CURRAGH BORD AND PILLAR MINE PROJECT
ENVIRONMENTAL ASSESSMENT REPORT

APPENDICES
PART 2 OF 2

HANSEN
ENVIRONMENTAL
CONSULTING

Appendix C Numerical groundwater modelling report

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Curragh North
Numerical Groundwater Modelling Report

Prepared for

Coronado Curragh Pty Ltd

C1. Introduction

hydrogeologist.com.au has developed a 3D numerical groundwater flow model for the Curragh North Mine to simulate the existing conditions of the groundwater regime and provide predictions of the effects of potential future underground mining.

The model represents the hydrogeology of the Curragh North Mine and its surrounds based on the conceptual groundwater model described in Section 5 of the Groundwater Report.

The modelling results presented in this report have been used to support the assessment of groundwater effects presented in the Groundwater Report. The specific objectives of the model included:

- predicting changes to local and regional groundwater flow regimes;
- predicting project-specific effects on groundwater resources, users and the environment;
- estimating groundwater inflow into open cut mining operations;
- predicting post-mining recovery of the groundwater regime;
- predicting cumulative drawdown on groundwater resources, users and the environment; and
- addressing regulatory requirements in relation to groundwater modelling.

This report provides a detailed description of the modelling, including model design and construction, calibration, predictions and uncertainty analysis. This report is presented as a technical appendix to the Groundwater Report and is intended to be read in conjunction with the groundwater assessment presented in the Groundwater Report.

The report is structured as follows:

- Section C1 – Introduction and overview of the report scope and structure.
- Section C2 – Model design, construction and calibration.
- Section C3 – Model predictive simulations.
- Section C4 - Model uncertainty analysis.
- Section C5 – References.

Appendix C 1 includes a cross referenced checklist from the Australian Groundwater Modelling Guidelines (Barnett *et al.*, 2012) including a model classification checklist.

Appendix C 2 includes the calibrated hydrographs.

Appendix C 3 includes the parameter sample distributions for the uncertainty analysis.

C2. Model design

C2.1. Model code selection

MODFLOW-USG (Panday *et al.*, 2015) was used as the modelling code. MODFLOW-USG is an "unstructured grid" version of MODFLOW that optimises the model grid and increases numerical stability by using unstructured, variably sized cells (Panday *et al.*, 2013). These cells take any polygonal shape, with variable size constraints allowing for refinement in areas of interest. It also facilitates implementation of pinching-out layers and/or layer discontinuities within the model domain. This can greatly reduce the number of grid cells within the model domain and thus reduce the model runtimes.

MODFLOW-USG is also able to simulate unsaturated conditions, allowing progressive mine dewatering and post-closure rewetting to be represented by the model.

MODFLOW-USG is widely used and accepted by groundwater modelling specialists for mining projects.

C2.2. Model domain

The model domain is shown in Figure C 1. The domain covers an area of approximately 158.55 km^2, extending approximately 9 km west to east and 20 km north to south.

The model domain extents were designed to be large enough to:

- Encompass the full extent of Curragh North Mine and any associated groundwater effects, including any cumulative interactions with surrounding mines and undeveloped mining projects.
- Encompass relevant surrounding mines with potential to result in cumulative groundwater effects. More distant and/or hydraulically disconnected operations are unlikely to add any significant depressurisation to the extensively depressurised groundwater regime at the Curragh North Mine. These operations were not included in the model domain as there is no potential for interaction between the groundwater effects of these activities and the Curragh North Mine.
- Remove significant interaction (i.e., boundary effects) between the depressurisation associated with mining activities and the model boundary conditions.

Natural geological, hydrological and hydrogeological features such as groundwater units, geological structures, watercourses and catchment boundaries were also considerations in determining the extents of the model domain, as required.

C2.3. Model processing and discretisation

Algomesh (Merrick, 2016) was used to develop an unstructured grid based on Voronoi polygons. The model mesh is comprised of 11886 active cells, which range in area of between 586 m^2 to 417850 m^2.

The model mesh was refined around surface water drainage lines, mining areas, geological structure (fault) and the location of groundwater observation sites. The extent of the model mesh, illustrating the refinement around the various spatial definition features, is shown in Figure C 1.

The overview of temporal discretisation for individual phases of modelling is presented in Table C 1.

Table C 1 Model temporal discretisation – overview

# of stress periods	Stress period length	Dates	Modelling phase
1	-	-	Steady state, pre-mine development
24	1 year	01/01/2000 – 31/12/2023	Transient calibration period

C2.4. Model layers

The model was constructed with eight layers to represent the hydrogeological units described in the Groundwater Report. Table C 2 lists the model layer numbers and the corresponding hydrostratigraphic units. Not all model layers are continuous over the entire model domain. Where necessary (for example Layer 1), some model layers pinch out and are no longer present. This has been carried out to be consistent with the geology and conceptual models.

Table C 2 Model layer definition

Model layer	Hydrogeological unit	Minimum thickness (m)	Average thickness (m)	Maximum thickness (m)	# Cells per layer
1	Mackenzie River floodplain alluvium	0.53	20.21	44.96	4279
2	Weathered profile	0.50	18.38	56.20	11499
3	Permian coal measures - overburden	0.55	114.62	311.38	7257
4	Permian coal measures - overburden	0.40	41.51	131.48	9045
5	Permian coal measures - Mammoth seam	0.55	3.48	8.90	9479
6	Permian coal measures - interburden	0.41	47.97	98.40	10389
7	Permian coal measures - Mackenzie seam	0.77	5.08	10.50	10490
8	Underlying Permian coal measures	100	100	100	11886

The surface elevation of Layer 1 (topography) was based on detailed LiDAR data provided by the proponent and modified to represent a pre-mining topographic surface. The pre-mining topographic surface elevation is presented in Figure C2.

The elevation of base of Mackenzie River floodplain alluvium (Layer 1) is presented in Figure C3, the base elevation of the weathered profile (Layer 2) is presented in Figure C4, the base elevation of the Permian coal measures – overburden (Layer 3) is shown in Figure C5. The base elevation of the Permian coal measures - overburden (Layer 4) and Mammoth seam (Layer 5) are shown in Figure C6 and Figure C 7 respectively. The base elevation of the Permian coal measures - interburden (Layer 6) and the Mackenzie seam (Layer 7) are shown in Figure C 8 and Figure C 9.

The thickness of the layers was developed from the Curragh North geological database and drilling/bore logs, supplemented with publicly available data where relevant as discussed in Section 4 of the Groundwater Report. Layer 8 was modelled underlying the Mackenzie seam with uniform thickness of 100 m.

C2.5. Hydrostratigraphy zonation

The model used 11 zones to represent hydraulic properties of horizontal hydraulic conductivity (K_X), vertical hydraulic conductivity (K_Z), specific yield (S_Y), and specific storage (S_S). These zones are summarised in Table C 3. These zones were used so as to spatially represent sub-vertical structures such as the Jellinbah Fault zone, the Burngrove Formation to the east of the Jellinbah Fault zone and to represent a higher permeability zone in the weathered profile underneath the Mackenzie River floodplain alluvium.

Table C 3 Hydrostratigraphic zonation

Zone	Layer	Hydrostratigraphy
1	1	Mackenzie River floodplain alluvium
2	2	Weathered profile
11	2	Weathered profile (Higher Kx)
3	3	Permian coal measures - overburden
4	4	Permian coal measures - overburden
5	5	Permian coal measures - Mammoth seam
6	6	Permian coal measures - interburden
7	7	Permian coal measures - Mackenzie seam
8	8	Burngrove Formation - west of JF
9	9	Burngrove Formation - east of JF
10	10	Jellinbah Fault zone

Note: JF refers to Jellinbah Fault zone

The zonation for Mackenzie River floodplain alluvium (Zone 1) is presented in Figure C 10, the weathered profile (Zone 2 and 11) is presented in Figure C 11 and Permian coal measures - overburden (Zone 3) is presented in Figure C 12. Zone 4 (Permian coal measures - overburden) is presented in Figure C13 and Zones 5 and 7 (Mammoth and Mackenzie seams) are presented in Figure C14 and Figure C16 respectively. Zones 6 and 8 (Permian coal measures – interburden and the Burngrove Formation) are shown in Figure C15 and Figure C17.

The conceptualisation of the Jellinbah Fault zone defines it as a structure which will not contribute to the assessment of the project. Based on available geological and hydrogeological data, the Jellinbah Fault zone is conceptualised as a feature that does not extend into the shallow strata (Layers 1 and 2) and one that hydraulically isolates Permian strata on either side of the fault. The fault zone itself is identified as claybound and of low permeability. The Permian strata is conceptualised to behave as an aquitard and therefore the fault is unlikely to form a vertical causal pathway to any shallow receptors (see Table 1 of the IESC Information Guidelines Explanatory Note - Characterisation and modelling of geological fault zones). On this basis it is considered appropriate to simplify the modelled representation of the fault as a separate zone within the model layers, rather than including it as a discrete layer.

C2.6. Model boundary conditions

Boundary conditions are necessary for solution of the 3D groundwater flow equation that is implemented by MODFLOW-USG. They also provide a means by which auxiliary groundwater fluxes and stresses can be specified within the model. The following boundary conditions have been adopted in the model.

C2.6.1. Rainfall recharge

Recharge was applied to Zones 1 and 2 (Mackenzie River floodplain alluvium and the weathered profile), using the MODFLOW Recharge (RCH) module. Recharge was calculated as a percentage of rainfall. The recharge zones are shown in Figure C18. The percentage of rainfall that enters the model as recharge in each zone was optimised during calibration.

A chloride mass balance assessment was carried out for all monitoring bores screened within the Mackenzie River floodplain alluvium. The data indicates that the annual net recharge within the Mackenzie River floodplain alluvium is low to moderate (between 0.7 mm/year to 16.5 mm/year). This is equivalent to approximately 0.13% to 3.1% of average annual rainfall.

A chloride mass balance assessment was carried out for all monitoring bores screened within the weathered profile. The chloride mass balance calculations indicate that the annual net recharge within the weathered profile is very low (between 0.055 mm/year to 1.31 mm/year). This is equivalent to approximately 0.01% to 0.25% of average annual rainfall.

C2.6.2. Evapotranspiration

Evapotranspiration was applied in zones (Figure C 19), using the MODFLOW Evapotranspiration (EVT) module.

EVT in the model only occurs where the groundwater table is shallow and within the extinction depth. Due to the general lack of shallow groundwater in the model domain, EVT is largely irrelevant and has negligible effect on the water balance.

An initial extinction depth of 5.0 m was applied to all zones. The 5 m extinction depth is considered appropriate as it represents the depth within which evapotranspiration activity is typically focussed. The maximum rate of evapotranspiration (pan factor) was initially set at 890.36 mm/year for all zones, which is equivalent to 80% of the average annual evaporation. The maximum rate of evapotranspiration is considered appropriate to represent the rate at which ponded water at the ground surface can be evaporated.

C2.6.3. Surface drainage

Surface water drainage was applied using the MODFLOW River (RIV) module to represent the Mackenzie River, Blackwater Creek and other minor tributaries (Figure C 20). The RIV module simulates a head-dependent flux boundary and is an appropriate boundary type to simulate the surface water drainage in the vicinity of the project area.

The Mackenzie River was modelled with a vertical hydraulic conductivity of 0.01 m/day and a stream width of 110 m. A stream depth of 0.2 m and a bed thickness of 3 m was applied to the Mackenzie River. This setup was based on field observations whereby water was generally observed year-round in the Mackenzie River. The streambed conductance or vertical hydraulic conductivity in the bed of the Mackenzie River was defined from the hydraulic testing carried out within the shallow project monitoring bores that intersect the same fresh Permian bedrock that forms the riverbed.

Blackwater Creek and the minor drainages were modelled with a vertical hydraulic conductivity of 0.01 m/day, and a stream width of 10 m and 2 m were applied for Blackwater Creek and minor drainage respectively. Blackwater Creek and the minor drainages were modelled as ephemeral drainage features with no head in the boundary condition. These features are only capable of removing water from the model and not introducing water. This setup was based on field observations and stream gauging data which show that Blackwater Creek and the minor drainages are ephemeral in nature, with nil flow for the majority of each year.

Hydraulic conductance of the surface drainage features was calculated for each individual cell based on the cell geometry, that is the length of the stream segment within each individual cell. The modelled conductance of the surface drainage features is only relevant in those areas where groundwater is known to discharge to surface, or where surface water is known to recharge the underlying groundwater system. There is no groundwater discharge to surface in the model domain and surface water recharge to the underlying groundwater system only occurs along the bed of the Mackenzie River (which is comprised of fresh Permian bedrock).

C2.6.4. Initial heads

The initial heads for the steady state model were applied at topographic surface. This is a standard approach that helps minimise the convergence time for the steady state model. The heads from the steady state model were then used as the starting heads for the transient calibration. The heads from the end of transient calibration were then used as starting heads for the predictive models.

C2.6.5. General head boundaries

General head boundary cells were applied to the edges of the model boundary using the MODFLOW General Head Boundary (GHB) module. Steady state and transient GHBs were applied in zones located on the western, southern, southeastern and northeastern boundaries.

The steady state GHBs were applied in model layers 2 to 7 and allow for the interconnectivity of the model domain with the wider regional groundwater flow system and facilitate groundwater flow across the model boundaries. The transient GHBs were used to simulate the effect of the Curragh Mine and the Jellinbah Mine at the boundary of the model domain. This is considered appropriate given the duration and historical mining (progression and depth) in these areas. The transient GHBs were applied to layers 3, 4 and 5.

The inputs for the GHB include conductance factors and the change from the initial heads (See Section 2.6.4). The conductance factors on the GHB are typically set high so as to not impede the flow of groundwater in/out of the model domain. The change from the initial heads allows the model to modulate the head at the boundary of the model during calibration to provide a best level of fit to regional groundwater flow conditions.

A 'no-flow' boundary was applied to the northern model boundary. The northern model boundary is not important in the regional groundwater context nor is it an area that provides significant inflows / outflows to the model. On this basis, its representation as a 'no flow' boundary is considered appropriate.

The locations of the GHBs are shown in Figure C 21 and Figure C 22.

C2.6.6. Mining

Mine dewatering was simulated using the MODFLOW Drain (DRN) module. The drain cells allow for one-way flow of water out of the model. When the computed head drops below the elevation of the drain, the drain cells become inactive. This is an effective way of representing the removal of water seeping into a mine over time.

To simulate open cut mining, DRN cells were applied to all active layers from the surface to the base of the target coal seam to ensure full desaturation of the layers above the coal seam. A conductance 100 m^2/day was applied to all DRN cells. Experience shows that this conductance value is effective in representing open cut mining.

The extent of the DRN cells applied to represent mining activity are shown in Figure C 23 and timing for mining progression is presented in Table C 4 and Table C 5.

Table C 4 Mining progression timing – calibration – historic mining

mining pit / stress period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Pit U	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Pit T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	o	o	o	o	o	o	o	o	o	o
Pit S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x

Note: Mining depth: 'x' – Mammoth seam, 'o' – Mackenzie seam

Table C 5 Mining progression timing – prediction – future mining

mining pit / stress period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Pit U	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Pit T	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Pit S	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Pit X	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Project																				

Note: Mining depth: 'x' – Mammoth seam, 'o' – Mackenzie seam

Table C 5 (continued)

mining pit / year	21	22	23	24	25	26	27	28	29	30
Pit U	o	o	o	o	o	o	o	o	o	o
Pit T	o	o	o	o	o	o	o	o	o	o
Pit S	o	o	o	o	o	o	o	o	o	o
Pit X	o	o	o	o	o	o	o	o	o	o
Project		x	x	x	x	x	x	x	x	x

Note: Mining depth: 'x' – Mammoth seam, 'o' – Mackenzie seam

C2.7. Calibration process and metrics

Model calibration was performed to optimise the model parameter values so that the model can better replicate historical observations. The outcome of the calibration process also provides the initial conditions for the transient predictive simulations used to assess the potential effects of the project on the groundwater regime.

C2.7.1. Approach

Calibration was performed by applying both automated PEST (Doherty, 2019a, 2019b) routines and a manual trial-and-error approach. In order to achieve the best possible calibration fit, both approaches allowed for modification of the relevant model properties (i.e. hydraulic parameters, recharge rate, and the general head boundary elevations) within pre-set calibration bounds. Prior to calibration, upper and lower calibration bounds were set for each of the tested parameters based on available hydraulic testing data.

C2.7.2. Targets

The available groundwater level data was reviewed to identify the most reliable groundwater level measurements for the transient calibration period. In total, 563 groundwater level measurements collected from 53 observation sites (including monitoring bores and multi-level VWP arrays) were initially included in the calibration dataset. Section 4 of the Groundwater Report describes how these data were sourced. The locations of the observation sites are shown in Figure C 24 and overview of calibration targets is presented in Table C 6.

The calibration data were weighted so that every observation site had an equal weighting (proportional to the number of groundwater level measurements). The actual weight for each individual observation was calculated using the formula:

$$weight = \frac{1}{\sqrt{n}}$$

where n is a number of observations within each observation group.

A qualitative calibration target also included the representation of Blackwater Creek as an ephemeral drainage feature with no baseflow or groundwater discharge occurring from the system throughout the model simulation.

Table C 6 Summary of model observations

Bore ID	Original bore id	Easting	Northing	#obs	Date from	Date to	Model layer	Weight
158168	158168	694576	7426442	1	24/11/2012		2	1.00000000
1309mb	1309mb	689081	7423299	21	11/07/2013	12/04/2021	2	0.21821790
1312mb	1312mb	689147	7423115	6	12/07/2013	13/07/2021	2	0.40824830
1410mb	1410mb	688841	7423142	25	27/11/2014	18/01/2022	2	0.20000000
1411mb	1411mb	688973	7423008	24	3/03/2016	05/04/2022	2	0.20000000
1419mb	1419mb	693081	7418827	20	20/11/2014	04/09/2023	2	0.00000000
1420mb	1420mb	693002	7418878	7	10/06/2016	13/05/2020	2	0.00000000
1426mb	1426mb	691084	7419861	27	25/11/2014	10/11/2020	2	0.18898220
1428mb	1428mb	691265	7418515	1	21/06/2021		2	1.00000000
1529mb	1529mb	691160	7417209	14	16/11/2014	10/09/2023	2	0.26726120
1531mb	1531mb	691986	7426515	18	20/07/2015	04/09/2023	2	0.23570230
1533mb	1533mb	689527	7421686	2	20/02/2018	16/04/2018	2	0.70710680
1534mb	1534mb	689538	7421684	29	20/07/2015	21/06/2021	2	0.18569530

Bore ID	Original bore id	Easting	Northing	#obs	Date from	Date to	Model layer	Weight
h01vma	HYDRO23_01 VWP: Mammoth seam	692338	7424269	9	21/08/2023	12/10/2023	6	0.33333330
h01vmac	HYDRO23_01 VWP: Mackenzie seam	692338	7424269	9	15/11/2021	25/09/2023	5	0.33333330
h01vs3p	HYDRO23_01 VWP: Permian overburdenSensor3	692338	7424269	9	21/08/2023	12/10/2023	4	0.33333330
h01vs4p	HYDRO23_01 VWP: Permian overburdenSensor4	692338	7424269	9	21/08/2023	12/10/2023	4	0.33333330
h03vcan	HYDRO23_03 VWP: Permian overburden	693308	7419685	9	22/08/2023	12/10/2023	5	0.33333330
h03vma	HYDRO23_03 VWP: Mammoth seam	693308	7419685	9	05/09/2023	10/10/2023	6	0.33333330
h03vmac	HYDRO23_03 VWP: Mackenzie seam	693308	7419685	9	27/07/2023	13/10/2023	6	0.33333330
h04vcan	HYDRO23_04 VWP: Permian overburden	693113	7417623	13	27/07/2023	12/10/2023	5	0.00000000
h04vma	HYDRO23_04 VWP: Mammoth seam	693113	7417623	13	27/07/2023	13/10/2023	5	0.27735010
h04vmac	HYDRO23_04 VWP: Mackenzie seam	693113	7417623	12	3/08/2023		7	0.28867510
h04vp	HYDRO23_04 VWP: Permian overburden	693113	7417623	13	27/07/2023	13/10/2023	4	0.00000000
h05vcan	HYDRO23_05 VWP: Permian overburden	694188	7414797	11	03/08/2023	13/10/2023	5	0.00000000
h05vma	HYDRO23_05 VWP: Mammoth seam	694188	7414797	11	03/08/2023	12/10/2023	6	0.30151130
h05vmac	HYDRO23_05 VWP: Mackenzie seam	694188	7414797	11	03/08/2023	12/10/2023	6	0.00000000
h05vp	HYDRO23_05 VWP: Permian overburden	694188	7414797	11	03/08/2023	12/10/2023	4	0.30151130
h05vte	HYDRO23_05 VWP: Weathered profile	694188	7414797	11	03/08/2023	12/10/2023	3	0.30151130
h06vma	HYDRO23_6 VWP: Mammoth seam	691308	7414495	11	08/08/2023	11/10/2023	6	0.30151130
h06vmac	HYDRO23_6 VWP: Mackenzie seam	691308	7414495	5	08/08/2023	11/10/2023	4	0.00000000
h06vp	HYDRO23_6 VWP: Permian overburden	691308	7414495	11	08/08/2023	11/10/2023	4	0.30151130
h07vma	HYDRO23_07 VWP: Mammoth seam	692301	7413364	6	21/08/2023	11/09/2023	2	0.40824830
h07vmac	HYDRO23_07 VWP: Mackenzie seam	692301	7413364	10	13/08/2023	11/10/2023	6	0.31622780
h07vp	HYDRO23_07 VWP: Permian overburden	692301	7413364	9	13/08/2023	12/10/2023	5	0.33333330
h09517jf	HYDRO23_09 VWP: serial12517_Jellinbah Fault	692818	7424296	7	26/08/2023	12/10/2023	3	0.37796450
h09vjf	HYDRO23_09 VWP: serial12629_Jellinbah Fault	692818	7424296	7	26/08/2023	12/10/2023	4	0.37796450

Bore ID	Original bore id	Easting	Northing	#obs	Date from	Date to	Model layer	Weight
h10359jf	HYDRO23_10 VWP: Serial #12359_Jellinbah Fault	695051	7417050	7	22/08/2023	13/10/2023	3	0.33333330
h10633jf	HYDRO23_10 VWP: Serial #12633_Jellinbah Fault	695051	7417050	6	22/08/2023	13/10/2023	3	0.33333330
h12vcan	HYDRO23_12VWP: Permian overburden	692783	7415996	14	03/08/2023	13/10/2023	4	0.00000000
h12vma	HYDRO23_12 VWP: Mammoth seam	692783	7415996	14	03/08/2023	13/10/2023	6	0.26726120
h12vmac	HYDRO23_12 VWP: Mackenzie seam	692783	7415996	14	03/08/2023	13/10/2023	6	0.00000000
h17355jf	HYDRO23_17 VWP: Serial #12355_Jellinbah Fault	693797	7421159	12	03/08/2023	13/10/2023	4	0.28867510
h17jf	HYDRO23_17 VWP: Serial #12627_Jellinbah Fault	693797	7421159	12	03/08/2023	13/10/2023	3	0.28867510
h312357p	HYDRO23_03 VWP: Serial #12357_Permian overburden	693308	7419685	9	24/08/2023	13/10/2023	3	0.33333330
h712511p	HYDRO23_07 VWP: Serial #12511_Permian overburden	692301	7413364	9	13/08/2023	12/10/2023	4	0.33333330
hyd02	HYDRO23_02MB	691426	7413825	5	20/08/2023	03/10/2023	4	0.44721360
hyd06	HYDRO23_06 MB	691308	7414494	6	24/08/2023	12/10/2023	3	0.40824830
hyd07	HYDRO23_07 MB	692293	7413360	6	11/08/2023	17/09/2023	2	0.40824830
hyd08	HYDRO23_08 MB	694604	7413222	4	13/08/2023	11/09/2023	2	0.50000000
hyd09	HYDRO23_09 MB	692818	7424296	4	16/08/2023	26/09/2023	4	0.50000000
hyd11	HYDRO23_11 MB	693976	7426442	5	27/08/2023	11/09/2023	2	0.44721360
hyd19	HYDRO23_19 MB	620079	7423299	6	27/08/2023	11/09/2023	2	0.40824830

C2.7.3. Results

A scatter plot of predicted versus observed hydraulic heads is presented in Figure C 25. The statistics from the calibrated model are reported in Table C 7. The calibration hydrographs are provided in Appendix C 1.

Table C 7 Summary of model calibration performance

Statistical measure		Unit	Value (unweighted)	Value (weighted)
Number of observations	n	-	455	
Range of measured heads	-	m	42.55	
Sum of squared residuals	SSQ, Φ	m^2	7521.8	747.7
Root mean squared error	RMS	m	4.07	1.28
Scaled root mean squared error	SRMS	%	9.56	3.01
Residual mean	MSR	m	5.66	0.87
Scaled absolute residual mean	SMSR	%	13.29	2.05

The transient calibration, across all observations and time steps, achieved an unweighted root mean square error (RMS) of 4.07 m. The unweighted scaled root mean square error (SRMS) was 9.56% and the weighted SRMS was 3.01%. The SRMS value is below the 10% recommended by the Australian Groundwater Modelling Guidelines (Barnett *et al.*, 2012), and hence. the model calibration is acceptable.

C2.8. Calibrated hydraulic parameters

The hydraulic properties were assigned to individual model cells using the zonation approach described in Section C2.5.

The available data do not indicate a depth dependent relationship or significant spatial variation within zones 1, 2, 8, 9, 10 and 11. On this basis, the hydraulic properties in zones 1, 2, 8, 9, 10 and 11 (see Table C 5) have been modelled with a single value and no spatial or depth variability.

Permeability data from the Permian coal measures for the project site typically shows a reduction in hydraulic conductivity with depth below ground. This trend is consistent with data from other mine sites within the Bowen Basin. Zones 3 through to 7 are represented by depth dependent horizontal (K_x) and vertical (K_z) hydraulic conductivity parameters, that is the deeper the model cell, the lower the Kx and Kz values.

For the depth dependent parameters, the actual Kx for each model cell is calculated using formula:

$$K_x = K_{x0} \times e^{(-slope \times depth)}$$

where the calculated horizontal hydraulic conductivity for each cell (K_x) is proportional to the K_x at the surface (K_{x0}) and the *depth* of the model cell. The K_x value decreases exponentially. The parameters of K_{x0}, and *slope* were incorporated into the model calibration. This depth dependence equation generally provides an approximation that correlates well with observed permeability data.

The depth dependence of Kx and Kz within the Permian overburden and interburden (layers 4 and 6, zones 4 and 6) as well as the coal seams (layers 5 and 7, zones 5 and 7) is presented as an example in Figure C 26.

Calibrated hydraulic properties for individual zones are summarised in Table C 8 (Kx), Table C 9 (Kz) and Table C 10 (specific yield and storage).

Table C 8 Summary of calibrated K_X values

Zone	Layer	Hydrostratigraphy	Kx | Kx (depth 0 m)	Slope	Kx (max)	Kx (min)
1	1	Mackenzie River floodplain alluvium	1.02211790	--	--	--
2	2	Weathered profile	0.31722264	--	--	--
11	2	Weathered profile (Higher kx)	0.47583396	--	--	--
3	3	Permian coal measures - overburden	2.24262830	0.02588873	0.00058944	2.00000000
4	4	Permian coal measures - overburden	0.00535113	0.03200000	0.00000100	0.00526619
5	5	Permian coal measures - Mammoth seam	0.02012924	0.02360760	0.00000263	0.01942845
6	6	Permian coal measures - interburden	0.01708835	0.02537943	0.00000100	0.01647678
7	7	Permian coal measures - Mackenzie seam	0.01001539	0.02000000	0.00000155	0.00935867
8	8	Burngrove Formation - west of JF	0.50000000	--	--	--
9	9	Burngrove Formation - east of JF	0.04313042	--	--	--
10	10	Jellinbah Fault zone	0.00960815	--	--	--

Note: JF refers to Jellinbah Fault zone

Table C 9 Summary of calibrated K_Z values

Zone	Layer	Hydrostratigraphy	Kz | Kz (depth 0m)	Slope	Kz (max)	Kz (min)
1	1	Mackenzie River floodplain alluvium	0.05110590	--	--	--
2	2	Weathered profile	0.04960045	--	--	--
11	2	Weathered profile	0.07440067	--	--	--
3	3	Permian coal measures - overburden	0.00265293	0.02588873	0.00530586	0.00000156
4	4	Permian coal measures - overburden	0.00341986	0.03200000	0.00001801	0.00000000
5	5	Permian coal measures - Mammoth seam	0.01500000	0.02360760	0.00029143	0.00000004
6	6	Permian coal measures - interburden	0.01207591	0.02537943	0.00019897	0.00000001
7	7	Permian coal measures - Mackenzie seam	0.00608873	0.02000000	0.00005698	0.00000001
8	8	Burngrove Formation - west of JF	0.00079075	--	--	--
9	9	Burngrove Formation - east of JF	0.00064696	--	--	--
10	10	Jellinbah Fault zone	0.00019216	--	--	--

Note: JF refers to Jellinbah Fault zone

Table C 10 Summary of calibrated storage values

Zone	Layer	Hydrostratigraphy	Ss	Sy
1	1	Mackenzie River floodplain alluvium	0.00000100	0.02868228
2	2	Weathered profile	0.00041798	0.04781440
11	2	Weathered profile	0.00041798	0.02390720
3	3	Permian coal measures - overburden	0.00000001	0.00015735
4	4	Permian coal measures - overburden	0.00000288	0.00000524
5	5	Permian coal measures - Mammoth seam	0.00000015	0.00000171
6	6	Permian coal measures - interburden	0.00000001	0.00000163
7	7	Permian coal measures - Mackenzie seam	0.00005159	0.00000336
8	8	Burngrove Formation - west of JF	0.00005317	0.00000100
9	9	Burngrove Formation - east of JF	0.00000012	0.00000142
10	10	Jellinbah Fault zone	0.00004920	0.00052085

Note: JF refers to Jellinbah Fault zone

C2.9. Calibrated recharge

Based on the recharge zonation described in Section C2.6.1, the recharge rate factors were calibrated as percentage of actual rainfall. The calibrated recharge factors for the steady state and transient models are presented in Table C 11. The calibrated recharge rates are consistent with those calculated from the chloride mass balance assessment (see Section C2.6.1).

