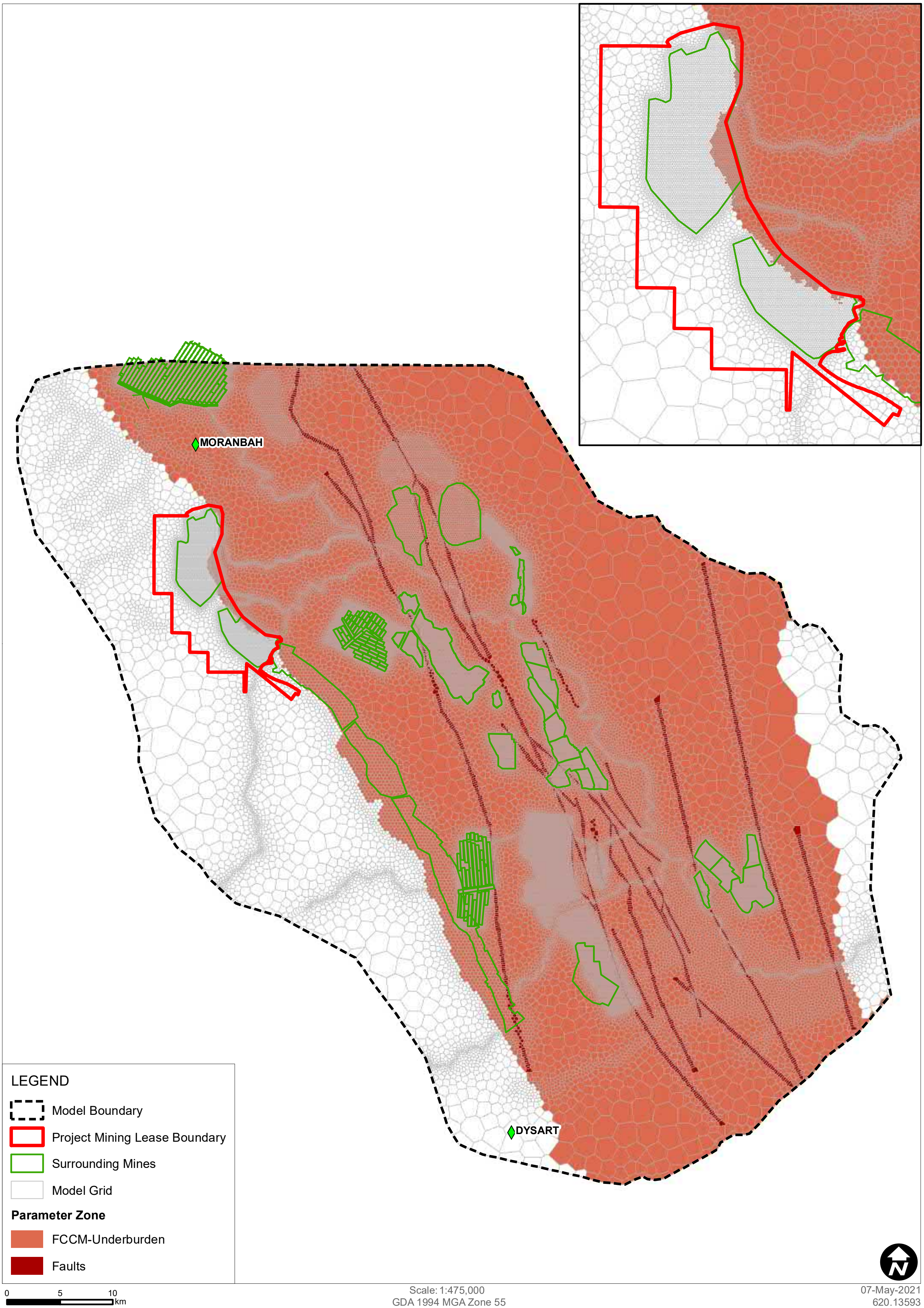
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-10 Hydraulic Zone Distribution (Layer 10).mxd

SLR

Hydraulic Parameter
Zone Distribution
Layer 10

FIGURE C-10



Scale: 1:475,000
GDA 1994 MGA Zone 55

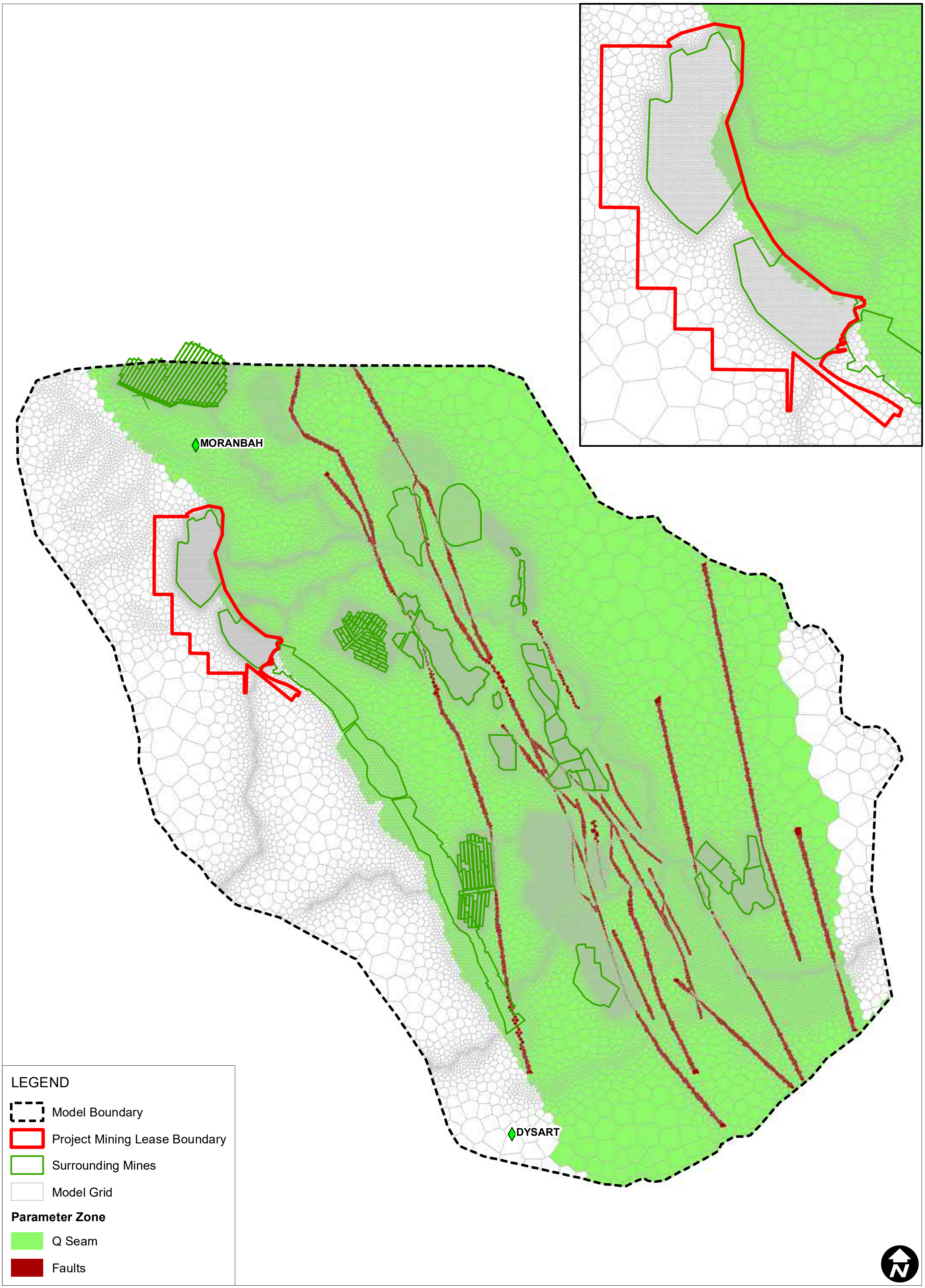
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-11 Hydraulic Zone Distribution (Layer 11).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 11

FIGURE C-11



LEGEND

- ⬚ Model Boundary
- 🟥 Project Mining Lease Boundary
- 🟩 Surrounding Mines
- ☐ Model Grid

Parameter Zone

- 🟩 Q Seam
- 🟥 Faults

Scale: 1:475,000
GDA 1994 MGA Zone 55

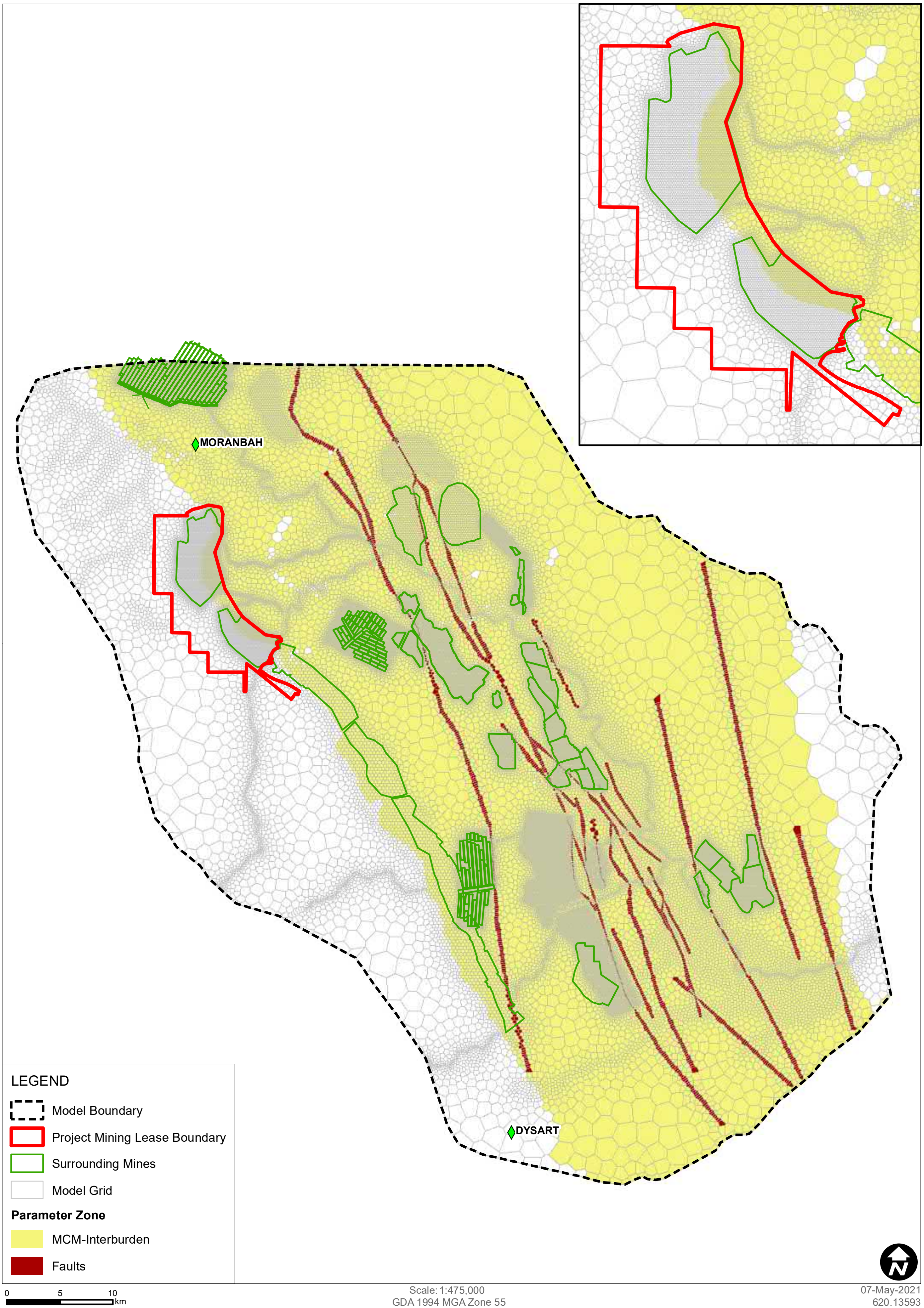
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-12 Hydraulic Zone Distribution (Layer 12).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 12

FIGURE C-12



Scale: 1:475,000
GDA 1994 MGA Zone 55

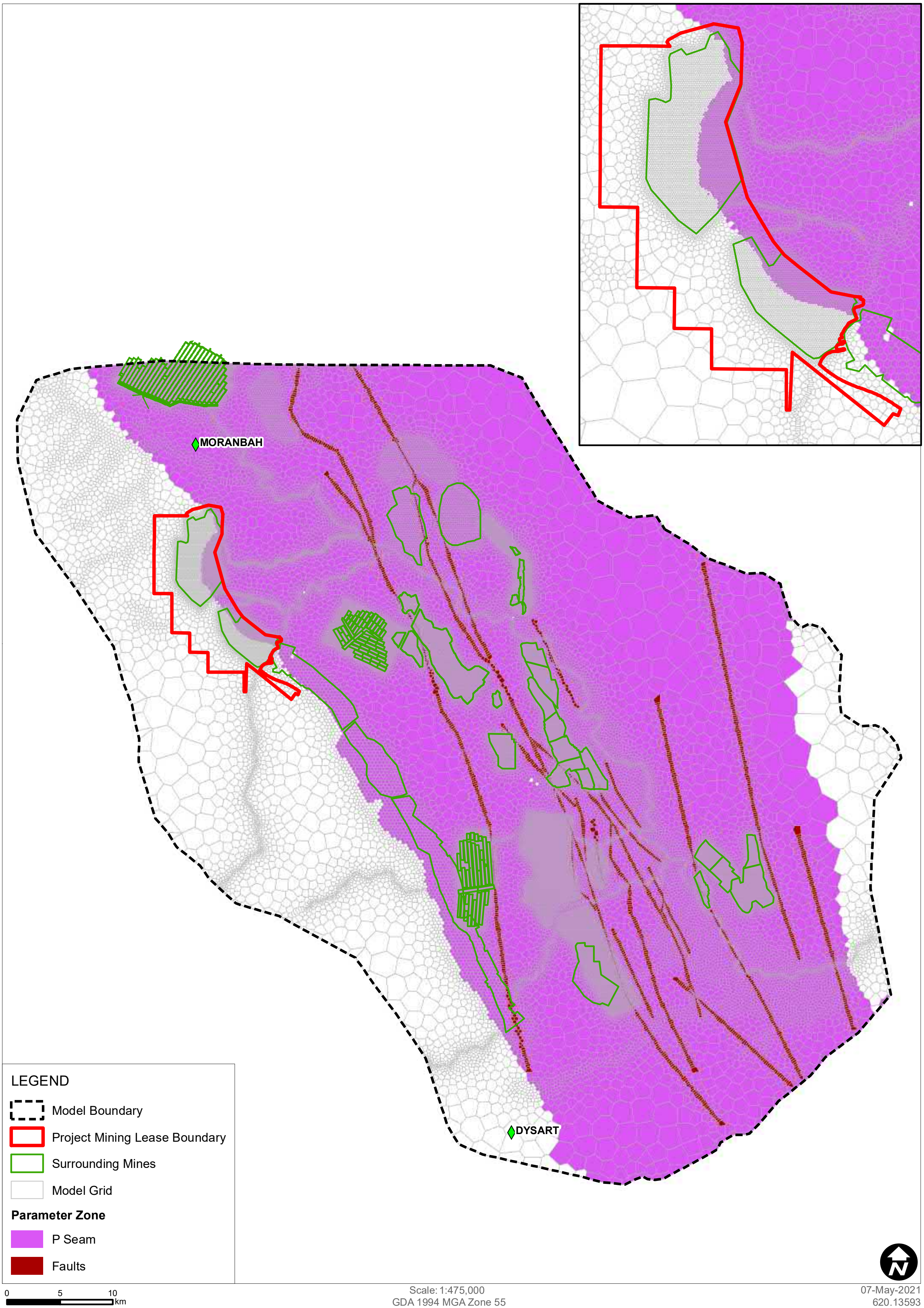
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-13 Hydraulic Zone Distribution (Layer 13).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 13

