

17 May 2024

Department of Planning, Housing and Infrastructure
4 Parramatta Square
PARRAMATTA NSW 2150

Attention: Stephen O'Donoghue, Director Resource Assessments

Dear Stephen,

**RE: MOOLARBEN OC3 EXTENSION PROJECT – INDEPENDENT EXPERT ADVISORY PANEL FOR MINING
PRELIMINARY REQUEST FOR ADDITIONAL INFORMATION**

On 19 April 2024, NSW Department of Planning, Housing and Infrastructure (DPHI) requested Moolarben Coal Operations Pty Ltd (MCO) provide additional information in response to preliminary queries from the Independent Expert Advisory Panel for Mining (The Panel) on the Moolarben OC3 Extension Project (SSD-33083358) Amendment and Submissions Reports.

A reconciliation table with responses to the Panel's preliminary information request is provided in Attachment 1.

Should DPHI or The Panel have any queries regarding the information provided in this letter, please do not hesitate to contact the undersigned via email (Trent.Cini@yancoal.com.au) or phone (0408 312 269).

Yours sincerely,



Trent Cini
Environment & Community Manager
Moolarben Coal Operations Pty Ltd

ATTACHMENT 1

**MOOLARBEN OC3 EXTENSION PROJECT – INDEPENDENT EXPERT ADVISORY PANEL FOR MINING PRELIMINARY
REQUEST FOR ADDITIONAL INFORMATION RECONCILIATION TABLE**

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

Information Required		Response
Greenhouse Gas		
a. Gas content	Formal reports on gas content and gas composition testing for the underground and open cut areas.	- The target coal seams at the Moolarben Coal Complex and the Project area are very shallow (Figure 4-18 from the Submissions Report, repeated as Attachment 1 to this response). - Within the amended Project open cut pit extents, the depth of cover ranges from ~10 m to ~70 m. This is consistent with historical open cut mining operations at the Moolarben Coal Complex. - The Ulan Seam has a very low gas content, and the gas composition is largely CO₂ (i.e. very low methane). - The existing Moolarben Coal Complex reports annual emissions under the <i>National Greenhouse and Energy Reporting Act 2007</i> (NGER Act). - Fugitive emissions from the open cut extraction of coal are estimated using Method 2 under the <i>National Greenhouse and Energy Reporting (Measurement) Determination 2008</i> and the <i>Guidelines for the Implementation of NGER Method 2 or 3 for Open Cut Coal Mine Fugitive GHG Emissions Reporting (C20005)</i>, published by the Australian Coal Association Research Program (ACARP Guidelines). - Method 2 relies on measurements of in situ gas content and composition from drill cores and gas domain modelling. The most recent gas drilling and sampling program was undertaken by GeoGAS in 2021 and included drillholes within the Project Area. These results indicate that the gas properties for the Ulan Seam are relatively uniform across the Moolarben Coal Complex. - A site-specific fugitive emissions factor of 0.0009 t CO₂-e/t ROM has been used in the calculation of greenhouse gas emissions for the amended Project. This factor is based on recent NGERs data for the open cut operations. - For comparison, the default Method 1 fugitive emissions factor for NSW is 0.061 t CO₂-e/t ROM.
	Coordinates of gas content test boreholes.	
b. Geology	Confirmation/description of geology (is the Ulan seam the only seam, depth of cover maximum 100 m).	- Within the amended Project open cut pit extents, the depth of cover ranges from ~10 m to ~70 m (Attachment 1 of this response). - A general description of the geology and working sections are provided in the Project Description¹: <i>The Ulan Seam is divided into five key working sections (i.e. A1, WS1, WS2, ELWR and G) that are separated by recognised partings. The Illawarra Coal Measures are overlain by the Triassic Narrabeen Group (locally known as the Wollar Sandstone) and comprise mainly conglomerate and sandstone. The Ulan Seam typically ranges from 2.5 to 7.5 m thick in the Project area. Typical thickness of recovered coal plies mined by the existing Moolarben Coal Complex is 5.5 m in total, with various interburden thicknesses between plies.</i> - Further detail is provided in Section 4 of the EIS Groundwater Assessment².

¹ <https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-33083358%2120240315T015227.445%20GMT>

² <https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-33083358%2120221104T091021.759%20GMT>

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

Information Required		Response																					
	- Example geological written and geophysical logs for each pit and if possible, for those boreholes where gas content testing was undertaken. - Coordinates of supplied borehole logs.	A JORC Statement for the Project area was provided in the EIS³, which shows geological logs in the various Project mining areas.																					
c. Underground mining emissions	Annual return emission for each underground mine of CH ₄ and CO ₂ up the return shaft/s (or gas concentrations, air quantities). Temperature and pressure basis to be specified.	- Moolarben's approved underground operations also target the Ulan Seam. MCO monitors emissions from its upcast ventilation shaft for safety and reporting purposes. Results from this monitoring also demonstrate that the Ulan Seam has very low gas contents, and very low methane. - It is noted the Project does not involve any underground mining.																					
d. Copies of National Greenhouse and Energy Reporting (NGER) for the last four years		- The previous six years of reported Scope 1 emissions for the Moolarben Coal Complex are shown in the below figure: Moolarben - NGERs Data <table border="1"> <caption>Moolarben - NGERs Data</caption> <thead> <tr> <th>Financial Year</th> <th>Scope 1 Emissions (t CO₂-e)</th> <th>Intensity (t CO₂-e/ t ROM Coal)</th> </tr> </thead> <tbody> <tr> <td>FY18</td> <td>155,000</td> <td>0.008</td> </tr> <tr> <td>FY19</td> <td>152,000</td> <td>0.007</td> </tr> <tr> <td>FY20</td> <td>165,000</td> <td>0.008</td> </tr> <tr> <td>FY21</td> <td>165,000</td> <td>0.008</td> </tr> <tr> <td>FY22</td> <td>180,000</td> <td>0.009</td> </tr> <tr> <td>FY23</td> <td>215,000</td> <td>0.012</td> </tr> </tbody> </table> - Moolarben Coal Complex's emissions intensity is ~0.01 tCO₂-e/t ROM which is significantly below the industry average under the Safeguard Mechanism (0.0653 t CO₂-e/t ROM).	Financial Year	Scope 1 Emissions (t CO ₂ -e)	Intensity (t CO ₂ -e/ t ROM Coal)	FY18	155,000	0.008	FY19	152,000	0.007	FY20	165,000	0.008	FY21	165,000	0.008	FY22	180,000	0.009	FY23	215,000	0.012
Financial Year	Scope 1 Emissions (t CO ₂ -e)	Intensity (t CO ₂ -e/ t ROM Coal)																					
FY18	155,000	0.008																					
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FY23	215,000	0.012																					

³ <https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-33083358%2120221104T091007.849%20GMT>

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

Information Required	Response
e. Latest approved Greenhouse Gas Management Plan(s) for the complex	- The <i>Greenhouse Gas Minimisation Plan</i> for the existing Moolarben Coal Complex is available on the MCO website⁴, and is focused on reviewing gas minimisation options for the existing underground operations. Based on the low gas contents, the plan concludes that it is not technically feasible to capture and/or reuse fugitive emissions from the underground. - The Project has committed to continued implementation of reasonable and feasible greenhouse gas mitigation and management measures, which are generally focused on minimising emissions through efficient use of diesel, such as: - optimising mine plans and schedules to minimise haul distances and re-handle - maximising equipment utilisation/productivity and mining yields - maintaining or improving equipment to maximise fuel efficiency and consideration of fuel efficiency when procuring new or replacement equipment. - In addition, an independent peer review of greenhouse gas emission reduction options for the Project was prepared by GHD for the EIS, which states⁵: Scope 1 Emissions: - As discussed in section 3, GHG Management, Scope 1 emissions are dominated by diesel consumption by the mobile mining fleet (66%). - Due to the proposed life of the project being only 10 years (from about 2025 to 2034) the option for electrification of the mine fleet is not considered feasible due to the lack of battery electric mobile equipment currently available at the required scale plus the short project time frame available for a return on capital investment. - MCO should investigate the option of the replacement of the standard diesel fuel with biodiesel as B10 or B20 which would reduce the emissions associated with diesel consumption by up to 10% or 20% respectively. The feasibility of replacing standard diesel with biodiesel will be dependent on the local availability and cost of biodiesel and negotiation with engine manufacturers to ensure that engine warranties are not impacted, and that engine efficiencies and maintenance standards are not compromised. - The low level of fugitive emission associated with the open cut mine extension means that it is not feasible to minimise these emissions. Scope 2 Emissions: - As highlighted in the GHG report the option for purchasing renewable electricity should be reviewed if the existing contractual arrangements allow. A corporate Power Purchase Agreement (PPA) for the partial or complete supply of renewable electricity for the life of the open cut extension should be possible. It is noted that the recent upheaval in the National Electricity Market (NEM) has impacted the ability to negotiate new supply contracts. - The purchase of Large Generation Certificates (LGC's) with the electricity under a PPA would add a premium in the order of A\$40-70/MWh (LGC price range last 12 months). Electricity retailers may be able to offer GreenPower at a lower rate than the LGC price. Other Initiatives: - MCO may also consider the reforestation of land in addition to rehabilitation and biodiversity offsetting required by regulation. This could serve the dual purpose of enhancing the biodiversity and habitat at the site along with the sequestration of CO2.

⁴ https://www.moolarbencoal.com.au/icms_docs/258181_greenhouse-gas-minimisation-plan.pdf

⁵ <https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-33083358%2120221104T091006.260%20GMT>

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

Information Required	Response
Surface Geology	
a. <i>Is there field mapping that clearly delineates the alluvial and palaeochannel areas along Moolarben Creek and the existing/proposed spoil emplacement areas?</i>	- The regional geological mapping is provided in Figure 4.1 of the EIS Groundwater Assessment⁶ (see also Attachment 2 of this response). - The regional mapping has been refined by MCO based on the outcomes of exploration across the site. - The extent of mapped Tertiary Sediment / Palaeochannel (based on the site geology model), as well as mapped Triassic, Permian and Ulan Seam, as incorporated in AGE's Groundwater Model, is provided in Figures 5.10 to 5.13 of the EIS Groundwater Assessment (see also Attachment 2). - The extent of open cuts for the Project (and approved open cut extent) is also shown on these figures. - There are no out of pit spoil emplacement areas proposed for the Project – the open cuts will be progressively backfilled. - Ultimately the final landform will be a free-draining landform with no final voids (this is an improvement relative to the approved Moolarben Coal Complex, where a final void is approved in the southern extent of the existing OC3 pit).
Groundwater	
<i>Have any of the proposed alluvial and Triassic monitoring bores proposed by AGE for this OC3 extension area been constructed?</i>	- Although construction of these bores is linked to approval of the Project, MCO proposes to commence installation of these bores during 2024. - Note, Water Group within DCCEEW (previously DPE Water) stated it should be a <u>post-approval</u> requirement to prepare a Water Management Plan covering newly constructed bores for the Project (emphasis added): <i>Recommendation – <u>post approval</u></i> <i>Develop a water management plan (WMP) including the construction and placement of new monitoring sites, frequency of monitoring, water quality analyte suits and trigger action response plan ...</i>
<i>If not what is the expected timing to obtain baseline data in advance of mining given that 2 years is typically required?</i>	- Consistent with indicative mine sequencing shown on Figure 3-2 of the Amendment Report (see also Attachment 3 of this response), mining in the first two years of Project operations would occur adjacent to current mining in the approved OC3 area, where existing GW monitoring data is available. - It is also noted there would be a time period between approval of the Project and commencement of mining of the new Project pits (when considering EPBC Act Approval, granting of mining lease, secondary approvals, construction of new haul roads, etc).