Table C 11 Summary of calibrated recharge values

Zone	Description	RCH rate factor steady state (% of rainfall)	RCH rate factor Transient (% of rainfall)
1	Alluvium_West	5.00 E-02	0.04938410
2	Alluvium_Centre	5.00 E-02	0.03015006
3	Alluvium_East	5.00 E-02	5.00 E-02
4	Weathered profile_West	5.00 E-02	1.00 E-03
5	Weathered profile_East	5.00 E-02	1.00 E-03
6	Jellinbah Fault zone	5.00 E-04	5.00 E-04

C2.10. Calibrated evapotranspiration

The evapotranspiration pan factor and extinction depth were calibrated based on the evapotranspiration zonation and rates described in Section C2.6.2. The model calibration is insensitive to the evapotranspiration values. The calibrated evapotranspiration values are presented in Table C 12.

Table C 12 Summary of calibrated evapotranspiration values

Zone	Description	EVT pan factor	EVT extinction depth
1	Weathered profile	8.00 E-01	5.00 E+00
2	Mackenzie River floodplain alluvium	8.00 E-01	5.00 E+00

C2.11. Calibrated surface water drainage

Based on the surface water drainage zonation described in Section C2.6.3, the vertical streambed conductance was calibrated. The calibrated streambed conductance is presented in Table C 13.

Table C 13 Summary of calibrated streambed conductance values

Zone	Description	Streambed conductance
1	Mackenzie River	1.00 E-02
2	Blackwater Creek	1.00 E-01
3	Minor drainage	1.00 E+00

A qualitative calibration target also included the representation of Blackwater Creek as an ephemeral drainage feature with no baseflow or groundwater discharge occurring from the system throughout the model simulation. This qualitative calibration target was achieved, and the model outputs match the conceptualisation.

C2.12. Calibrated general head boundary

The calibrated general head boundary parameters are presented in Table C 14 and Table C 15 for the steady state and transient models respectively. Parameters representing the initial head change (difference from the initial heads – see Section C2.6.4) and GHB conductance were calibrated. The general head boundary zonation is described in Section C2.6.5.

The initial water level change in the transient GHB zones is greater (deeper groundwater level) than the change in the steady state GHB zones. This is a reflection of the approved mining operations (cumulative effects) at Curragh Main and Jellinbah locally causing drawdown on the groundwater table.

Table C 14 Summary of calibrated general head boundary values (steady state)

Zone	Description	Initial water levels change	Conductance factor
1	West	1.00 E-06	1.00 E+00
2	South	0.00 E+00	1.00 E+00
3	South east	0.00 E+00	1.00 E+00
4	North east	0.00 E+00	0.00 E+00

Table C 15 Summary of calibrated general head boundary values (transient)

Zone	Description	Initial water levels change	Conductance factor
1	West	1.00 E-06	1.00 E+00
2	South	10.00 E+00	1.00 E+00
3	South east	40.00 E+00	10.00 E+00
4	Centre east	50.00 E+00	10.00 E+00
5	North east	45.00 E+00	10.00 E+00

C2.13. Modelled budgets

A summary of the transient calibration water budget is presented in Table C 16. It shows that the main source of groundwater inflow to the model from recharge and via changes in storage. The average recharge rate is 4349.7 m^3/day. The average cross-boundary inflow is 260.4 m^3/day.

The main source of outflow from the model is via cross boundary flow (GHB), then mining (average of 3117.8 m^3/day).

Table C 16 Transient calibration water budget and mass balance error

		Total volume (m^3)	Total volume (%)	Average rate (m^3/day)
inflow	Storage	38129270.38	44.1	4349.7
	recharge (RCH)	35905845.74	41.5	4096.04
	surface drainage runoff (RIV)	10194496.70	11.8	1163
	cross boundary flow (GHB)	2282602.45	2.6	260.4
	Total	**86512215.27**	**100.0**	**9869.14**

		Total volume (m^3)	Total volume (%)	Average rate (m^3/day)
outflow	Storage	4360460.46	5.0	497.4
	drains / mining (DRN)	27330468.25	31.6	3117.8
	EVT	19013653.85	22.0	2169.0
	surface drainage runoff (RIV)	3017844.97	3.5	344.3
	cross boundary flow (GHB)	32790678.20	37.9	3740.7
	Total	**86513105.73**	**100.0**	**9869.2**
	Δ(in-out)	**-19.03**		**-0.06**

Note: This table may contain minor rounding errors where the data has been limited to one decimal place.

The water budget convergence error is presented in Figure C 27 while the actual inflow and outflow rates for individual boundary conditions are presented in Figure C 28 to Figure C 29. The water budget convergence error is generally less than 0.5 m^3/d which is considered acceptable given the magnitude of fluxes in the transient model. The modelled inflows and outflows fluctuate gradually over the transient calibration period, and this is expected as the model responds to changes in recharge and discharge to the approved mining operations. The DRN outflows from the model has the greatest variation over the transient calibration period. This variation is expected and is in response to the removal of water from the approved mining operations.

C2.14. Overall calibration performance

The model has been appropriately calibrated to transient conditions based on the following criteria:

- the conceptual model for groundwater flow has been honoured by the calibration;
- calibration-optimised hydraulic data for the key hydrogeological units are within the range of values measured during the field campaigns and derived using independent studies;
- quantitative calibration metrics (e.g., residual errors) are within guideline-recommended ranges (Barnett *et al.*, 2012); and
- the relative contributions of recharge/discharge processes in the model water balance are within the ranges expected and are supported by independent calculations and field observations (e.g. absence of baseflow in mine site watercourses).

The calibrated model is therefore deemed to be a suitable tool for assessing the groundwater level effects of Curragh North Mine operations within the model domain. The predictive scenarios based on the calibrated model are presented in Section C3.

C3. Model predictions

Two transient predictive model scenarios were developed, as follows:

- an 'approved mining operations' scenario which includes the approved Curragh mining operations, including Pit U, Pit T, Pit S and Pit X, and represents the baseline conditions for the project; and
- a 'project' scenario which includes representation of 'approved mining operations' and the project underground mining area.

The differences between these predictive model scenarios represent the incremental additional groundwater effects of the project, which are discussed in Section 6 of the Groundwater Report.

C3.1. Transient prediction – Approved mining operations scenario

The transient prediction run ('approved mining operations' scenario) uses a long-term climatic average (recharge and evapotranspiration rates) to define the main boundary conditions (RCH and EVT). Predicted heads of the transient calibration model are used as starting heads for the transient prediction modelling phase. The predictive model stress period (SP) setup is detailed in Section C2.3.

The remaining mine progression parameters remain unchanged from the calibrated model, that is, the mining progression continues to be represented by DRN package and drain cells have the same drain conductance of 100 m²/day applied to the full depth of the drain cell (i.e. to the base of approved mining operations in the target Mackenzie seam).

C3.1.1. Modelled budgets

The summary of the transient prediction water budget is presented in Table C 17, the breakdown of mining inflows into the mining pits under this scenario is presented in Table C 18.

The main source of inflow to the predictive model is recharge, with an average recharge rate of 3957 m³/day. The average cross-boundary inflow is 611.49 m³/day. The main outflow from the predictive model is through the DRN cells representing mining (average of 5826.17 m³/day).

Table C 17 Approved mining scenario – transient prediction water budget and mass balance error

		Total volume (m³)	Total volume (%)	Average rate (m³/day)
inflow	Storage	28152886.5	29.92	2569.17
	recharge (RCH)	43359888.9	46.08	3956.93
	surface drainage runoff (RIV)	15893255.2	16.89	1450.38
	cross boundary flow (GHB)	6700793.9	7.12	611.50
	Total	**94106824.5**	**100.00**	**8587.98**
outflow	Storage	3897.8	0.00	0.36
	drains / mining (DRN)	63843034.9	67.84	5826.17
	EVT	13049724.9	13.87	1190.89
	surface drainage runoff (RIV)	87371.5	0.09	7.97
	cross boundary flow (GHB)	17123030.5	18.2	1562.61
	Total	**94107059.6**	**100.00**	**8588.00**
Δ(in-out)		**-235.1**		**0.00**

Note: This table may contain minor rounding errors.

Table C 18 Approved mining scenario – transient calibration – – DRN extraction

SP	Curragh North (z01)	Curragh Extension (z02)	Total (m^3/day)	SP	Curragh North (z01)	Curragh Extension (z02)	Total (m^3/day)
1	4896.68	28.5092	4925.19	16	4318.40	1678.48	5996.88
2	4889.81	66.4413	4956.25	17	4262.77	1636.37	5899.14
3	4712.56	403.060	5115.62	18	4214.20	1598.82	5813.02
4	5332.33	650.578	5982.90	19	4166.08	1564.28	5730.36
5	5072.02	1198.09	6270.12	20	4120.92	1533.48	5654.40
6	4925.68	1298.79	6224.47	21	4073.24	1507.09	5580.33
7	4855.21	1598.2	6453.48	22	4034.12	1483.41	5517.54
8	4878.55	1586.28	6464.84	23	3996.83	1461.92	5458.75
9	4853.90	2136.13	6990.03	24	3963.16	1442.51	5405.67
10	4750.65	2148.41	6899.06	25	3930.40	1424.12	5354.52
11	4658.72	2020.57	6679.29	26	3903.16	1407.26	5310.42
12	4577.21	1930.50	6507.71	27	3877.14	1391.84	5268.99
13	4503.44	1854.38	6357.82	28	3854.57	1377.82	5232.40
14	4437.91	1783.01	6220.92	29	3830.47	1364.94	5195.41
15	4376.37	1727.19	6103.57	30	3812.32	1353.07	5165.39

The water budget convergence error is presented in Figure C 30 while the actual inflow and outflow rates for individual boundary conditions are presented in Figure C 31 to Figure C 32.

C3.1.2. Modelled heads

The modelled groundwater table and Mammoth seam heads at the end of the predictive run for the approved mining operations scenario are presented in Figure C 33 to Figure C 34.

C3.2. Transient prediction – Project scenario

The transient prediction run ('project' scenario) includes representation of the Curragh Bord and Pillar Mine. The project activities are described in Section 6.1 of the Groundwater Report.

A drain conductance of 100 m^2/day was applied to represent underground mining activities. A drain conductance of 10 m^2/day was applied to represent gas drainage activities. These conductance values were applied to allow for the partial and complete depressurisation of the gas drainage activities and underground mining activities respectively. The Australian Groundwater Modelling Guidelines state that "*Conductance as a model parameter cannot be measured directly. It is a surrogate for the combination of hydraulic conductivities and geometries that occur in the near field of the water body. A number of analytical solutions give guidance for this kind of conductance, but values are generally either assumed or chosen during model calibration*".

Time Varying Materials (TVM) package was used to represent underground mining and gas drainage activities (borehole stimulation) in the model. A horizontal hydraulic conductivity of 0.3 m/day (which is 100 times greater than the calibrated average Kx value for the Mammoth seam) and a vertical hydraulic conductivity of 0.1 m/day was applied to the gas drainage stimulation area. The storage parameters used for the gas drainage activities (borehole stimulation) were a specific yield of 0.15 and a specific storage of 1 x 10^{-4}. These values were derived after consideration of gas drainage information provided by Coronado.

These higher hydraulic conductivity and storage values were applied to represent the opening of fractures in the coal seam. The parameter values were based upon information provided by the proponent and represent a conservative assessment of the likely parameters of the borehole stimulation (i.e. these values are likely to be higher than actual values and will likely predict greater depressurisation effects).

C3.2.1. Modelled budgets

The water budget for the mine scenario transient prediction is summarised in Table C 19. Table C 20 shows the relative contribution of the project underground mining activities to DRN outflows from the water balance.

The water budget convergence error is presented in Figure C 35 while the actual inflow and outflow rates for individual boundary conditions are presented in Figure C 36 to Figure C 37. Figure C 38 and Figure C 39 provide groundwater inflows for the two transient predictive scenarios and show that the project groundwater inflow is negligible relative to inflows to the approved mining operations. Figure C 40 shows the mining inflows for the project.

Table C 19 Project scenario – transient prediction water budget and mass balance error

		Total volume (m^3)	Total volume (%)	Average rate (m^3/day)
inflow	storage	28232474.13	29.97	2576.43
	recharge	43359888.90	46.03	3956.92
	surface drainage runoff (RIV)	15893319.30	16.87	1450.38
	cross boundary flow	6701498.63	7.11	611.56
	Total	**94187180.96**	**100.00**	**8595.29**
outflow	storage	9965.64	0.01	0.90
	drains / mining	63920563.12	67.86	5833.24
	EVT	13049287.45	13.85	1190.84
	surface drainage runoff (RIV)	87371.24	0.09	7.97
	cross boundary flow	17120264.42	18.17	1562.35
	Total	**94187451.87**	**100.00**	8595.33
Δ(in-out)		-270.9		0.00

Note: This table may contain minor rounding errors.

Table C 20 Project scenario – transient prediction – DRN extraction

SP	Curragh North (z01)	Curragh Extension (z02)	Project (z03)	Total (m^3/day)
1	4896.68	28.5092	0.00	4925.19
2	4889.81	66.4413	0.00	4956.25
3	4712.56	403.060	0.00	5115.62
4	5332.33	650.578	0.00	5982.90
5	5072.02	1198.09	0.00	6270.12
6	4925.68	1298.79	0.00	6224.47
7	4855.21	1598.27	0.00	6453.48
8	4878.55	1586.28	0.00	6464.84
9	4853.90	2136.13	0.00	6990.03
10	4750.65	2148.41	0.00	6899.06
11	4658.72	2020.57	0.00	6679.29
12	4577.21	1930.50	0.00	6507.71
13	4503.44	1854.38	0.00	6357.82
14	4437.91	1783.01	0.00	6220.92
15	4376.37	1727.19	0.00	6103.57
16	4318.40	1678.48	0.00	5899.14
17	4262.77	1636.37	0.00	5813.02
18	4214.20	1598.82	0.00	5730.36
19	4166.08	1564.28	0.00	5654.40
20	4120.92	1533.48	0.00	5583.81
21	4073.24	1507.05	3.51	5521.75
22	4034.13	1483.16	4.46	5521.75
23	3996.83	1461.16	10.41	5468.4
24	3963.16	1441.33	18.59	5423.08
25	3930.40	1422.65	45.31	5398.36
26	3903.17	1405.57	56.09	5364.83
27	3877.14	1389.97	26.20	5293.31
28	3854.58	1375.77	27.79	5258.14
29	3830.47	1362.67	31.71	5224.85
30	3812.32	1350.65	31.72	5194.69

C3.2.2. Modelled heads

The modelled groundwater table and groundwater head elevations in the Mammoth seam at the beginning of the project (stress period 20 of the project scenario) are presented in Figure C 41 and Figure C 42. The modelled groundwater table and groundwater head elevations in the Mammoth seam at the end of the project (stress period 30 of the project scenario) are presented in Figure C 43 and Figure C 44.

C3.3. Modelled project effects

The incremental effect of the project gas drainage activities on the groundwater table was calculated from the difference in groundwater elevation between the two predictive scenarios.

The incremental effect of the project gas drainage activities on pore pressure in the Mammoth seam was similarly calculated from the difference in pressure between the two predictive scenarios.

The project drawdown and cumulative drawdown on the groundwater table are presented in Section 6.3 of the Groundwater Report.

The project depressurisation and the cumulative depressurisation on the Mammoth seam are shown in Figure C 45 and Figure C 46 respectively.

C3.4. Transient prediction – Post mining

The post-mining / recovery model was run for the period of 1000 years. The final recovery model uses the MODFLOW river package (RIV) to simulate increasing void lake elevations in each of the final voids over the recovery period. The final void lake levels were represented as follows; X Pit (west void) 98 mAHD, X Pit (east void) 67 mAHD, Curragh North 23 mAHD. These elevations were provided in the Curragh PRCP.

A summary of hydraulic properties for spoil and void areas is presented in Table C 21. The following changes were implemented for the post-mining / recovery model:

- no mining (no DRN boundary condition) represented;
- updated recharge zonation with inclusion of in-pit spoil and pit voids with increased recharge to the areas of in-pit spoil and pit voids;
- updated EVT surfaces to allow for in-pit spoil and pit voids, with no EVT in pit voids; and
- representation of void lakes in final voids at Curragh North, X Pit (west void) and X Pit (east void).

Table C 21 Summary of hydraulic properties for spoil and void areas

Zone	Hydrostratigraphy	Kx	Kz (factor)	Ss	Sy
12	Opencut voids	0.20 E+03	1.00 E+00	1.00E-03	9.90 E-01
13	Spoil	5.00 E-01	1.00E-01	4.00E-04	2.00E-02
14	Underground voids	0.20E+03	1.00 E+00	1.00 E-03	9.90E-01

C4. Model – uncertainty analysis

In the context of model-based decision support or risk assessment or management, uncertainty can be defined as *any deviation from the unachievable ideal of completely deterministic knowledge of the relevant system* (Walker *et al.*, 2003). Understanding where the unknowns are hidden and what their impact on modelling prediction is (or might be) is a strength of the model and a necessary tool supporting the decision-making effort (Johnson, 2010).

In more current (and Australian) context Peeters *et al.* (2018) pilot a combination of approaches to discuss impact of limitations of knowledge on modelling predictions in the context of decreasing risks associated with the environmental impact assessments. Authors further refined their recommendations in the form of IESC Information Guidelines Explanatory Note: Uncertainty analysis for groundwater modelling guidelines (2018 and 2023) where they recommend both qualitative and quantitative approach to uncertainty analysis.

C4.1. Qualitative uncertainty

Qualitative uncertainties are defined by lack of knowledge with respect to either structure or processes within the groundwater flow system. They can usually be reduced by collecting more data, or collecting data from areas that were not previously sampled or monitored.

The potential 'conceptual/knowledge' issues recognised during the evaluation of the effects of the project on the groundwater system include:

- heterogeneity of hydraulic properties; and the
- timing and location of system stresses – dewatering (pumping, mining) or recharge (water storage in pits).

Heterogeneity of hydraulic properties

Each hydrostratigraphic unit has natural heterogeneity and this heterogeneity results in spatial (horizontal) and vertical variations in hydraulic properties.

It is not possible for a groundwater model to precisely capture the full range of real-world spatial variation in hydraulic properties. This is largely due to the model scale, resolution (both horizontal and vertical) and computational limitations. Hence, the groundwater model provides a simplification of real-world variations in hydraulic properties. This simplification can introduce uncertainty into the groundwater model, specifically the model layering and parameter values (hydraulic conductivity and storage parameters).

In order to minimise the uncertainty the following was undertaken:

- Incorporated the site geological model into the groundwater model to best represent the model layering (vertical resolution).
- Collected site specific hydraulic conductivity data, with data collection focussed on the target coal seam, the fresh Permian bedrock and the shallowest hydrostratigraphic units in key areas of interest (such as Blackwater Creek). Therefore collecting data associated with areas of the groundwater regime that have the greatest potential to influence model predictions, and areas where potential groundwater effects may have greater significance.
- Established depth dependent relationships for site hydraulic conductivity data, and incorporated this into the groundwater model to better approximate real world variations.

In addition to the above, the existing open cut pits at Curragh North are providing a long-term (over 20 years), extensive hydraulic stress on the groundwater regime. This is acting like an extended pumping test for which the response in the surrounding groundwater regime can be calibrated. This provides a higher degree of confidence in the spatial and vertical model parameterisation.

The data and methods outlined above assist in minimising the qualitative uncertainty in the groundwater model associated with the heterogeneity of hydraulic properties.

Timing and location of system stresses

In the numerical model, the progression of the project underground mining is simulated using drain (DRN) boundary conditions, placed to the floor of the Mammoth seam. The project mine plan was detailed into annual sequencing to align with the mine stage plan provided by the proponent, ensuring a comprehensive depiction of the mining timeline.

In the case of open cut mining, DRN boundary conditions are placed to the floor of Mackenzie seam and all layers above. For the open cut mining, the historical and existing pit extents were captured from an assessment of historical aerial imagery, and spatial data showing mine progression (e.g. LiDAR data). The timing of the mining progression was represented using yearly stress periods. The use of yearly stress periods is an adequate simplification of historical and approved mining activities.

The above simplification of the mining progression will include a degree of uncertainty. This can be associated with the timing, extent and depth of historical mining. Assessment of historical aerial imagery is limited to the data available and may be subject to interpolation between annual stress periods (e.g. images may be available for June 2003 and December 2006 requiring interpolation for the stress periods representative of years 2003 through to 2007). Further, the modelled assumption is that the extent of mining disturbance is applied down to the target coal seam. Benching of open cut pits may mean that some areas of mining disturbance are excavated down into the fresh Permian overburden rather than the target coal seam.

In order to assess effects of the project, two prediction models were run: (1) the 'approved mining operations scenario', simulating mining at all approved open cut mining operations (2) the 'project' scenario simulating the approved open cut mining operations plus the project. The effects of the project are then expressed as difference between outputs of these two scenarios; difference in heads produces depressurisation induced by the project, difference in DRN budgets produces underground mine inflow estimates. The use of the same base modelling scenario removes any potential for timing or depth discrepancies to affect the project predictions. As such, effect of this issue on the predictive capability of the numerical model with respect to the project assessment is low.

C4.2. Quantitative uncertainty

Quantitative uncertainty analysis is a technique that aims to understand behaviour of the groundwater system by using mathematical and statistical approach to evaluate modelling inputs and outputs and assign a 'probability of occurrence' to selected effects.

C4.2.1. Methodology

The method quantifying the probability of effects exceeding certain value follows these steps:

- The model was calibrated by running PEST/BEOPEST to establish the 'base' model.
- Model sensitivity was assessed by investigating the Jacobian matrix created during the PEST run, from which the sensitive parameters were fixed, and the remaining were used to explore the model predictive uncertainty.
- Reassess and adjust the value ranges of the selected parameters for a reliable sampling of realisations.
- Utilise PESTPP-IES to run the calibration model based on posterior parameter probability distribution, three iterations and 1000 realisations were set to achieve better results.
- Check for calibration statistics (phi and SRMS) to assess level of 'miscalibration'. Remove parameter sets from the realisations that would be considered not calibrated.
- Use the 'qualified' model realisations generated during the second iteration of PESTPP-IES run for the predictive model runs considering the criteria of both phi and SRMS and adequate parameter uncertainties.
- Use PESTPP-SWP to run both the calibration model and prediction model for each 'realisation' and extract predictions (drawdowns, flows).
- Calculate outputs (i.e. underground inflows and project drawdown) for each of the accepted 'realisations'.
- Calculate minimum, maximum and selected percentile values for both underground inflows and project drawdown.

C4.2.2. Overview of PESTPP-IES and PESTPP-SWP

PESTPP-IES serves as a powerful tool for calculating samples from the posterior parameter probability distribution, making it adaptable to a range of modelling scenarios. It doesn't rely on the assumption of linearity, therefore no Jacobian matrix needs to be calculated during the iterations. For models with a substantial number of parameters, PESTPP-IES has better computational efficiency.

PESTPP-IES assimilates calibration data by using an iterative ensemble smoother algorithm. It combines the Bayesian and subspace methods and achieves great computational efficiency. The process starts with the generation of an ensemble of parameter fields characterised by a prior distribution, which are based on pre-calibration parameter uncertainty, combining expert knowledge and available measurements of system properties. The prior distribution is defined by the user, or PESTPP creates it using the parameter data provided in the pest control file. Through successive iterations (e.g. iteration #0, iteration #1 and iteration #2), PESTPP-IES adjusts these parameter fields to conform with calibration data constraints. The algorithm combines Bayesian principles with subspace methods to efficiently update the parameter realisations.

Rather than focusing solely on a single 'calibrated' parameter field, PESTPP-IES aims to construct an ensemble that holistically encompasses parameter uncertainty. This approach significantly reduces computational burden, making it suitable for models with a high number of parameters (such as the model developed for the project).

By observing how this base realisation changes during the iterations, the user can assess the impact of the ensemble smoother process on a non-random parameter field. Any biases or implausible variations introduced here are likely to extend to the other random parameter fields in the ensemble. This helps assess if the resulting ensemble truly represents the posterior parameter probability distribution. In our case, the 'base realisation' after three iterations is assessed as the single and unique 'calibrated' parameter field.

The sampling distributions for each parameter in the initial ensemble (iteration #0) and iteration #2 are depicted graphically in Appendix C1. A side-by-side comparison between the two iterations reveals a general improvement in the standard deviation in iteration #2. In theory, progressive iterations should yield a reductions in the standard deviation of the parameter fields which results in better performance in history matching (lower phi) compared to the initial ensemble. A reduction in the standard deviation of the parameter fields reflects a reduction in parameter uncertainty.

PESTPP-SWP runs a model using a suite of parameter fields. Parameter values that comprise these fields are supplied in a comma-delimited file or in a binary Jacobian matrix file. PESTPP-SWP records the values of model outputs calculated using these parameter fields in another CSV file, together with objective function (Phi) components calculated from these outputs. In this project, calibration-constrained parameter sets from iteration #2 were filtered out and utilised as the input parameter sets for the PESTPP-SWP run as discussed in the following section.

C4.2.3. Evaluation of model runs – calibration statistical measures

After running the PESTPP-IES, calibration statistics were computed to evaluate the accuracy of specific model predictions for each realisation of the model. If the calibration statistics, specifically the value of SRMS, indicated that a particular dataset caused the model to become de-calibrated, that realisation was excluded from the prediction run.

The parameter 'ies_num_reals' in PESTPP-IES defined the initial number of models, which was set to 1000, representing 1000 distinct realisations of the input dataset. During each iteration, some models were terminated by the run manager due to prolonged run times, controlled by the variable 'overdue_giveup_fac' in PESTPP-IES.

PESTPP-IES conducted three iterations, completing a total of 3202 successful model runs, including the Marquardt Lambda testing runs. However, models from iteration #3 were not used because certain parameters from this iteration are overly focused or constrained within a narrow range. This can hinder the exploration of model uncertainties. To effectively explore model uncertainties, it's crucial to maintain a well-spanned parameter range which should also be calibration constrained. Considering these factors, iteration #2 was selected to perform the predictive model uncertainty analysis.

In the second iteration, out of the 796 successful model runs, 494 (62.1%) model runs resulted in an SRMS value of less than 10%. Further scrutiny revealed that the phi values for these model runs ranged from 583 to 794 m², while the calibrated phi value was 748 m². The 494 realisations (parameter sets) that yielded an SRMS value of less than 10% were then approved to proceed to explore the calibration-constrained predictive model uncertainties. Figure C 47 and Figure C 48 show the distribution of SRMS and phi for model runs in iteration #2, respectively.

C4.2.4. Uncertainty analysis of effects

Two versions of the numerical model, representing the 'approved mining operations' and 'project' scenarios, were executed sequentially for each realisation using PESTPP-SWP, and model predictions for each realisation, including drawdown/depressurisation and inflows, were then extracted.

The uncertainty of exceedance of particular underground inflow rate is presented in Figure C 49. The original model prediction (the 'base' scenario) is represented by a black dashed line in Figure C 49. This figure indicates that the model prediction is not 'over-calibrated' nor unrealistic.