FIGURE C-13



Scale: 1:475,000
GDA 1994 MGA Zone 55

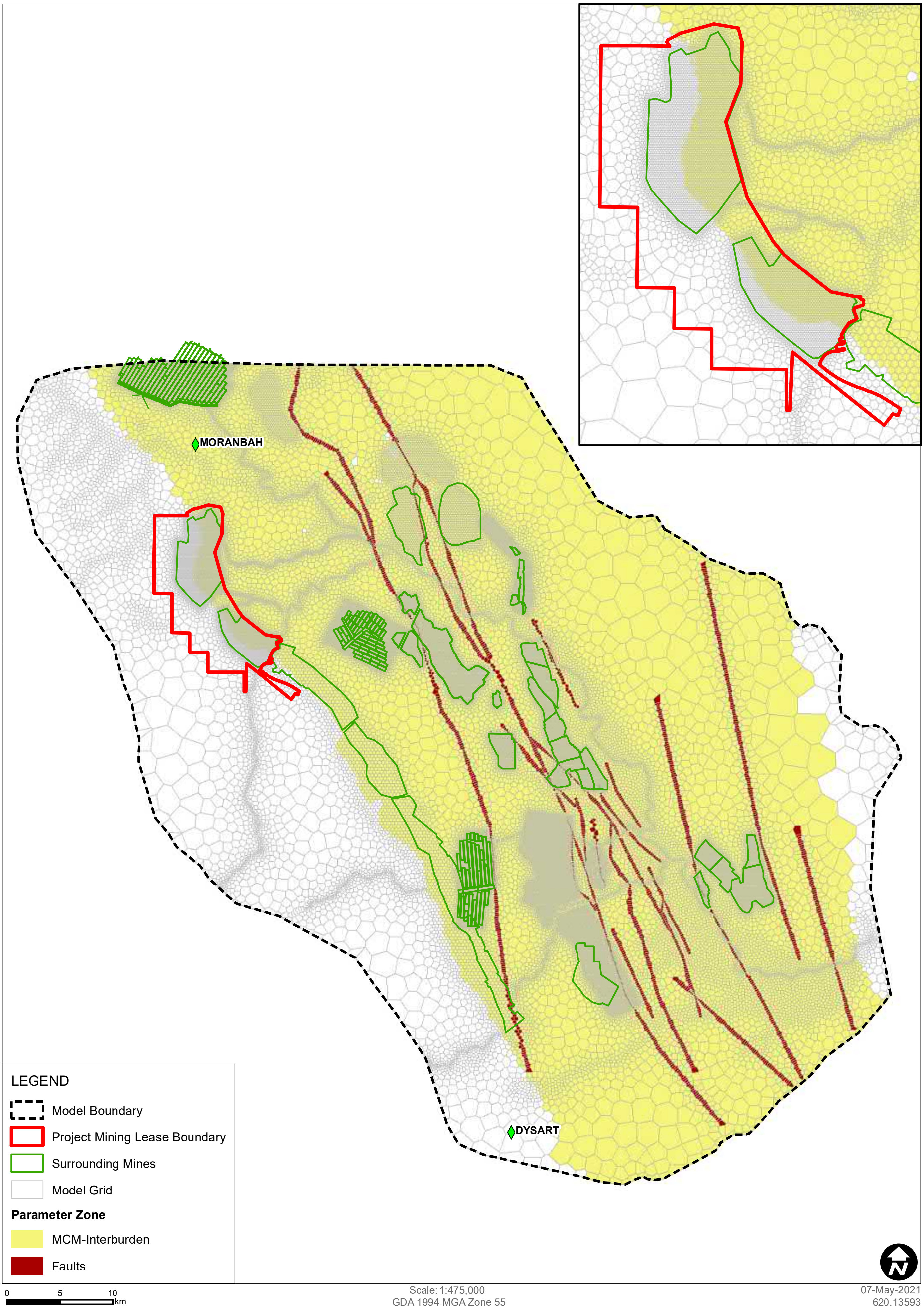
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-14 Hydraulic Zone Distribution (Layer 14).mxd

SLR

Hydraulic Parameter
Zone Distribution
Layer 14

FIGURE C-14



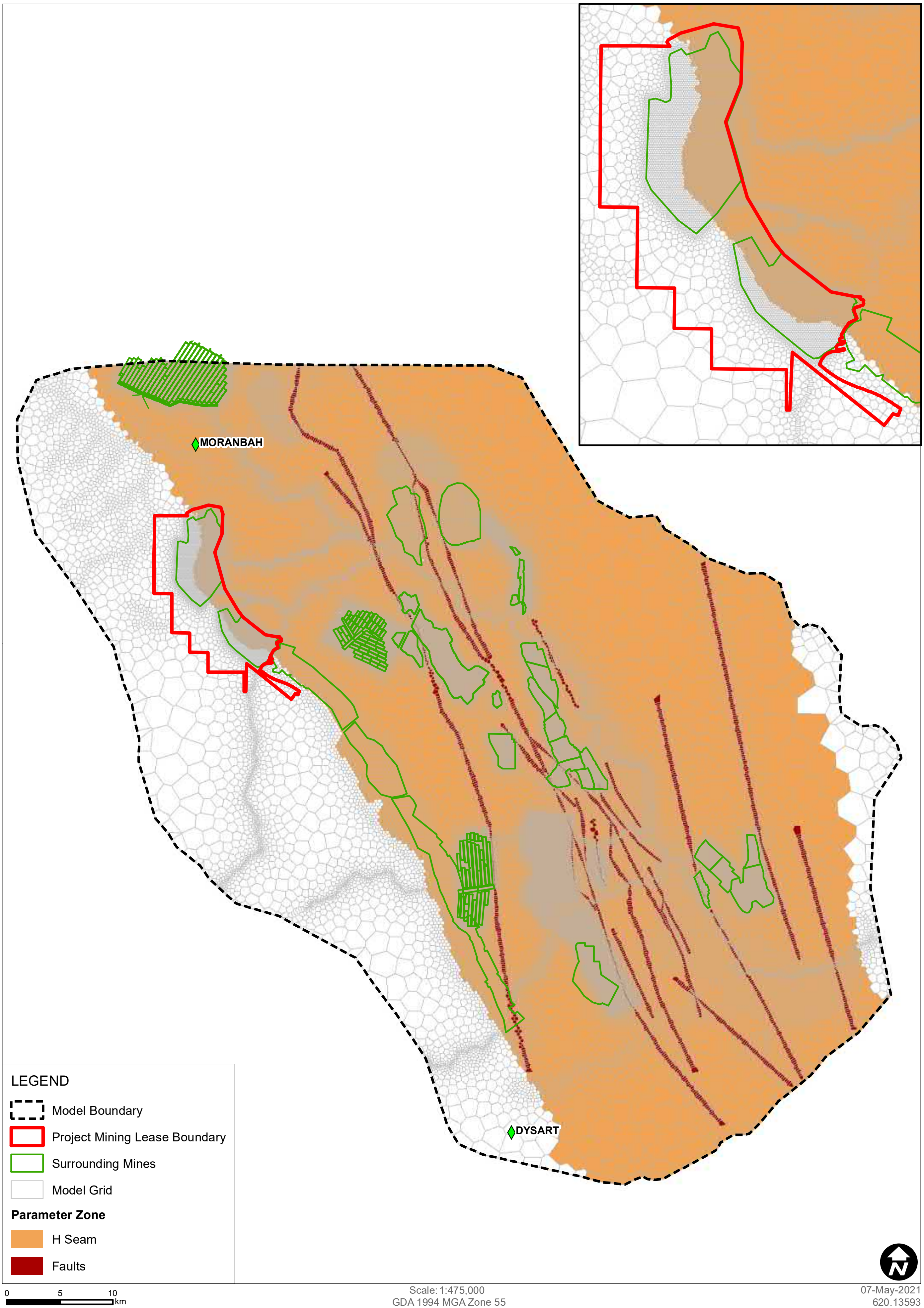
Scale: 1:475,000
GDA 1994 MGA Zone 55

07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-15 Hydraulic Zone Distribution (Layer 15).mxd

Hydraulic Parameter Zone Distribution Layer 15

FIGURE C-15



LEGEND

▭ Model Boundary

🟥 Project Mining Lease Boundary

🟩 Surrounding Mines

⬜ Model Grid

Parameter Zone

🟧 H Seam

🟥 Faults

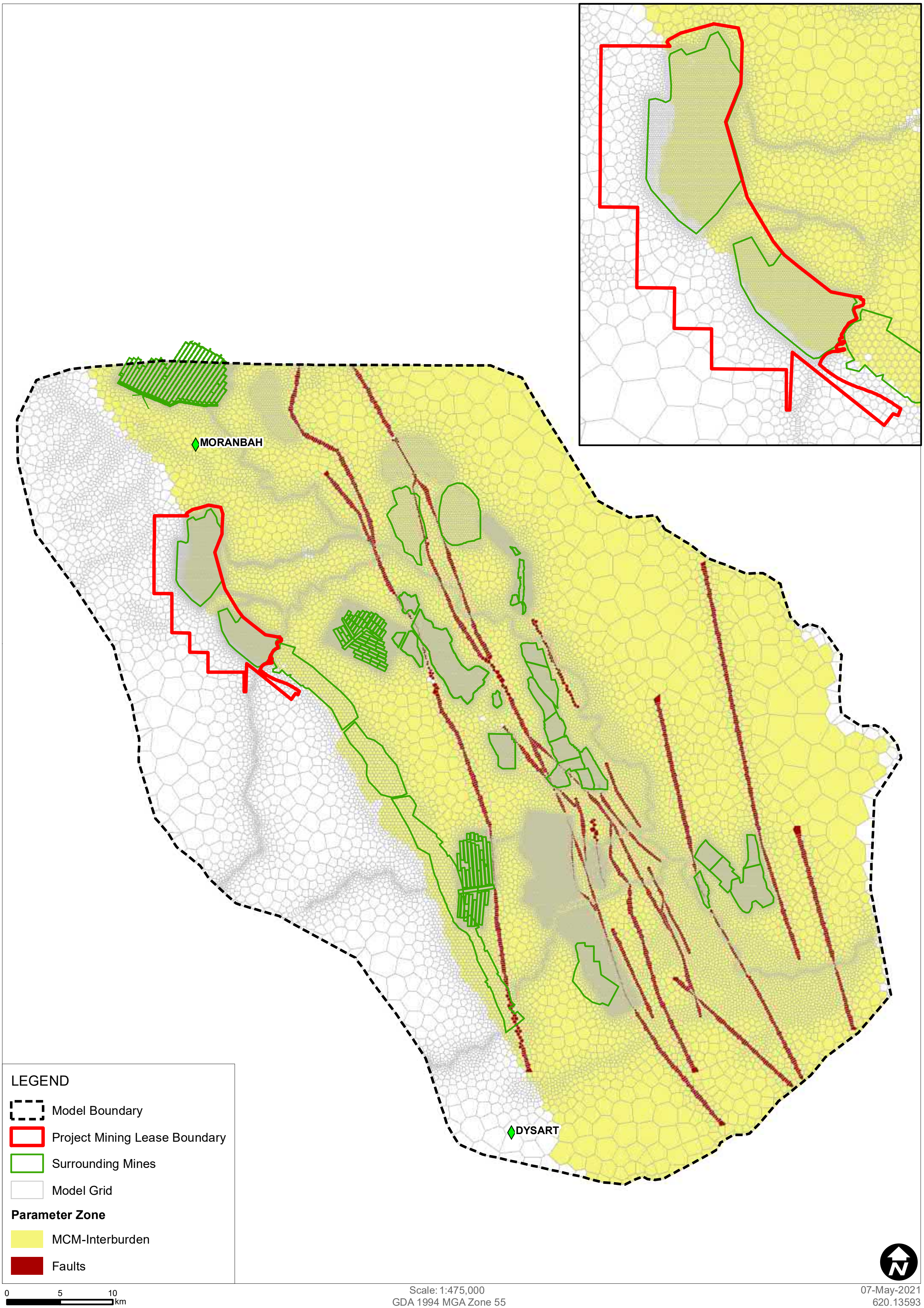
Scale: 1:475,000
GDA 1994 MGA Zone 55

07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-16 Hydraulic Zone Distribution (Layer 16).mxd

Hydraulic Parameter Zone Distribution Layer 16

FIGURE C-16



LEGEND

- ⬚ Model Boundary
- 🟥 Project Mining Lease Boundary
- 🟩 Surrounding Mines
- ☐ Model Grid

Parameter Zone

- 🟨 MCM-Interburden
- 🟥 Faults

Scale: 1:475,000
GDA 1994 MGA Zone 55

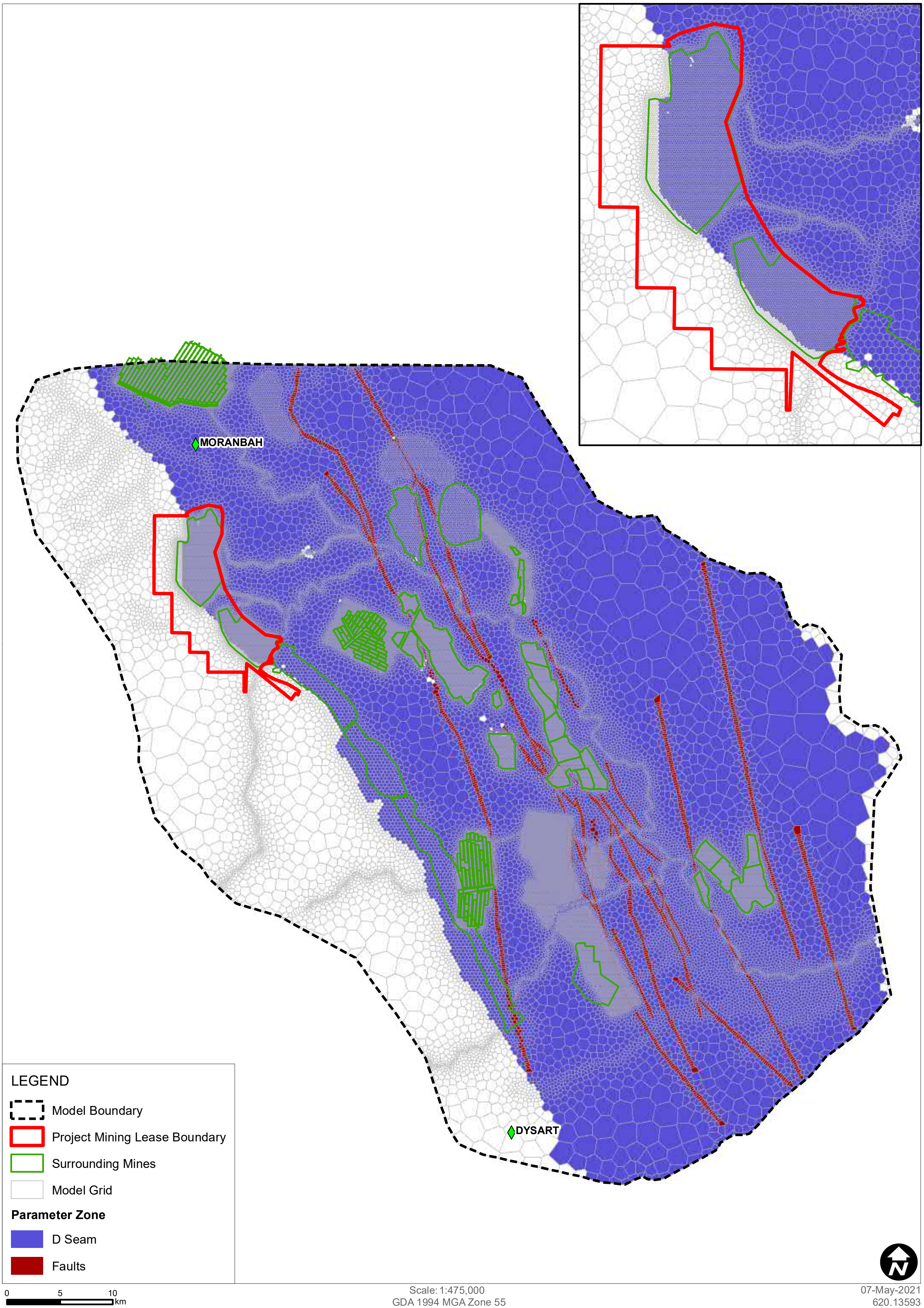
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-17 Hydraulic Zone Distribution (Layer 17).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 17