⁶ <https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-33083358%2120221104T091021.759%20GMT>

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

Information Required		Response
Are any additional alluvial monitoring bore sites being proposed as per the IESC advice recommendations?		- Yes, a number of new bores in the Alluvium/Tertiary Palaeochannel are proposed, as per Figure 25 of the Groundwater Review⁷ for the Amendment Report (which is consistent with Figure 8.1 of the EIS Groundwater Assessment) (see also Attachment 4 of this response). - It is noted the Water Group within DCCEE (previously DPE Water) stated in its Submission (emphasis added): <i>All the SEARs relevant to groundwater impact have been satisfactorily addressed in the Groundwater Assessment report.</i> <i>The impact of the project on groundwater and its receptors was estimated using Modflow-USG groundwater model that was independently peer reviewed as fit for the purpose.</i> <i>Nevertheless, DPE Water assessed the groundwater model as acceptable with 66% rating.</i> <u><i>DPE Water agrees with the selection of proposed monitoring sites and the proposal to update the approved WMP for MCC once baseline information of the proposed monitoring sites are analysed.</i></u>
Are any new Permian overburden/Ulan seam monitoring bores proposed to validate the model predictions? If so, where?		- Existing groundwater bores PZ003, PZ221 and PZ217 are all screened in the Ulan Seam and monitoring data from these bores would be used to validate the model predictions. - These bores are shown on Figure 25 of the Groundwater Review for the Amendment Report (which is consistent with Figure 8.1 of the EIS Groundwater Assessment) (see also Attachment 4 of this response).
a. In relation to groundwater modelling:	Why does the uncertainty analysis for baseflow changes not account for the key factors that are expected to impact on simulated baseflow (including: hydraulic properties of the alluvium, initial water levels in alluvium, recharge rates to the alluvium and stream bed conductance)?	Please refer to the response to Question 1 in AGE's letter memorandum (provided as Attachment 5).
	Can the Panel please have access to the monitoring data to support the claim that "large areas of the project are currently unsaturated, limiting the potential for impacts associated with changes in groundwater levels"?	Please refer to the response to Question 2 in AGE's letter memorandum (provided as Attachment 5).
	Can the Panel please have access to the data to support the claim that the "variability in groundwater levels of around 5 m due to climatic variations" in existing monitoring bores?	Please refer to the response to Question 3 in AGE's letter memorandum (provided as Attachment 5).
	Can the Panel please have access to the data used to calculate recharge rates (to the alluvium and the geological units)?	Please refer to the response to Question 4 in AGE's letter memorandum (provided as Attachment 5).
Surface Water		
Are SW sites SW08 and SW09 gauged sites or just WQ monitoring locations?		These SW sites upstream of Moolarben Dam are not gauged.

⁷ <https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-33083358%2120240315T015231.396%20GMT>

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

Information Required	Response
<i>Has the proposed SW WQ site on Murdering Creek been established?</i>	Yes, Attachment 6 provides a figure which depicts the new locations of the surface water monitoring sites (SW26, SW27, SW28).
<i>Are additional SW monitoring sites being proposed along Moolarben Creek as per the IESC advice?</i>	Yes, as stated in the Submissions Report MCO accepts the IESC recommendations regarding the establishment of additional water quality monitoring locations.
<i>It is noted that one of the few available gauging stations that has been referred to (SW01) has incomplete data “due to difficulties in ascertaining a robust curve due to the presence of reeds and periods of no flow”. The Panel would like to know whether efforts have been made more recently to improve the monitoring at this site (SW01)?</i>	- It should be noted there is significant uncertainty associated with collecting accurate flow data in these ephemeral creeks with sandy stream beds, due to inherently changing streambed dimensions, affecting streambed cross section accuracy at the gauging station location (i.e. it is not possible to construct v-notch weirs along the Goulburn River). - In addition, SW01 is located downstream of Moolarben Dam and gauged flows have limited relevance to the Project (as the upstream flows from the Moolarben Creek catchment are controlled by releases from Moolarben Dam). This gauging station is not operated by MCO, and is operated by Ulan Coal. - MCO has installed additional flow gauges downstream of the SW01 on the Goulburn River.
Aboriginal heritage	
<i>Heritage NSW have pointed out that there are many cultural heritage sites associated with Moolarben Creek and that it is unclear if this area has been extensively surveyed. Is further information available on the cultural heritage surveys that have been carried out at Moolarben Creek?</i>	- There has been extensive survey of Moolarben Creek to date, both associated with the Project Aboriginal Cultural Heritage Assessment and in previous assessments. - It is noted that avoidance of open cut mining within 200 m of Moolarben Creek was proposed in the EIS and is also proposed for the amended Project. In addition, extensive avoidance of other disturbance along Moolarben Creek is proposed for the Project. - Figure 10 from the ACHA for the Amended Project, which shows survey coverage, is provided in Attachment 7 to this response.

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

Information Required	Response
Biodiversity <i>In the submission by BCS and NPWS, there is a statement that “all natural values, inclusive of water resources both within and underneath Munghorn Gap Nature Reserve, geological features within the nature reserve and biodiversity occupying the nature reserve are legislatively protected under the National Parks and Wildlife Act 1974 (NPW Act). EHG consider that the EIS has not adequately assessed the potential impacts proposed mining operations will have on the surrounding nature reserve.” Yet, according to the groundwater modelling, groundwater drawdown is predicted to occur underneath the Munghorn Gap Nature Reserve in response to the planned mining activities. Please provide a further explanation of these apparent conflicts.</i>	
	• The EHG fail to specify any provision under the <i>National Parks and Wildlife Act 1974</i> (NPW Act) which is breached or in conflict with the proposed OC3 Extension Project. There is no statutory or common law basis to support the claim that the National Parks and Wildlife Service have any protection, control or management functions in relation to groundwater beneath the MGNR. • There is a well-established statutory framework for the take and use of water in NSW, governed by the <i>Water Management Act 2000</i> (and the <i>Water Act 1912</i> [NSW]) and enforced by the Natural Resources Access Regulator (NRAR) in accordance with their responsibilities provided under the <i>Natural Resources Access Regulator Act 2017</i> (NSW). • The coal measures are water bearing units and serve as a regional groundwater system, underlying much of the Sydney Basin. This groundwater system is regulated under a Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016. • MCO considers that it has adequately assessed the potential direct and indirect impacts to the surrounding Nature Reserve. • Predicted groundwater drawdown in the Ulan Seam for the amended Project-only as well as cumulatively is shown on Figure 6 of the Groundwater Review⁸ (AGE, 2024) (refer to Attachment 8 of this response). • The predicted extent of drawdown due to the amended Project is limited due to the extensive unsaturated areas in the vicinity of the Project, the subcrop of the Ulan Seam west of the Project, and erosion of the Ulan Seam and overburden beneath Moolarben Creek. The contribution of the amended Project to cumulative drawdowns (including drawdown within the Triassic sandstone) from the approved Moolarben Coal Complex and surrounding mines is negligible (AGE, 2024).

⁸ <https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-33083358%2120240315T015231.396%20GMT>

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

ATTACHMENT 1 – DEPTH TO BASE OF ULAN SEAM

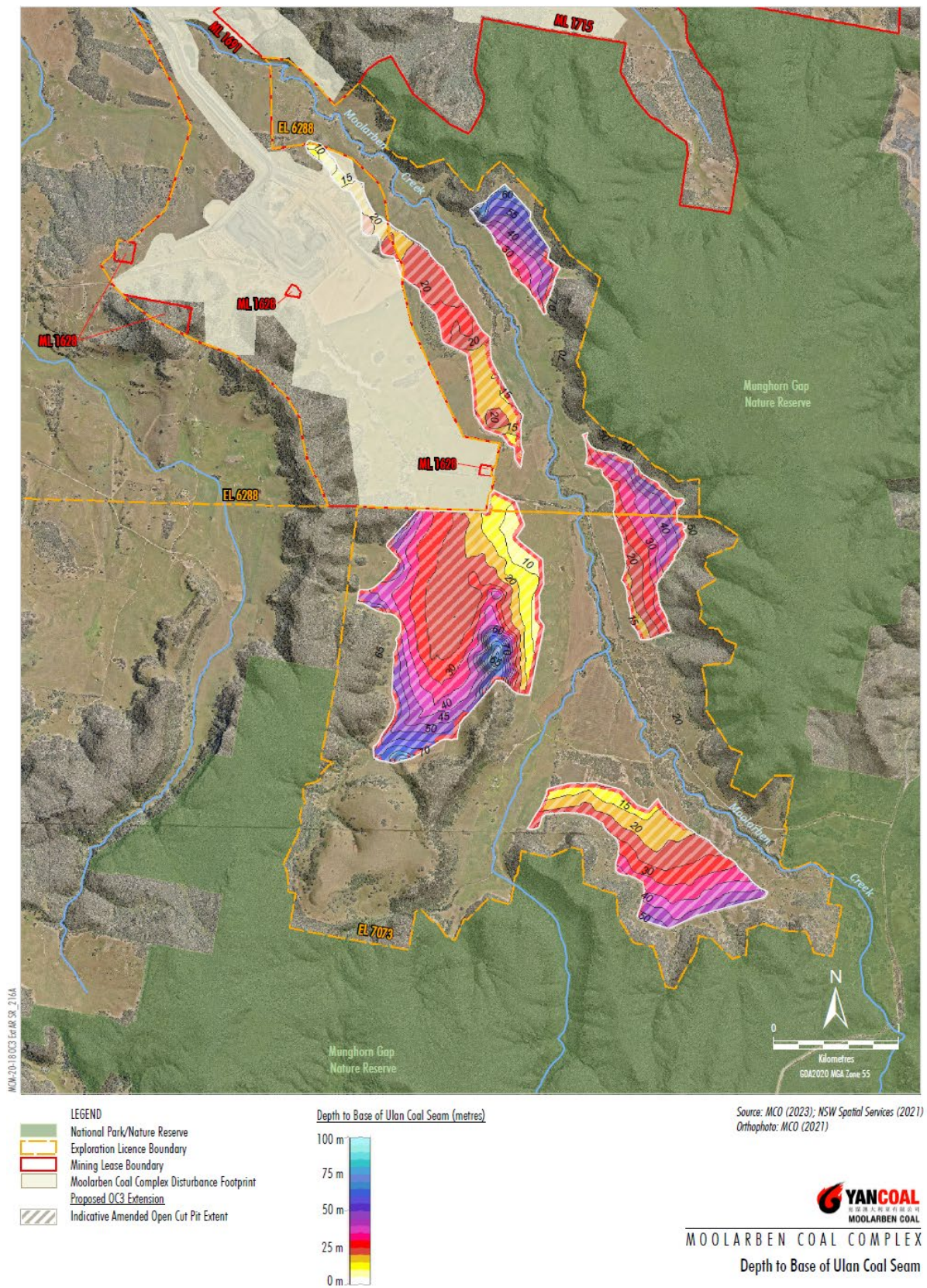
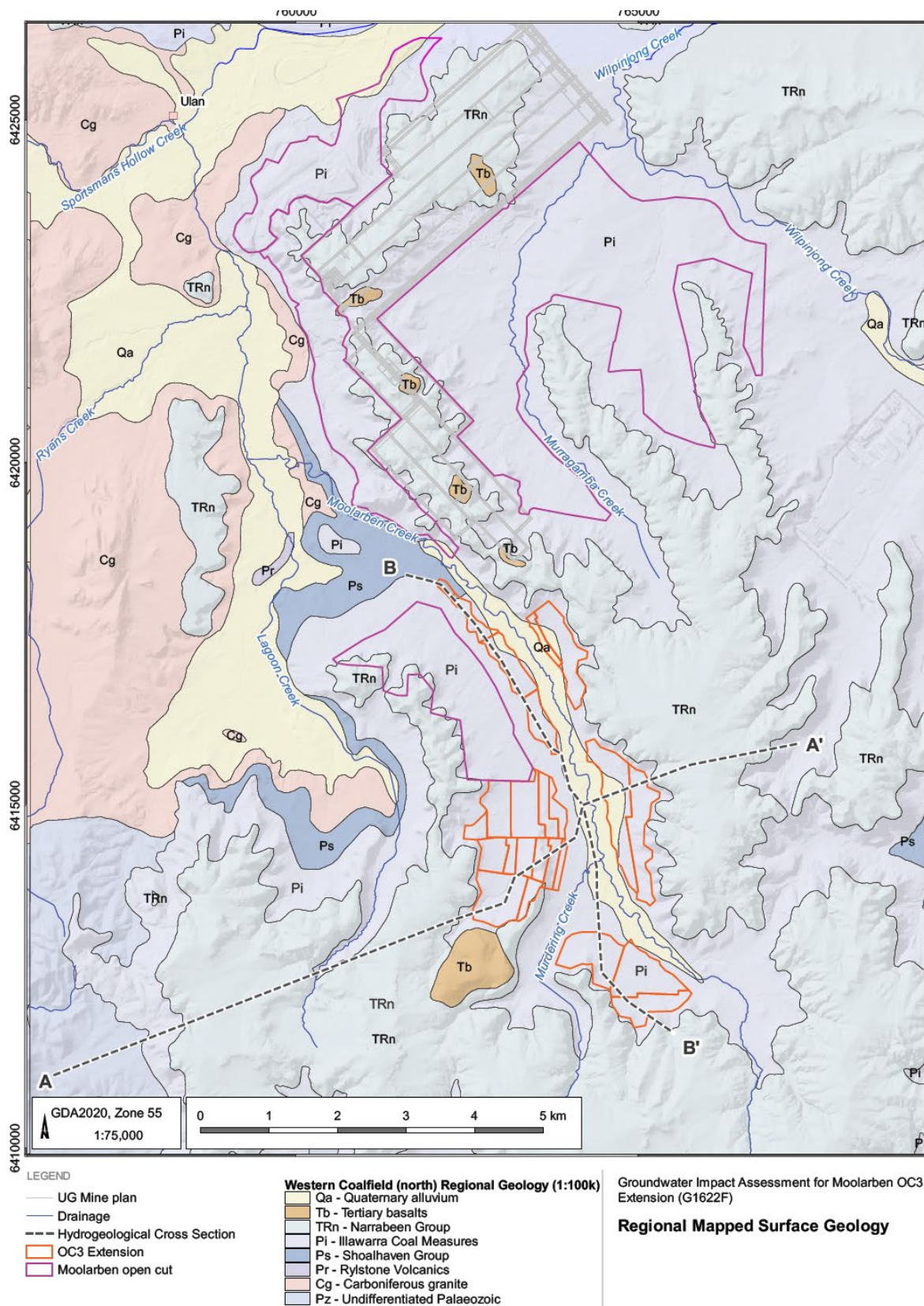