Figure C 50 shows the maximum project depressurisation zone (in the Mammoth seam) from each of the 494 realisations (parameter sets) that yielded an SRMS value of less than 10%. Figure C 51 shows the maximum project groundwater table drawdown zone from each of the 494 realisations. Each of these figures shows the area that lies within the project depressurisation/drawdown zone for the minimum, 10th percentile, 33rd percentile, 67th percentile, 90th percentile and maximum of the 494 realisations.

The basecase prediction is also shown for context. The basecase predictions are based on the most appropriate parameter set, which best represent real-world conditions and the conceptual groundwater model, while achieving the optimal calibration for all key calibration metrics (not only SRMS as used in the uncertainty analysis).

It is also important to acknowledge that for the purposes of these figures, the parameter set for each of the 494 realisations is assumed to be equally likely/probable, and therefore that each of the 494 drawdown/depressurisation zones is equally probable. However, in reality, the parameter set contains a distribution of values ranging from representative to extreme and, when applied across the model domain and/or in combination, will produce drawdown/depressurisation zones that range with significantly varying degrees of probability. Hence, the percentiles shown in Figures C 50 and C 51 simply show the range of modelling results produced by the most extreme combination of parameters that achieve a 10% SRMS and are not suitable for direct comparison with the basecase predictions or for use in impact assessment.

However, it can be seen from Figure C 50 that even the most extreme parameter set does not produce significantly different depressurisation extents in the Mammoth Seam, when compared to the basecase prediction. This indicates that the modelled quantitative uncertainty associated with the Mammoth seam is low and the uncertainty analysis does not provide predicted outputs that vary significantly from the basecase prediction.

The groundwater table drawdown extents for the extreme parameter sets (Figure C 51) extend beyond the basecase drawdown zone. The main cause of the extents shown in Figure C 51 are likely to be parameter sets with increased vertical permeability values. In these extreme realisations, the increased vertical permeability values are applied across the model domain and enable depressurisation to propagate through the aquitard. This is unsupported by the site-specific data (which shows low horizontal and vertical permeability) and therefore the additional areas of drawdown shown in Figure C 51 are considered implausible.

C5. References

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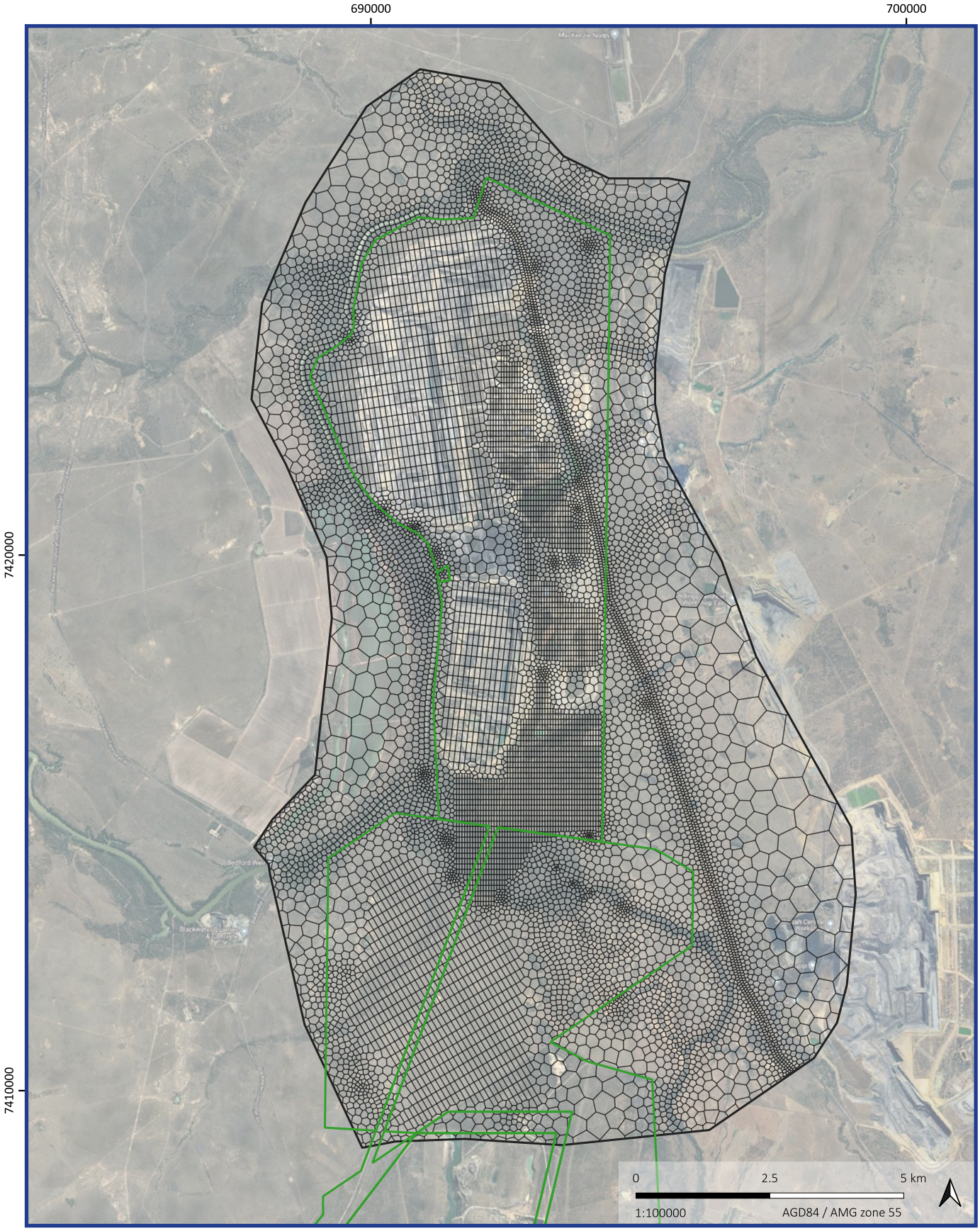
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Model mesh

(4150) HEC_Curragh North

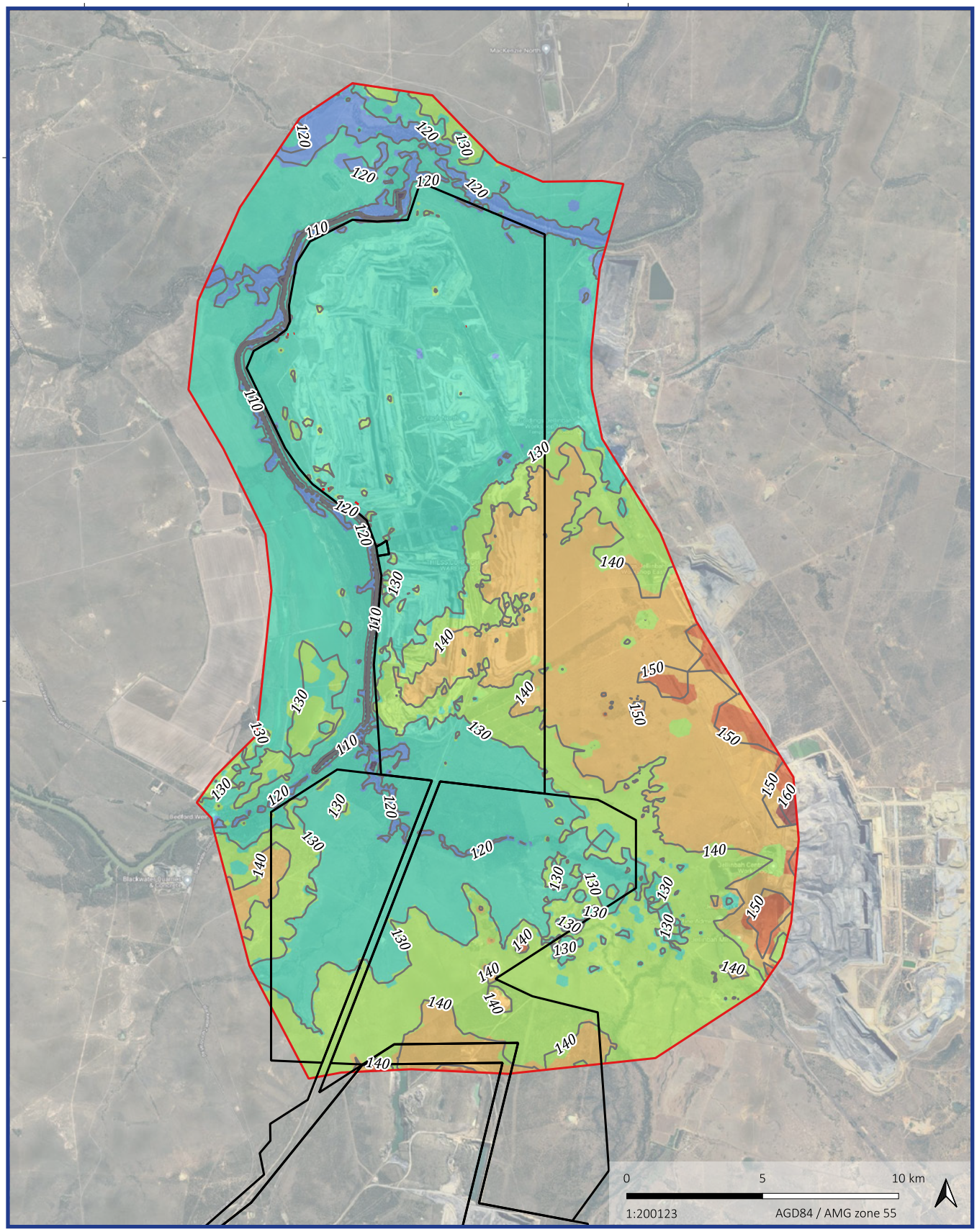
Figure C1

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Legend

- Model extent
- Model mesh
- Curragh Mining Lease Boundary

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Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- 100 - 110
- 110 - 120
- 120 - 130
- 130 - 140
- 140 - 150
- 150 - 160
- 160 - 170

Elevation of topographic surface (top of L01)

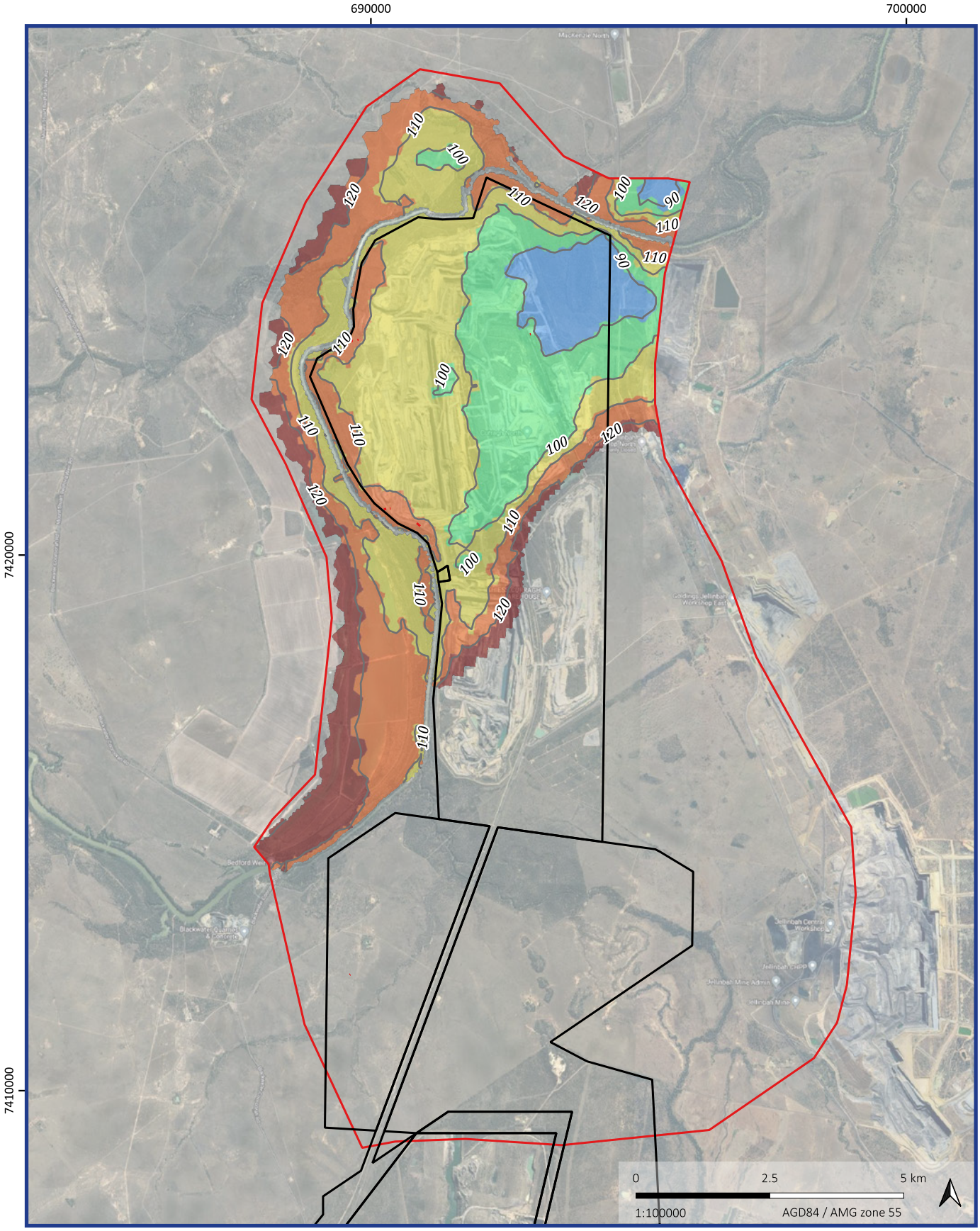
(4150) HEC_Curragh North

Figure C2

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Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110
- 110 - 120
- 120 - 130

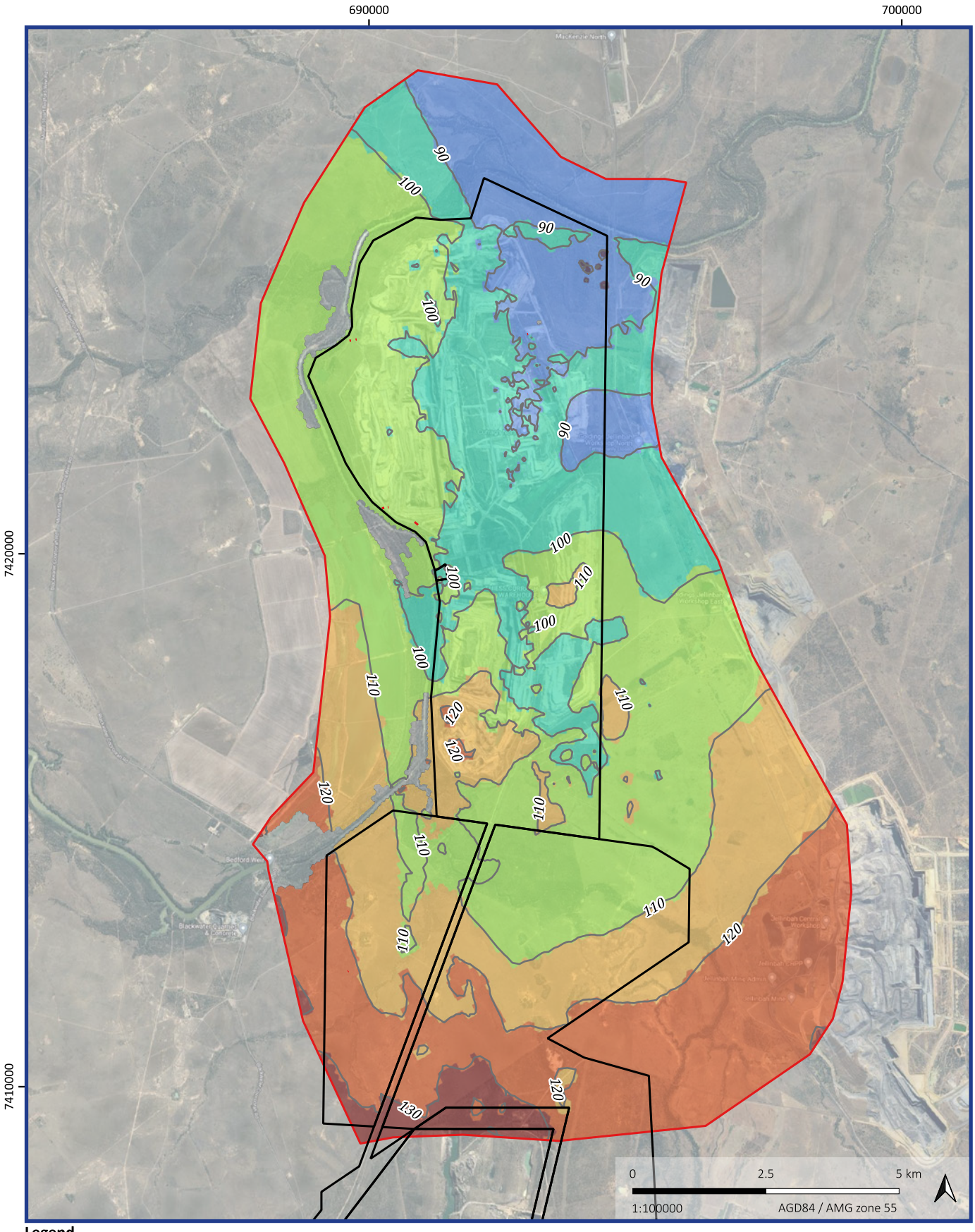
Elevation - base of layer 1

(4150) HEC_Curragh North

Figure C3

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Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110
- 110 - 120
- 120 - 130
- 130 - 140

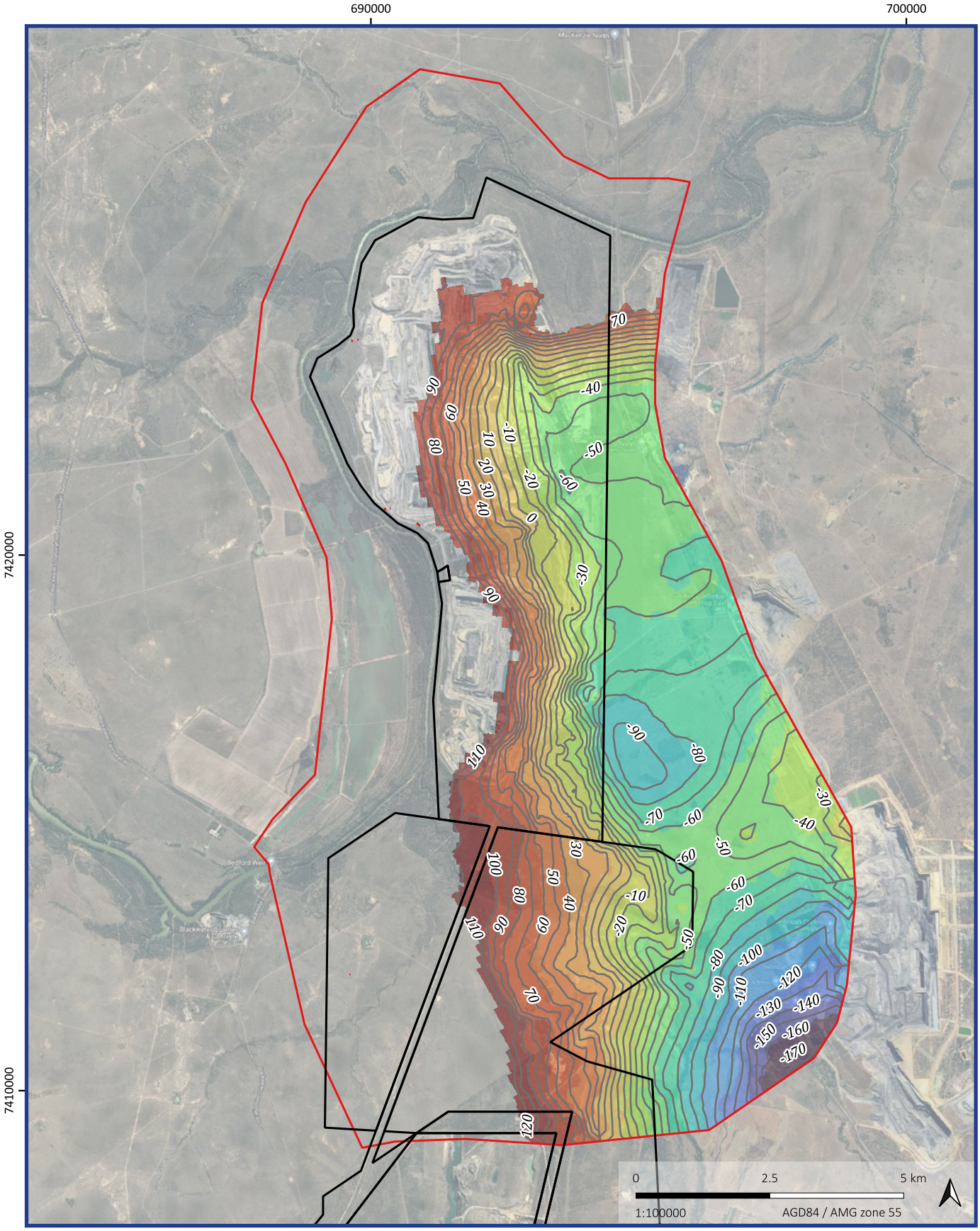
Elevation - base of layer 2

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Figure C4

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Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- -170 - -160
- -160 - -140
- -140 - -120
- -120 - -100
- -100 - -80
- -80 - -60
- -60 - -40
- -40 - -20
- -20 - 0
- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120

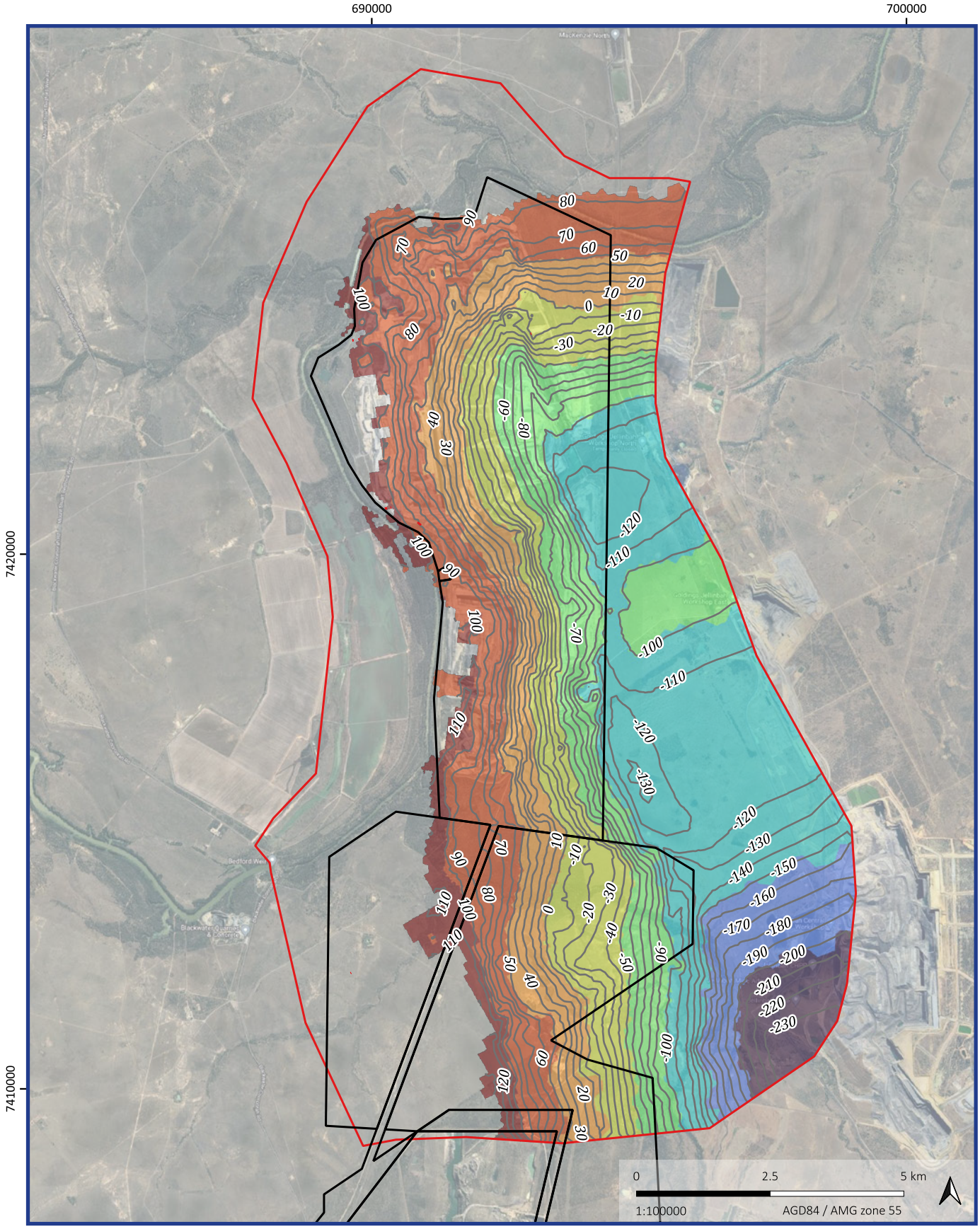
Elevation - base of layer 3

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Figure C5

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Elevation - base of layer 4

(4150) HEC_Curragh North

Figure C6

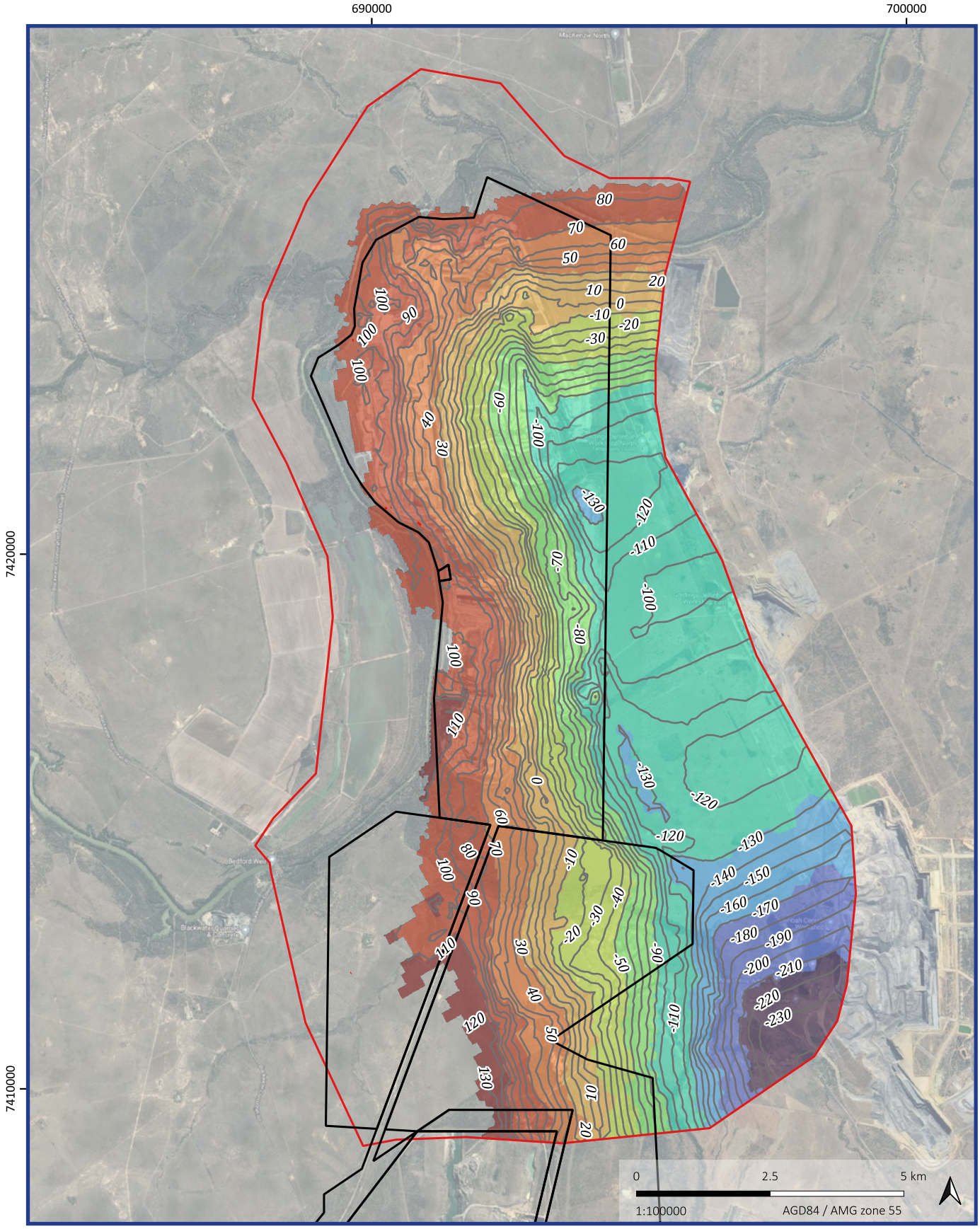
27/04/2024

Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- -240 - -200
- -200 - -150
- -150 - -100
- -100 - -50
- -50.00 - 0.00
- 0 - 50
- 50 - 100
- 100 - 130