FIGURE C-17



Scale: 1:475,000
GDA 1994 MGA Zone 55

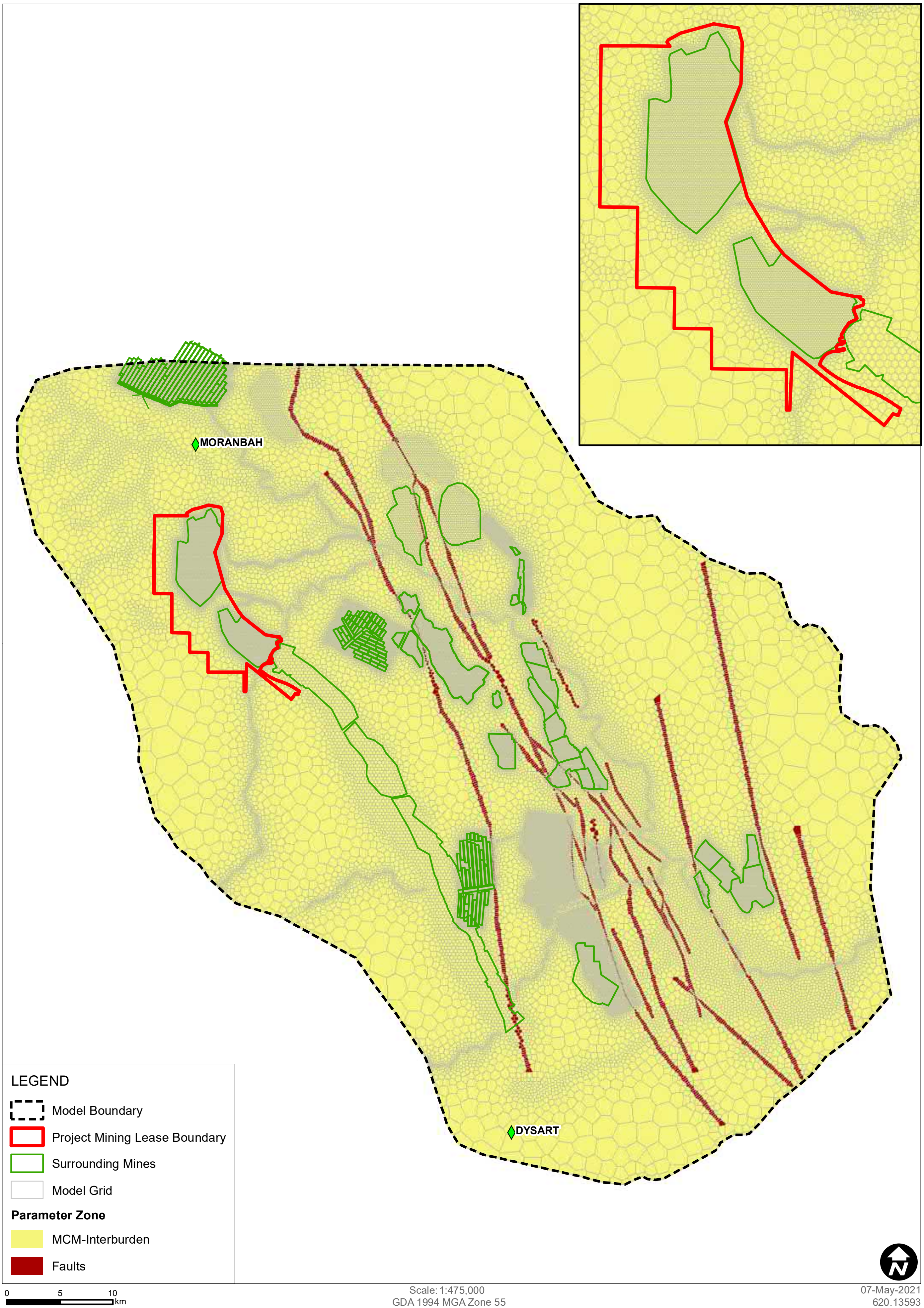
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-18 Hydraulic Zone Distribution (Layer 18).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 18

FIGURE C-18



Scale: 1:475,000
GDA 1994 MGA Zone 55

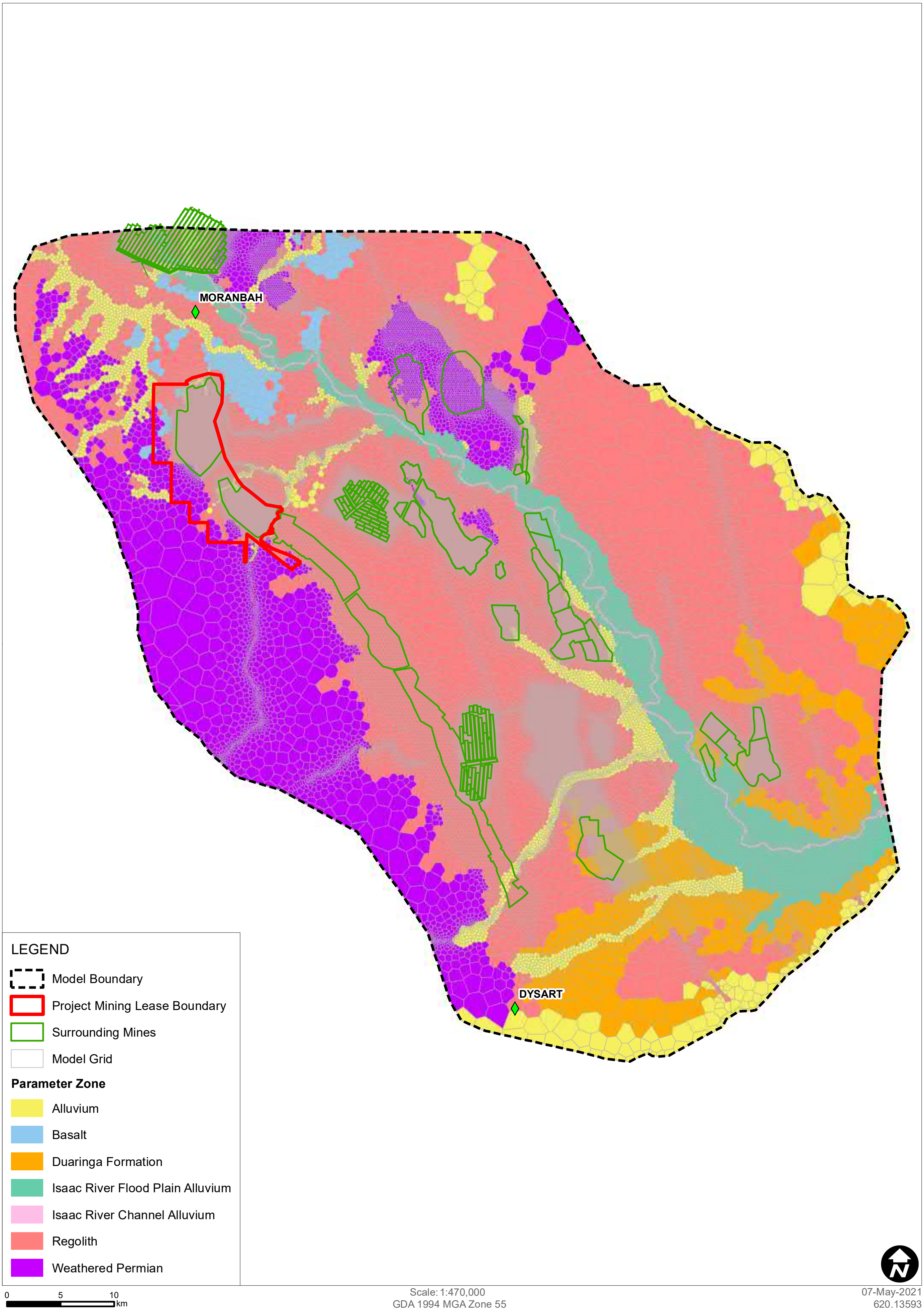
07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-19 Hydraulic Zone Distribution (Layer 19).mxd

SLR

Hydraulic Parameter Zone Distribution Layer 19

FIGURE C-19



Scale: 1:470,000
GDA 1994 MGA Zone 55

07-May-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Groundwater Appendix C\62013593 C-20 Recharge Zone Distribution.mxd

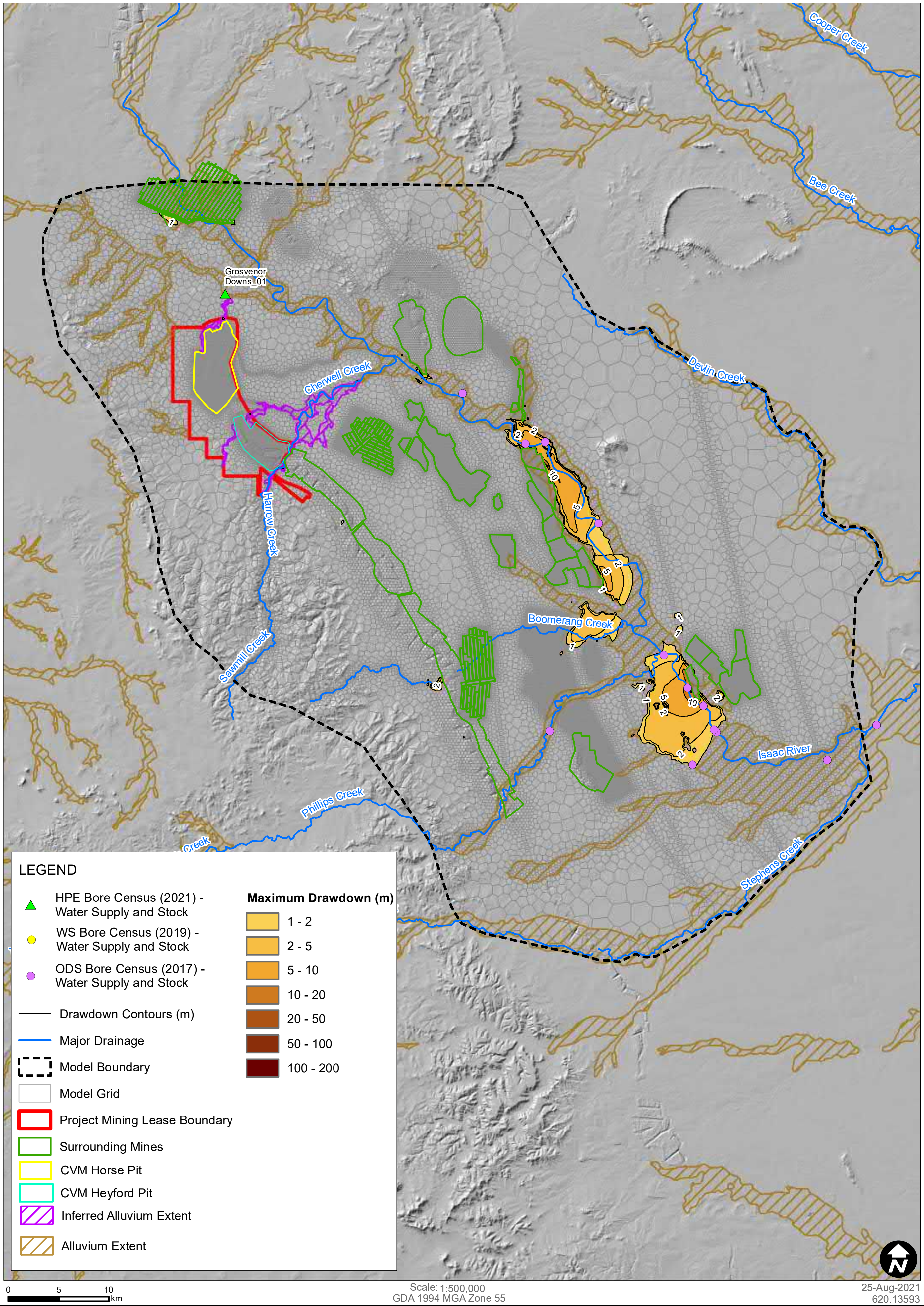
SLR

Recharge Zone Distribution

FIGURE C-20

APPENDIX D

Cumulative Drawdown Predictions



Scale: 1:500,000
GDA 1994 MGA Zone 55

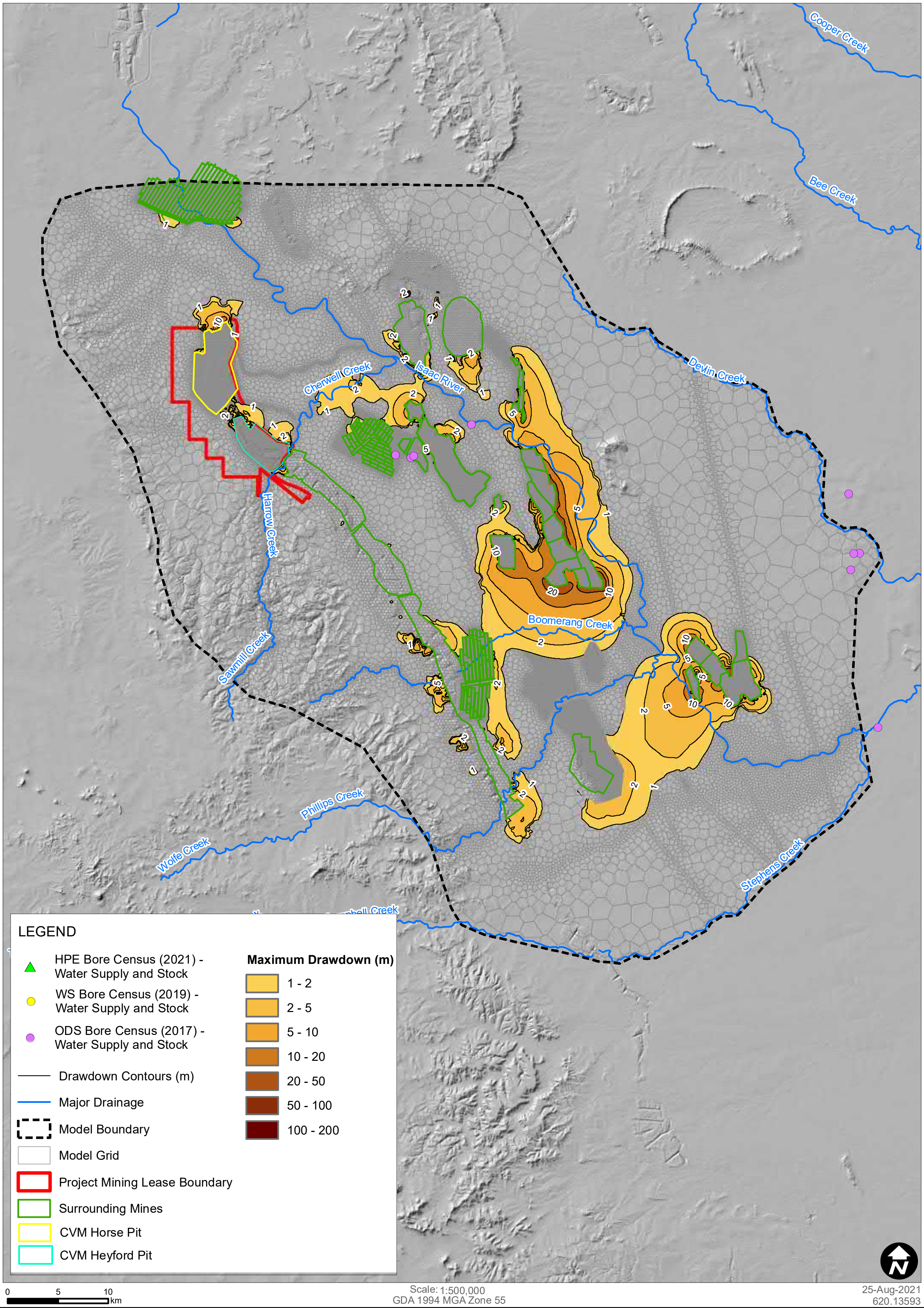
25-Aug-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\Appendix D\62013593 F D-1 Maximum Cumulative Drawdown in Quaternary Alluvium (Layer 1).mxd

SLR

Maximum Cumulative Drawdown in Quaternary Alluvium (Layer 1)

FIGURE D-1



Scale: 1:500,000
GDA 1994 MGA Zone 55

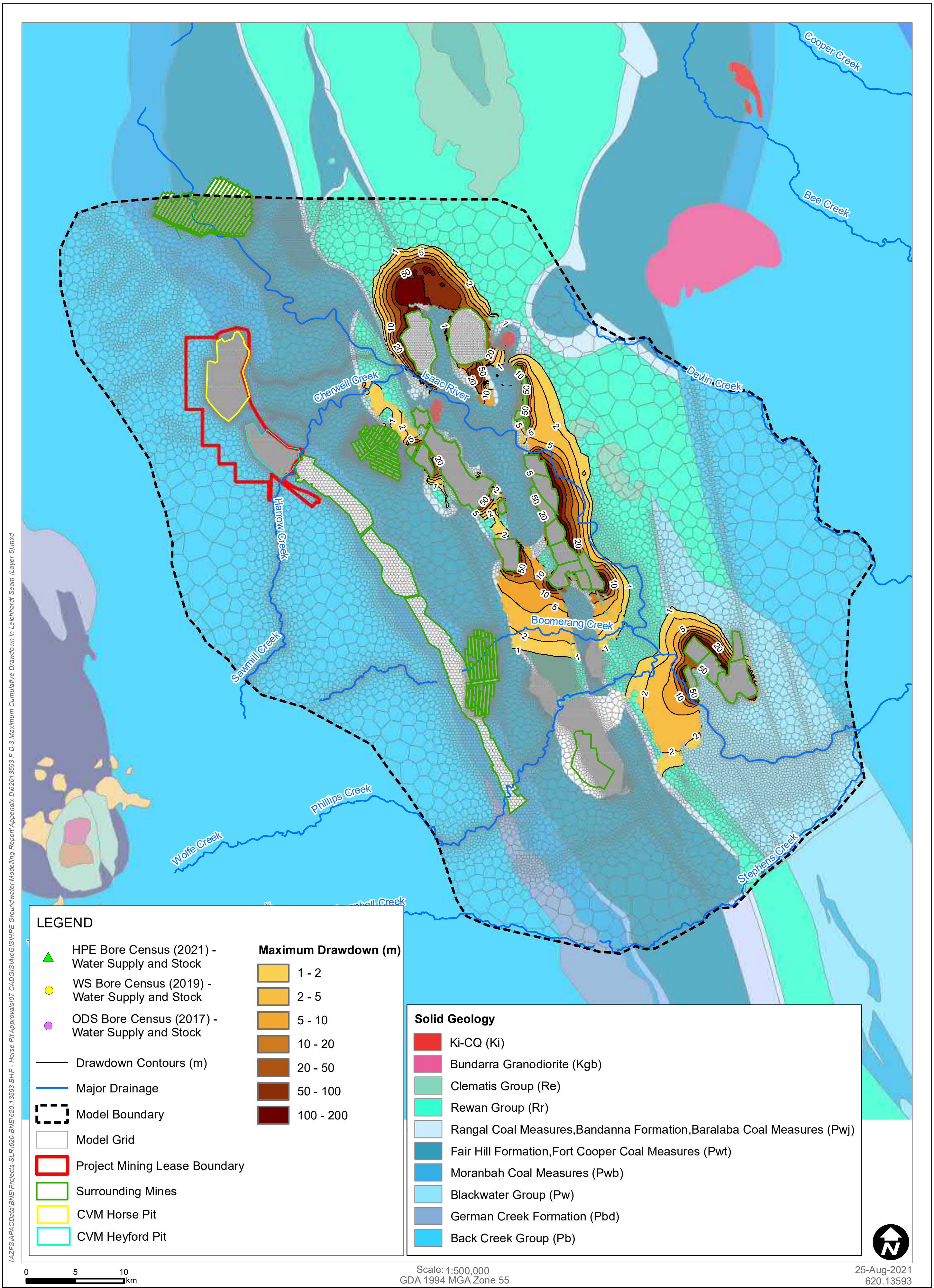
25-Aug-2021
620.13593

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\Appendix D\62013593 F D-2 Maximum Cumulative Drawdown in Regolith (Layer 2).mxd