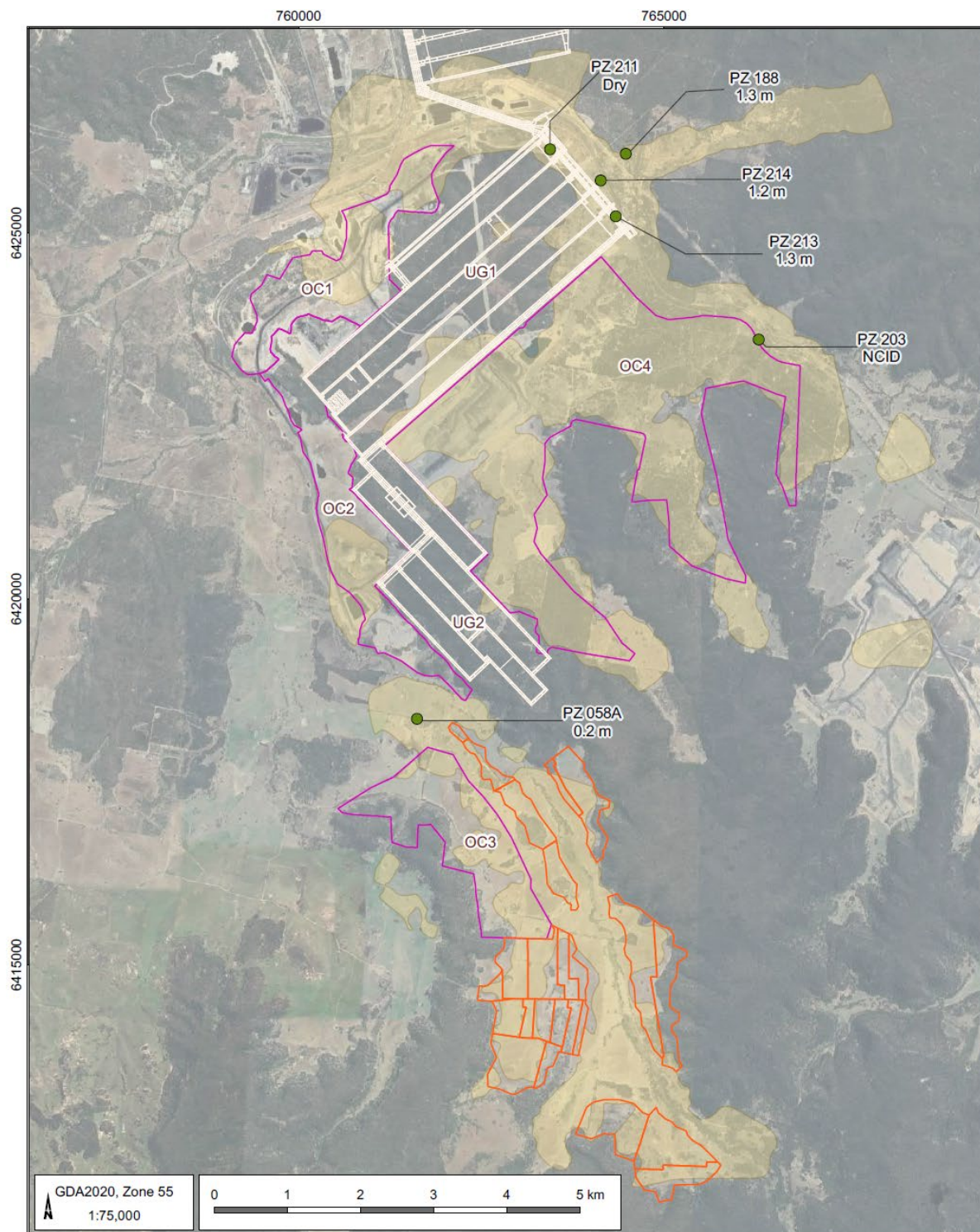
Figure 4-18

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

ATTACHMENT 2 – REGIONAL GEOLOGY AND GEOLOGICAL MODEL



Moolarben OC3 Extension Project – IEAPM Request for Additional Information Reconciliation Table



LEGEND

- Tertiary Sediments / Paleochannel (Drawdown in metres)
- UG Mine plan
- OC3 Extension
- Approved Opencuts
- Modelled Alluvium Paleochannel Extent

NCID: No Clearly Identifiable Drawdown as at December 2021

Groundwater Impact Assessment for Moolarben OC3 Extension (G1622F)

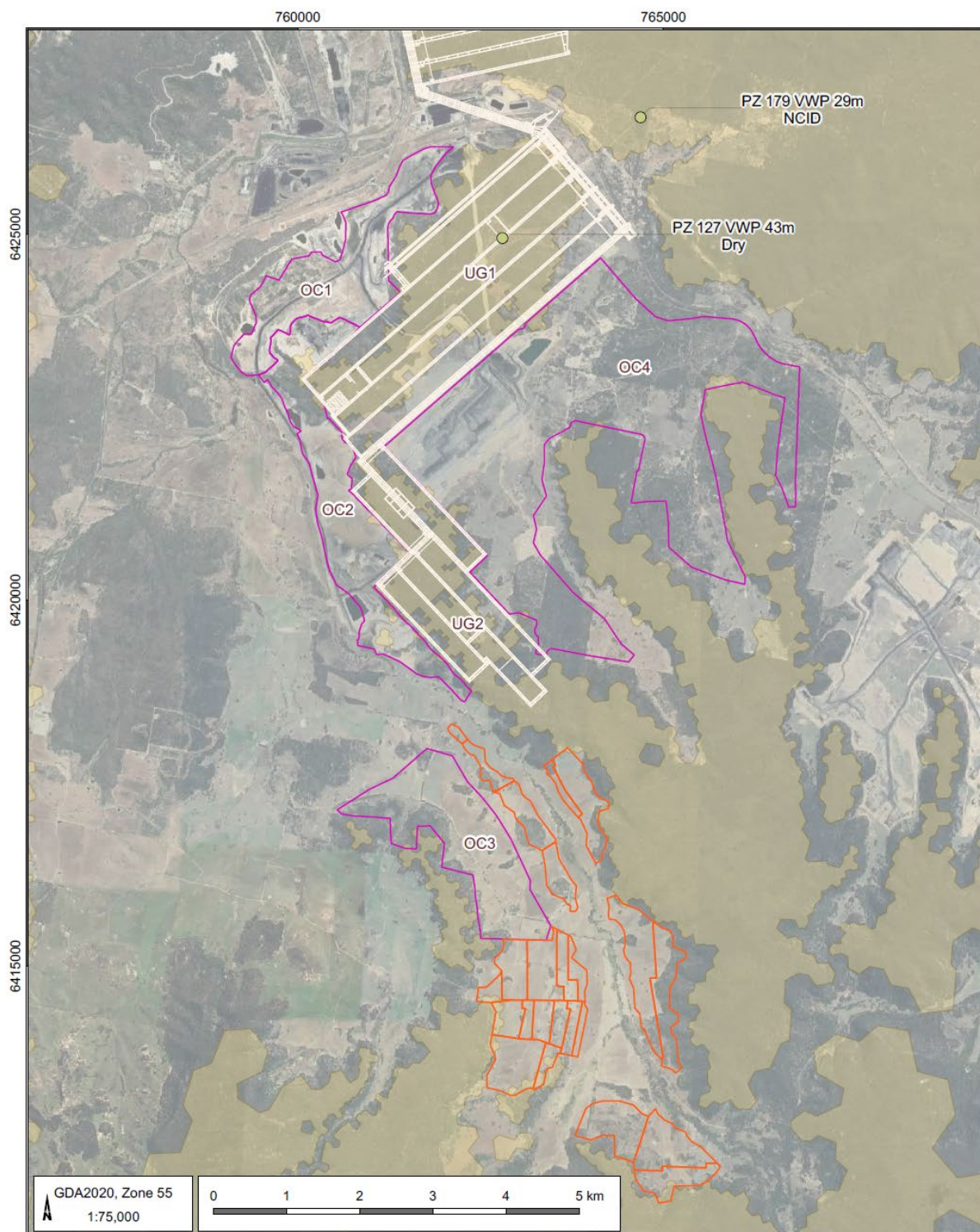
Estimated Palaeochannel Drawdown



DATE
02/11/2022

FIGURE No:
5.10

Moolarben OC3 Extension Project – IEAPM Request for Additional Information Reconciliation Table



LEGEND

- Triassic (Drawdown in meters)
- UG Mine plan
- OC3 Extension
- Approved Opencuts
- Modelled Triassic Extent

NCID: No Clearly Identifiable Drawdown as at December 2021

Groundwater Impact Assessment for Moolarben OC3 Extension (G1622F)

Estimated Triassic Drawdown

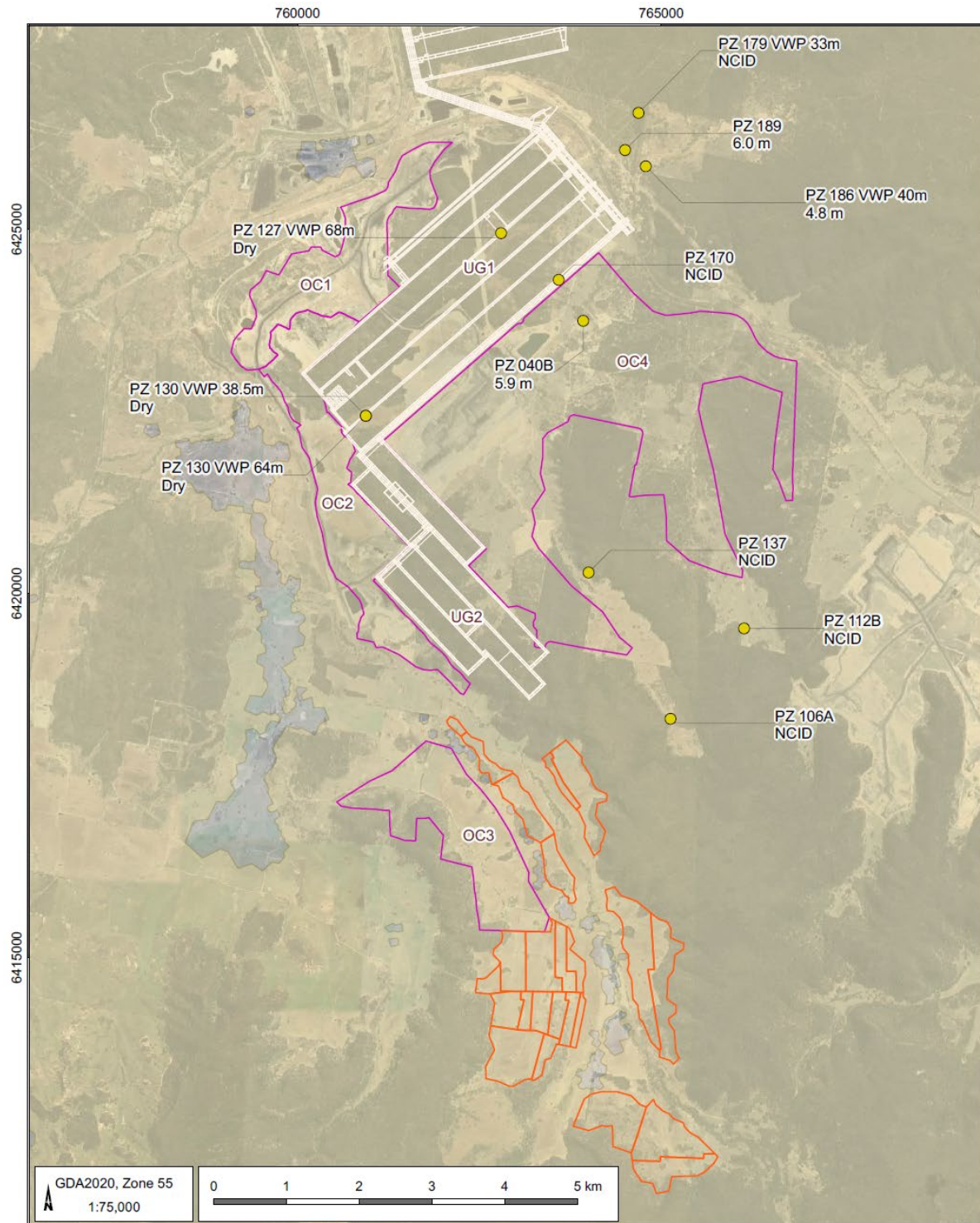


AGE

DATE
02/11/2022

FIGURE No:
5.11

Moolarben OC3 Extension Project – IEAPM Request for Additional Information Reconciliation Table