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Elevation - base of layer 5

(4150) HEC_Curragh North

Figure C7

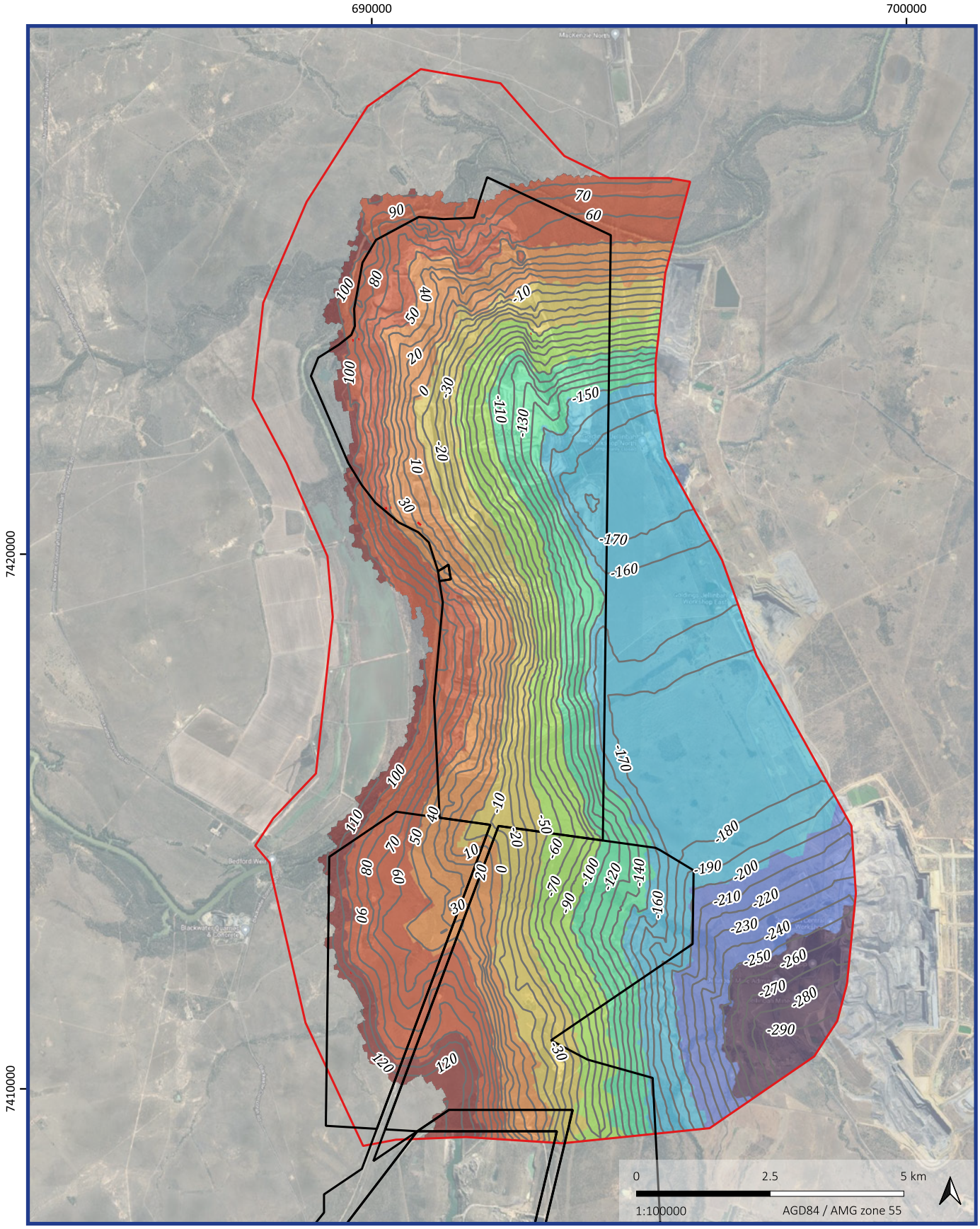
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Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- -240 - -210
- -210 - -170
- -170 - -130
- -130 - -90
- -90 - -50
- -50 - -10
- -10 - 30
- 30 - 70
- 70 - 110
- 110 - 140



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Elevation - base of layer 6

(4150) HEC_Curragh North

Figure C8

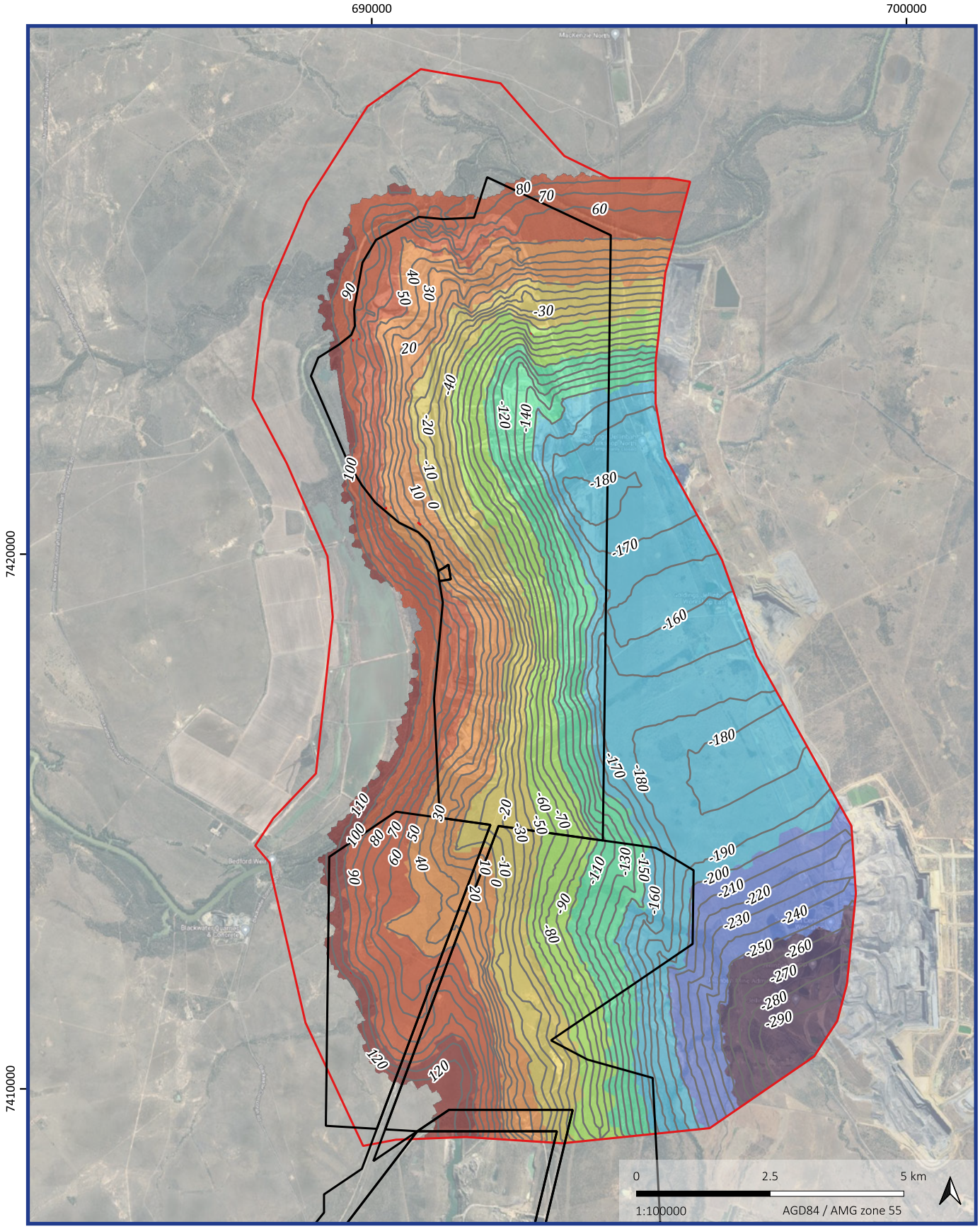
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Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- -300 - -250
- -250 - -200
- -200 - -150
- -150 - -100
- -100 - -50
- -50 - 0
- 0 - 50
- 50 - 100
- 100 - 130



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Elevation - base of layer 7

(4150) HEC_Curragh North

Figure C9

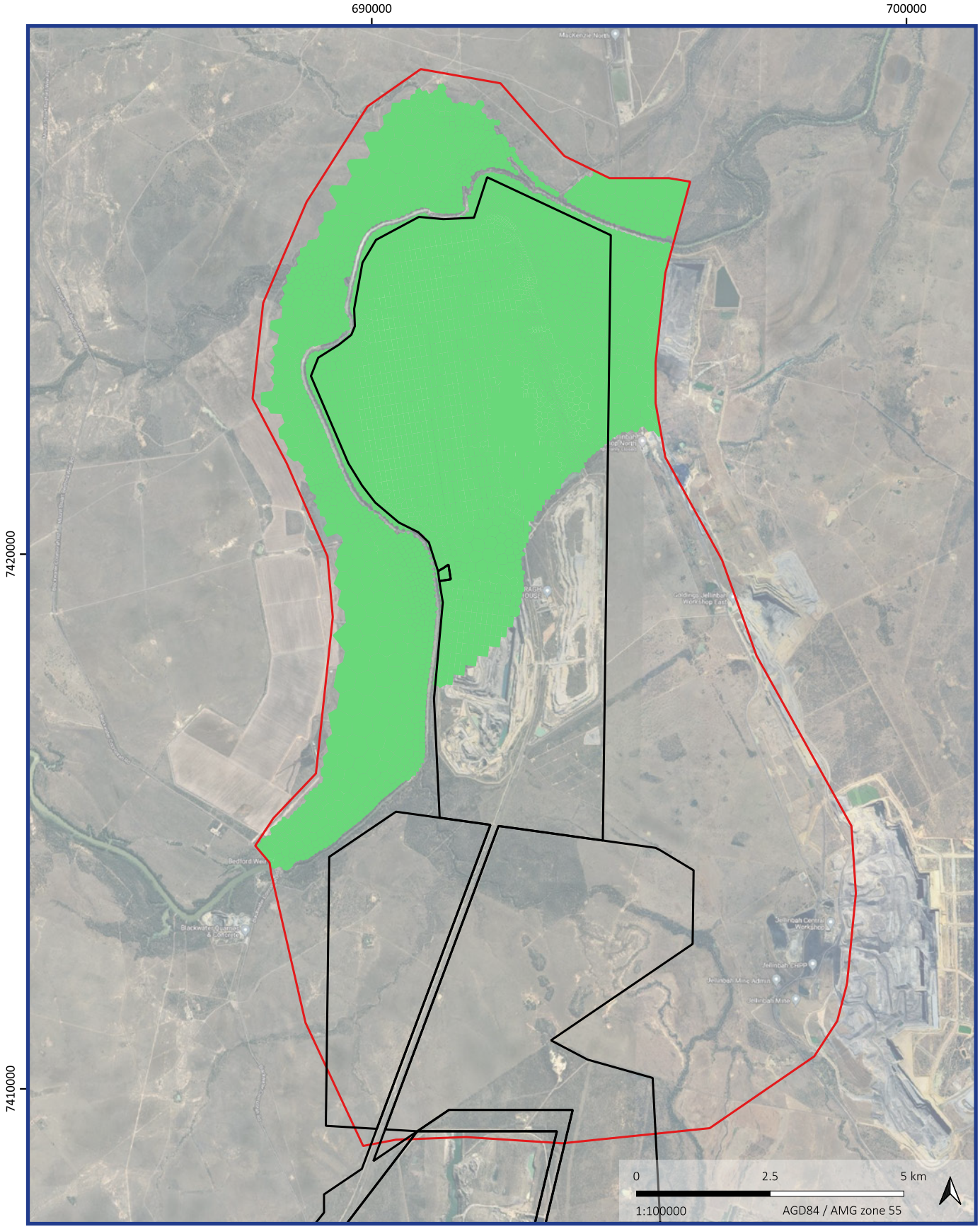
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Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- -300 - -250
- -250 - -200
- -200 - -150
- -150 - -100
- -100 - -50
- -50 - 0
- 0 - 50
- 50 - 100
- 100 - 130



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Hydraulic properties zonation - layer 1

Legend

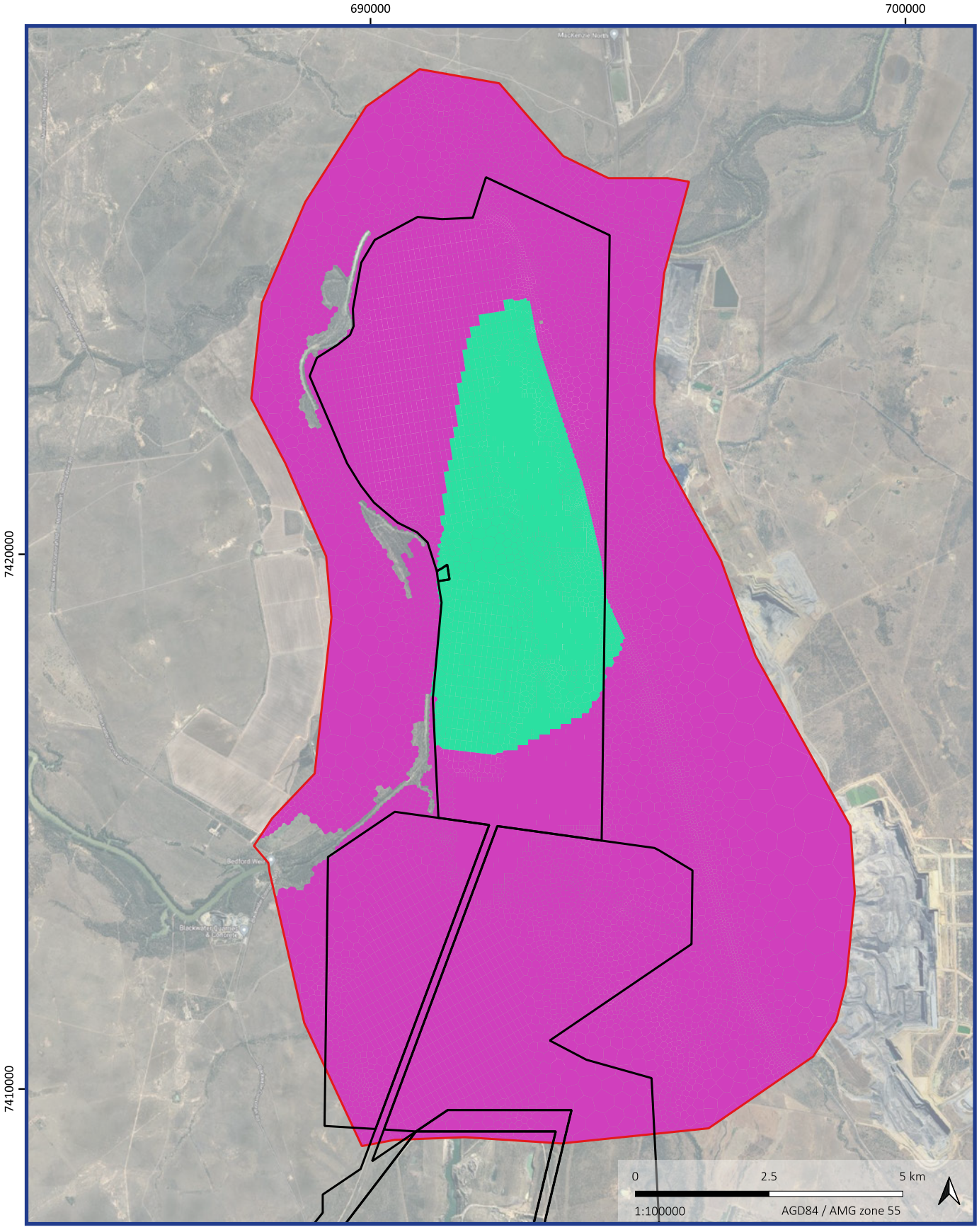
- Model extent
- Curragh Mining Lease Boundary
- Zone 1 (Mackenzie River floodplain alluvium)

(4150) HEC_Curragh North

Figure C10

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Hydraulic properties zonation - layer 2

Legend

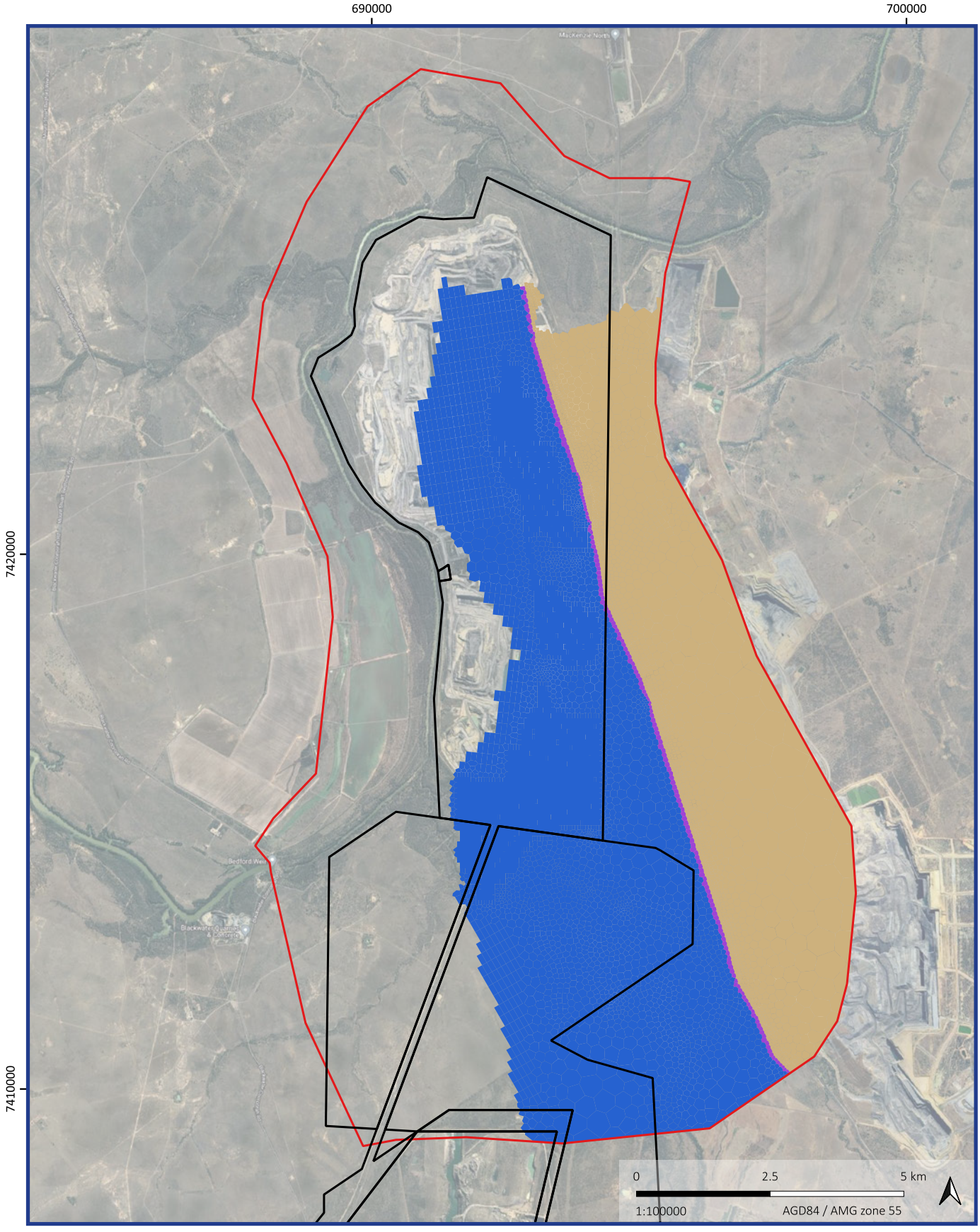
- Model extent
- Curragh Mining Lease Boundary
- Zone 2 (Weathered profile)
- Zone 11 (Weathered profile - high K zone)

(4150) HEC_Curragh North

Figure C11

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Hydraulic properties zonation - layer 3

Legend

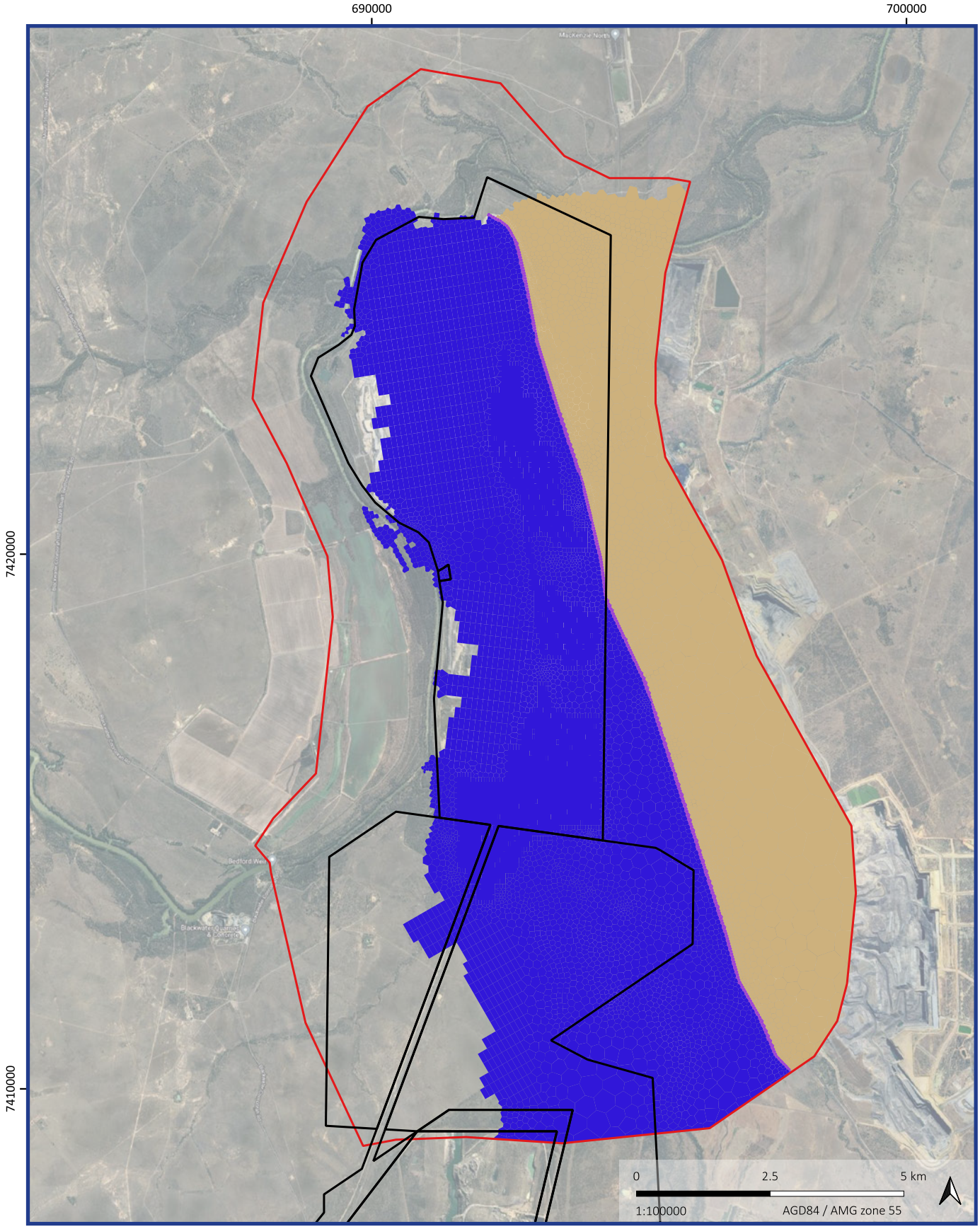
- Model extent
- Curragh Mining Lease Boundary
- Zone 3 (Permian coal measures - overburden)
- Zone 9 (Burngrove Formation - east of Jellinbah Fault)
- zone 10 (Jellinbah Fault zone)

(4150) HEC_Curragh North

Figure C12

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Hydraulic properties zonation - layer 4

Legend

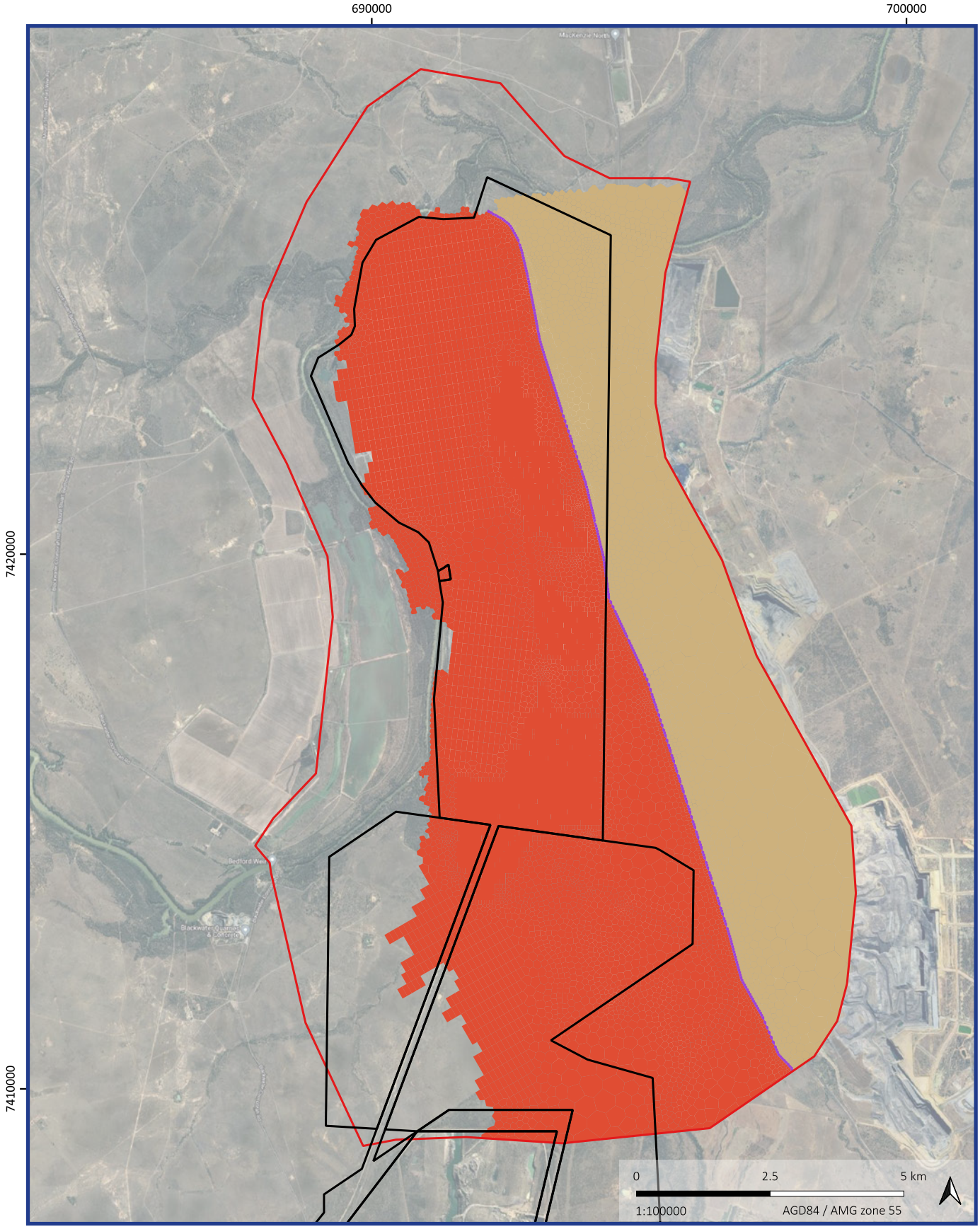
- Model extent
- Curragh Mining Lease Boundary
- Zone 4 (Permian coal measures - overburden)
- Zone 9 (Burngrove Formation - east of Jellinbah Fault)
- Zone 10 (Jellinbah Fault zone)

(4150) HEC_Curragh North

Figure C13

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Hydraulic properties zonation - layer 5