SLR

Maximum Cumulative Drawdown in Regolith (Layer 2)

FIGURE D-2



\\AZFS\APACData\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\Appendix D\62013593 F D-3 Maximum Cumulative Drawdown in Leichhardt Seam (Layer 5).mxd

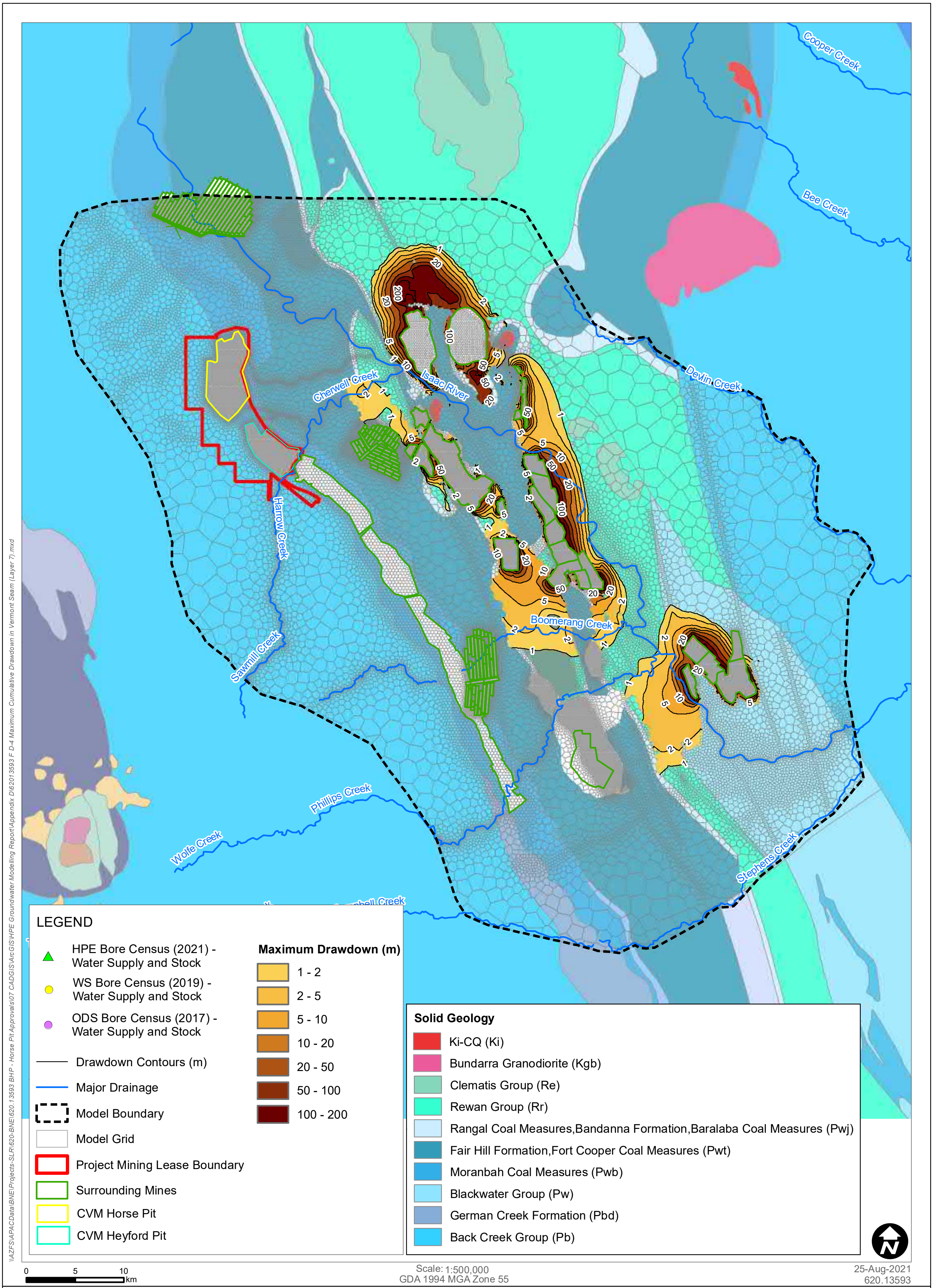
Scale: 1:500,000
GDA 1994 MGA Zone 55

25-Aug-2021
620.13593

SLR

Maximum Cumulative Drawdown in Leichhardt Seam (Layer 5)

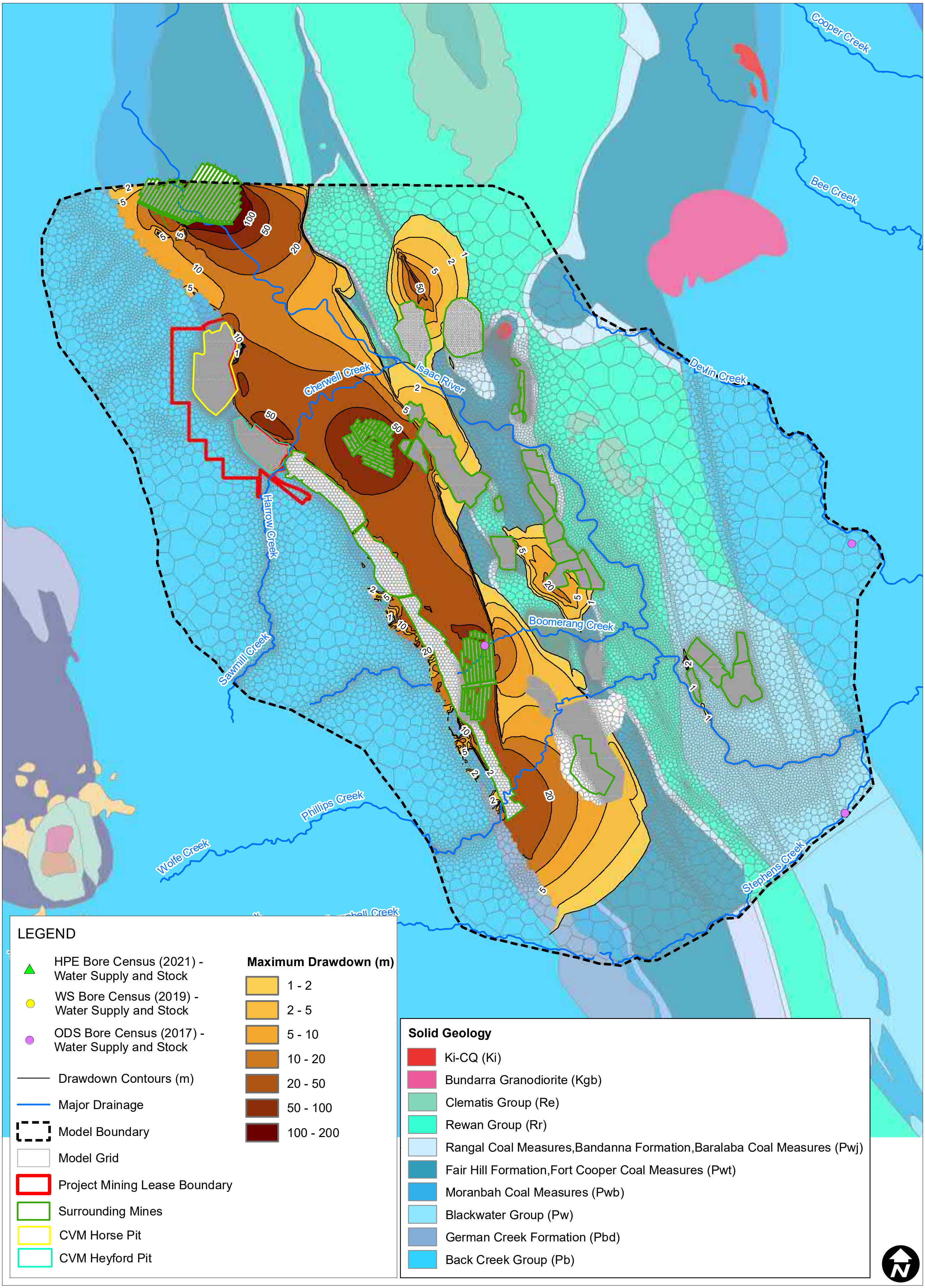
FIGURE D-3



SLR

Maximum Cumulative Drawdown in Vermont Seam (Layer 7)

FIGURE D-4



Scale: 1:500,000
GDA 1994 MGA Zone 55

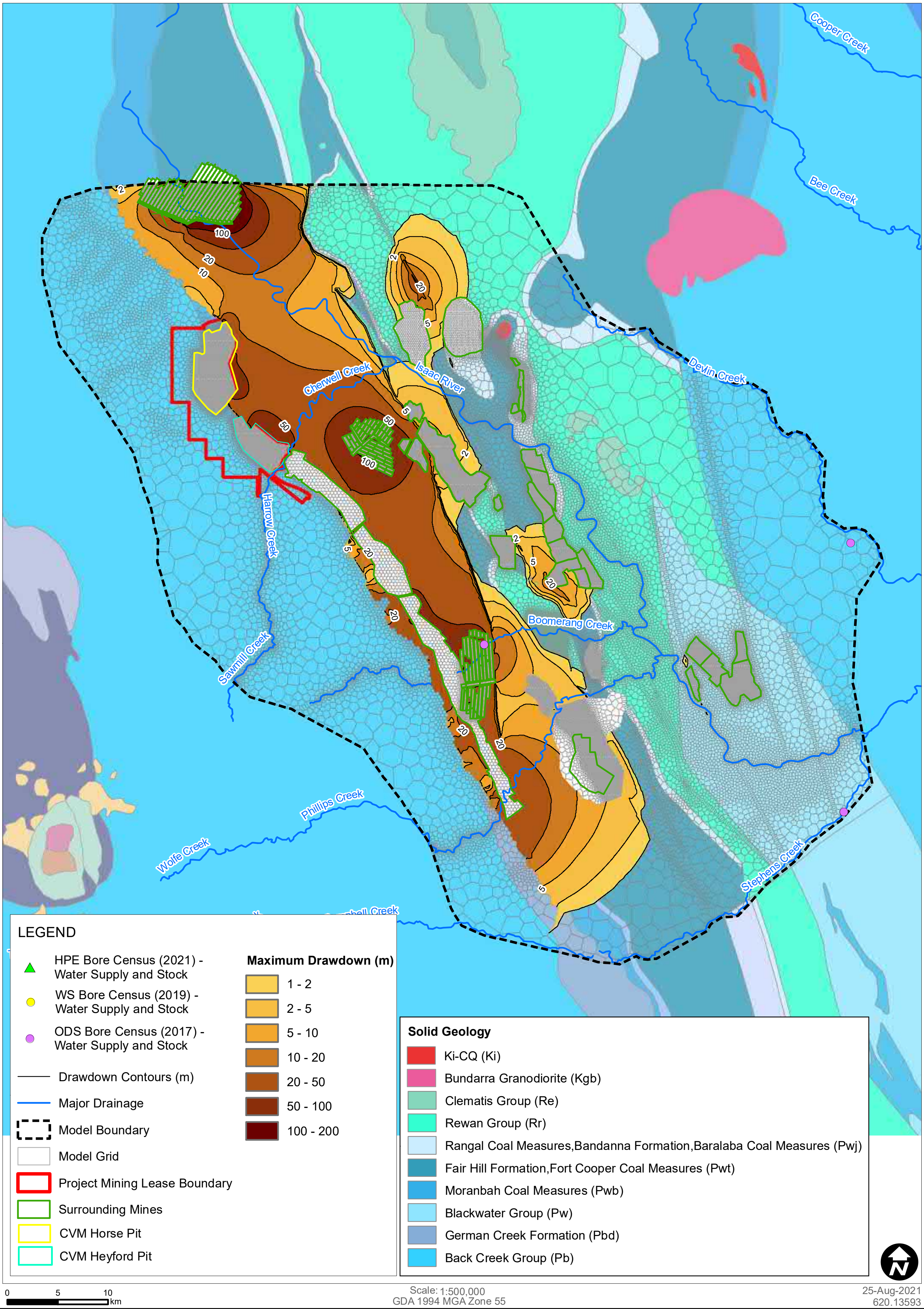
25-Aug-2021
620.13593

\\AZFS\APACData\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\Appendix D\62013593 F D-5 Maximum Cumulative Drawdown in Q Seam (Layer 12).mxd

SLR

Maximum Cumulative Drawdown in Q Seam (Layer 12)

FIGURE D-5



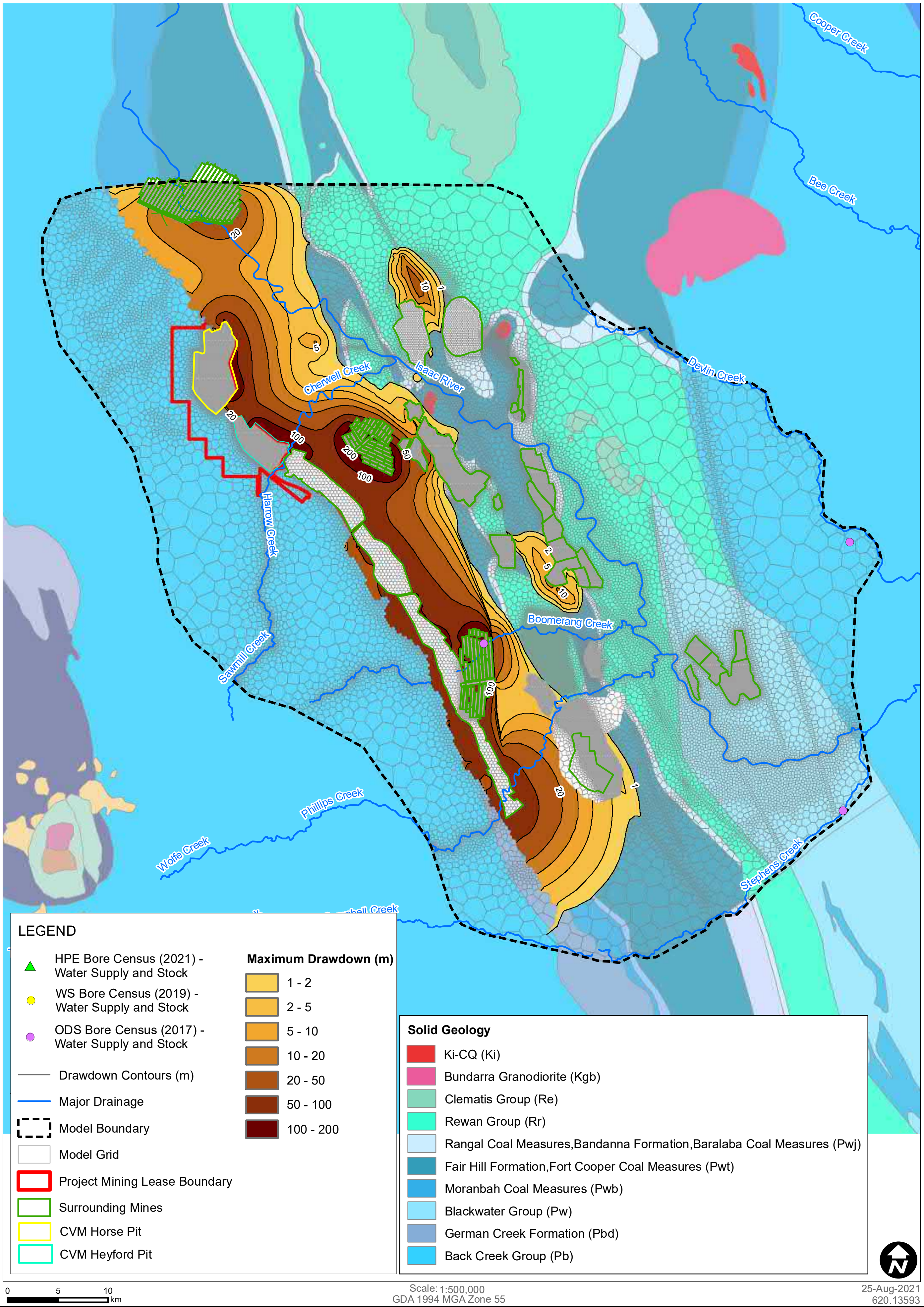
Scale: 1:500,000
GDA 1994 MGA Zone 55

25-Aug-2021
620.13593

\\AZFS\APACData\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\Appendix D\62013593 F D-6 Maximum Cumulative Drawdown in P Seam (Layer 14).mxd