LEGEND

- Permian (Drawdown in meters)
- UG Mine plan
- OC3 Extension
- Approved Opencuts
- Modelled Permian Extent

NCID: No Clearly Identifiable Drawdown as at December 2021

Groundwater Impact Assessment for Moolarben OC3
Extension (G1622F)

Estimated Permian Drawdown

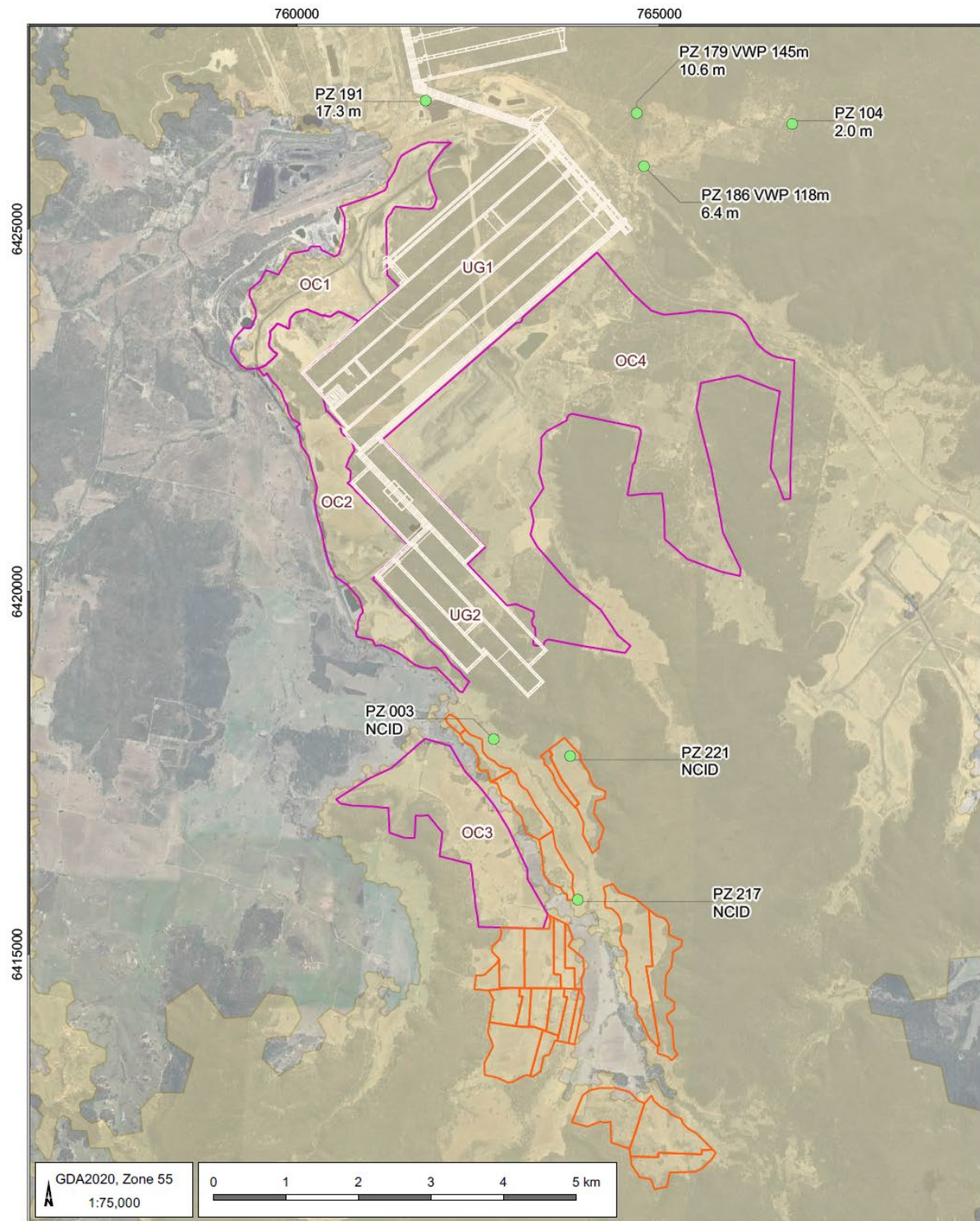


AGE

DATE
02/11/2022

FIGURE No:
5.12

Moolarben OC3 Extension Project – IEAPM Request for Additional Information Reconciliation Table



LEGEND

- Ulan Seam (Drawdown in meters)
- UG Mine plan
- OC3 Extension
- Approved Opencuts
- Modelled Ulan Extent

NCID: No Clearly Identifiable Drawdown as at December 2021

Groundwater Impact Assessment for Moolarben OC3 Extension (G1622F)

Estimated Ulan Seam Drawdown



AGE

DATE
02/11/2022

FIGURE No:
5.13

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

ATTACHMENT 3 – PROPOSED MINE SEQUENCING

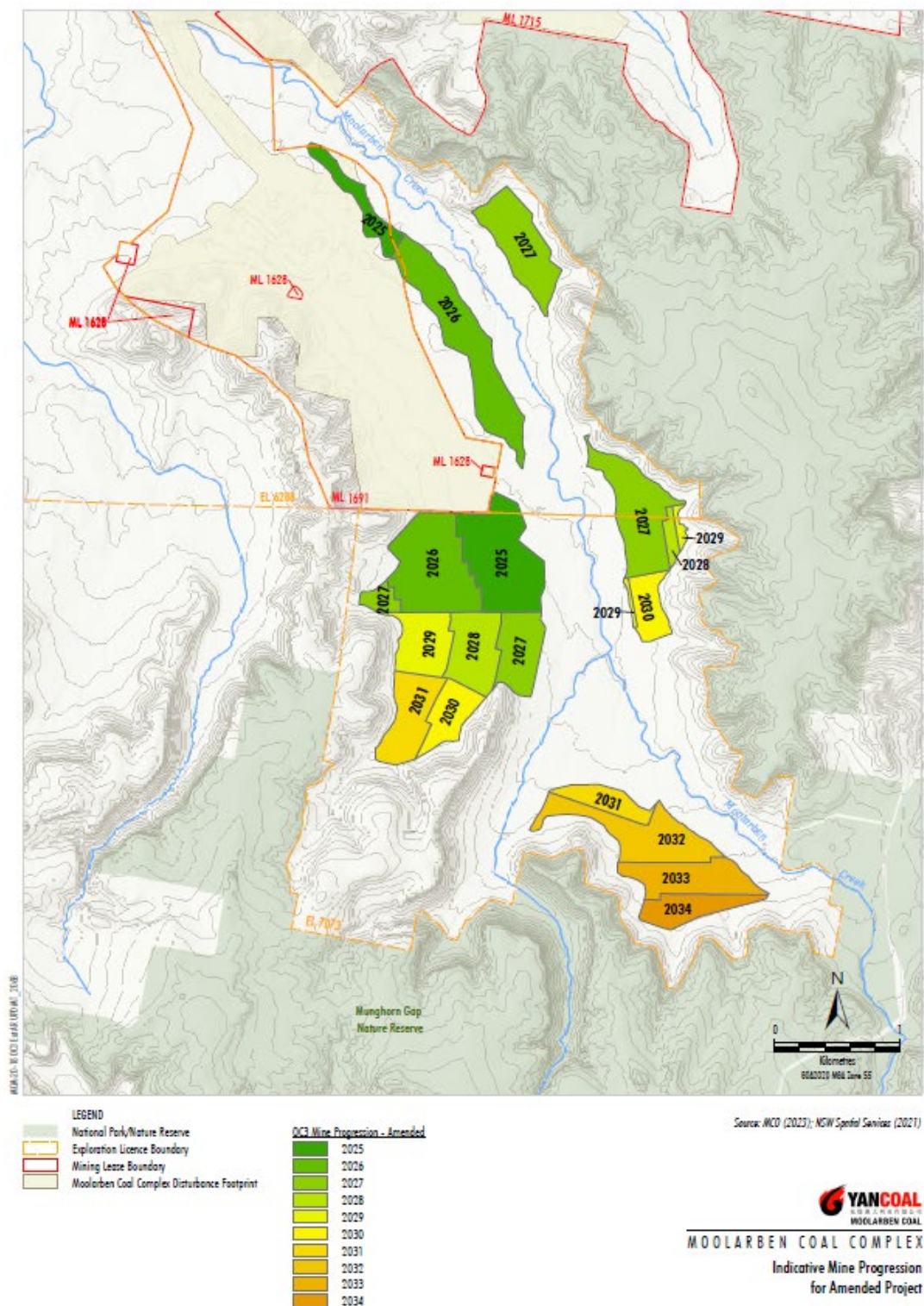
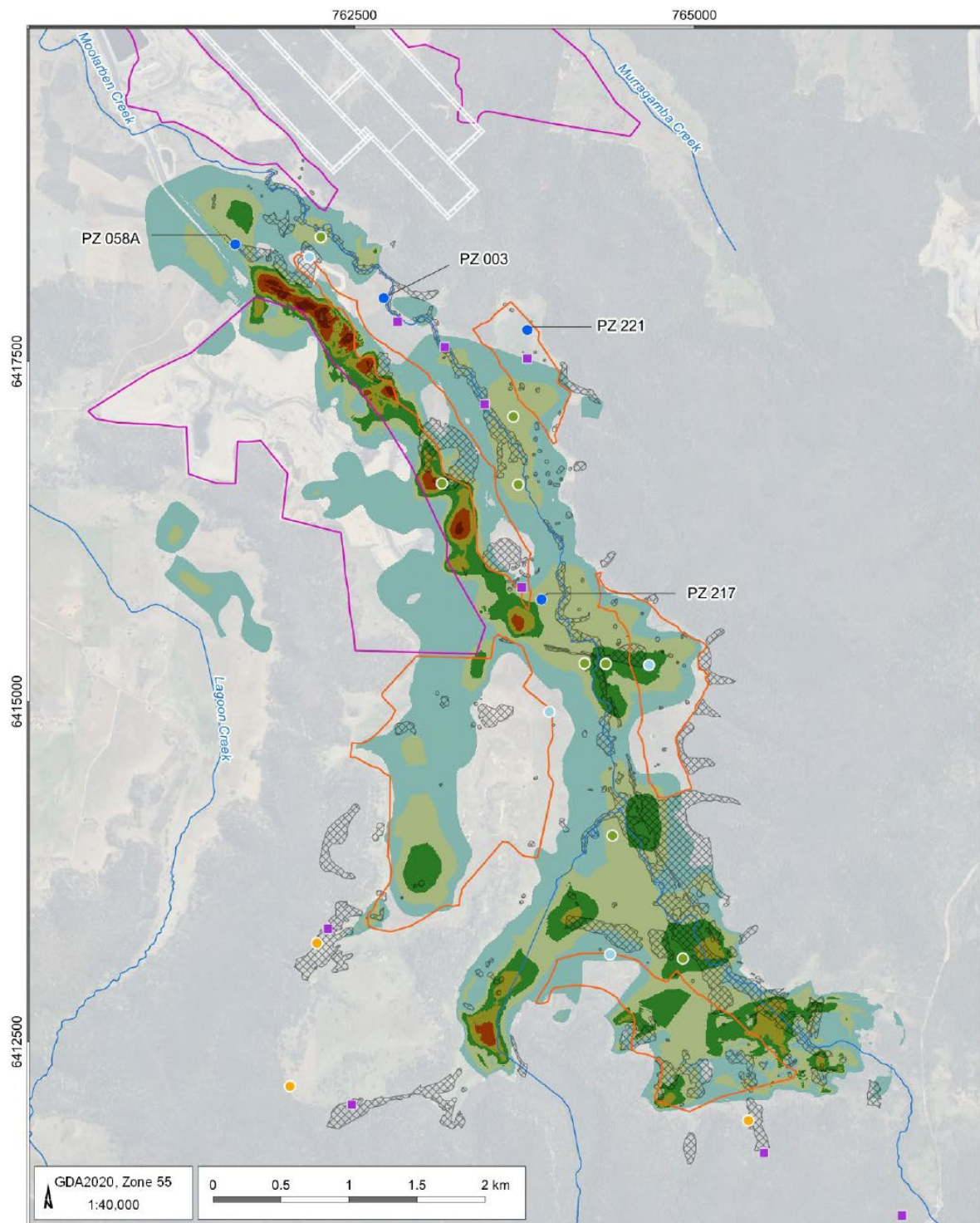


Figure 3-2

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

ATTACHMENT 4 – PROPOSED GROUNDWATER MONITORING NETWORK



LEGEND

- | | |
|--|--|
| <ul style="list-style-type: none"> ■ Regional Groundwater Feature Groundwater Monitoring Network Sites ● Standpipe Proposed Sites ● Mine Spoil ● Triassic ● Alluvium / Tertiary Palaeochannel | <ul style="list-style-type: none"> — Surface drainage — UG Mine plan OC3 Extension Approved Opencuts Potential GDEs |
|--|--|
-
- | |
|---|
| Palaeochannel Saturated Thickness (m)
<div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"> <ul style="list-style-type: none"> 0 to 5 m 5 to 8 m 8 to 11 m 11 to 14 m 14 to 17 m </div> <div style="width: 50%;"> <ul style="list-style-type: none"> 17 to 20 m 20 to 23 m 23 to 27 m 27 to 30 m </div> </div> |
|---|

Proposed OC3 Extension Amendment (MOO5005)

Proposed Groundwater Monitoring Network



DATE
29/02/2024

FIGURE No:
25

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

ATTACHMENT 5

RESPONSES TO GROUNDWATER INFORMATION REQUESTS (AGE, 2024)



Memorandum

Project number MOO5009.001

To Trent Cini

Company Yancoal - Moolarben

From AGE Consultants

Date 16 May 2024

RE: Moolarben OC3 Extension Project - Independent Expert Advisory Panel for Mining - Groundwater Responses

1 Introduction

Moolarben Coal Complex is an open cut and underground coal mine located approximately 40 kilometres (km) northeast of Mudgee and operated by Moolarben Coal Operations Pty Ltd (MCO). Moolarben Coal Complex comprises four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities). MCO have proposed an extension to the approved Open Cut 3 (OC3) mine footprint. The NSW Department of Planning, Housing and Infrastructure (DPHI) has requested the NSW Independent Expert Advisory Panel for Mining (IEAPM) provide advice the OC3 Extension Project. The IEAPM, through the DPHI, provided a request for additional information (RFI) dated 19 April 2024. The request includes a number of questions relating to groundwater.