Legend

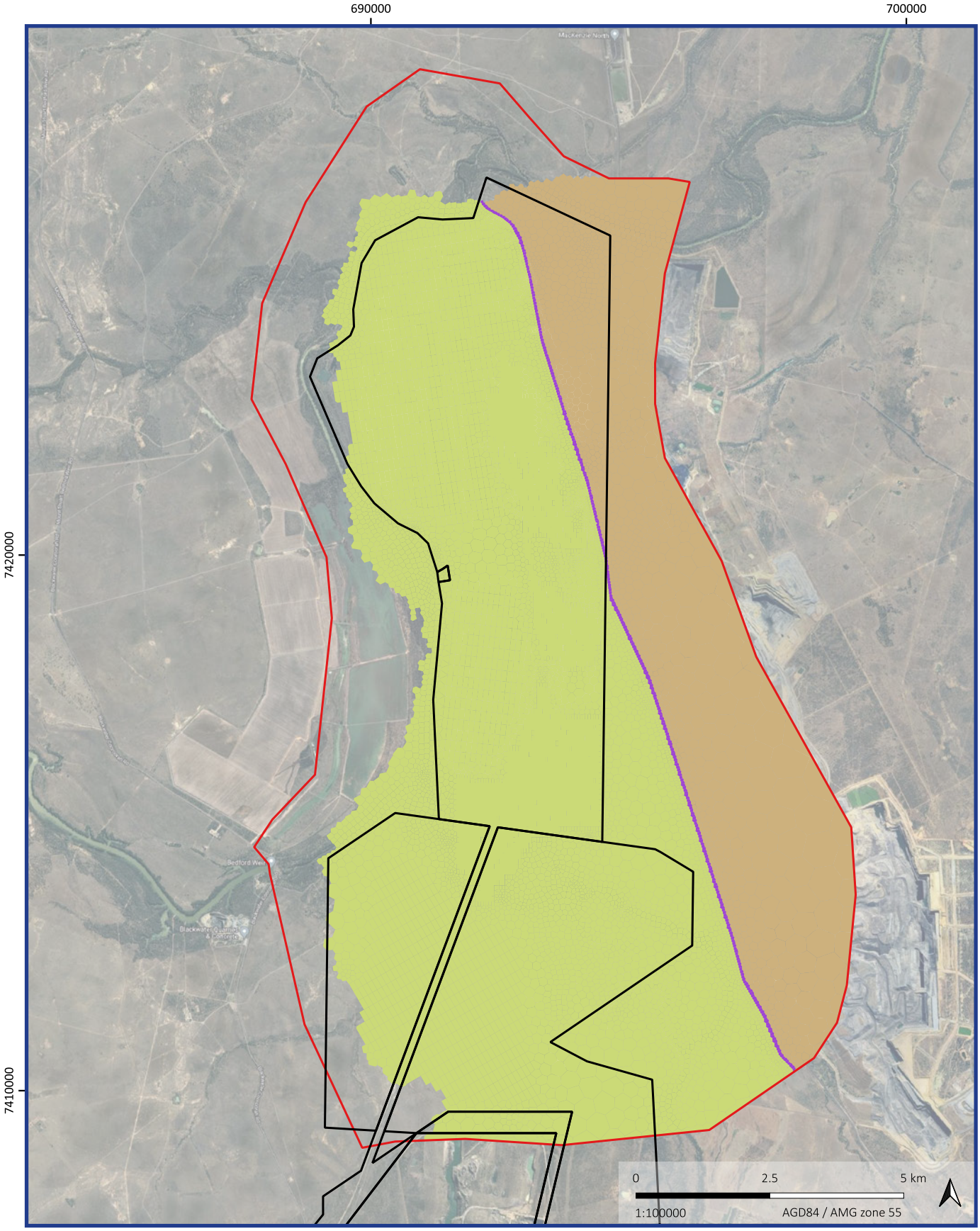
- Model extent
- Curragh Mining Lease Boundary
- Zone 5 (Permian coal measures - Mammoth seam)
- Zone 9 (Burngrove Formation - east of Jellinbah Fault)
- Zone 10 (Jellinbah Fault zone)

(4150) HEC_Curragh North

Figure C14

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Hydraulic properties zonation - layer 6

Legend

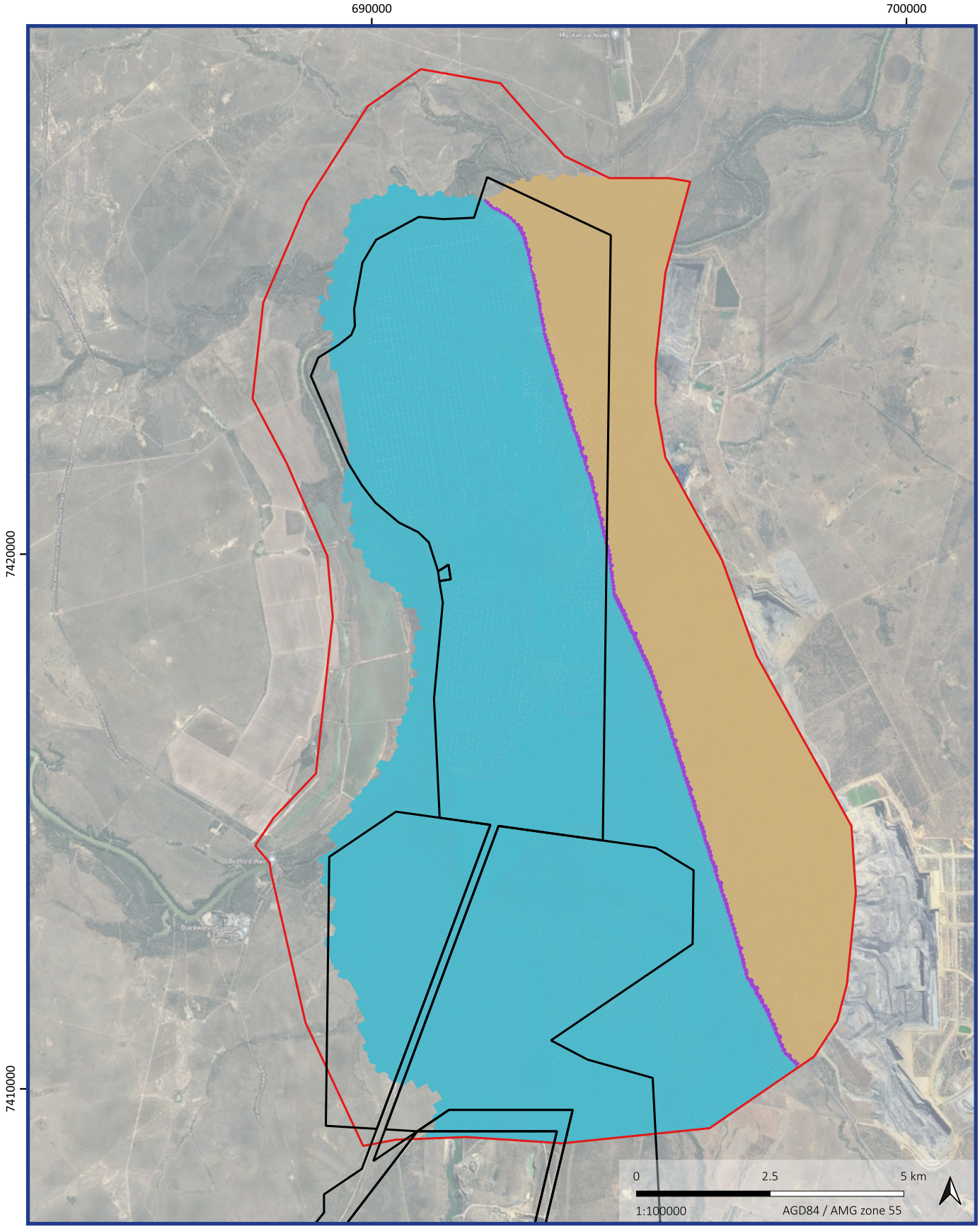
- Model extent
- Curragh Mining Lease Boundary
- Zone 6 (Permian coal measures - interburden)
- Zone 9 (Burngrove Formation - east of Jellinbah Fault)
- Zone 10 (Jellinbah Fault zone)

(4150) HEC_Curragh North

Figure C15

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Hydraulic properties zonation - layer 7

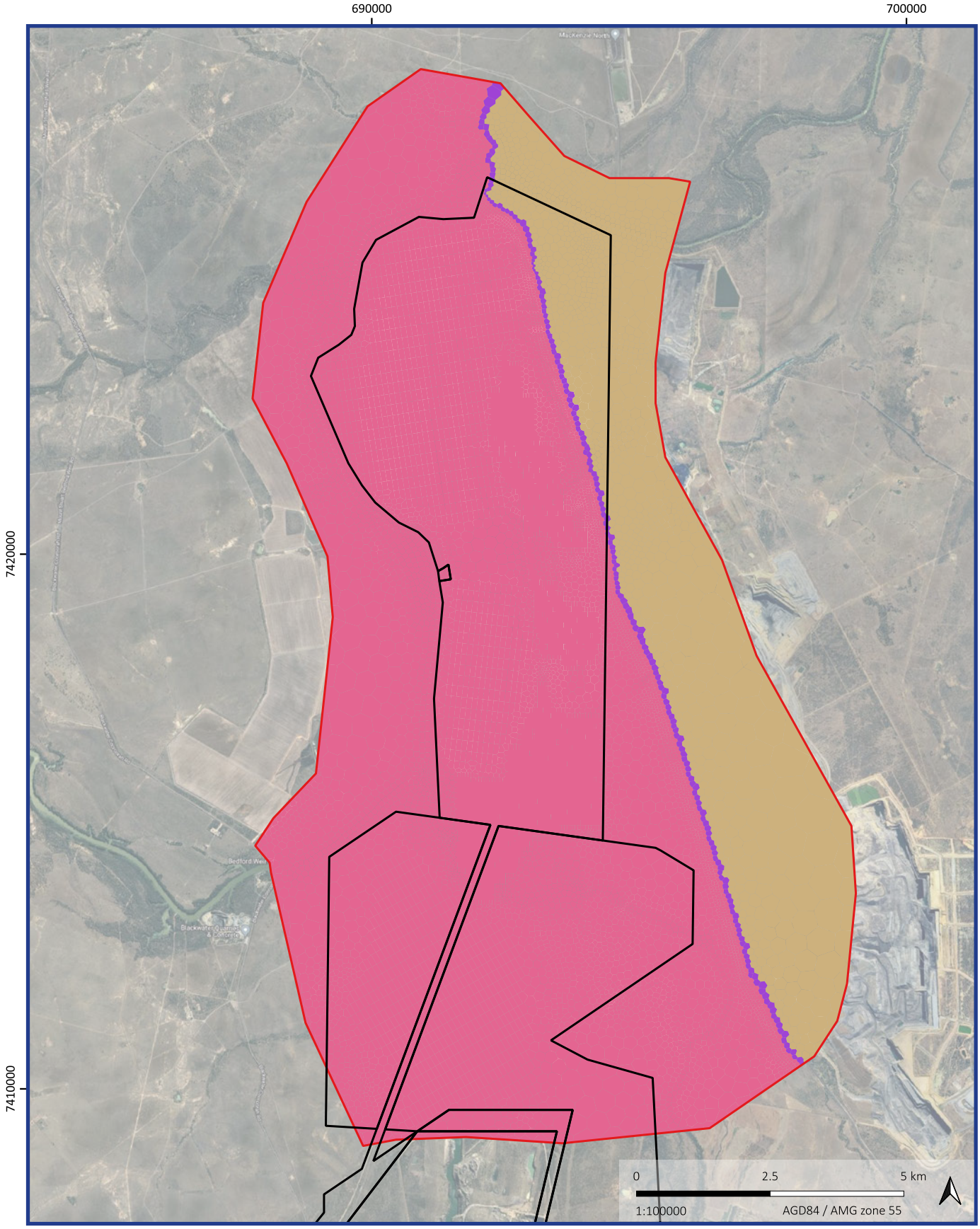
(4150) HEC_Curragh North

Figure C16

27/04/2024

Legend

- Model extent
- Curragh Mining Lease Boundary
- Zone 7 (Permian coal measures - Mackenzie seam)
- Zone 9 (Burngrove Formation - east of Jellinbah Fault)
- Zone 10 (Jellinbah Fault zone)



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Hydraulic properties zonation - layer 8

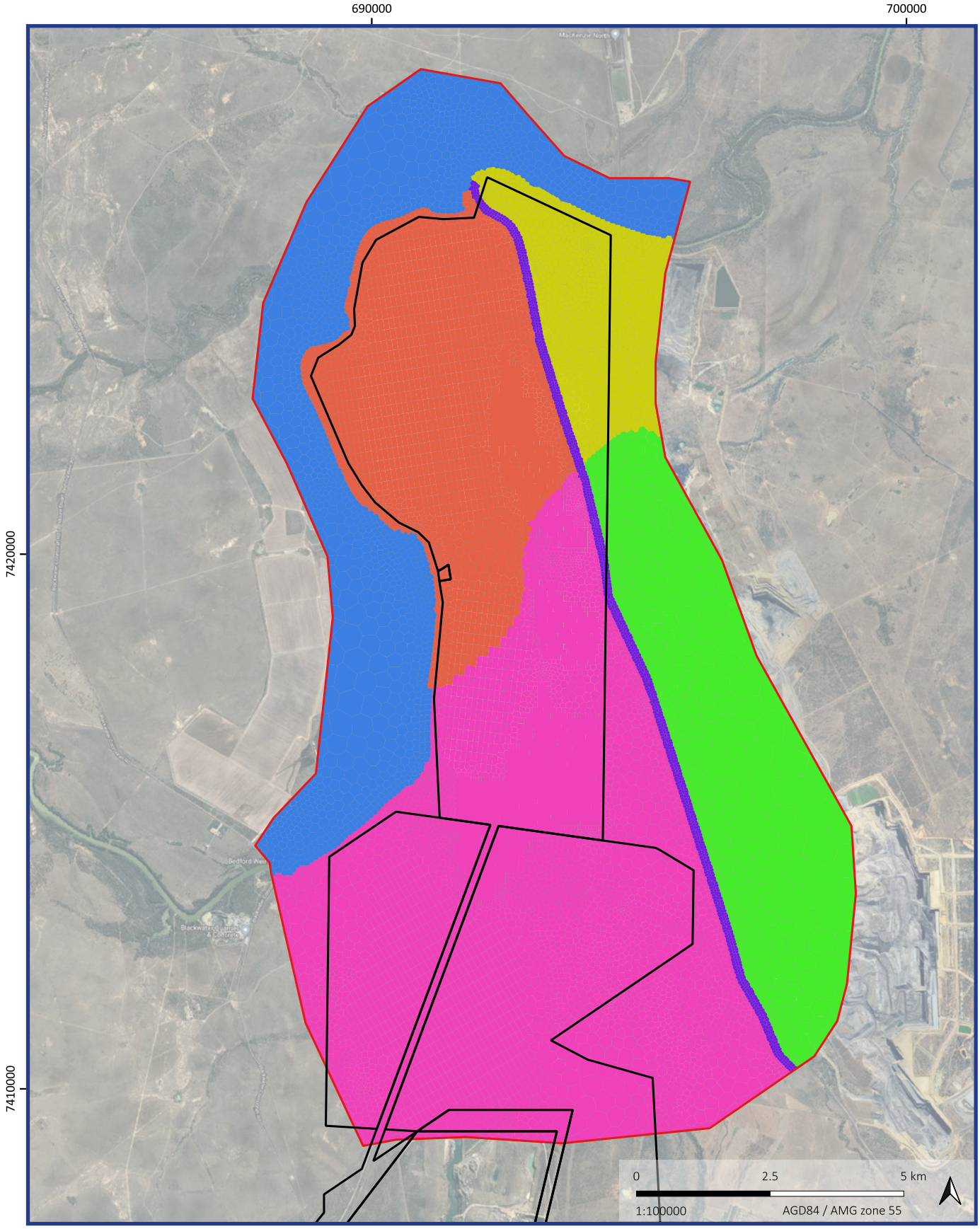
(4150) HEC_Curragh North

Figure C17

27/04/2024

Legend

- Model extent
- Curragh Mining Lease Boundary
- Zone 8 (Burngrove Formation - west of Jellinbah Fault)
- Zone 9 (Burngrove Formation - east of Jellinbah Fault)
- Zone 10 (Jellinbah Fault zone)



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Recharge zonation

) HEC_Curragh North

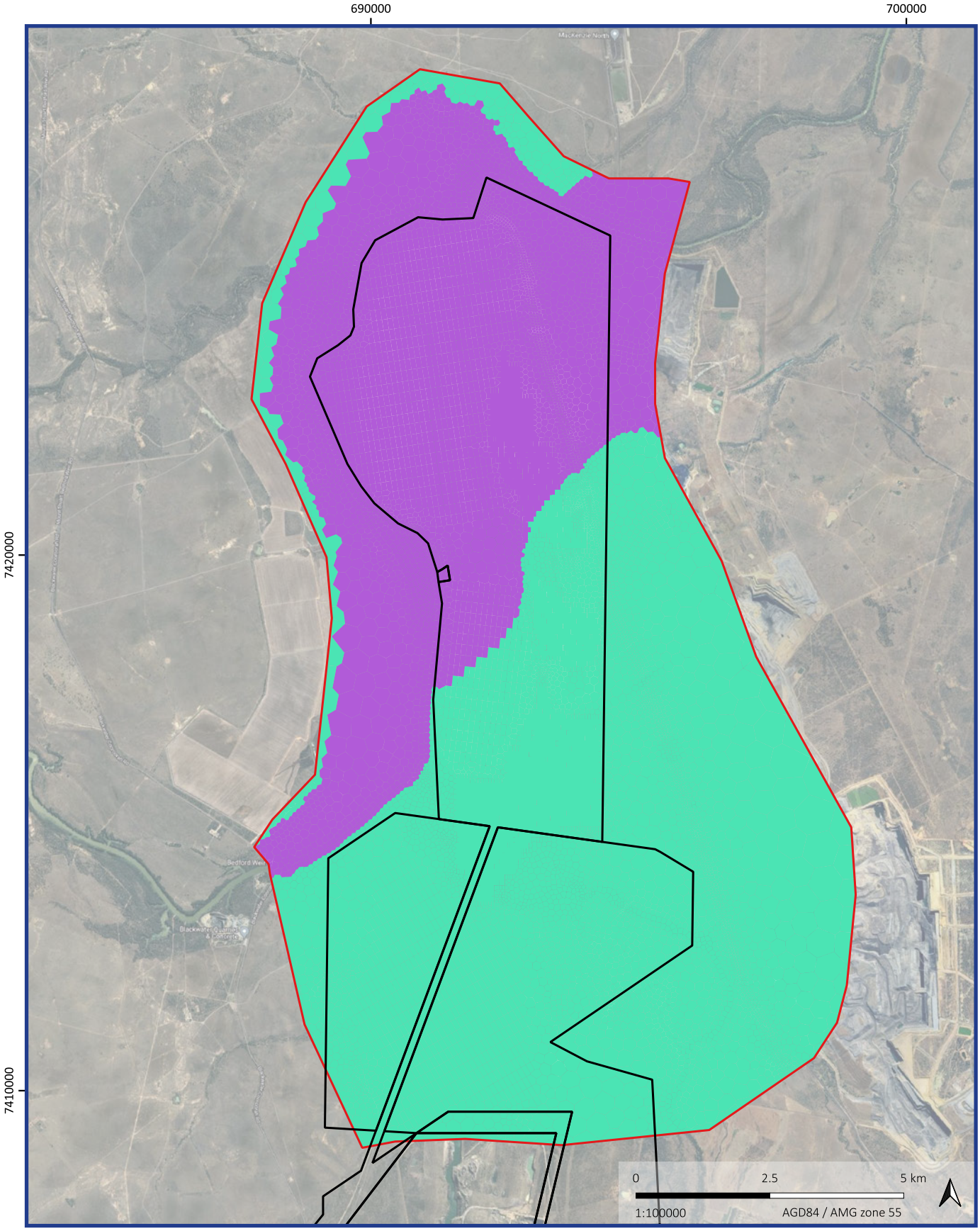
Figure C18

27/04/2024

Legend

- Model extent
- Curragh Mining Lease Boundary
- Zone 1 - Mac. River floodplain alluvium - west
- Zone 2 - Mac. River floodplain alluvium - centre
- Zone 3 - Mac. River floodplain alluvium - east
- Zone 4 - Weathered profile - west
- Zone 5 - Weathered profile - east
- Zone 6 - Jellinbah Fault zone

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Evapotranspiration zonation

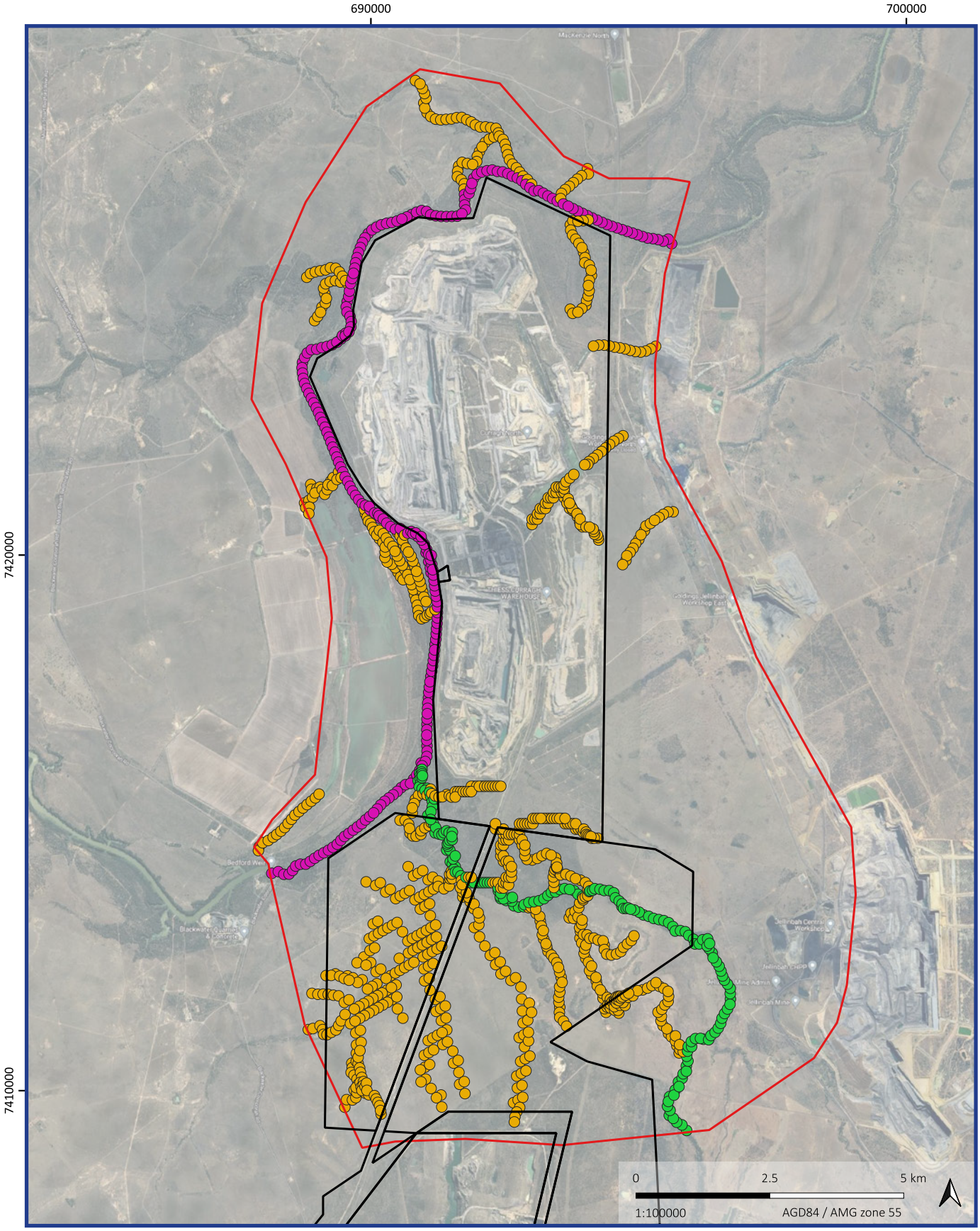
(4150) HEC_Curragh North

Figure C19

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Legend

- Model extent
- Curragh Mining Lease Boundary
- Zone 1 Weathered profile
- Zone 2 Mackenzie River floodplain alluvium



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Surface water drainage zones

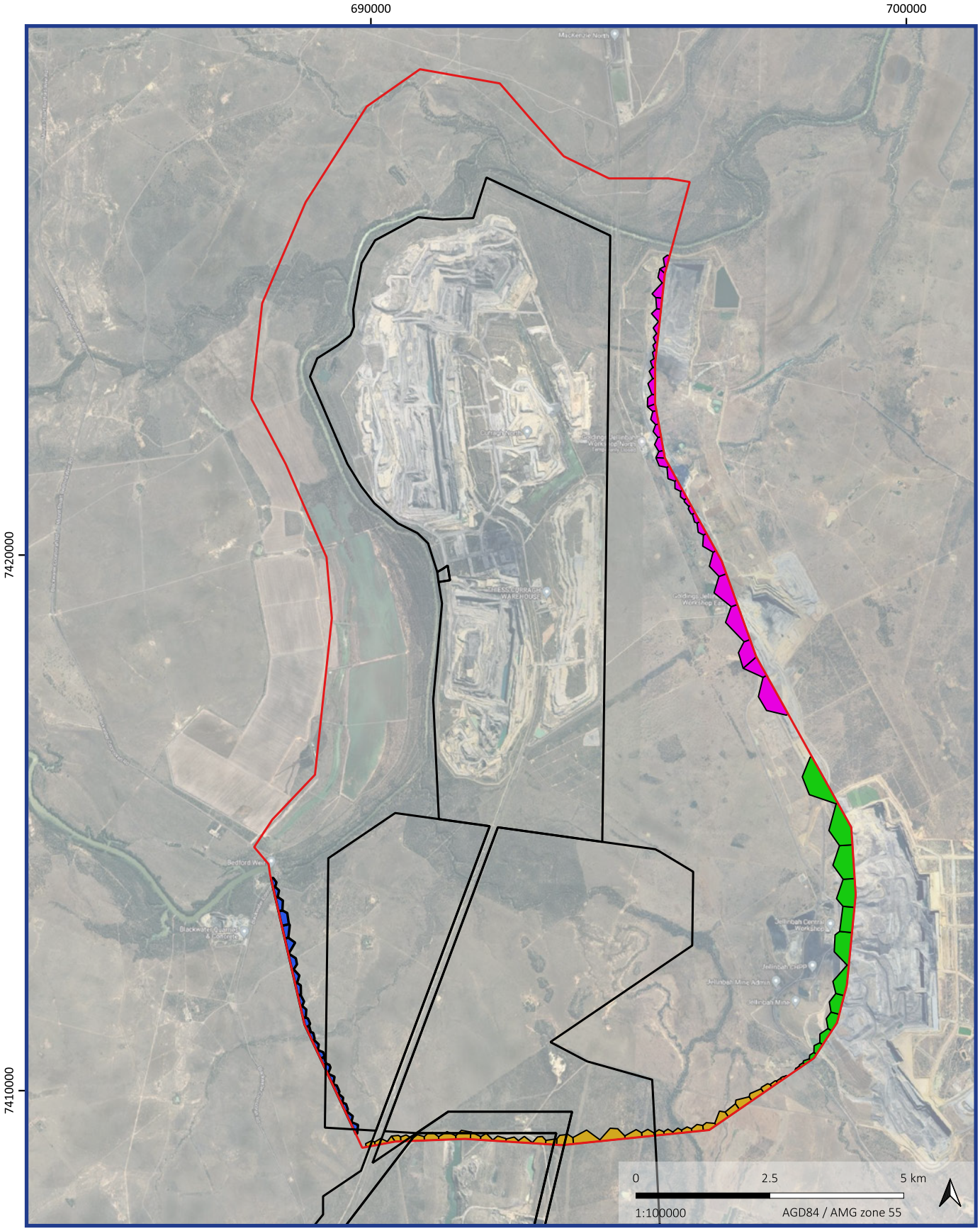
(4150) HEC_Curragh North

Figure C20

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Legend

- Model extent
- Curragh Mining Lease Boundary
- Zone 1 - Mackenzie River
- Zone 2 - Blackwater Creek
- Zone 3 - Minor drainage and tributaries



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General head boundary (steady state) conditions