Maximum Cumulative Drawdown in P Seam (Layer 14)

FIGURE D-6



Scale: 1:500,000
GDA 1994 MGA Zone 55

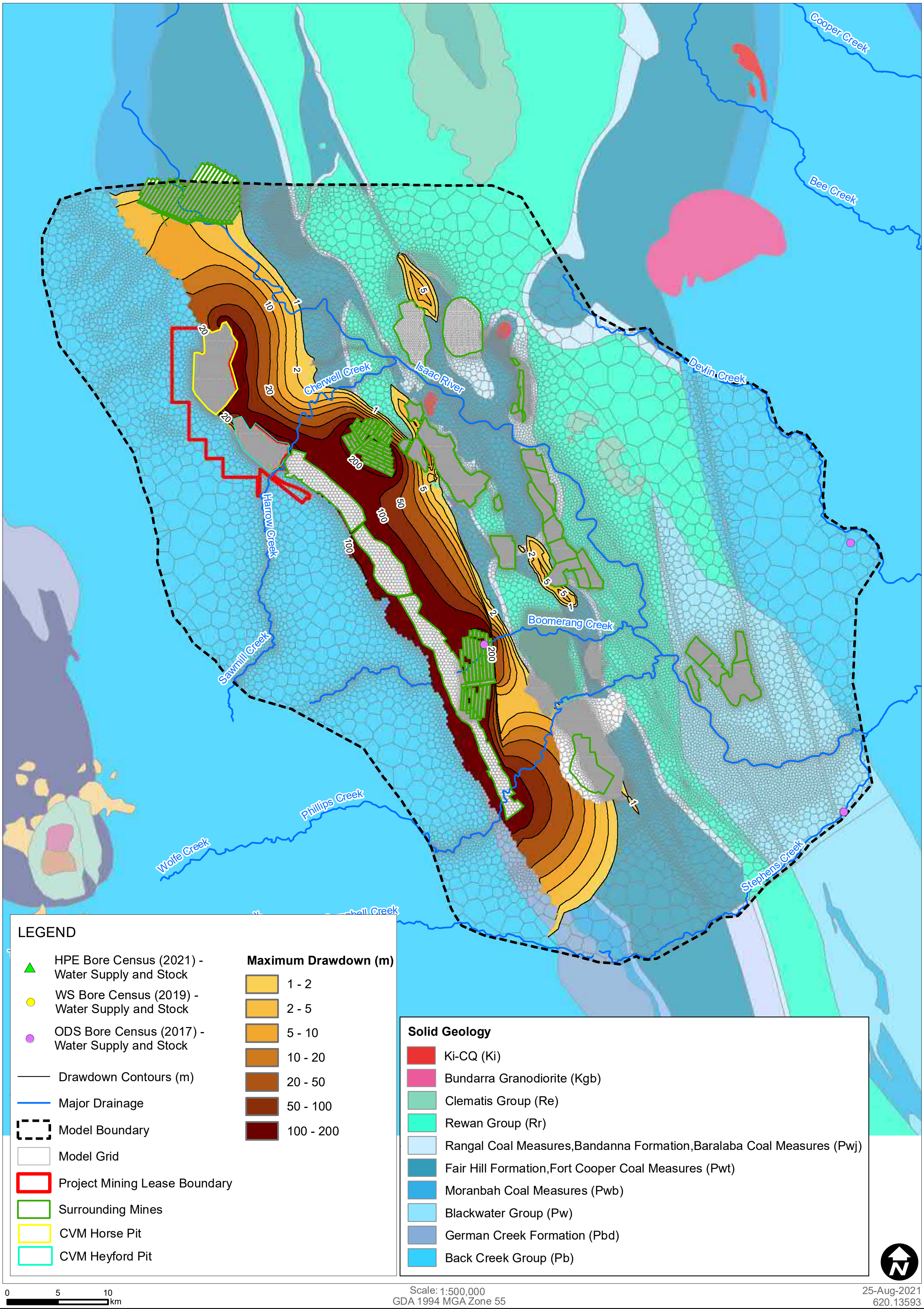
25-Aug-2021
620.13593

\\AZFS\APACData\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\Appendix D\62013593 F D-7 Maximum Cumulative Drawdown in H Seam (Layer 16).mxd

SLR

Maximum Cumulative Drawdown in H Seam (Layer 16)

FIGURE D-7



LEGEND

- ▲ HPE Bore Census (2021) - Water Supply and Stock
- ● WS Bore Census (2019) - Water Supply and Stock
- ● ODS Bore Census (2017) - Water Supply and Stock
- Drawdown Contours (m)
- Major Drainage
- Model Boundary
- Model Grid
- Project Mining Lease Boundary
- Surrounding Mines
- CVM Horse Pit
- CVM Heyford Pit

Maximum Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200

Solid Geology

- Ki-CQ (Ki)
- Bundarra Granodiorite (Kgb)
- Clematis Group (Re)
- Rewan Group (Rr)
- Rangal Coal Measures,Bandanna Formation,Baralaba Coal Measures (Pwj)
- Fair Hill Formation,Fort Cooper Coal Measures (Pwt)
- Moranbah Coal Measures (Pwb)
- Blackwater Group (Pw)
- German Creek Formation (Pbd)
- Back Creek Group (Pb)

Scale: 1:500,000
GDA 1994 MGA Zone 55

25-Aug-2021
620.13593

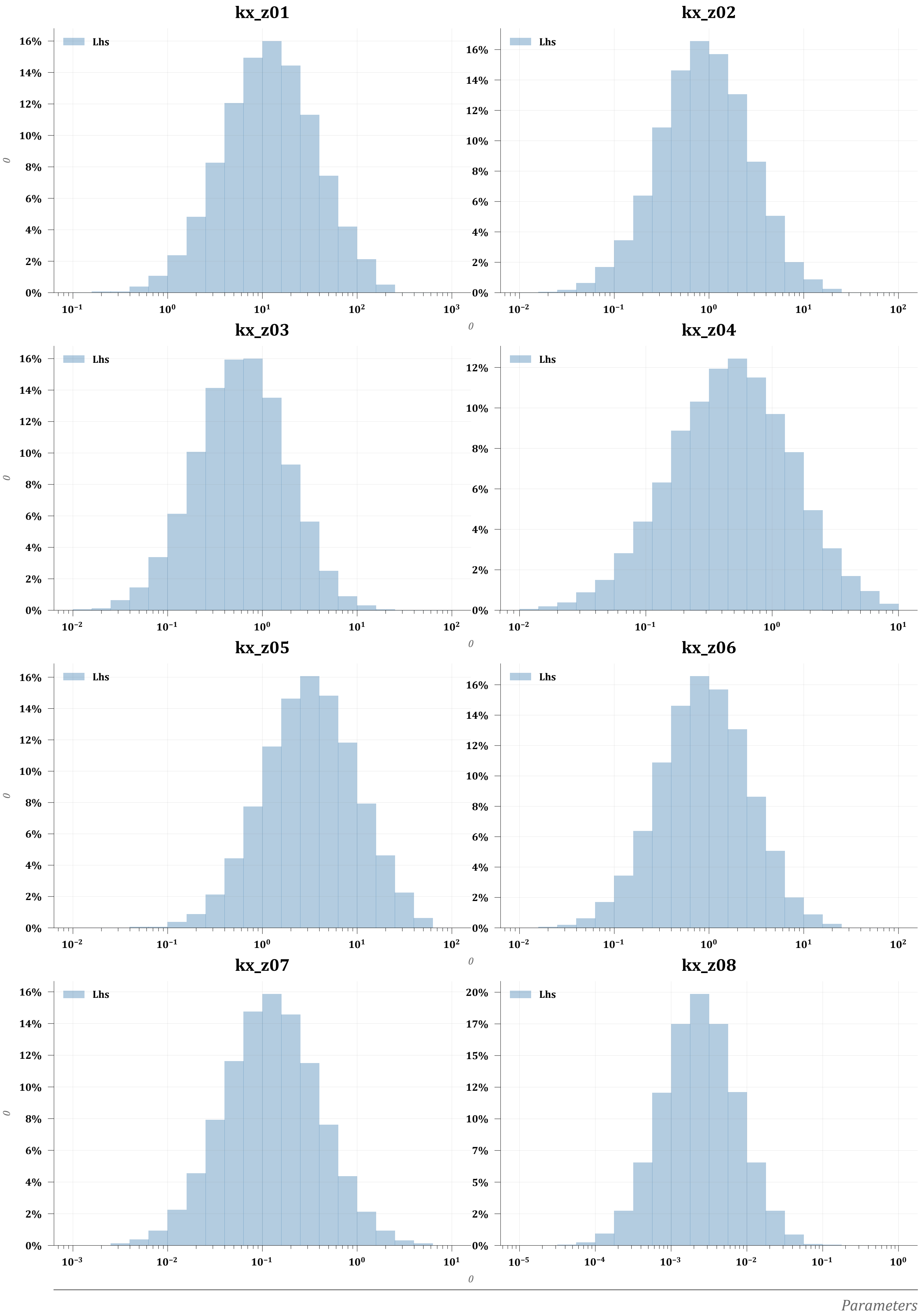
\\AZFS\APACData\BNE\Projects-SLR\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\HPE Groundwater Modelling Report\Appendix D\62013593 F D-8 Maximum Cumulative Drawdown in D Seam (Layer 18).mxd

Maximum Cumulative Drawdown in D Seam (Layer 18)

FIGURE D-8

APPENDIX E

Uncertainty Analysis Parameter Distributions


kx_z01
Lhs
16%
14%
12%
10%
8%
6%
4%
2%
0%
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
kx_z02
Lhs
16%
14%
12%
10%
8%
6%
4%
2%
0%
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
kx_z03
Lhs
16%
14%
12%
10%
8%
6%
4%
2%
0%
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
kx_z04
Lhs
12%
10%
8%
6%
4%
2%
0%
10^{-2}
10^{-1}
10^{0}
10^{1}
kx_z05
Lhs
16%
14%
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10%
8%
6%
4%
2%
0%
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
kx_z06
Lhs
16%
14%
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10%
8%
6%
4%
2%
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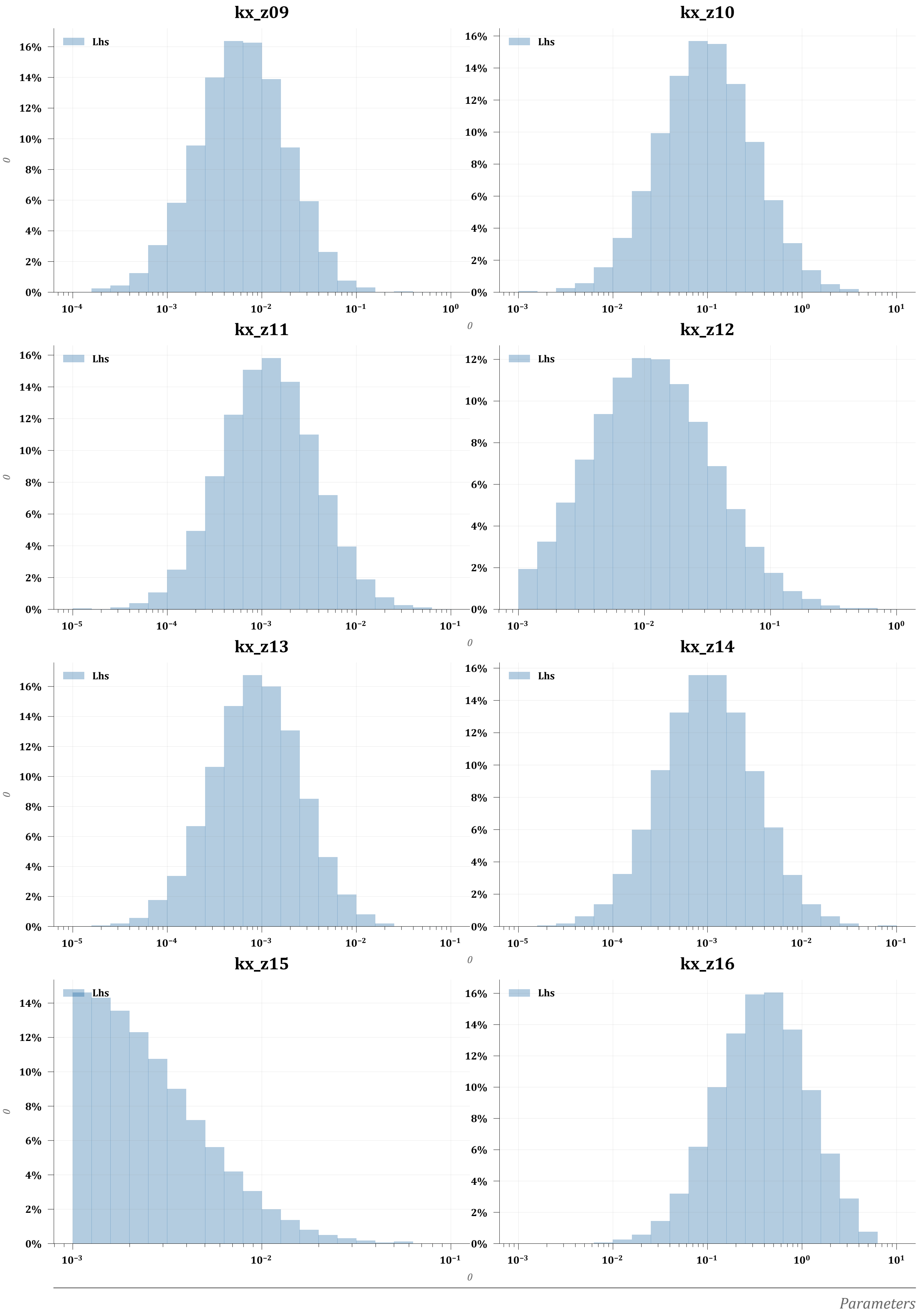
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
kx_z07
Lhs
16%
14%
12%
10%
8%
6%
4%
2%
0%
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
kx_z08
Lhs
20%
17%
15%
12%
10%
7%
5%
2%
0%
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
0
Parameters