MCO facilitated a site visit and meeting with the IEAPM on May 7th 2024 to address the RFI. The meeting and site visit were attended by MCO representatives, the IEAPM's members and MCO's specialist consultants. During the meeting an additional groundwater related request was raised by the IEAPM.

This memorandum addresses the groundwater related requests, specifically request (e), raised by the IEAPM.

2 RFI Responses

2.1 Question no. 1

- *Why does the uncertainty analysis for baseflow changes not account for the key factors that are expected to impact on simulated baseflow (including: hydraulic properties of the alluvium, initial water levels in alluvium, recharge rates to the alluvium and stream bed conductance)?*

The uncertainty analysis undertaken by AGE (2024) was run to assess the sensitivity of drawdown, pit inflows and baseflow estimates to a range of different hydraulic properties and stresses. This approach was peer reviewed by Brian Barnett for AGE (2022) and it was concluded the uncertainty analysis for the numerical groundwater model was considered suitable:

The method is considered to be the simplest approach to predictive uncertainty analysis and is usually considered appropriate for those modelling studies in which the predicted impacts are relatively modest or where the consequences of having poorly defined predictive uncertainty are not severe. In my opinion the approach is suitable for the current study.

The predicted impacts due to drawdown, pit inflows and baseflow from the uncertainty analysis are generally consistent with the base case predictions for the Project and are not significant in comparison to the predicted and observed impacts as a result of approved mining operations in the region.

This conclusion is supported by the conclusions of the peer review by Brian Barnett (2022) which states (emphasis added):

*Uncertainty analysis is presented in Section 7.4. Six model realisations were run to assess the sensitivity of drawdown, pit inflows and baseflow estimates to a range of different hydraulic properties and stresses. **In these models, all predicted impacts associated with the proposed OC3 extension are not significant compared to impacts that have already been observed and that are expected to occur as a result of approved mining operations at Moolarben and neighbouring mines.** The Report provides a summary of the groundwater modelling work described in the Appendix. Important groundwater modelling outcomes are clearly described and illustrated through a series of easily digested maps, charts and tables. The level of reporting is of a high standard and meets all requirements of the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).*

The structure of the alluvium and adjacent paleochannel mean that the connection between the dewatering in the pits and the alluvium, as well as Moolarben Creek is through either the paleochannel, or through the underlying Permian sediments. Moolarben Creek has been simulated with the MODFLOW-USG River (RIV) package as a drainage feature, where water can exit the model as baseflow in the creek, however the creek does not supply water to the aquifer. The conductance term applied to the RIV boundary condition is nominally high, to ensure water flowing to the bed of the creek is removed from the model domain. The river boundary condition is generally located within the model cells defined as alluvium. The alluvium has been assigned a high 44.8 m/day horizontal hydraulic conductivity determined through the model calibration process.

This means that the material providing the link between, and controlling the flow to the alluvium and Moolarben Creek is the paleochannel, which is assigned a horizontal hydraulic conductivity of 6.0×10^{-2} m/day, several orders of magnitude lower than the alluvium and more consistent with the coal seam hydraulic conductivity (6.3×10^{-1} m/day). Because the paleochannel properties were subject to change in the uncertainty analysis, the impact on the alluvium and baseflow in the creek was explored through the direct connectivity between the alluvium and the paleochannel layers.

Further detailed information on the uncertainty analysis is provided in AGE (2022) and AGE (2024).

2.2 Question no. 2

- *Can the Panel please have access to the monitoring data to support the claim that “large areas of the project are currently unsaturated, limiting the potential for impacts associated with changes in groundwater levels”?*

Figure 2-1 shows the seven (7) groundwater monitoring bores located in the vicinity of the Project area and Table 2-1 summarizes the construction details. Apart from bore PZ058A and bore PZ072C, which are screened in the Tertiary sediments, the monitoring bores are screened in the Ulan Seam. This bore construction is generally adopted when drilling indicates unsaturated conditions occur within the alluvial deposits at the time of installation.

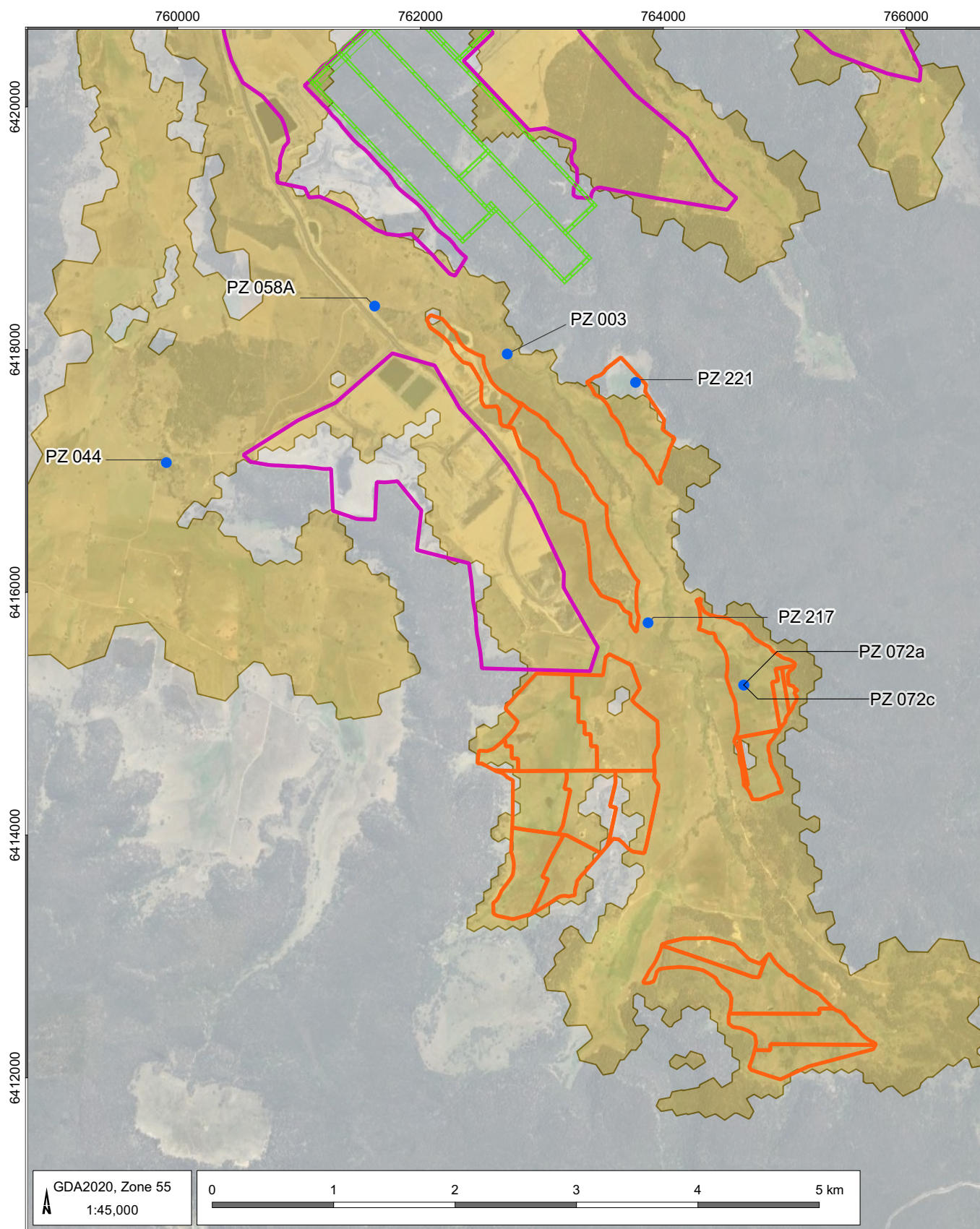
Figure 2-2 to Figure 2-8 show the recorded groundwater levels at each monitoring bore, along with the following information:

- Bore collar elevation;
- Unconsolidated sediments base; and
- Cumulative Rainfall Departure (CRD) curve, which indicates periods of above average or below average rainfall.

The charts show consistently unsaturated conditions within the unconsolidated deposits at monitoring sites PZ044 and PZ221. At monitoring site PZ003 the unconsolidated sediments were saturated for a short period of time in late 2022/early 2023 (coincident with extended wet periods). Monitoring sites PZ058A, PZ072A, PZ072C and PZ217 show permanent (or almost permanent at P072A) saturated conditions within the unconsolidated sediments, noting that P072A and PZ217 are screened within the Ulan Seam formation.

Table 2-1 Monitoring bores construction details

Bore	Type	Collar elevation (mAHD)	Depth (m)	Screened interval (mbgl)	Unit screened
PZ003	Stand Pipe	474.9	21	9 – 15	Ulan Seam
PZ044	Stand Pipe	491.5	23	20 - 23	Ulan Granite
PZ058A	Stand Pipe	478.1	12	8 – 11	Tertiary Sediments
PZ072a	Stand Pipe	510.1	35.9	27 – 33	Ulan Seam
PZ072c	Stand Pipe	510.3	14	10 - 13	Tertiary Sediments
PZ217	Stand Pipe	495.3	18	7 – 13	Ulan Seam
PZ221	Stand Pipe	499.8	66	49 – 58	Ulan Seam



LEGEND

- Alluvium / Tertiary paleochannel extent
- Groundwater Monitoring Site**
- Mining**
- UG Mine Plan
- Approved Opencuts
- Proposed OC3 extension

Moolarben OC3 Extension Project - Independent Expert Advisory Panel for Mining - Groundwater Responses (MOO5009.001)