Legend

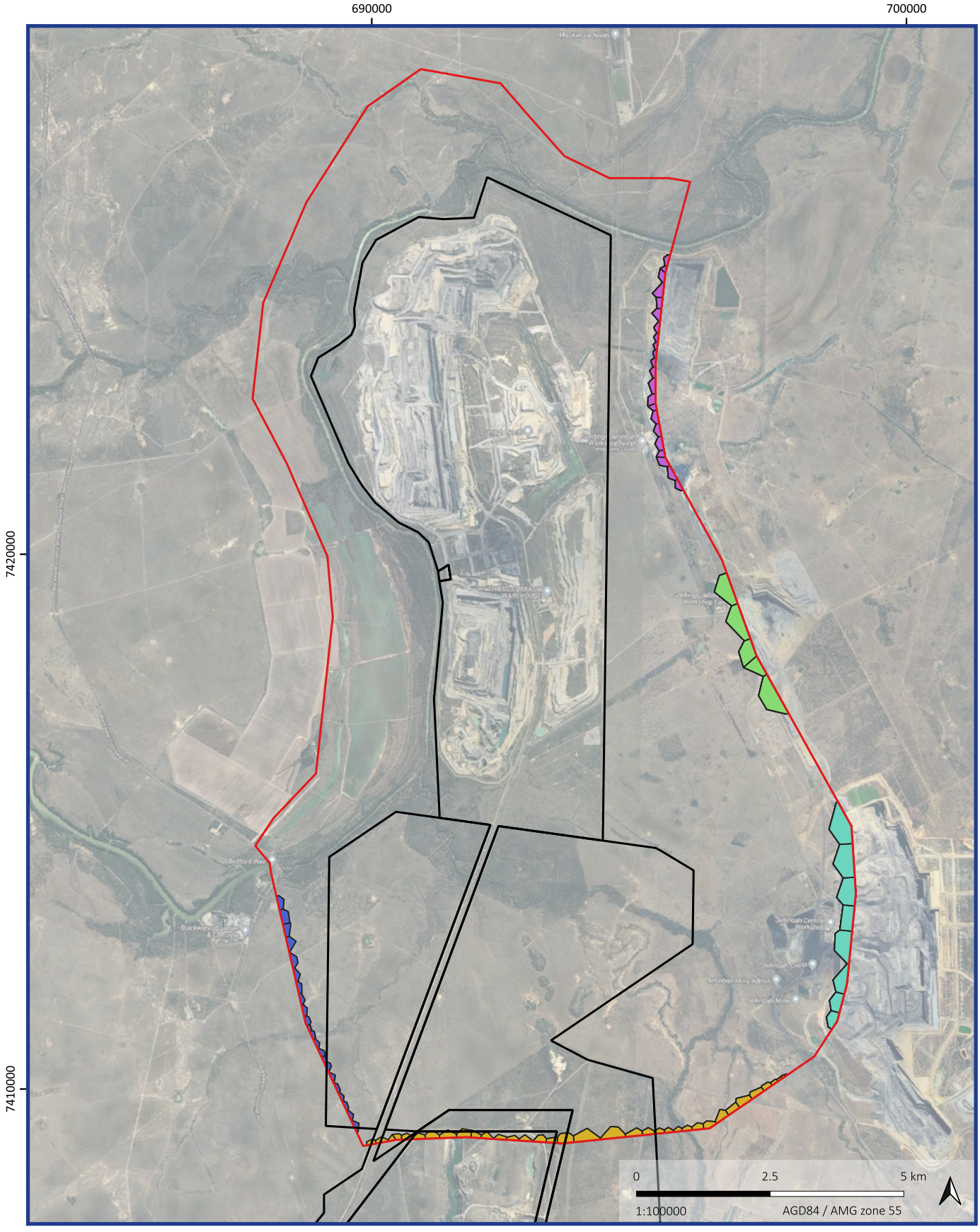
- Model extent
- Curragh Mining Lease Boundary
- Zone 1 - West
- Zone 2 - South
- Zone 3 - South east
- Zone 4 - North east

(4150) HEC_Curragh North

Figure C21

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General head boundary (transient) conditions

Legend

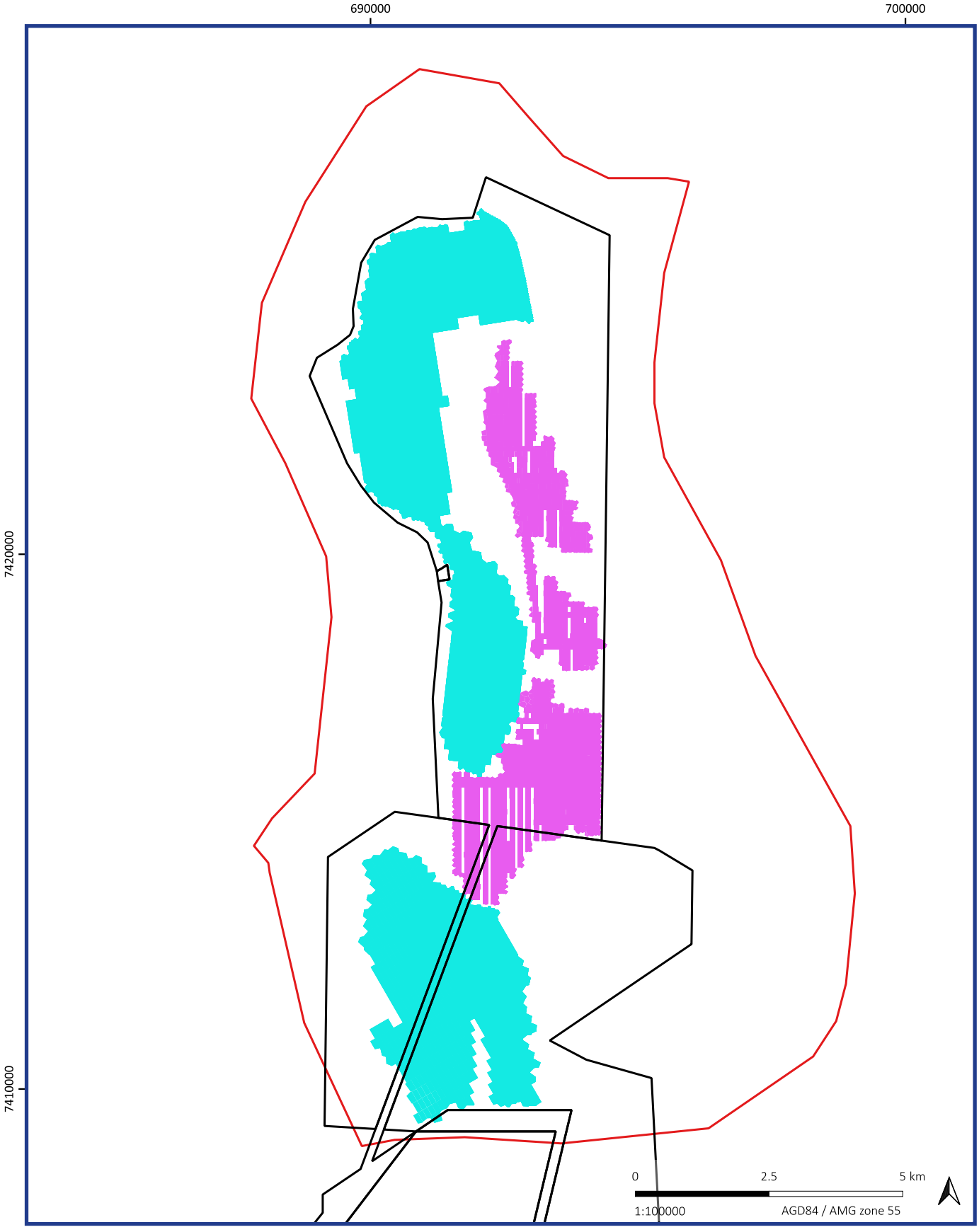
- Model extent
- Curragh Mining Lease Boundary
- Zone 1 - West
- Zone 2 - South
- Zone 3 - South east
- Zone 4 - Centre east
- Zone 5 - North east

(4150) HEC_Curragh North

Figure C22

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Mining zones (DRN)

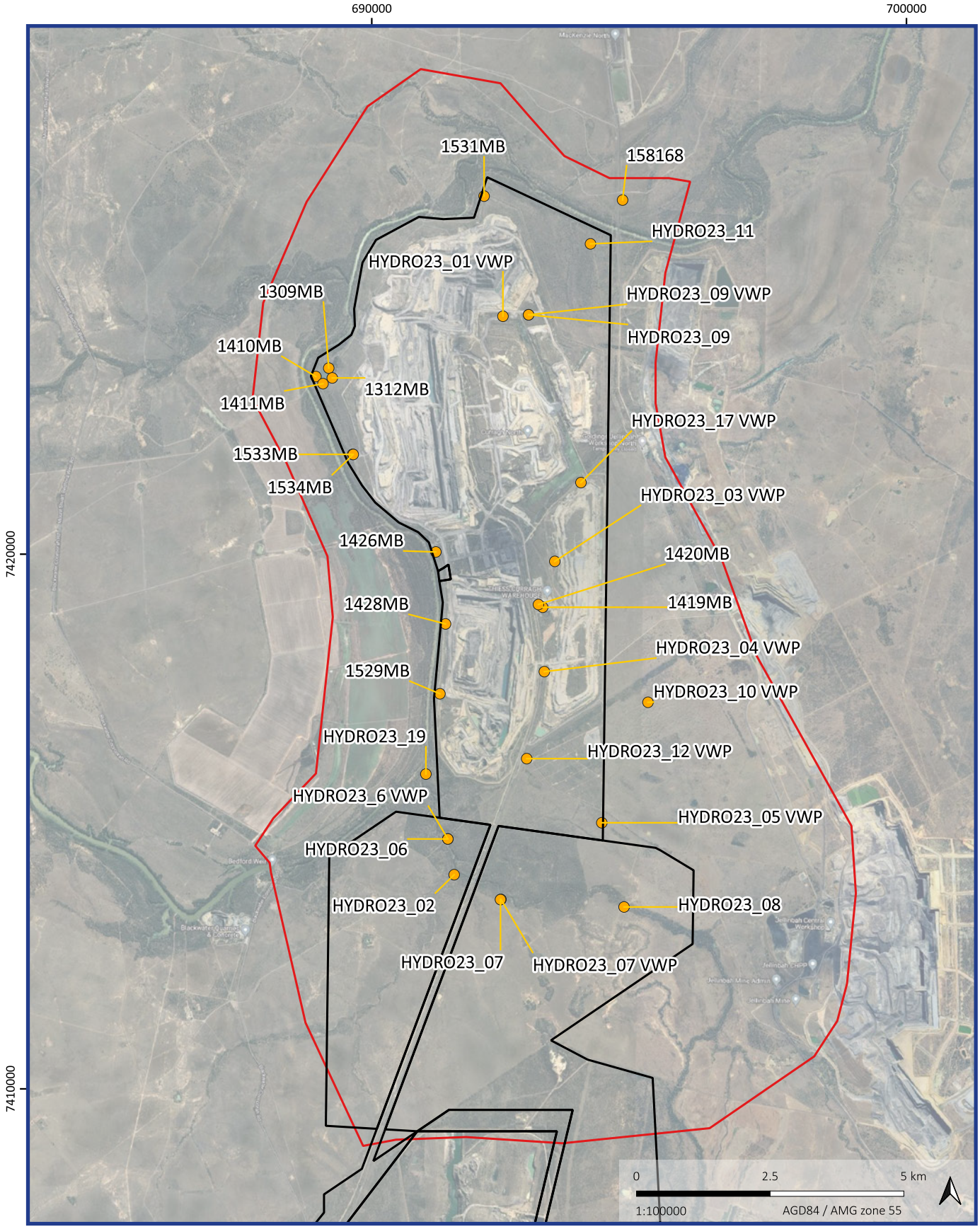
(4150) HEC_Curragh North

Figure C23

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Legend

- Model extent
- Curragh Mining Lease Boundary
- Approved open cut
- Project underground mining area



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Model observation sites

(4150) HEC_Curragh North

Figure C24

27/04/2024

Legend

- Model extent
- Curragh Mining Lease Boundary
- Observation site

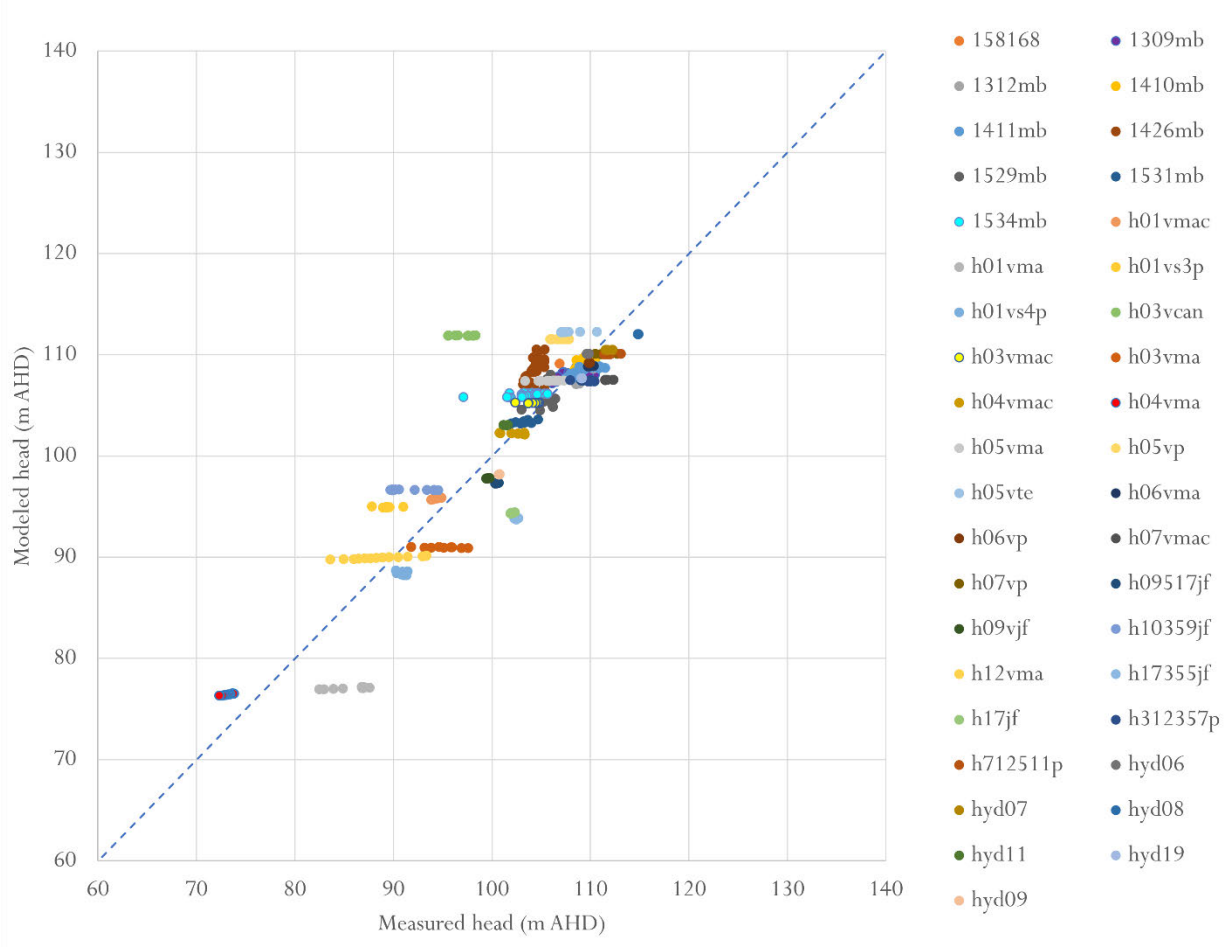


Figure C 25 Calibration scatter diagram – measured vs. modelled heads

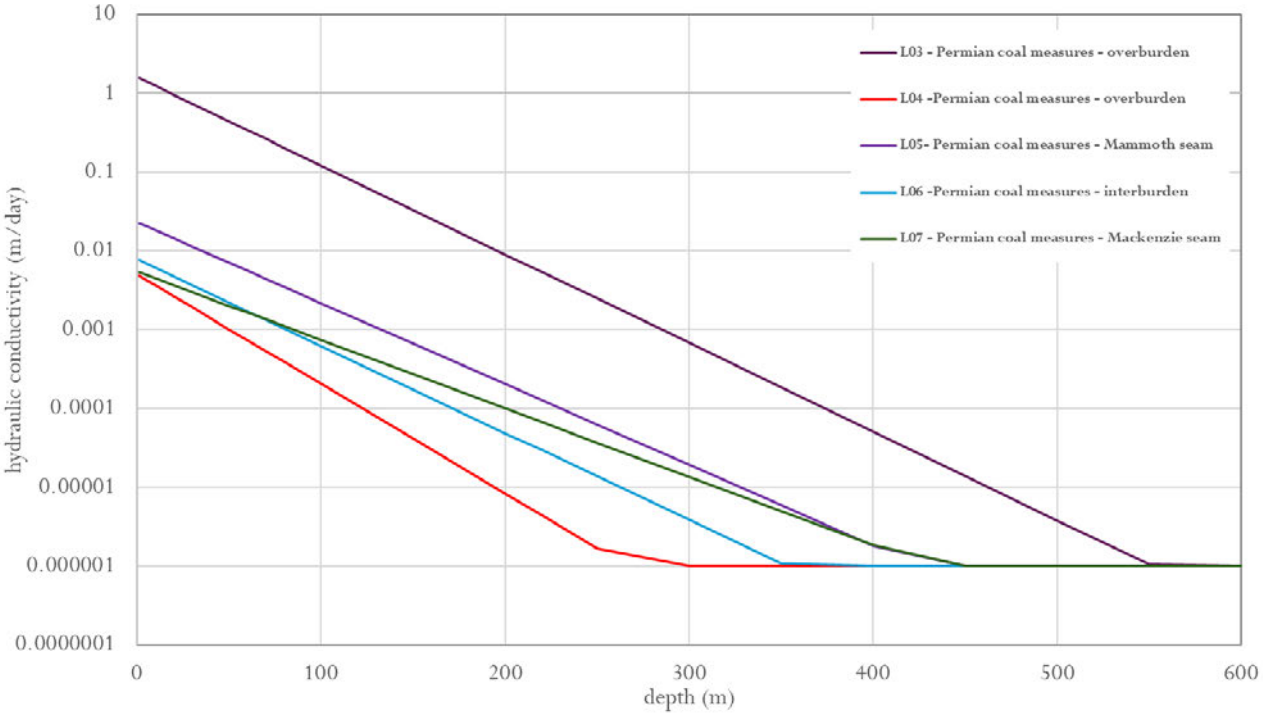


Figure C 26 Depth dependence of hydraulic conductivity

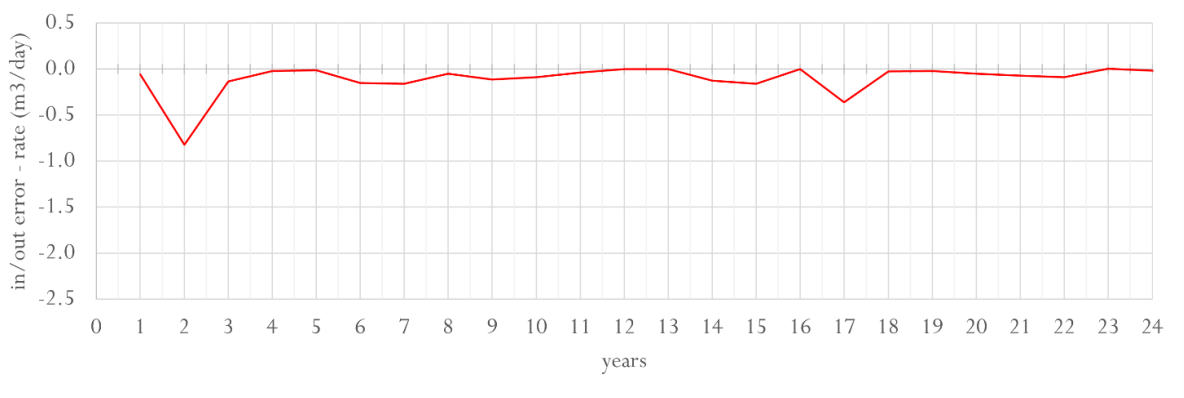
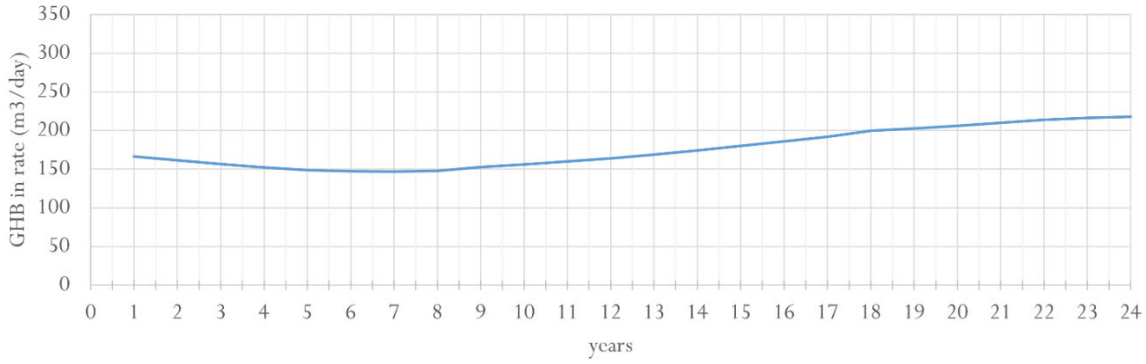
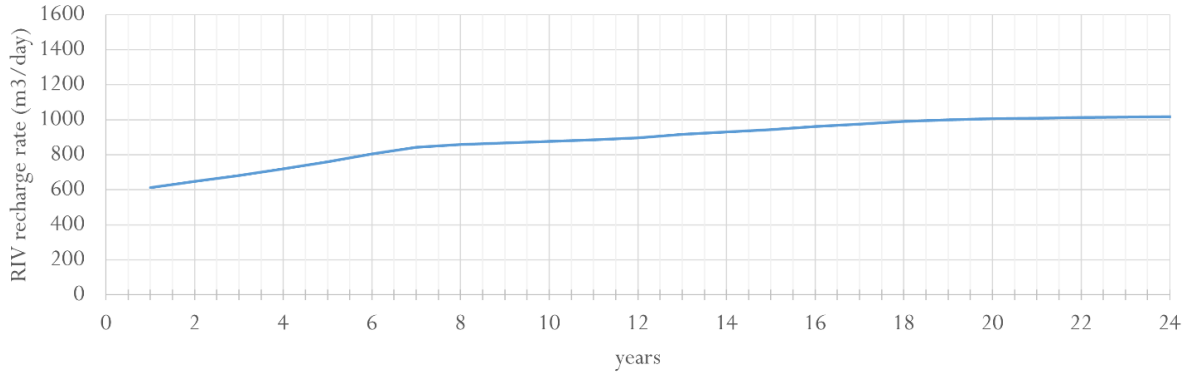


Figure C 27 Transient calibration – water balance convergence error





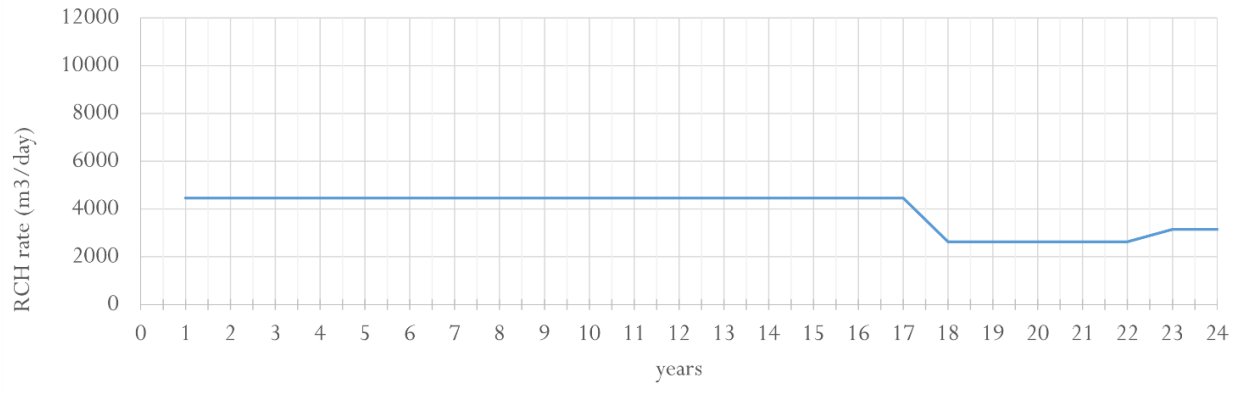


Figure C 28 Transient calibration – water balance inflows

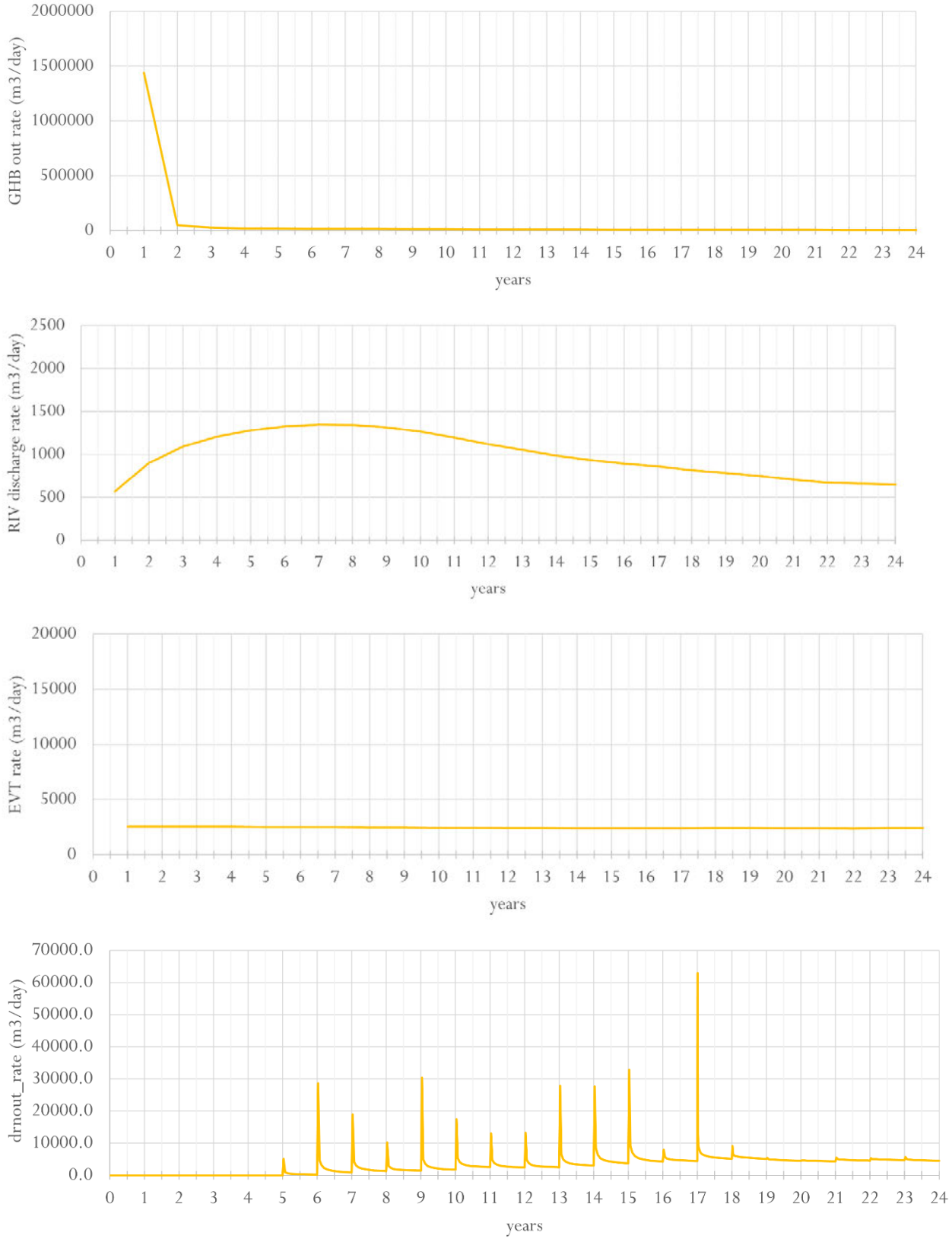


Figure C 29 Transient calibration – water balance outflows

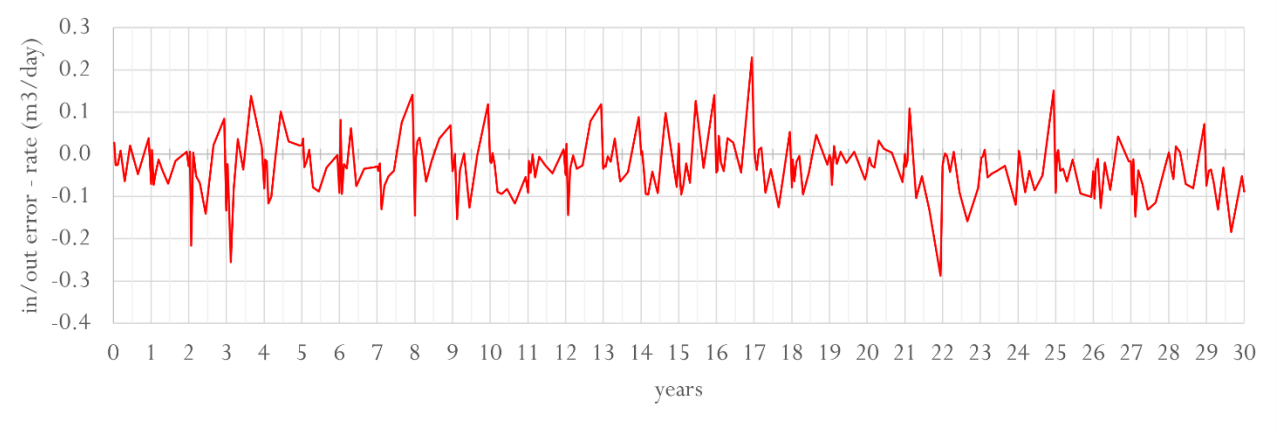


Figure C 30 Transient prediction – 'Approved mining operations scenario' – water balance convergence