kx_z09
Lhs
0%
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4%
6%
8%
10%
12%
14%
16%
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
kx_z10
Lhs
0%
2%
4%
6%
8%
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12%
14%
16%
10^{-3}
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10^{-1}
10^{0}
10^{1}
kx_z11
Lhs
0%
2%
4%
6%
8%
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10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
kx_z12
Lhs
0%
2%
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6%
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10%
12%
10^{-3}
10^{-2}
10^{-1}
10^{0}
kx_z13
Lhs
0%
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6%
8%
10%
12%
14%
16%
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
kx_z14
Lhs
0%
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12%
14%
16%
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
kx_z15
Lhs
0%
2%
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8%
10%
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14%
10^{-3}
10^{-2}
10^{-1}
kx_z16
Lhs
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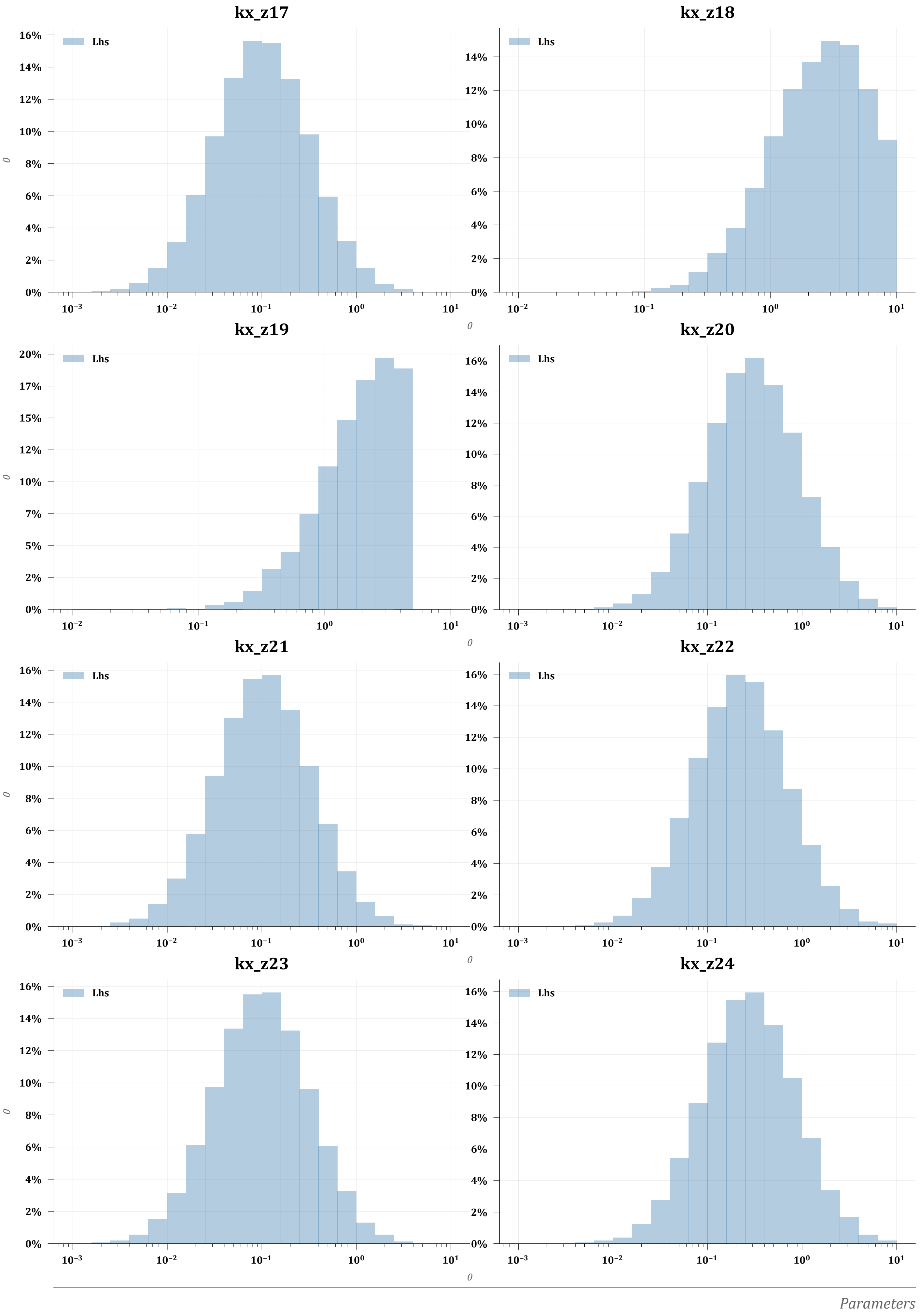
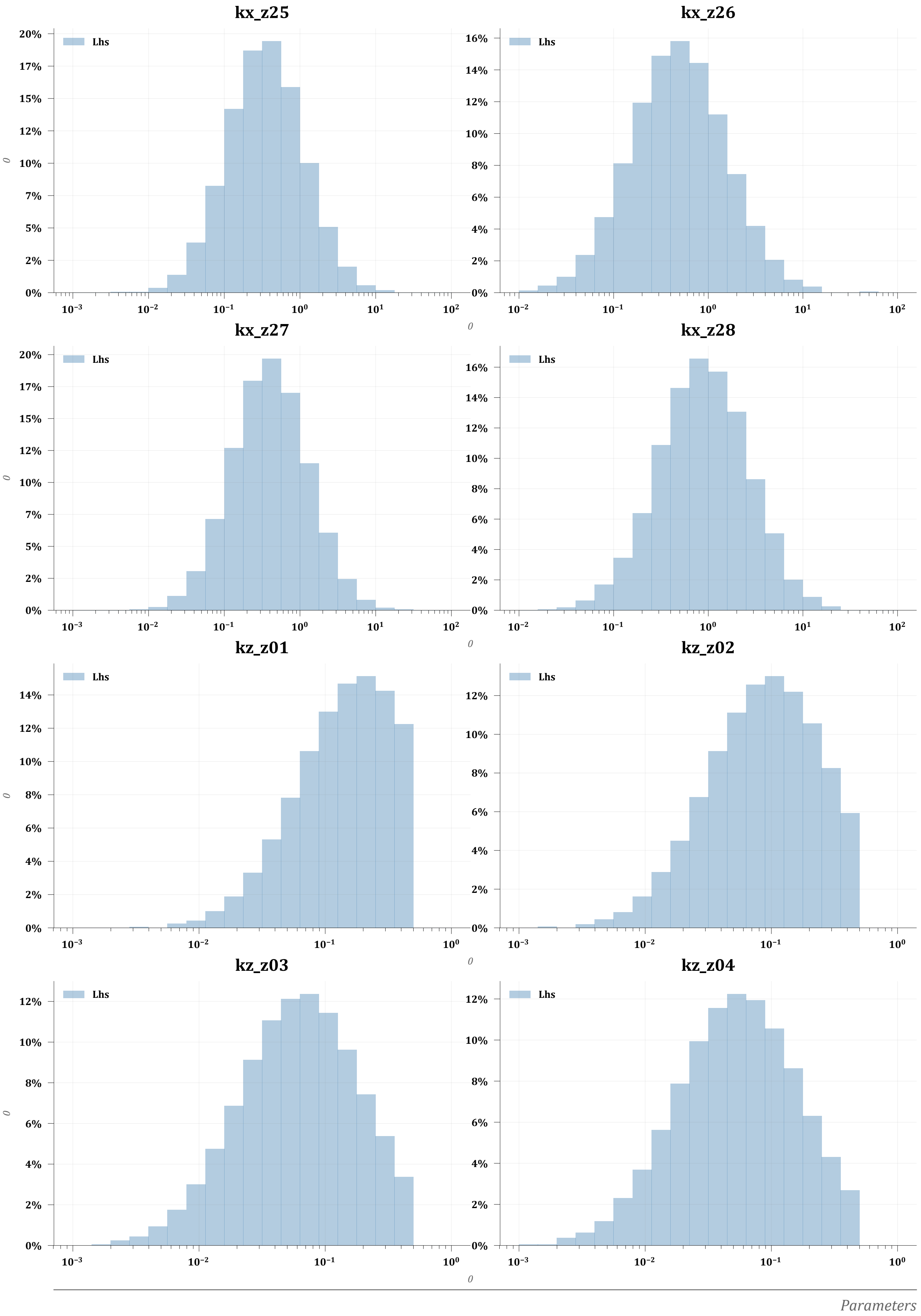
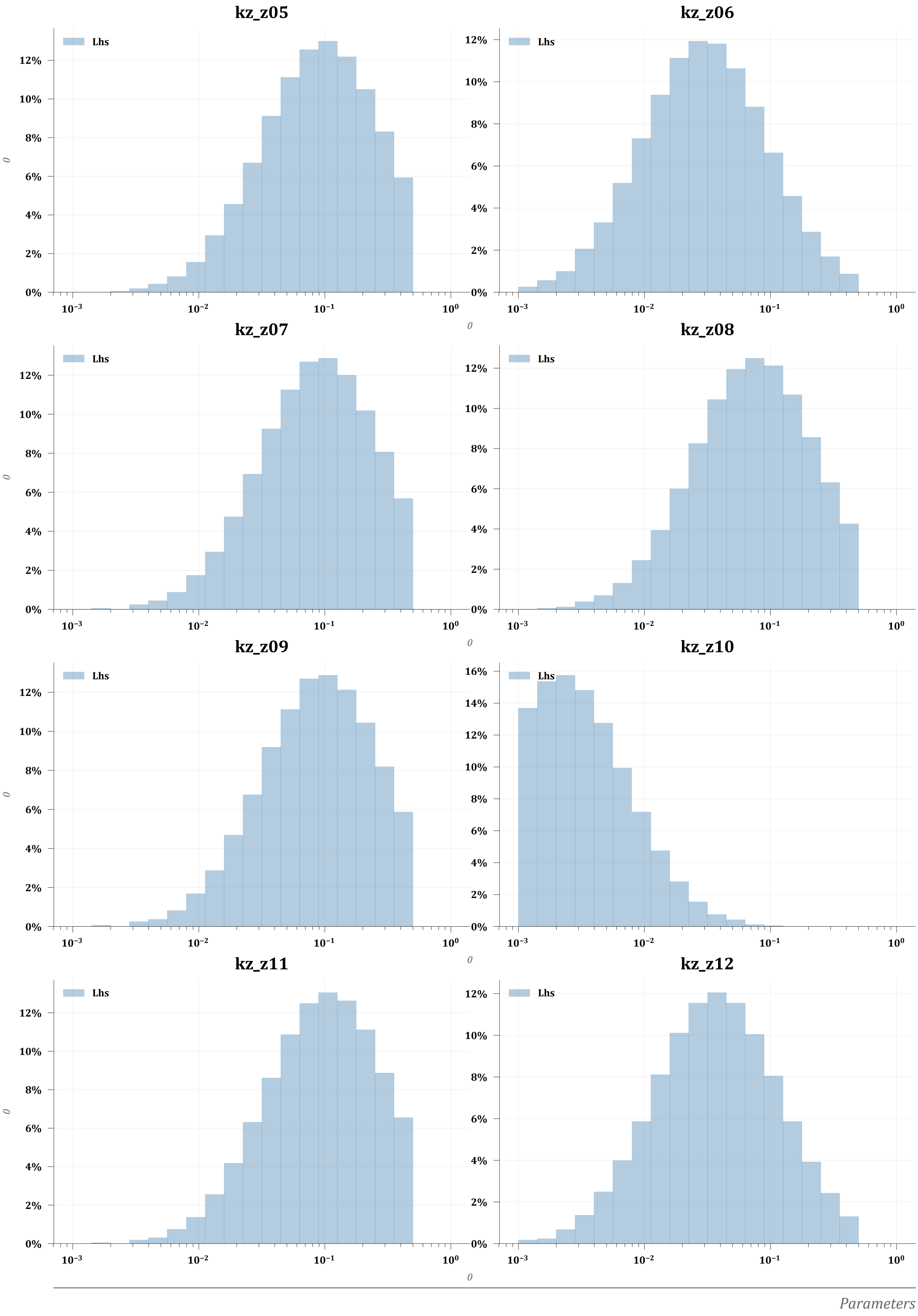
2%
4%
6%
8%
10%
12%
14%
16%
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
0
Parameters


kx_z17
kx_z18
kx_z19
kx_z20
kx_z21
kx_z22
kx_z23
kx_z24
Lhs
0
0%
2%
4%
6%
8%
10%
12%
14%
16%
17%
20%
5%
7%
15%
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
Parameters