Groundwater monitoring locations



AGE

DATE
16/05/2024

FIGURE No:
2.1

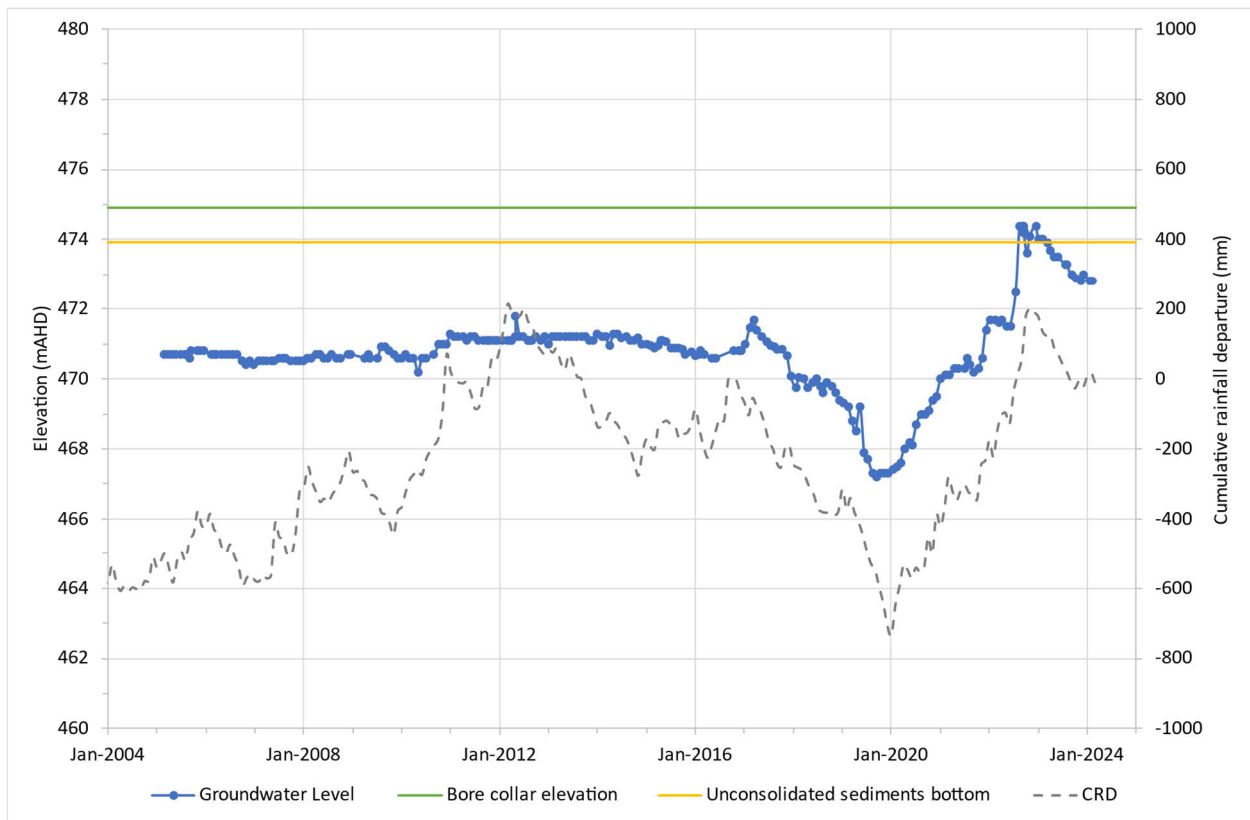


Figure 2-2 PZ003 recorded groundwater levels and CRD curve

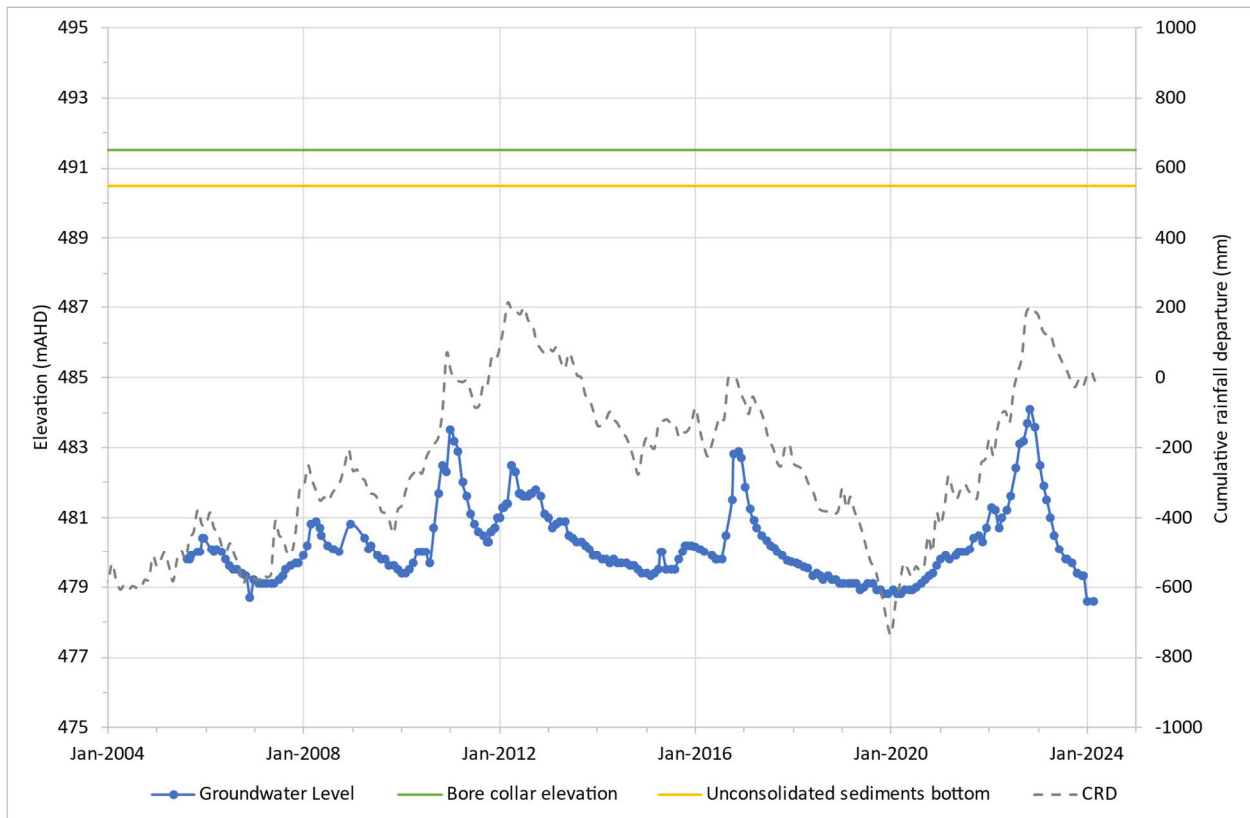


Figure 2-3 PZ044 recorded groundwater levels and CRD curve

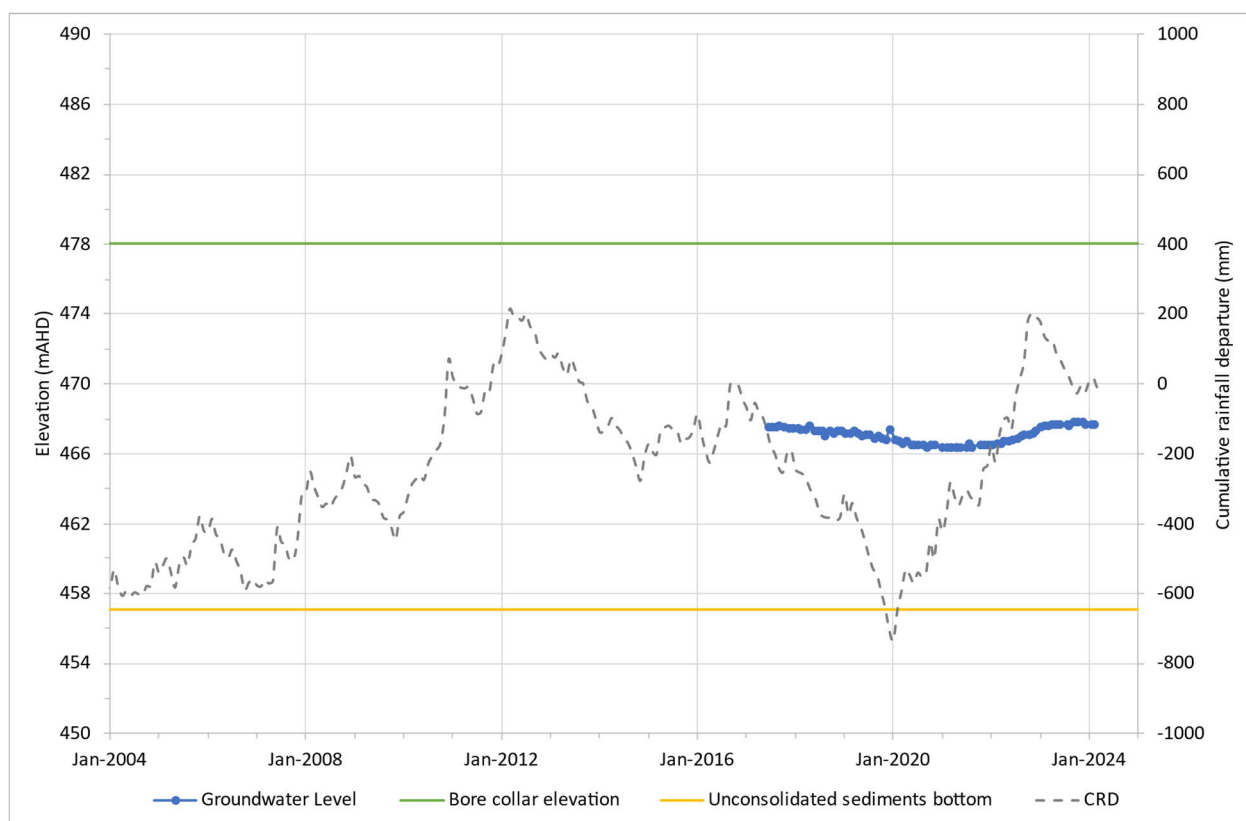


Figure 2-4 PZ058A recorded groundwater levels and CRD curve

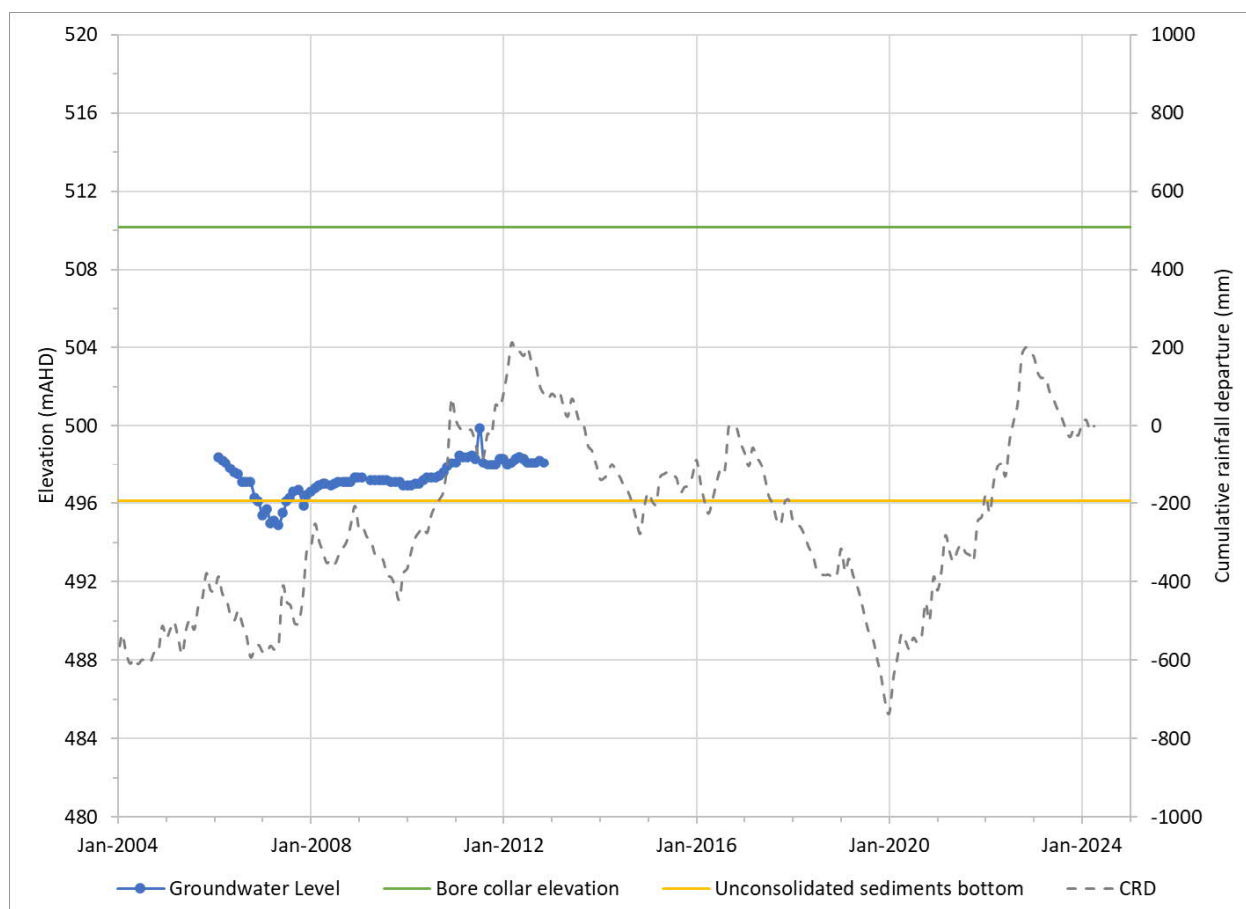


Figure 2-5 PZ072A recorded groundwater levels and CRD curve

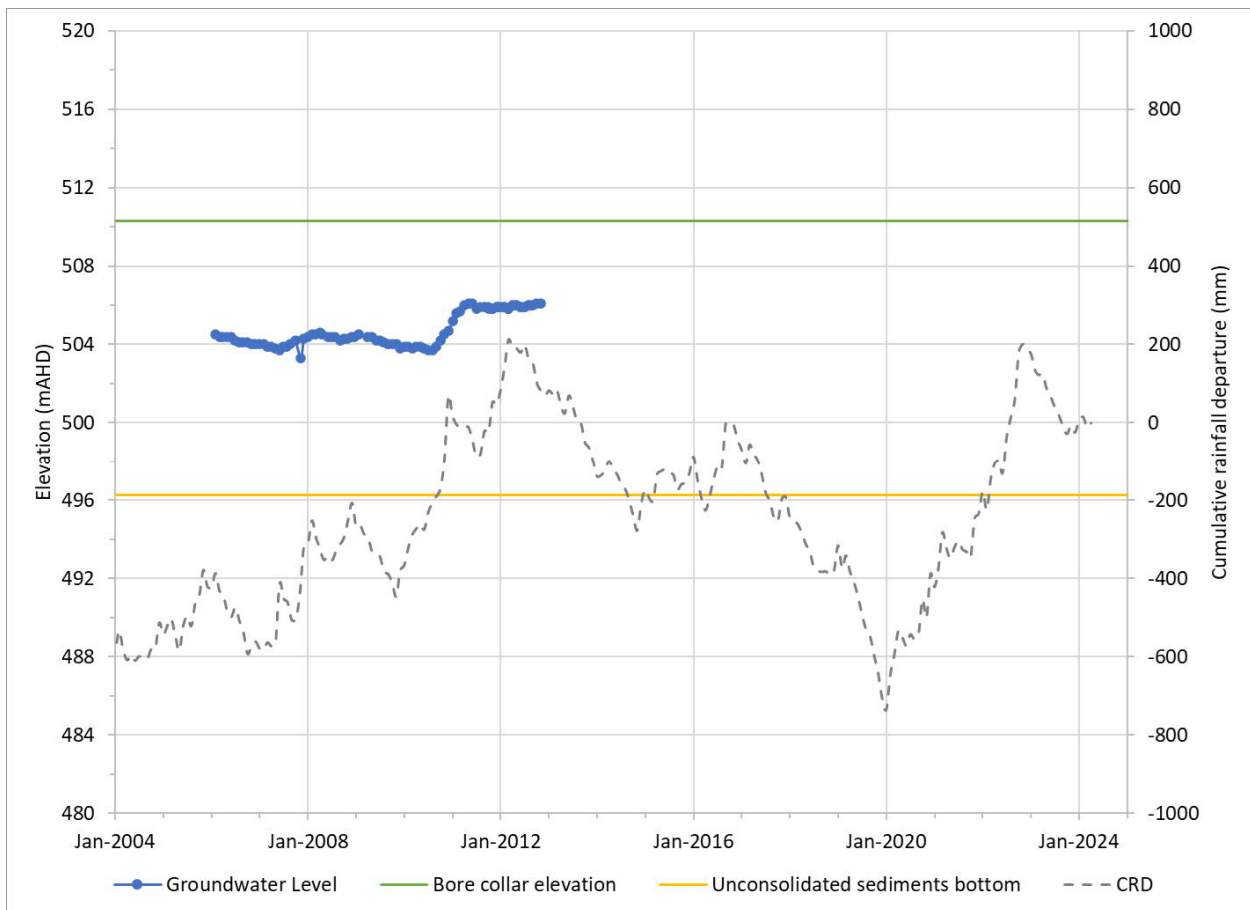


Figure 2-6 PZ072C recorded groundwater levels and CRD curve

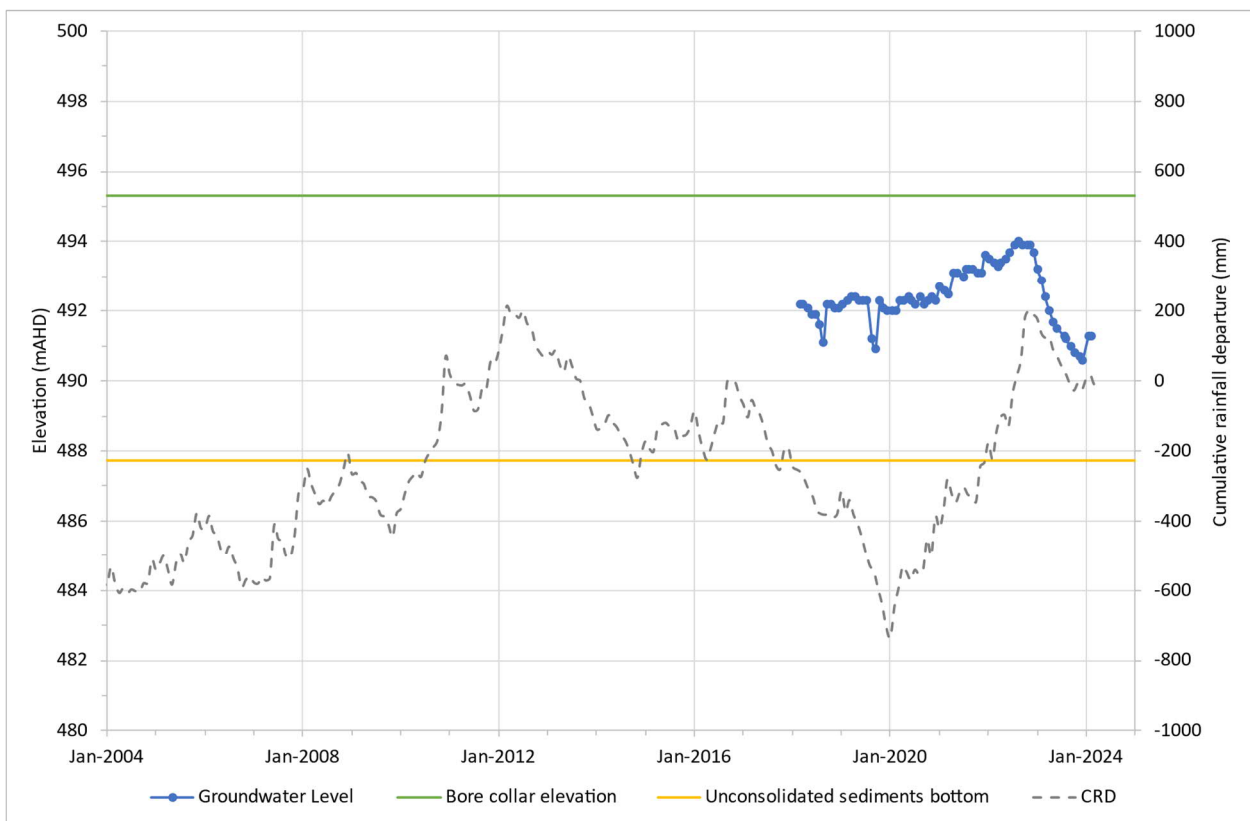


Figure 2-7 PZ217 recorded groundwater levels and CRD curve

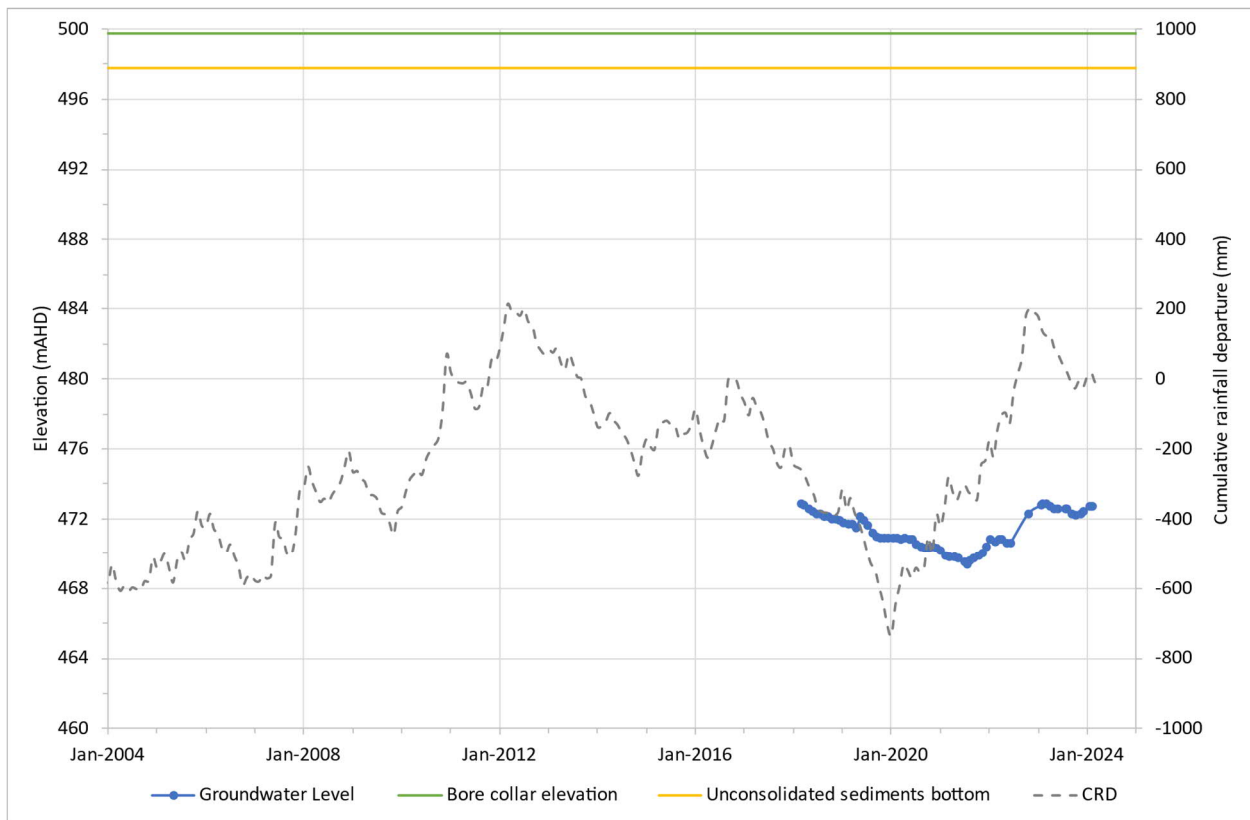


Figure 2-8 PZ221 recorded groundwater levels and CRD curve

2.3 Question no. 3

- Can the Panel please have access to the data to support the claim that the “variability in groundwater levels of around 5 m due to climatic variations” in existing monitoring bores?

As shown in Figure 2-2 and Figure 2-3, groundwater levels at monitoring sites PZ003 and PZ044 display a consistent response to climatic conditions as indicated by the correlation with the CRD. The charts show climatic stresses have result in groundwater levels at these bores varying by around 5 m.

2.4 Question no. 4

- Can the Panel please have access to the data used to calculate recharge rates (to the alluvium and the geological units)?