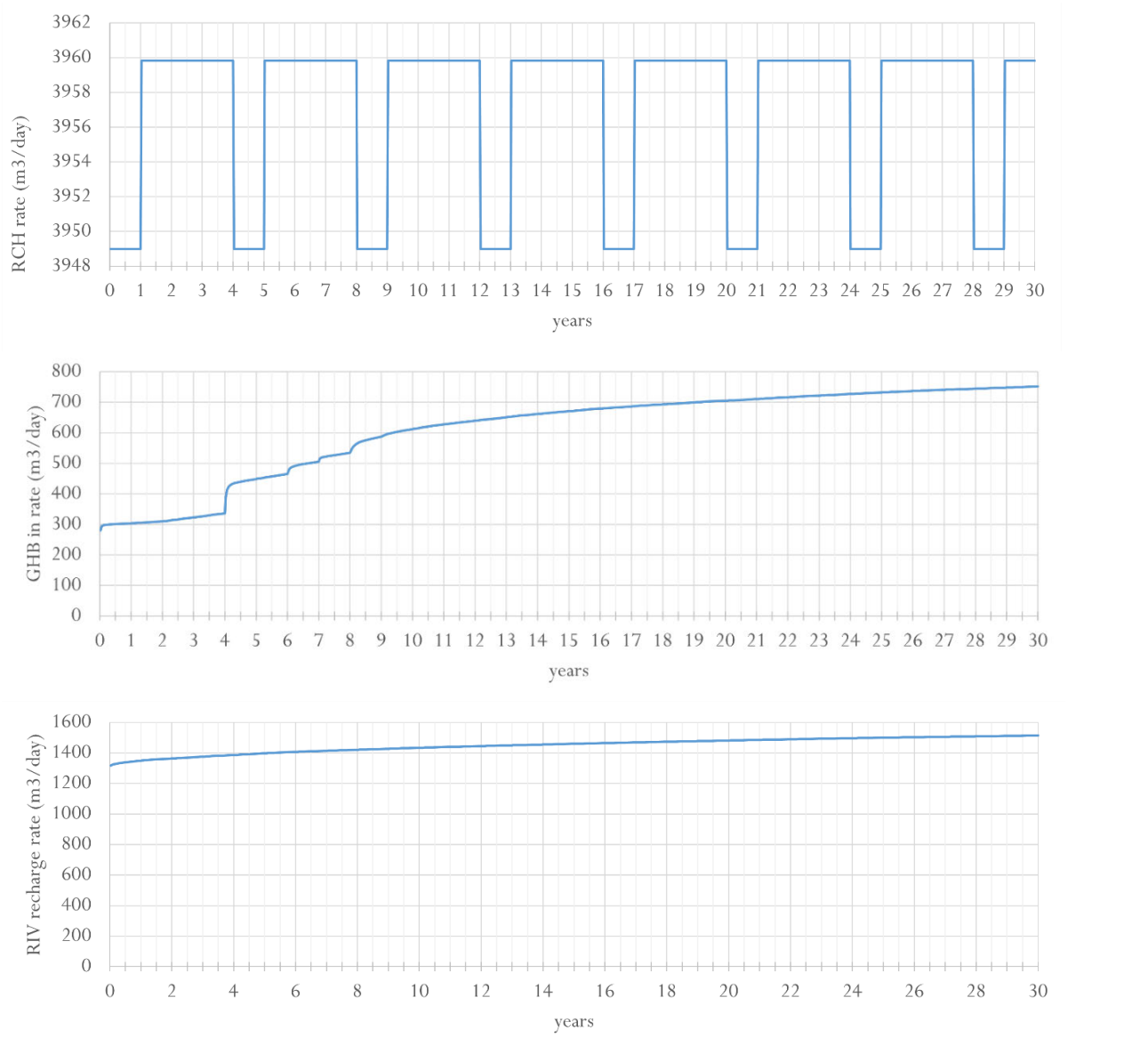


Figure C 31 Transient prediction – 'Approved mining operations scenario' – water balance inflows

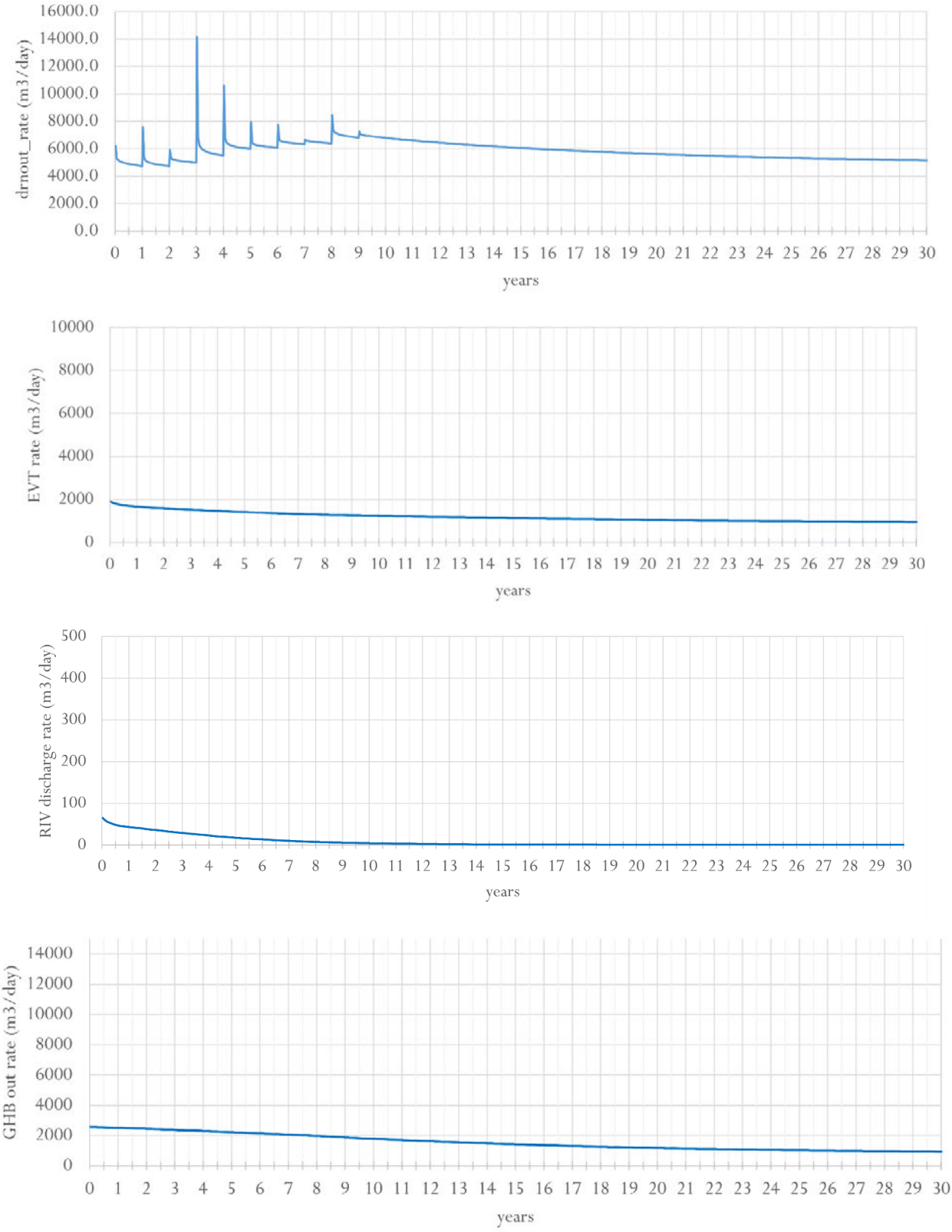
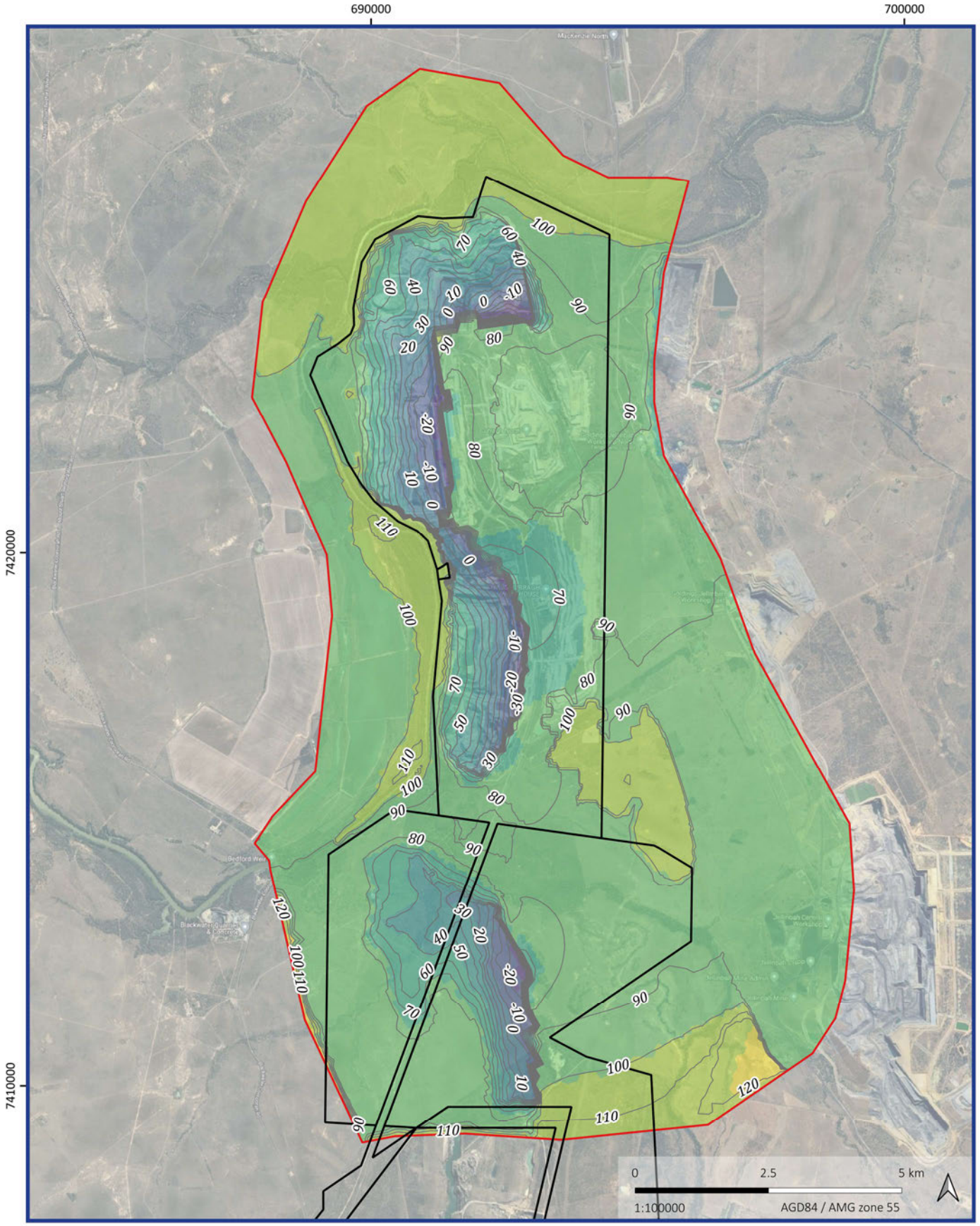


Figure C 32 Transient prediction – 'Approved mining operations scenario' – water balance outflows



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Groundwater table at the end of transient prediction - 'Approved mining operation scenario'

Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

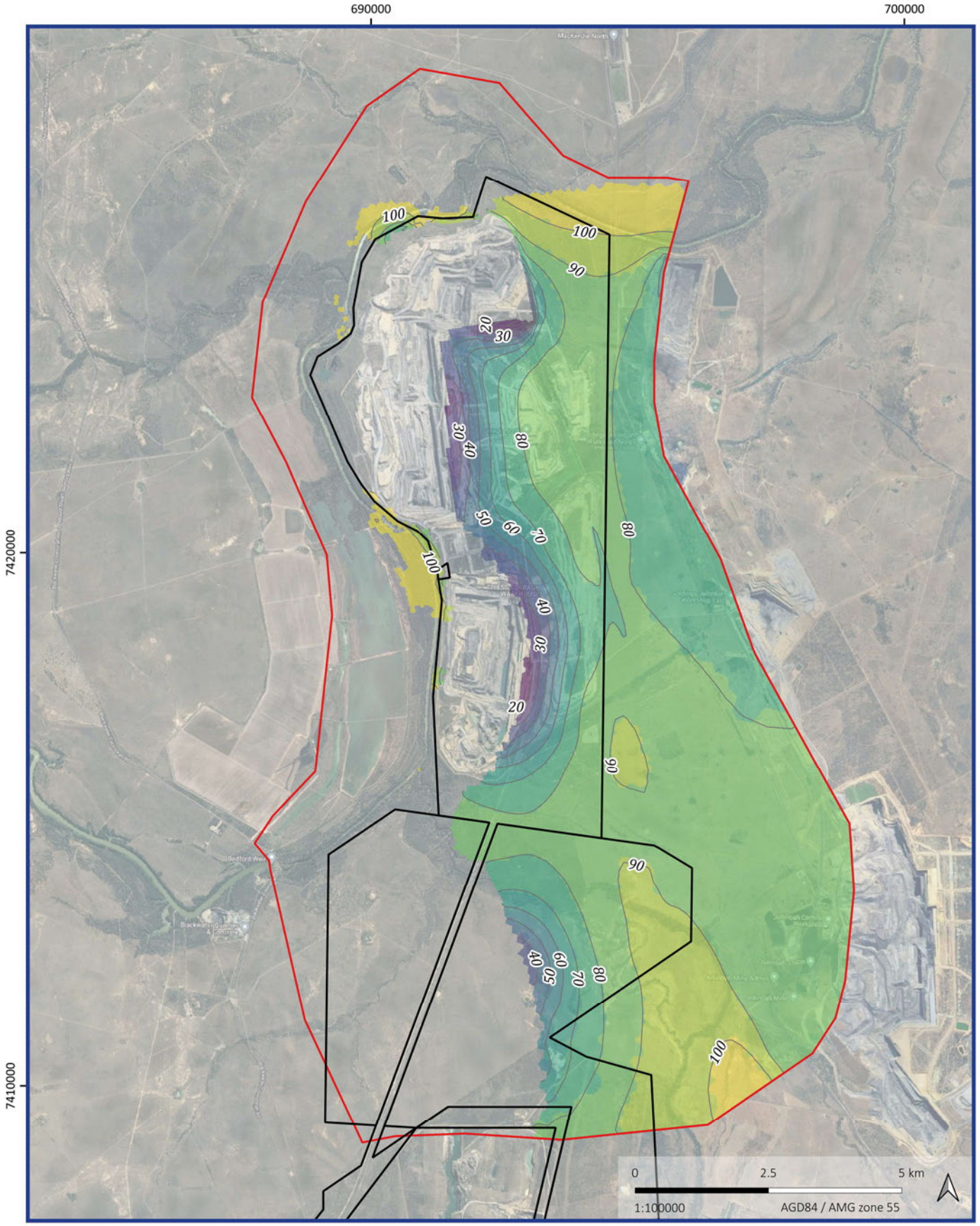
- -40 - -25
- -25 - 0
- 0 - 25
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 125
- 125 - 130

(4150) HEC_Curragh North

Figure C33

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Modelled head at the end of transient prediction layer 5 - 'Approved mining operations scenario'

Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110

(4150) HEC_Curragh North

Figure C34

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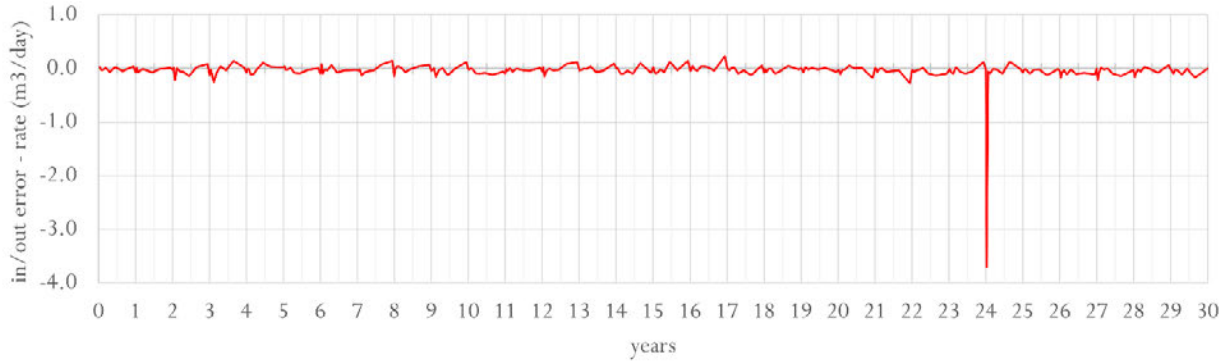