kx_z25
kx_z26
kx_z27
kx_z28
kz_z01
kz_z02
kz_z03
kz_z04
Lhs
0
20%
17%
15%
12%
10%
7%
5%
2%
0%
16%
14%
12%
10%
8%
6%
4%
2%
0%
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Parameters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kz_z06
kz_z07
kz_z08
kz_z09
kz_z10
kz_z11
kz_z12
Lhs
0%
2%
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10^{-2}
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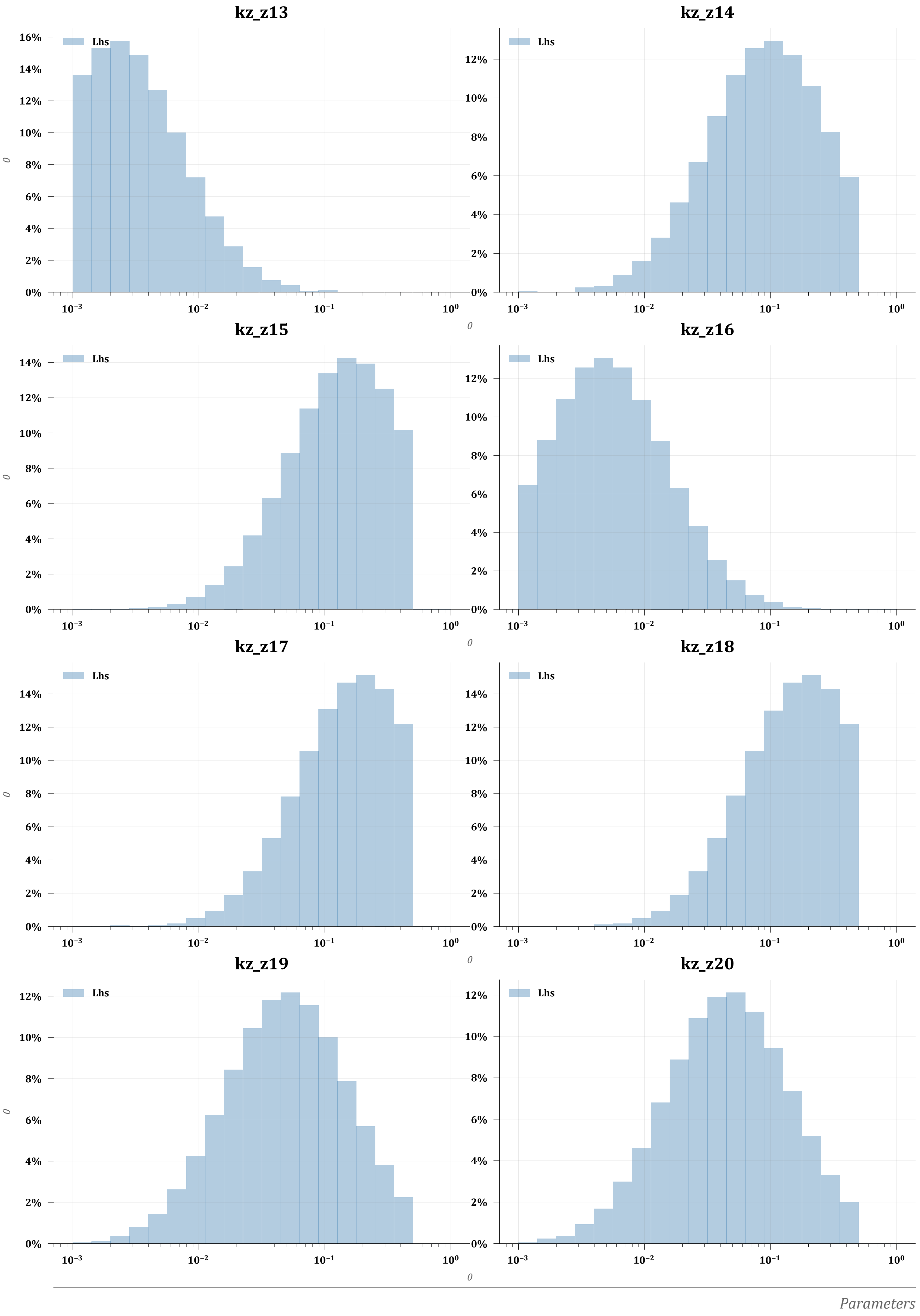
0
Parameters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kz_z14
kz_z15
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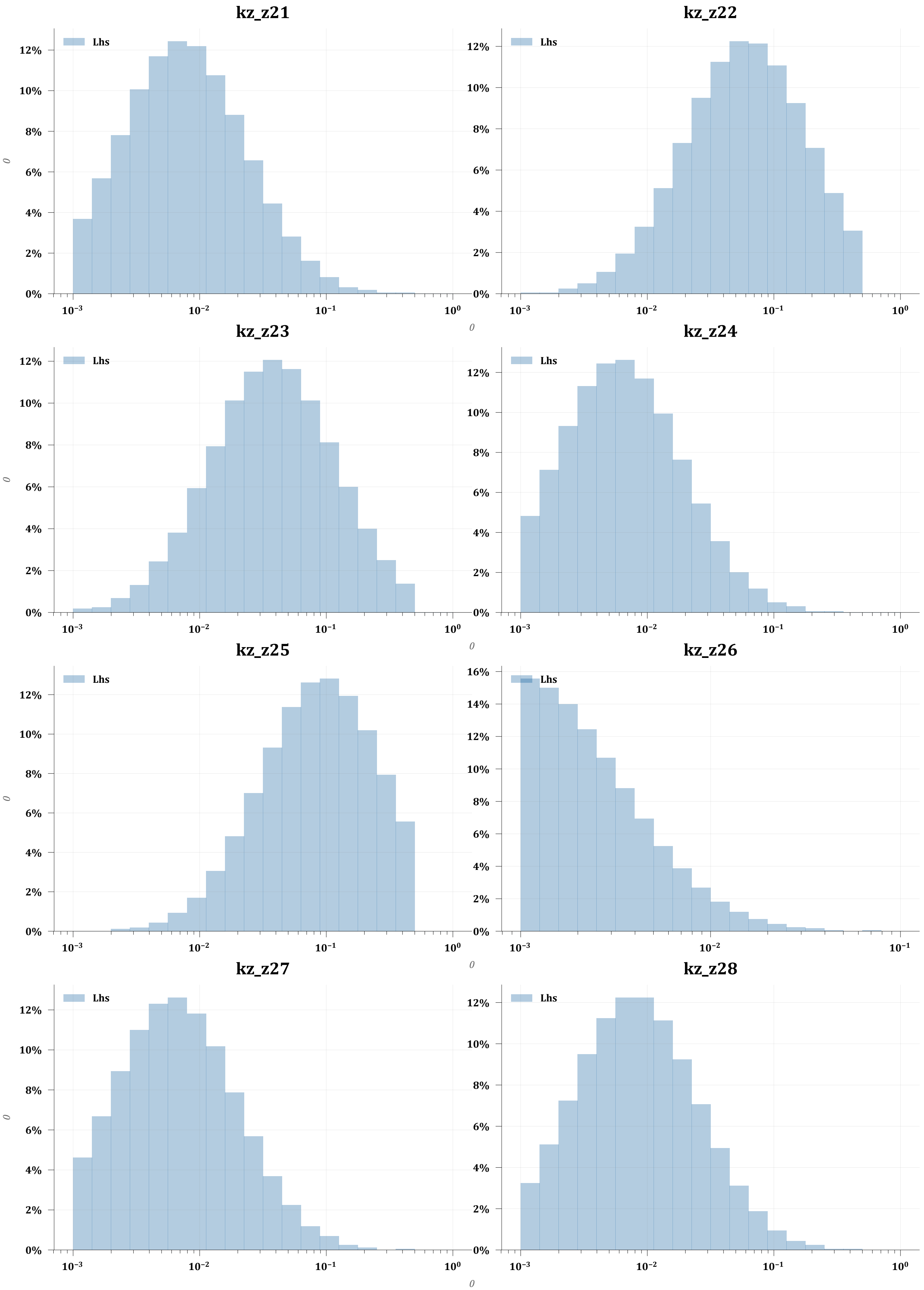
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10⁻²
10⁻¹
10⁰
kz_z22
Lhs
12%
10%
8%
6%
4%
2%
0%
10⁻³
10⁻²
10⁻¹
10⁰
0
kz_z23
Lhs
12%
10%
8%
6%
4%
2%
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0
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10⁻²
10⁻¹
10⁰
kz_z24
Lhs
12%
10%
8%
6%
4%
2%
0%
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10⁻²
10⁻¹
10⁰
0
kz_z25
Lhs
12%
10%
8%
6%
4%
2%
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0
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10⁻²
10⁻¹
10⁰
kz_z26
Lhs
16%
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10⁻²
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Lhs
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0
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10⁻²
10⁻¹
10⁰
kz_z28
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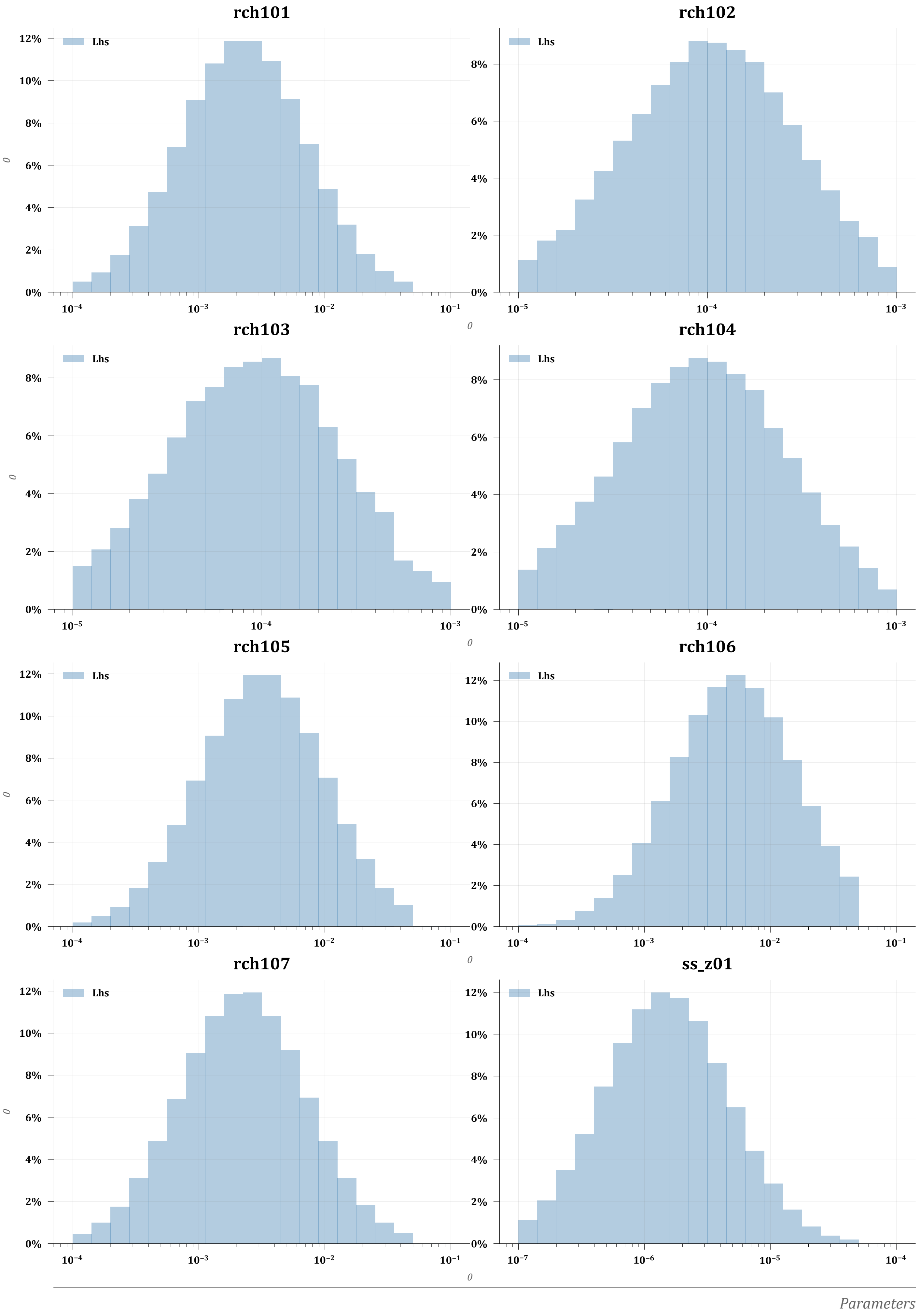
Parameters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rch102
Lhs
8%
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0
rch103
Lhs
8%
6%
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rch104
Lhs
8%
6%
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2%
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0
rch105
Lhs
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10^{-3}
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10^{-1}
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rch107
Lhs
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10%
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6%
4%
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0
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10^{-3}
10^{-2}
10^{-1}
ss_z01
Lhs
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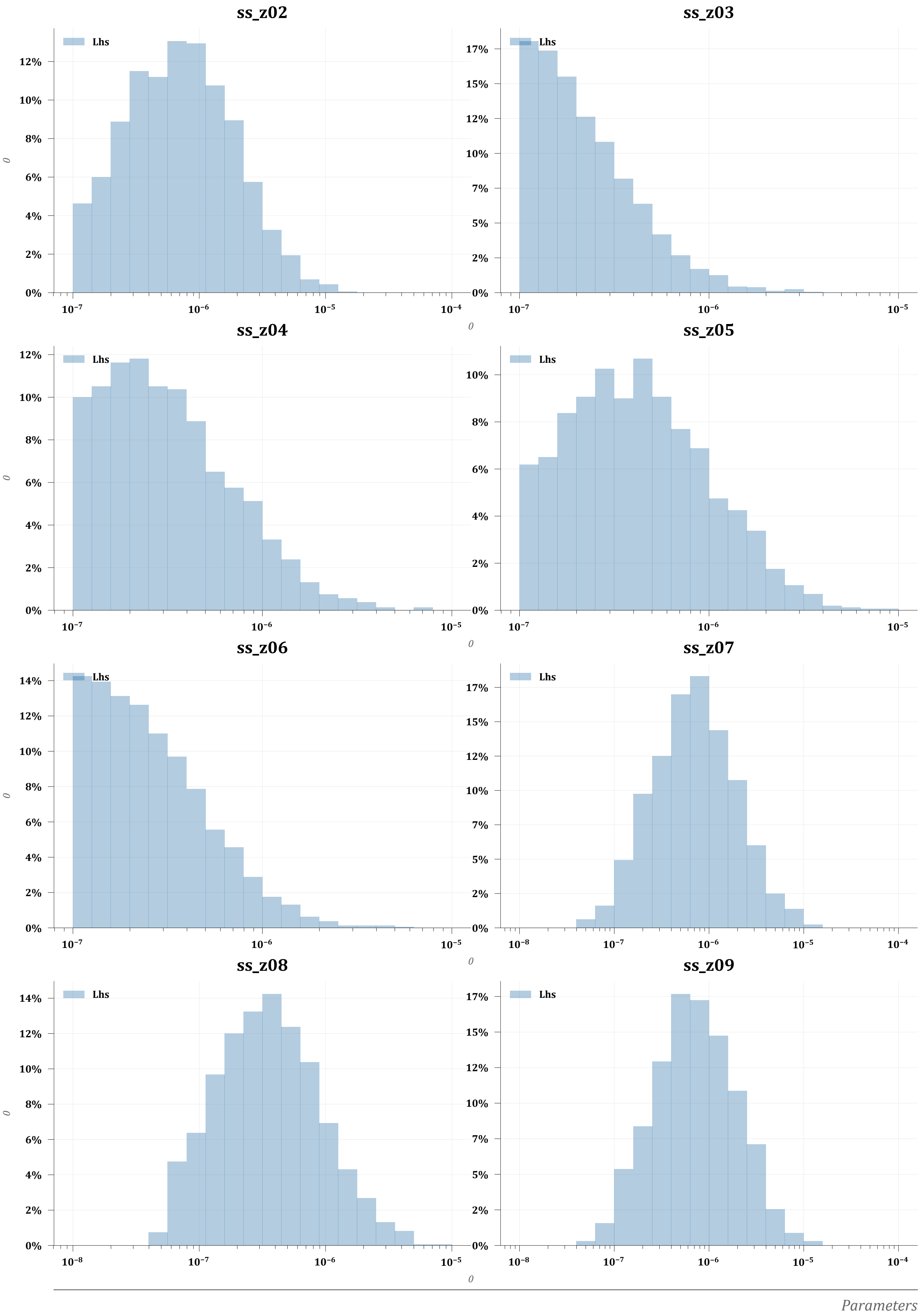
0
Parameters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ss_z03
Lhs
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15%
12%
10%
7%
5%
2%
0%
10^{-7}
10^{-6}
10^{-5}
0
ss_z04
Lhs
0
12%
10%
8%
6%
4%
2%
0%
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10^{-5}
ss_z05
Lhs
10%
8%
6%
4%
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0%
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ss_z06
Lhs
0
14%
12%
10%
8%
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10^{-5}
ss_z07
Lhs
17%
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7%
5%
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0%
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
0
ss_z08
Lhs
0
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12%
10%
8%
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4%
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10^{-8}
10^{-7}
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10^{-5}
ss_z09
Lhs
17%
15%
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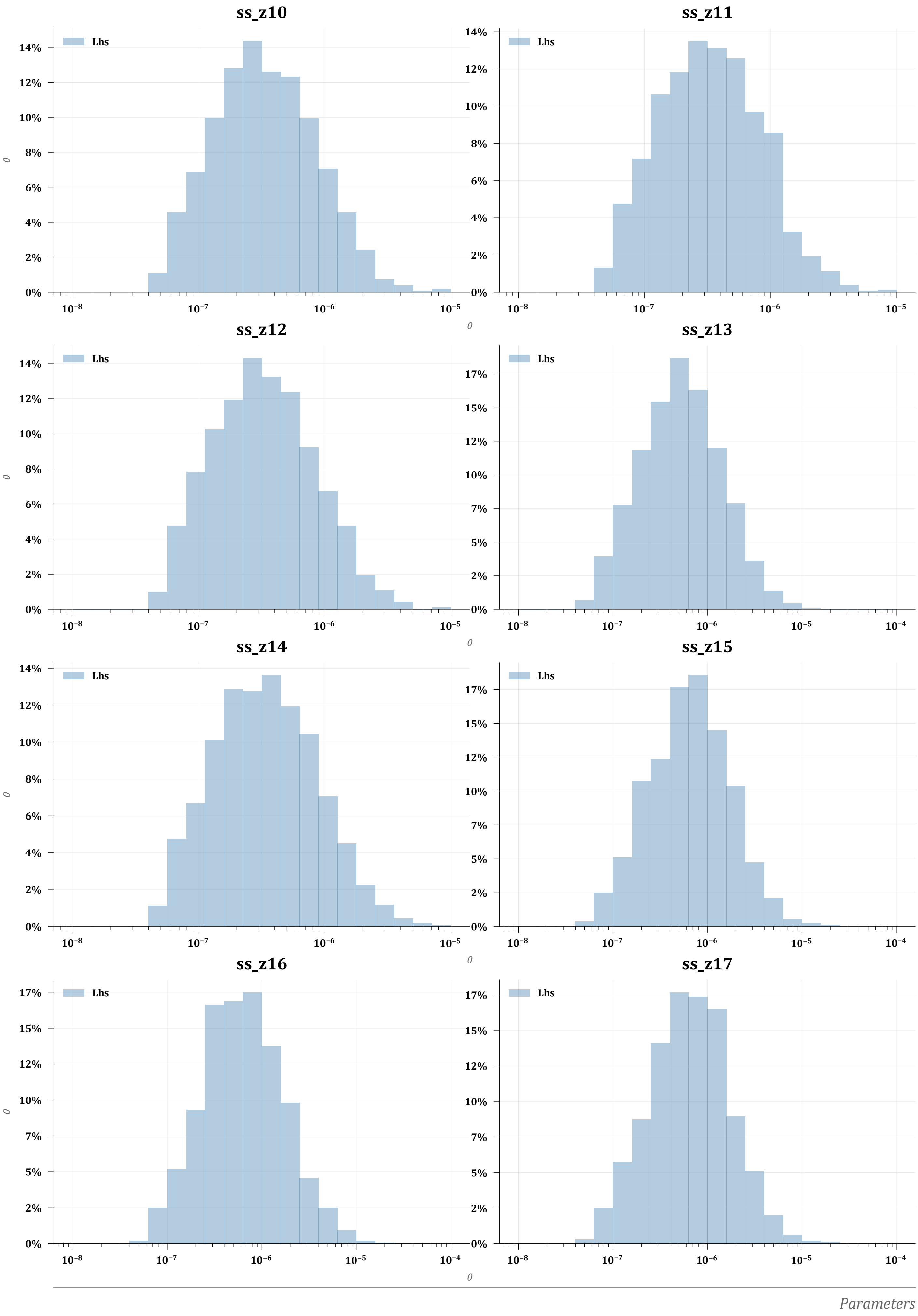
Parameters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Lhs
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10⁻⁶
10⁻⁵
ss_z11