The recharge rates to the alluvium and the other geological units were calculated through the Groundwater Chloride Mass Balance (GCMB) approach (Crosbie et. al, 2010¹; Leaney et. Al, 2011²). the following steps were carried out:

- collation of the available sampling results (chloride concentration) for each Moolarben Coal Operation (MCO) monitoring site;
- filtering out sites where the bore depth is greater than 40 m below the depth to water to remove chloride concentration data that might have been affected by mixing processes with deeper groundwater systems;

¹ Russell Crosbie, Ian Jolly, Fred Leaney, Cuan Pentheram and Dan Wohling (2010) “Review of Australian Groundwater Recharge Studies” CSIRO

² Fred Leaney, Russell Crosbie, Anthony O’Grady, Ian Jolly, Laura Gow, Phil Davies, John Wilford and Penny Kilgour (2011) “Recharge and Discharge Estimation in Data Poor Areas – Scientific Reference Guide” CSIRO

- estimation of the average rainfall at Moolarben area from the analysis of nearby rainfall station data;
- determination of the average chloride concentration for each monitoring site; and
- calculation of the lower, average and upper recharge rate limits based on the Australian gridded chloride deposition-rate dataset (Davies and Crosbie, 2018³)

Table A 1 contains the full GCMB processed dataset that was used to calculate average recharge rates and recharge rates' bounds for each formation.

³ Phil Davies and Russell Crosbie (2018) "*Mapping the spatial distribution of chloride deposition across Australia*"



Attachment A

Groundwater Chloride Mass Balance processed dataset



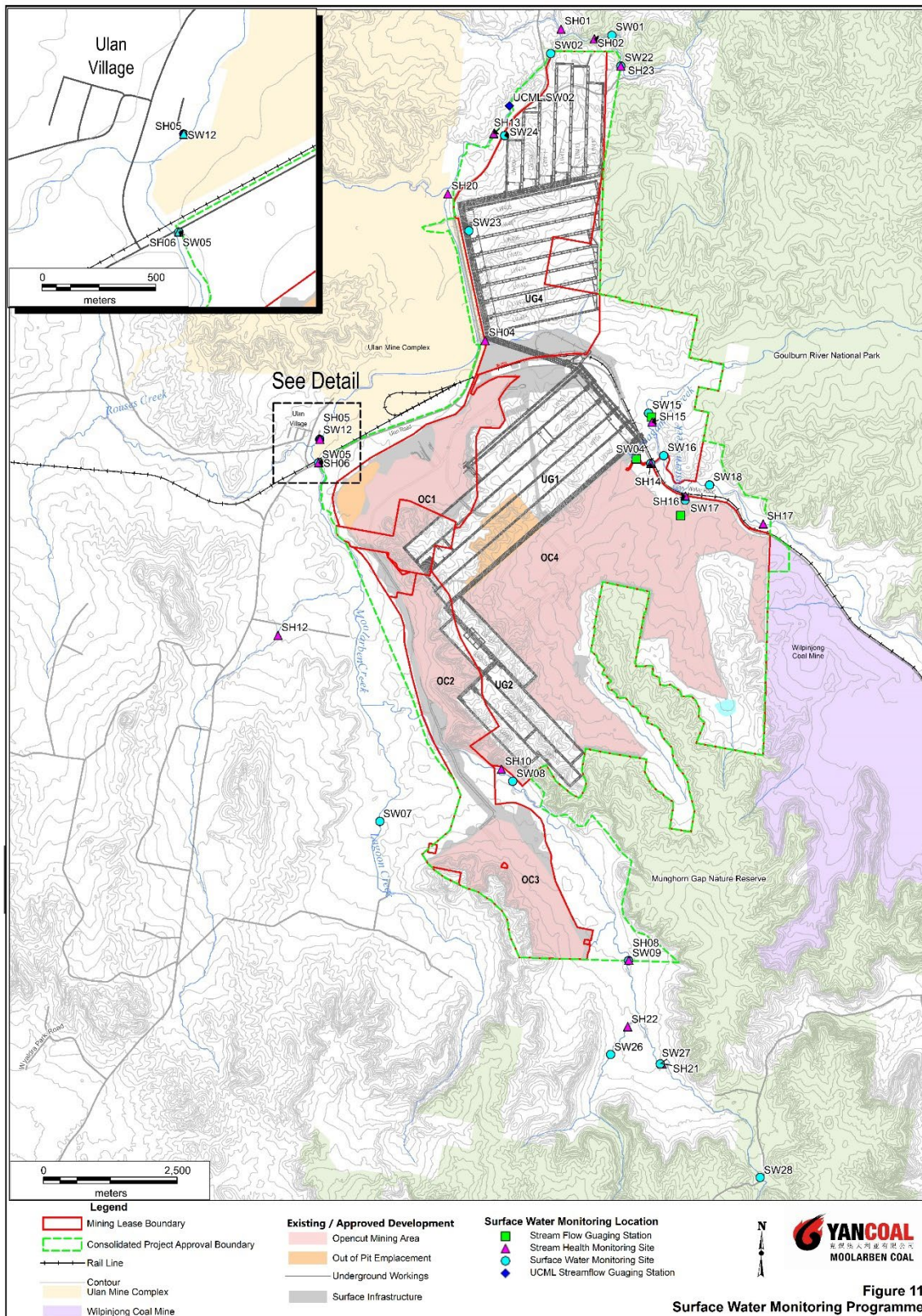
Table A 1 Groundwater Chloride Mass Balance processed dataset

Sample Point	TD (m)	Inferred Unit	Average Chloride (mg/L)	Count	Davies & Crosbie 2018 Lower Limit Inferred CI in Rainfall (mg/L)	Davies & Crosbie 2018 Inferred CI in Final Rainfall (mg/L)	Davies & Crosbie 2018 Upper Limit Inferred CI in Rainfall (mg/L)	Assumed Average Rainfall (mm)	Recharge Based on Lower Limit (Rainfall %)	Recharge Based on Davies Estimate (Rainfall %)	Recharge Based on Upper Limit (Rainfall %)
PZ 055	15.1	Marrangaroo Conglomerate	331	64	0.79	0.94	1.11	640	0.24%	0.29%	0.33%
PZ 215	18	Marrangaroo Conglomerate	466	5					0.17%	0.20%	0.24%
PZ 220	36	Marrangaroo Conglomerate	519	5					0.15%	0.18%	0.21%
PZ 165	6	Permian	16	19					4.86%	5.80%	6.80%
PZ 168	7	Permian	89	25					0.89%	1.06%	1.24%
PZ 177	7	Permian	1461	33					0.05%	0.06%	0.08%
PZ 141	9	Permian	1279	27					0.06%	0.07%	0.09%
PZ 173	9	Permian	2971	12					0.03%	0.03%	0.04%
PZ 155	10	Permian	2250	2					0.04%	0.04%	0.05%
PZ 149	11	Permian	1214	18					0.07%	0.08%	0.09%
PZ 112B	12	Permian	860	39					0.09%	0.11%	0.13%
PZ 175	12	Permian	3353	38					0.02%	0.03%	0.03%
PZ 201	12	Permian	40	5					1.97%	2.36%	2.76%
PZ 202	12	Permian	14	5					5.72%	6.83%	8.01%
PZ 152	13	Permian	1975	25					0.04%	0.05%	0.06%
PZ 172	24	Permian	2448	25					0.03%	0.04%	0.05%
PZ 134	26	Permian	1204	26					0.07%	0.08%	0.09%
PZ 131	27	Permian	1408	25					0.06%	0.07%	0.08%
PZ 176	28	Permian	168	38					0.47%	0.56%	0.66%
PZ 043A	30	Permian	370	29					0.21%	0.25%	0.30%
PZ 137	30	Permian	350	39					0.23%	0.27%	0.32%
PZ 181	30	Permian	20	27					3.96%	4.72%	5.54%
PZ 170	31	Permian	1287	41					0.06%	0.07%	0.09%
PZ 174	32	Permian	3631	38					0.02%	0.03%	0.03%
PZ 074	34.8	Permian	1016	22	0.79	0.94	1.11	640	0.08%	0.09%	0.11%
PZ 106B	41	Permian	560	41					0.14%	0.17%	0.20%
PZ 050C	12	Tertiary Sediments	71	4					1.11%	1.32%	1.55%
PZ 058	12	Tertiary Sediments	2450	27					0.03%	0.04%	0.05%

Sample Point	TD (m)	Inferred Unit	Average Chloride (mg/L)	Count	Davies & Crosbie 2018 Lower Limit Inferred Cl in Rainfall (mg/L)	Davies & Crosbie 2018 Inferred Cl in Final Rainfall (mg/L)	Davies & Crosbie 2018 Upper Limit Inferred Cl in Rainfall (mg/L)	Assumed Average Rainfall (mm)	Recharge Based on Lower Limit (Rainfall %)	Recharge Based on Davies 2018 Estimate (Rainfall %)	Recharge Based on Upper Limit (Rainfall %)
PZ 058A	12	Tertiary Sediments	3545	8					0.02%	0.03%	0.03%
PZ 184	12	Tertiary Sediments	1335	36					0.06%	0.07%	0.08%
PZ 072c	14	Tertiary Sediments	655	22					0.12%	0.14%	0.17%
PZ 203	21	Tertiary Sediments	76	11					1.04%	1.24%	1.46%
PZ 213	21.6	Tertiary Sediments	124	6					0.64%	0.76%	0.89%
PZ 214	25.2	Tertiary Sediments	49	6					1.61%	1.92%	2.25%
PZ 212	40	Tertiary Sediments	82	6					0.97%	1.16%	1.36%
PZ 043B	19	Triassic	776	29					0.10%	0.12%	0.14%
PZ 105C	28	Triassic	50	38					1.58%	1.88%	2.21%
PZ 101C	30	Triassic	74	32					1.07%	1.27%	1.49%
PZ 103C	30	Triassic	68	40					1.16%	1.39%	1.63%
PZ 018	15	Ulan Seam	125	27					0.63%	0.75%	0.88%
PZ 217	18	Ulan Seam	695	5					0.11%	0.14%	0.16%
PZ 003	21.35	Ulan Seam	240	39					0.33%	0.39%	0.46%
PZ 164	26.5	Ulan Seam	1405	25					0.06%	0.07%	0.08%
PZ 216	30	Ulan Seam	959	4					0.08%	0.10%	0.12%
PZ 004	32.35	Ulan Seam	573	26					0.14%	0.16%	0.19%
PZ 072a	35.9	Ulan Seam	269	22					0.29%	0.35%	0.41%
PZ 218	36	Ulan Seam	263	5					0.30%	0.36%	0.42%
PZ 219	36	Ulan Seam	1132	5					0.07%	0.08%	0.10%
PZ 187	22	Undifferentiated Alluvium	69	39					1.15%	1.37%	1.61%

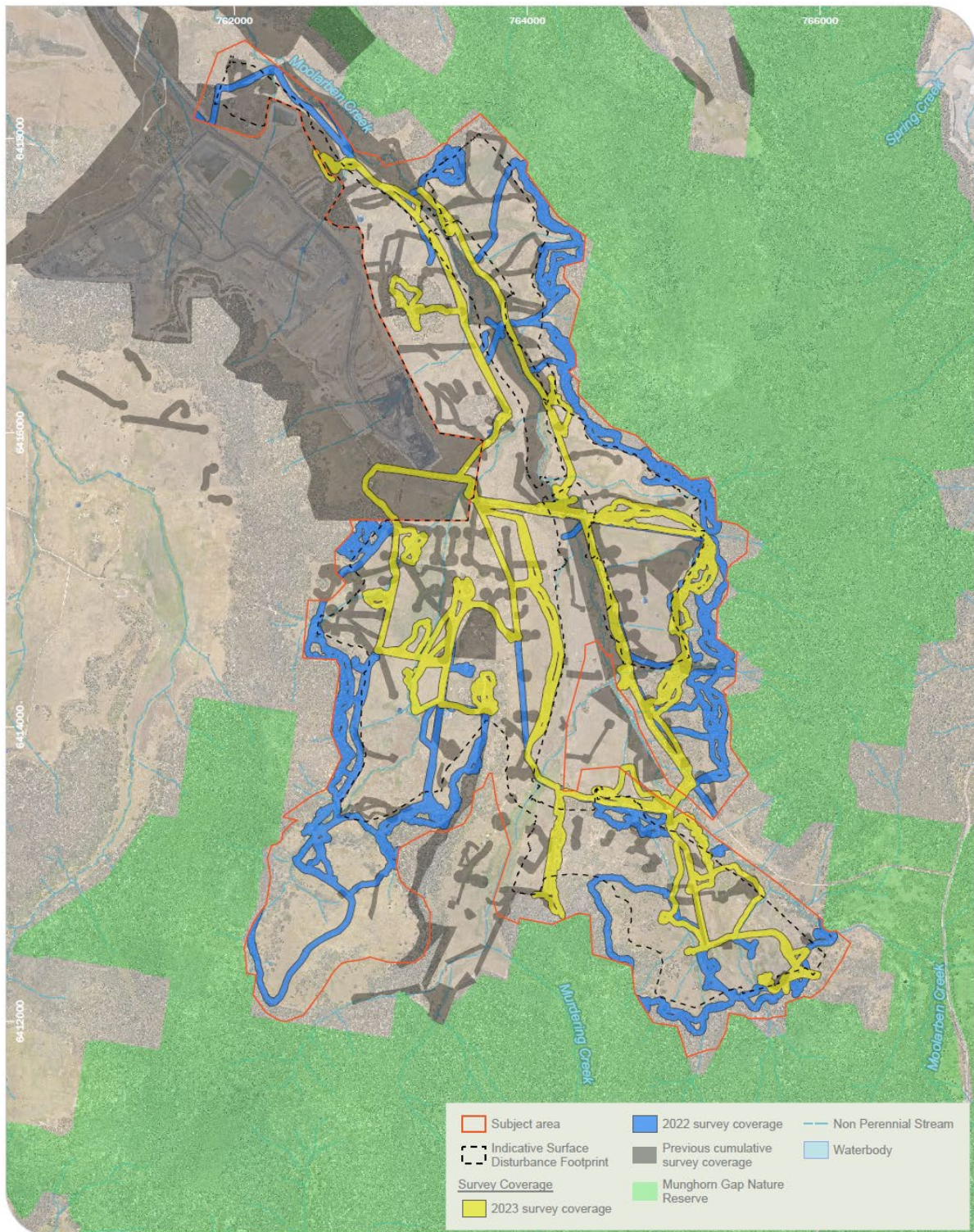
**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

ATTACHMENT 6 – SURFACE WATER MONITORING SITES



Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table

ATTACHMENT 7 – ABORIGINAL HERITAGE SURVEY COVERAGE



niche
Environment and Heritage

0 600
m

Niche PM: Ben Slack
Niche Proj. #: 8064
Client: Moolarben Coal Operations

Survey Coverage within the Subject Area
MCC OC3 Extension Project - ACHA

Figure 10

**Moolarben OC3 Extension Project – IEAPM Request for Additional Information
Reconciliation Table**

ATTACHMENT 8 – MAXIMUM PREDICTED GROUNDWATER DRAWDOWN IN THE ULAN SEAM