Lhs
14%
12%
10%
8%
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10⁻⁸
10⁻⁷
10⁻⁶
10⁻⁵
0
ss_z12
Lhs
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12%
10%
8%
6%
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2%
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0
10⁻⁸
10⁻⁷
10⁻⁶
10⁻⁵
ss_z13
Lhs
17%
15%
12%
10%
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5%
2%
0%
10⁻⁸
10⁻⁷
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0
ss_z14
Lhs
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0
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10⁻⁵
ss_z15
Lhs
17%
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10⁻⁸
10⁻⁷
10⁻⁶
10⁻⁵
10⁻⁴
0
ss_z16
Lhs
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5%
2%
0%
0
10⁻⁸
10⁻⁷
10⁻⁶
10⁻⁵
10⁻⁴
ss_z17
Lhs
17%
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12%
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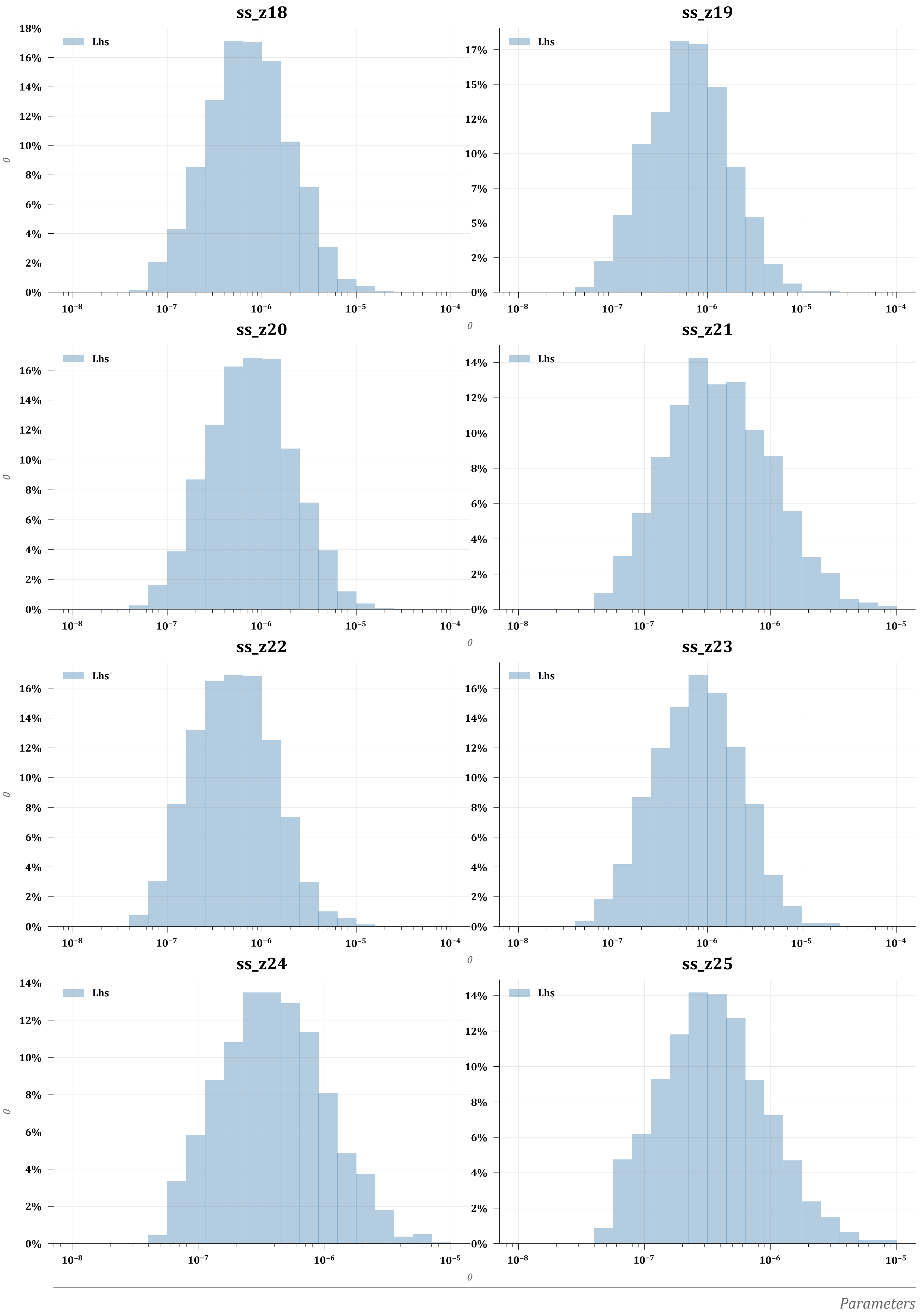
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Lhs
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10^{-4}
ss_z19
Lhs
17%
15%
12%
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ss_z20
Lhs
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ss_z21
Lhs
14%
12%
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10^{-8}
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ss_z22
Lhs
0
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14%
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ss_z23
Lhs
16%
14%
12%
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Lhs
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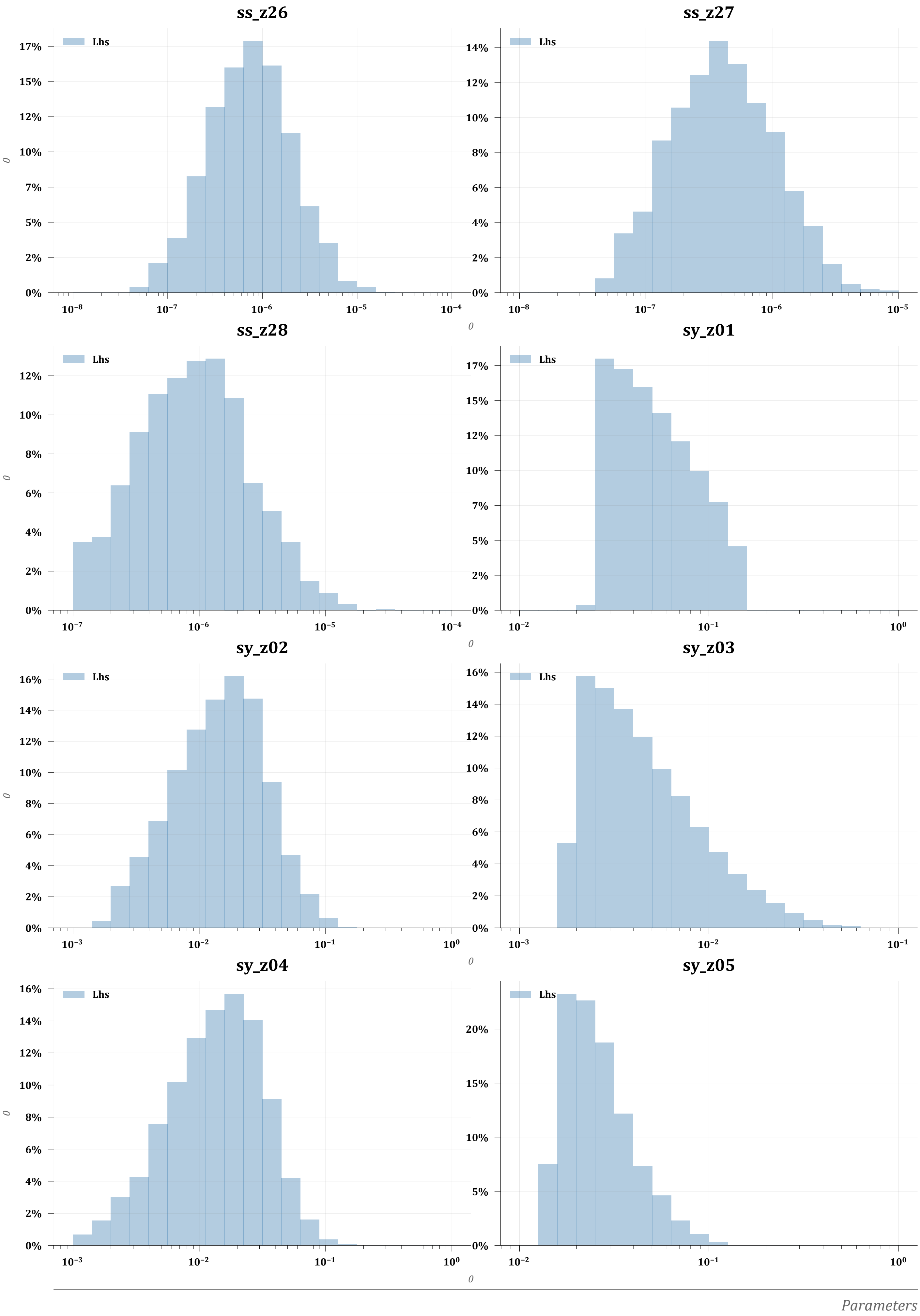
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ss_z27
Lhs
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10^{-7}
10^{-6}
10^{-5}
ss_z28
Lhs
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10^{-6}
10^{-5}
10^{-4}
sy_z01
Lhs
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sy_z02
Lhs
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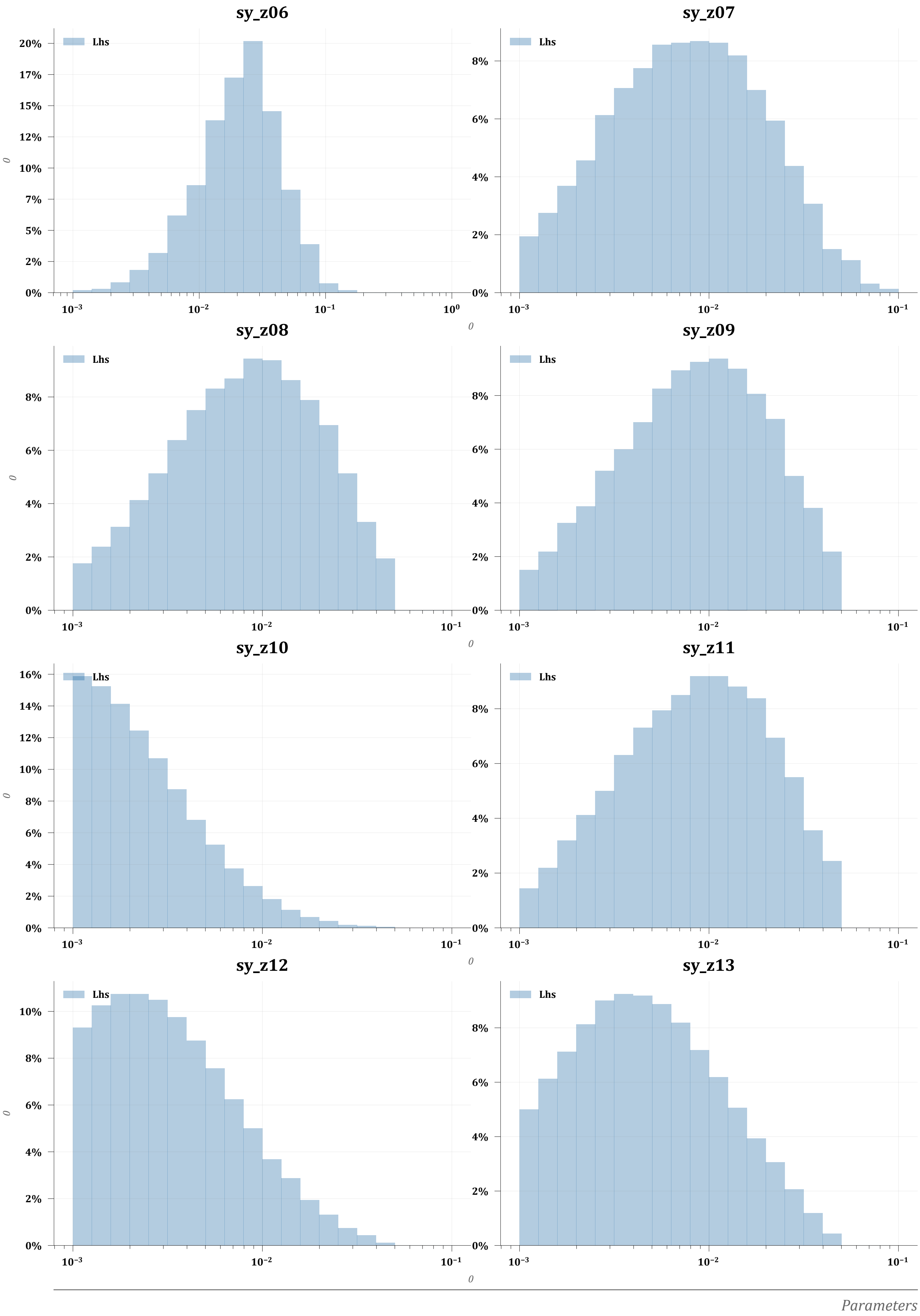
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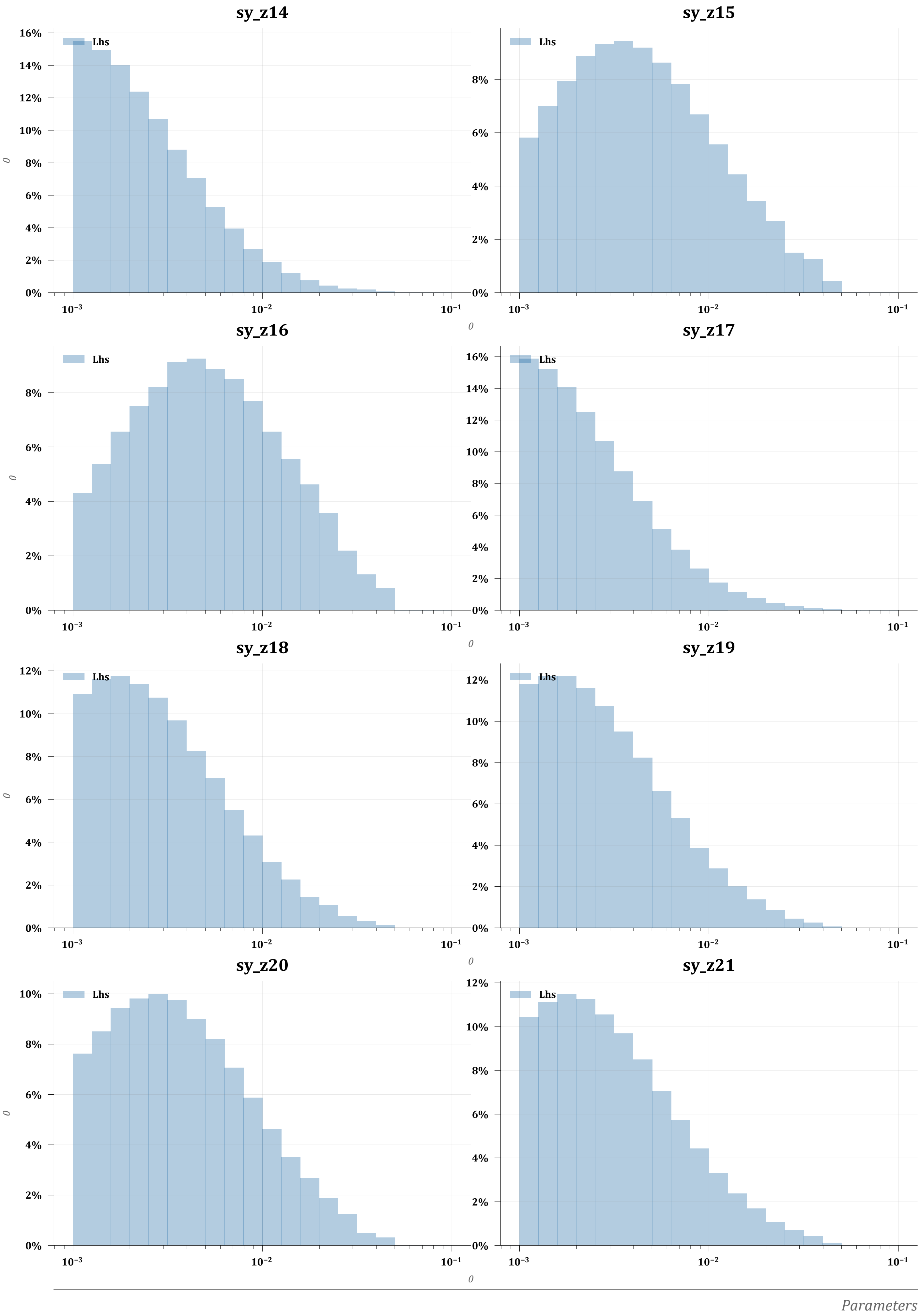
sy_z14
sy_z15
sy_z16
sy_z17
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sy_z19
sy_z20
sy_z21
Lhs
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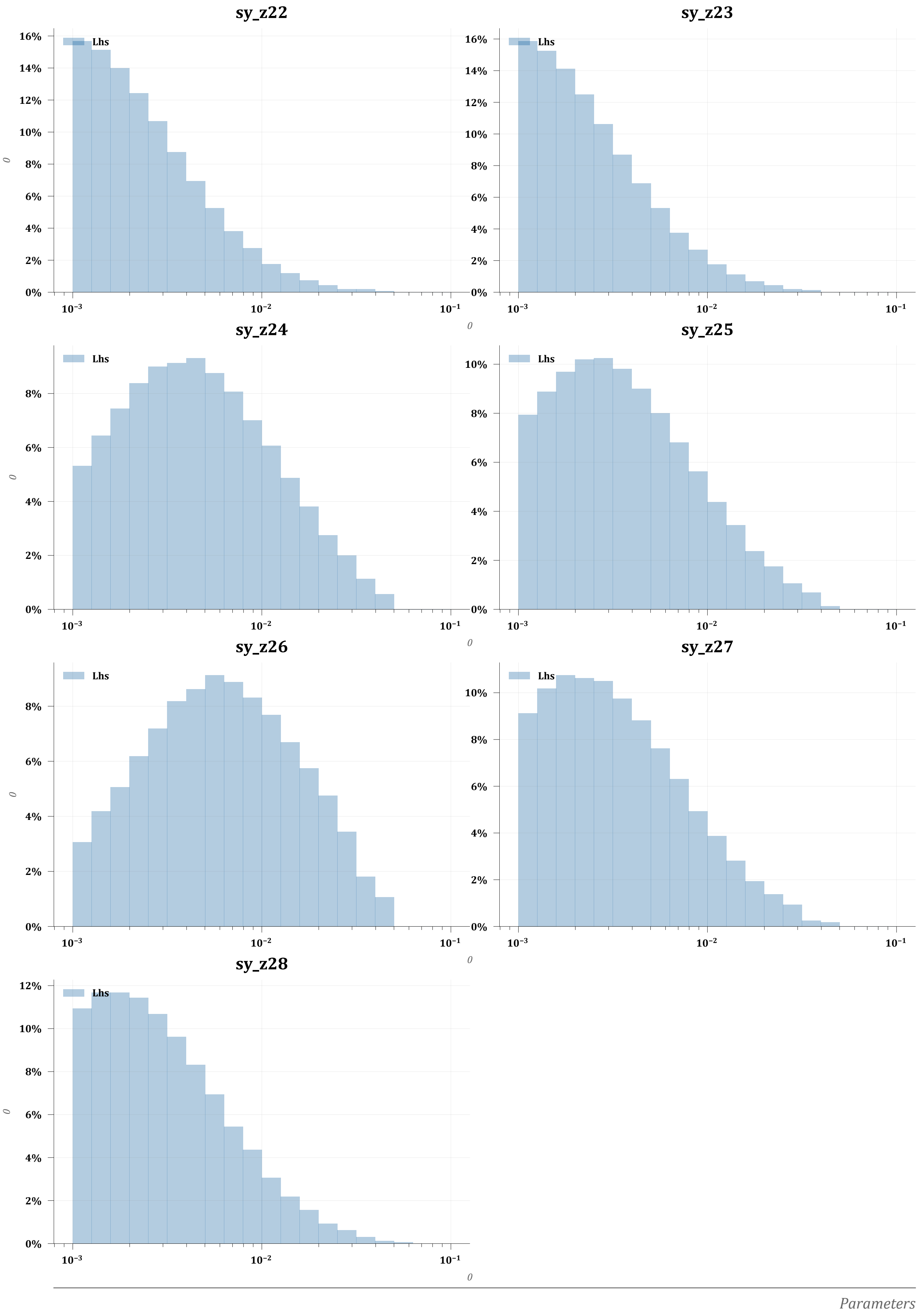
Parameters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sy_z23
sy_z24
sy_z25
sy_z26
sy_z27
sy_z28
Lhs
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10^{-3}
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Parameters

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Level 11, 176 Wellington Parade
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T: +61 7 3858 4800
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Unit 5, 21 Parap Road
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Level 2, 194 Varsity Parade
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M: +61 438 763 516

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21 River Street
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Australia
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T: +61 3 9249 9400
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10 Kings Road
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F: +61 2 4037 3201

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Ground Floor, 503 Murray Street
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T: +61 8 9422 5900
F: +61 8 9422 5901

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T: +61 2 9427 8100
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