Figure C 35 Transient prediction – 'Project scenario'– water balance convergence

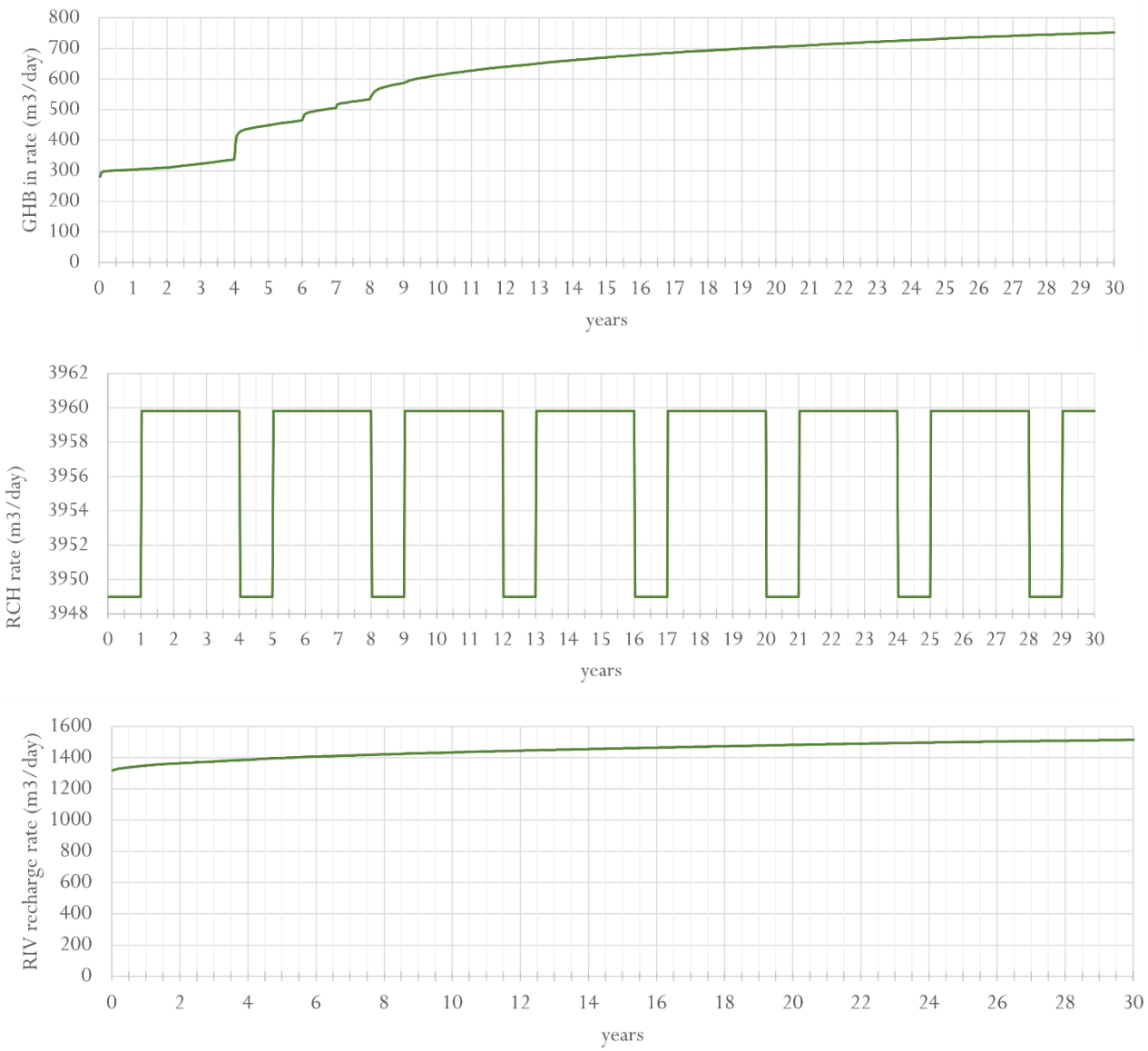


Figure C 36 Transient prediction – 'Project scenario'– water balance inflows

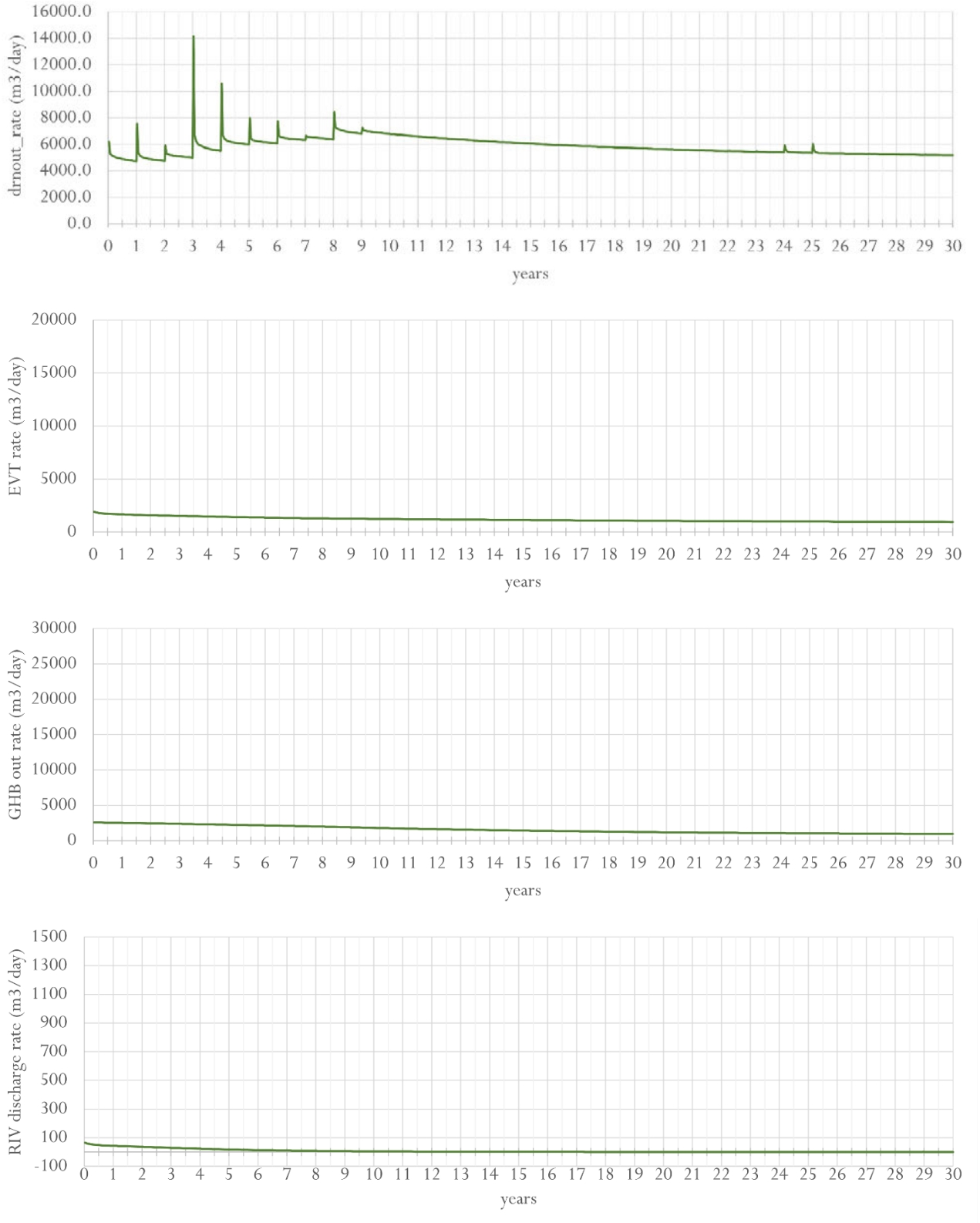


Figure C 37 Transient prediction – 'Project scenario'– water balance outflows

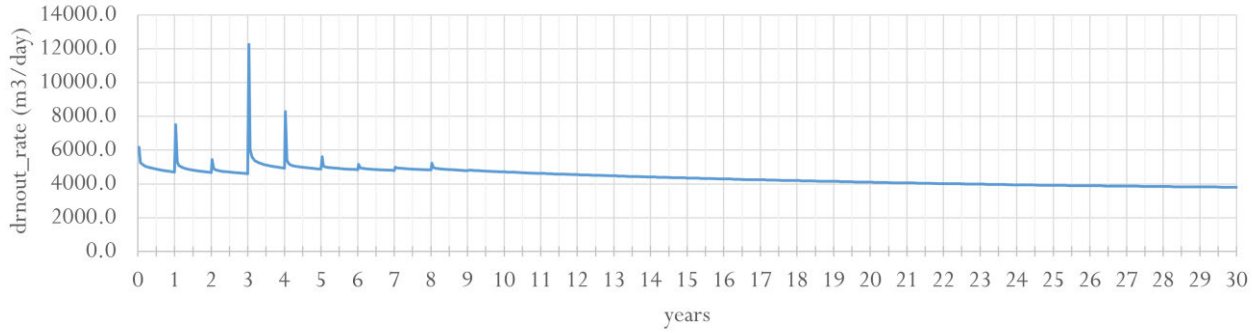


Figure C 38 Mining inflows for Curragh North Mine

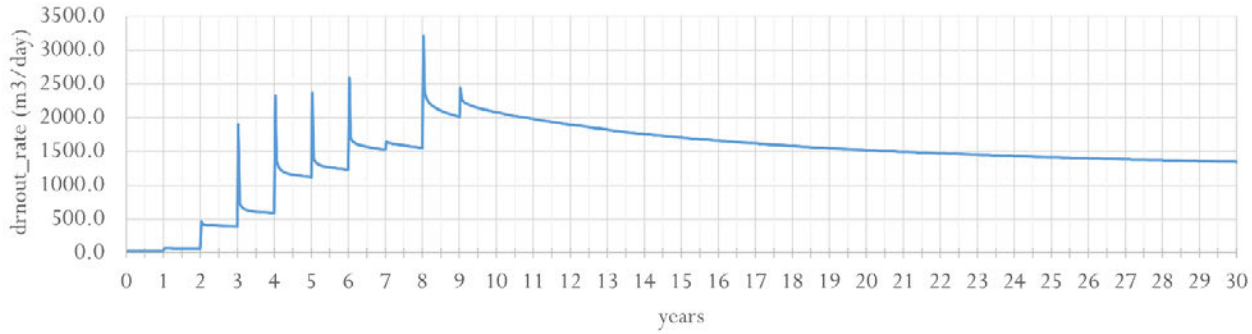


Figure C 39 Mining inflows for Curragh Extension Project

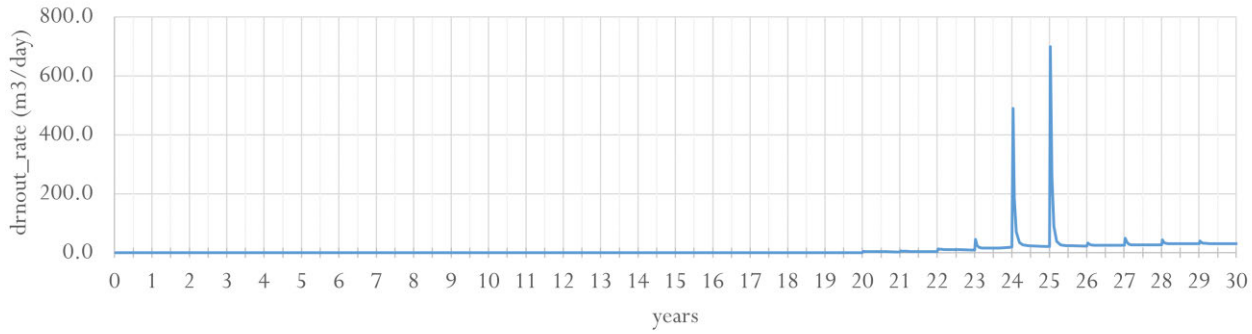
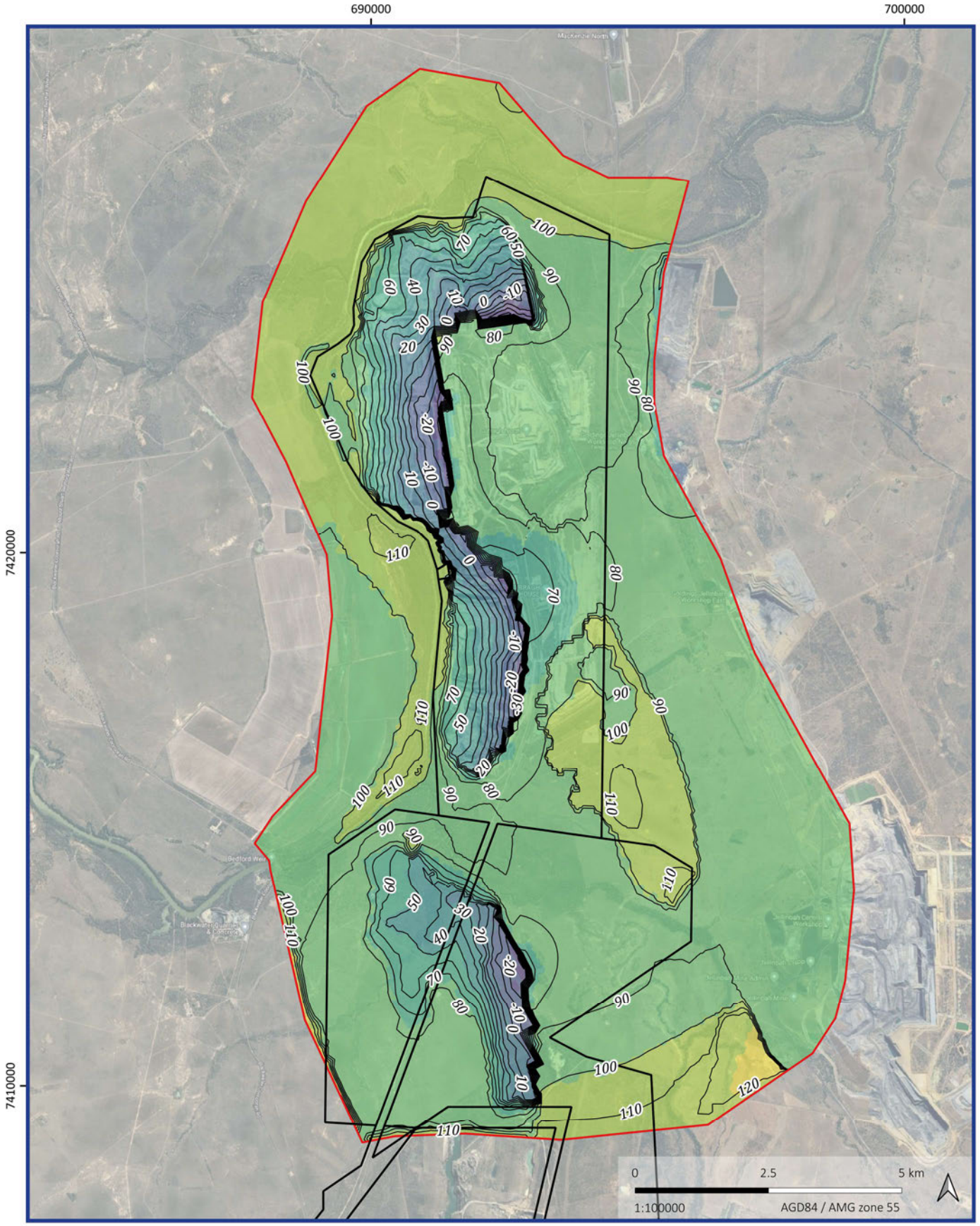


Figure C 40 Mining inflows for the Project



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Groundwater table at the start of transient prediction - 'Project scenario'

Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

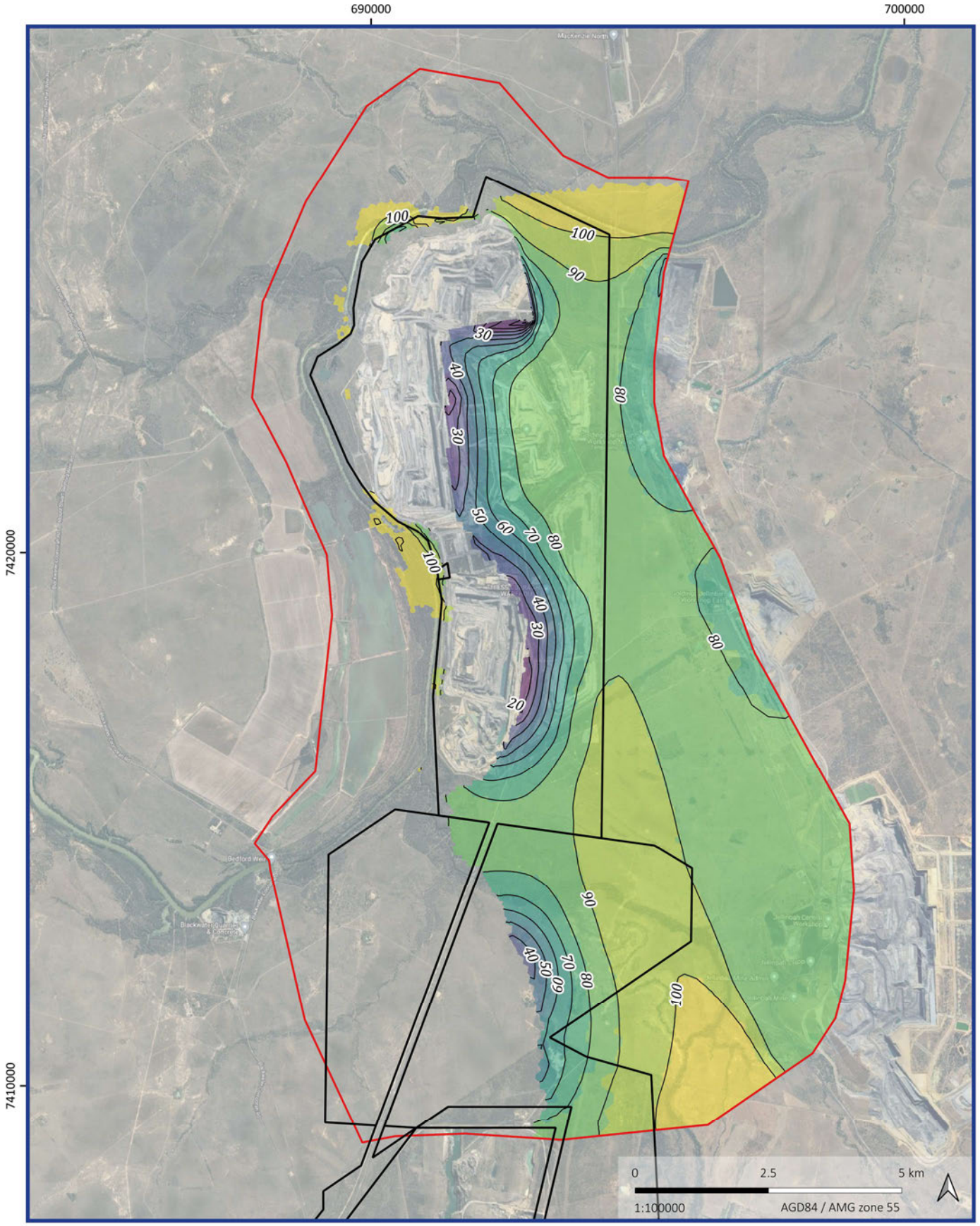
- -40 - -25
- -25 - 0
- 0 - 25
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 125
- 125 - 130

(4150) HEC_Curragh North

Figure C41

27/04/2024

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Modelled head at the start of transient prediction layer 5 - 'Project scenario'

Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

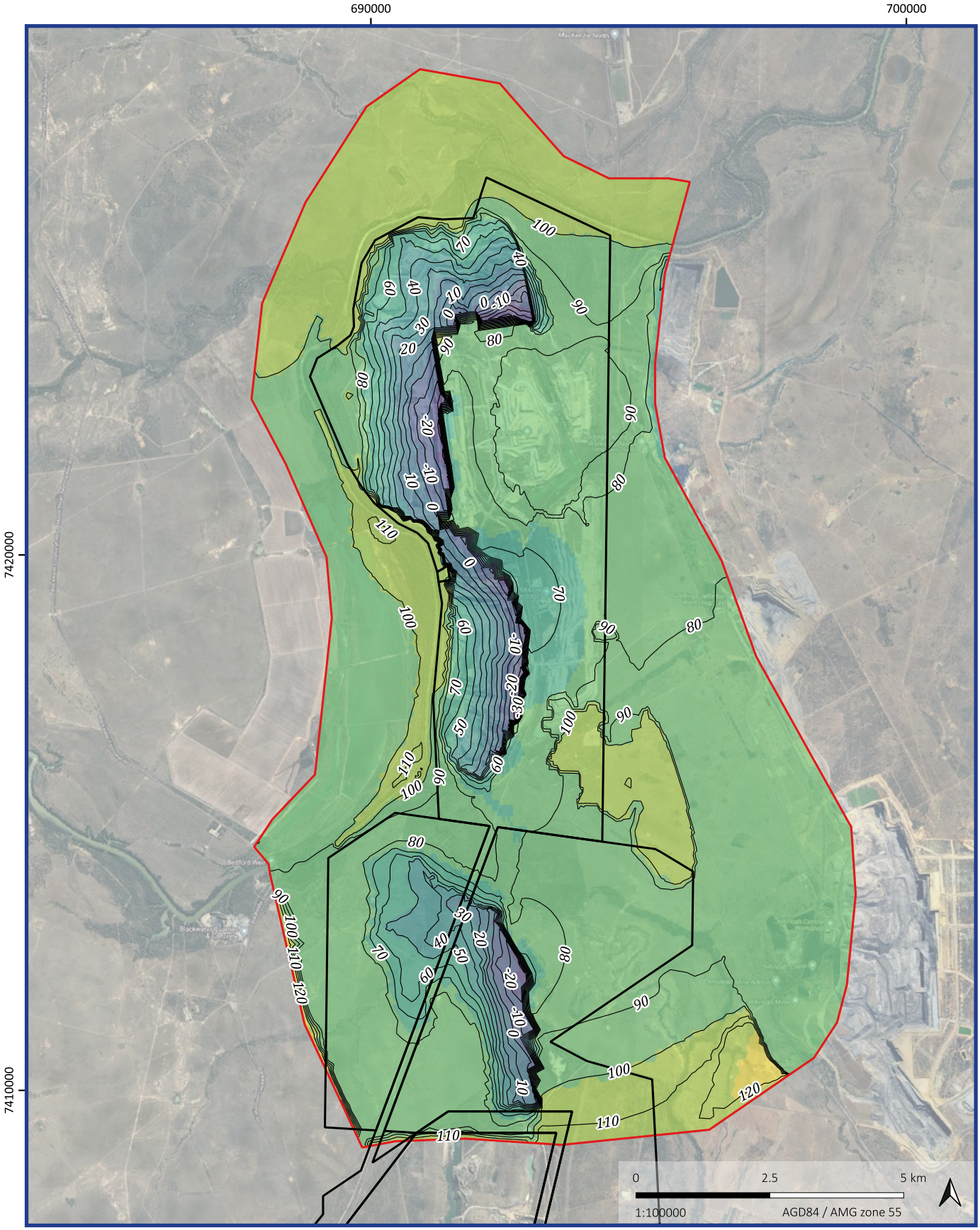
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110

(4150) HEC_Curragh North

Figure C42

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Groundwater table at the end of transient prediction - 'Project scenario'

Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

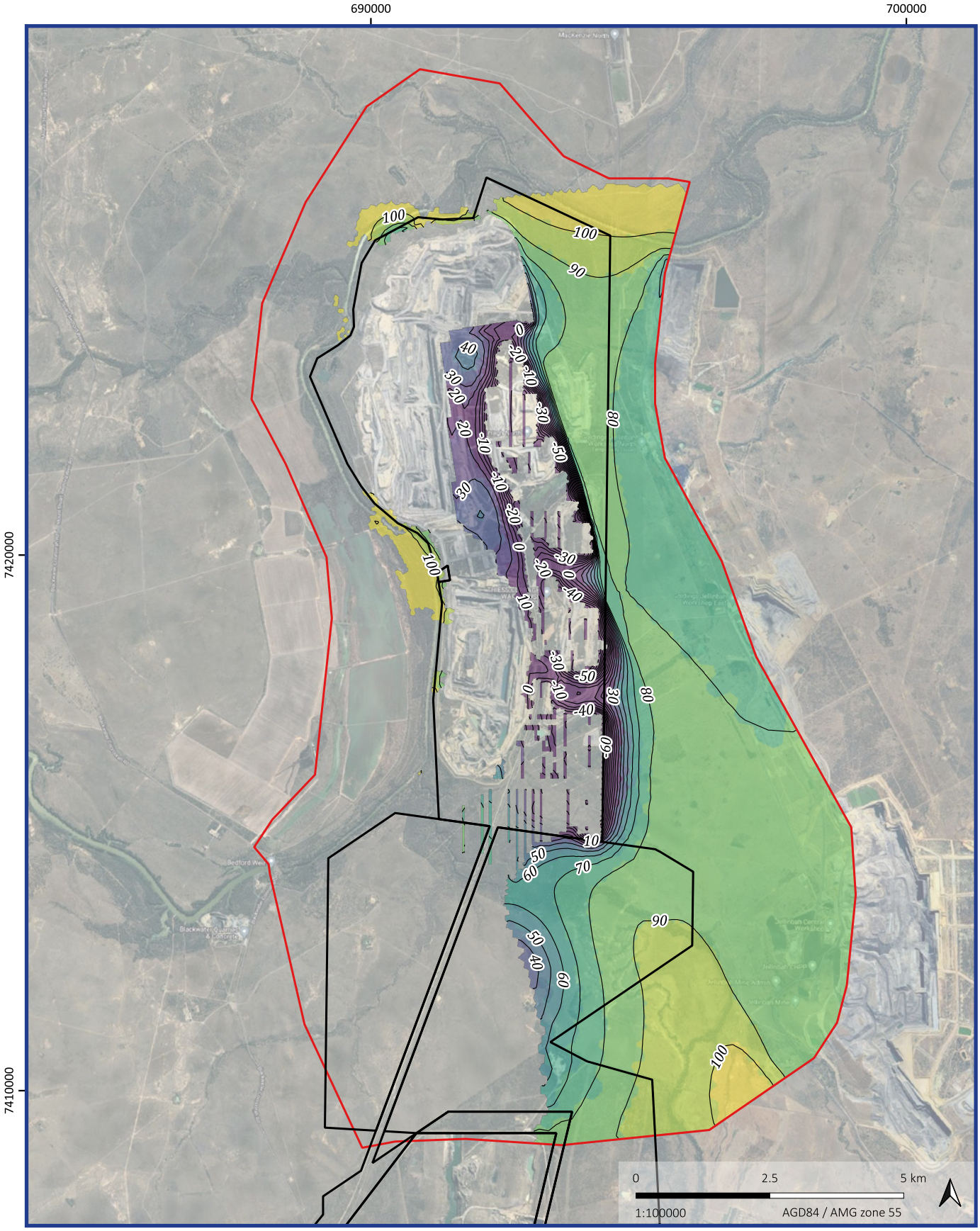
- -40 - -25
- -25 - 0
- 0 - 25
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 125
- 125 - 130

(4150) HEC_Curragh North

Figure C43

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Modelled head at the end of transient prediction layer 5 – 'Project scenario'

Legend

- Model extent
- Curragh Mining Lease Boundary

Elevation (mAHD)

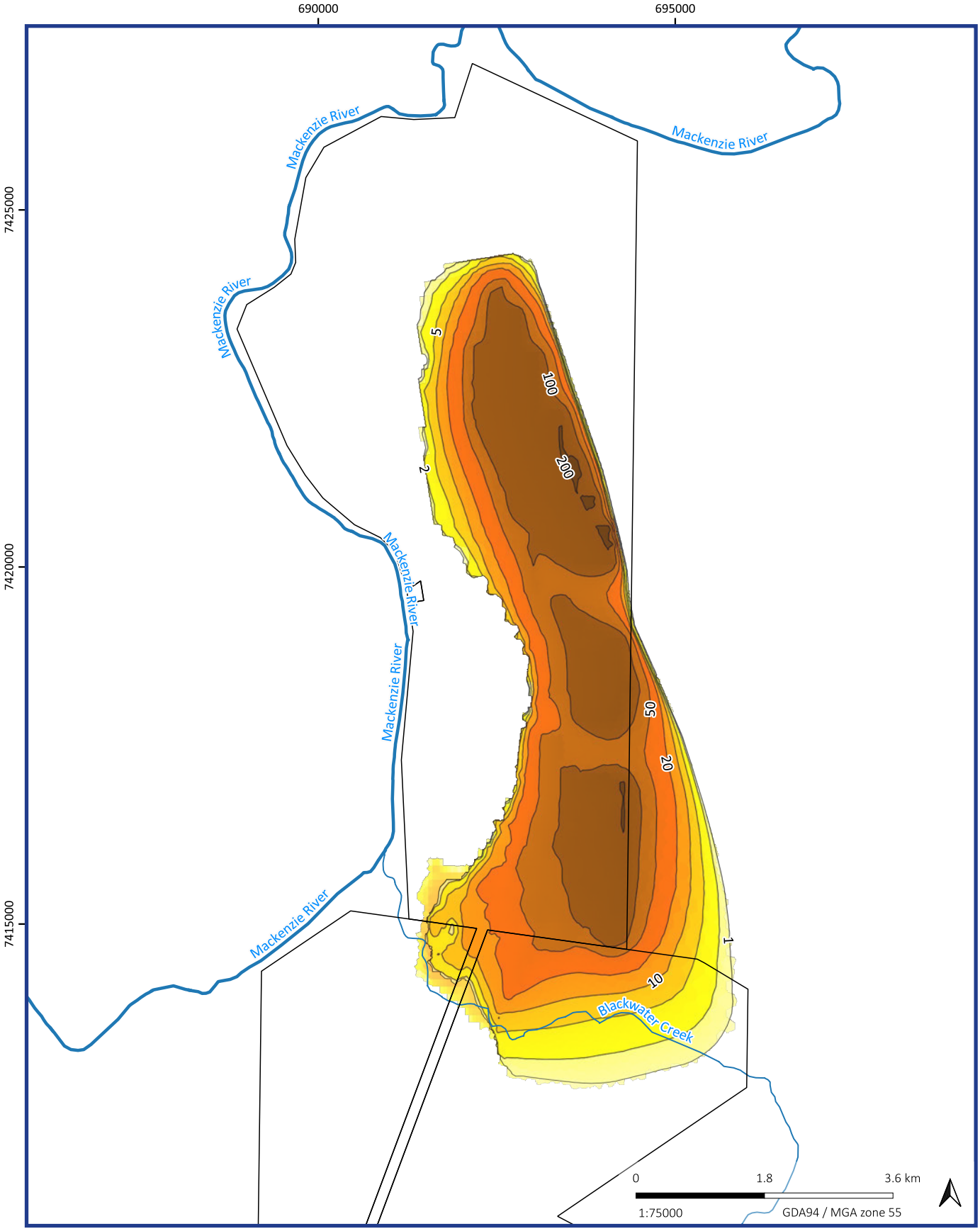
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110

(4150) HEC_Curragh North

Figure C44

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Maximum predicted project depressurisation of the Mammoth seam

4150A - Curragh Bord and Pillar Mine Project

Figure C45

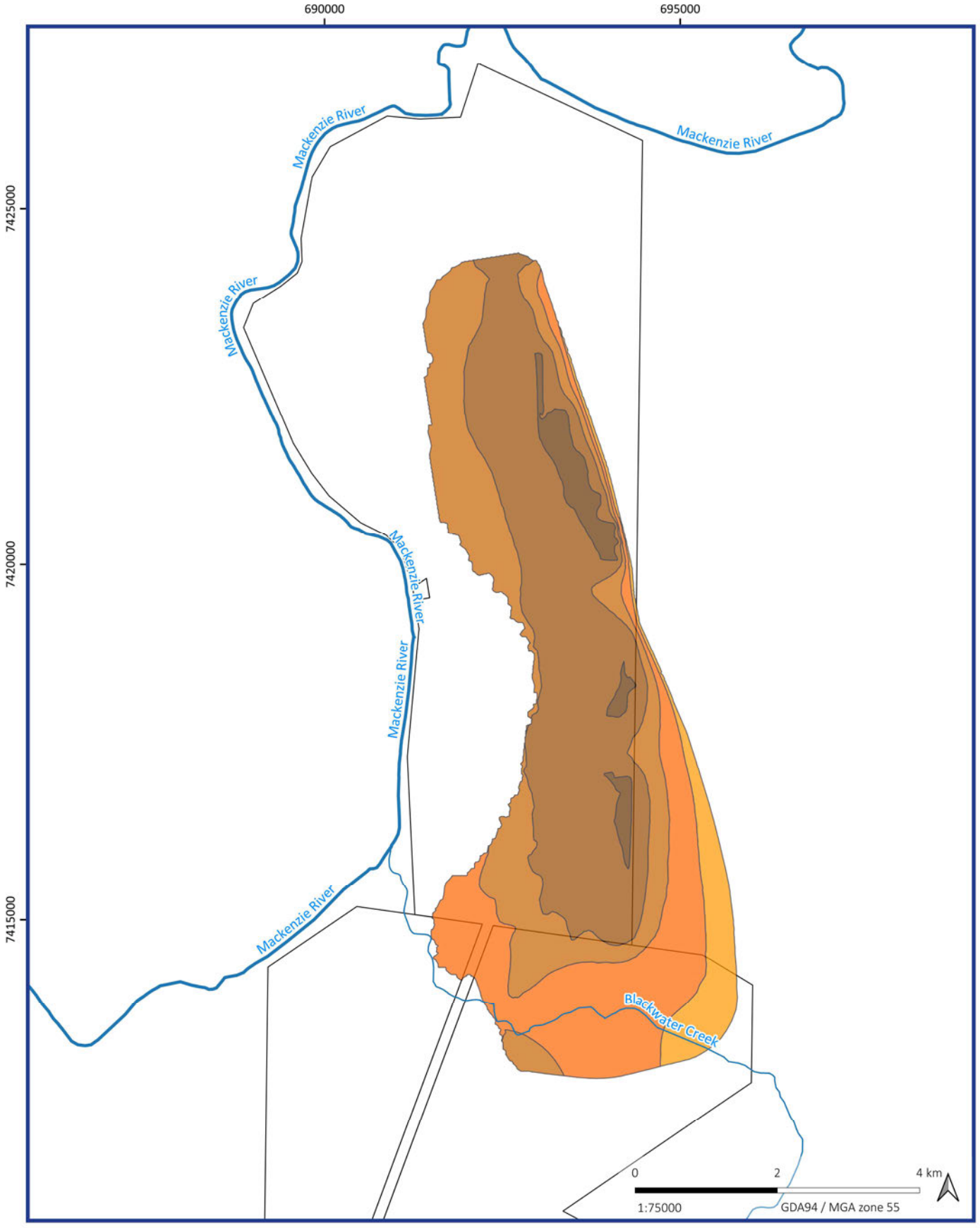
15/05/2024

Legend

- Curragh Mining Leases
- Contour (m)
- Blackwater Creek
- Mackenzie River

Reduction in pore pressure as hydraulic head (mH2O)

>1 - 2	>10 - 20	>100 - 200
>2 - 5	>20 - 50	>200 - 215
>5 - 10	>50 - 100	



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Maximum predicted cumulative depressurisation in the area effected by the project - Mammoth seam

4150A - Curragh North Bord and Pillar Project

Figure 46

15/05/2024

Legend

- Curragh Mining Leases
- Contour (m)
- Blackwater Creek
- Mackenzie River

Reduction in pore pressure as hydraulic head (mH2O)

- >10 - 20
- >20 - 50
- >50 - 100
- >100 - 200
- >200 - 300

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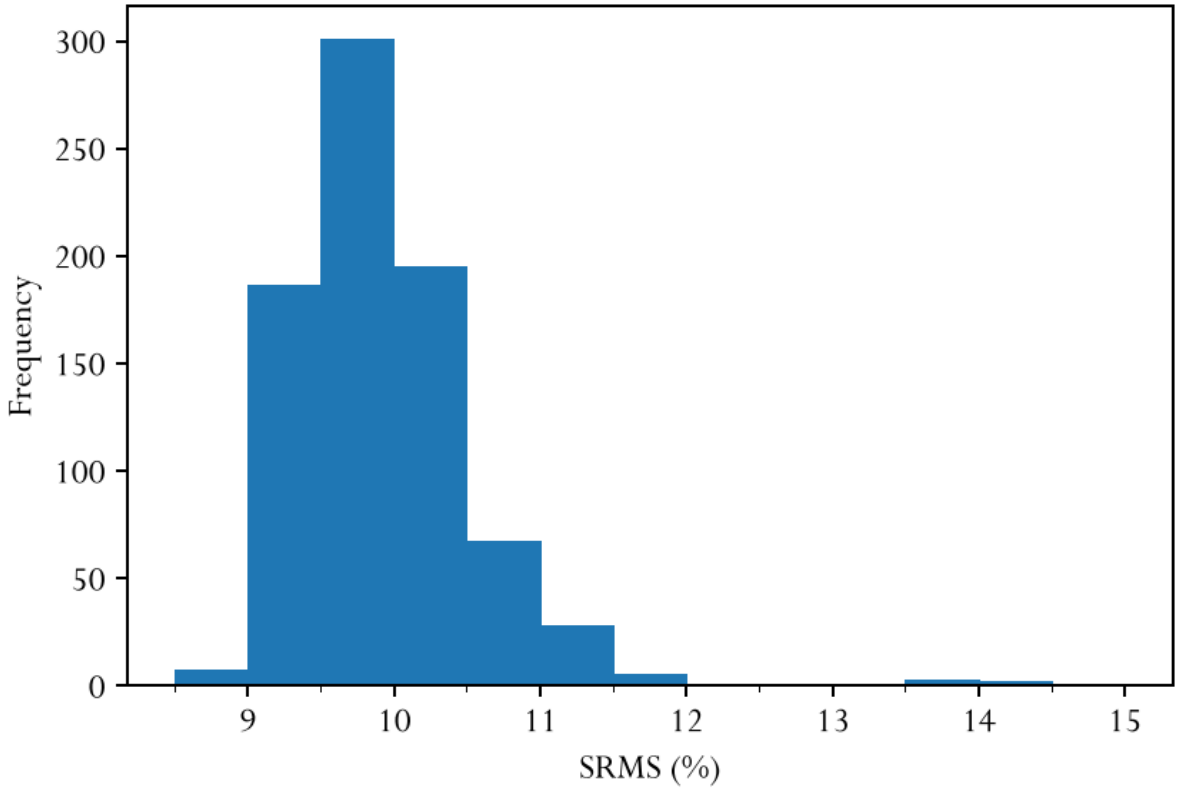


Figure C 47 Distribution of SRMS for model runs in iteration #2

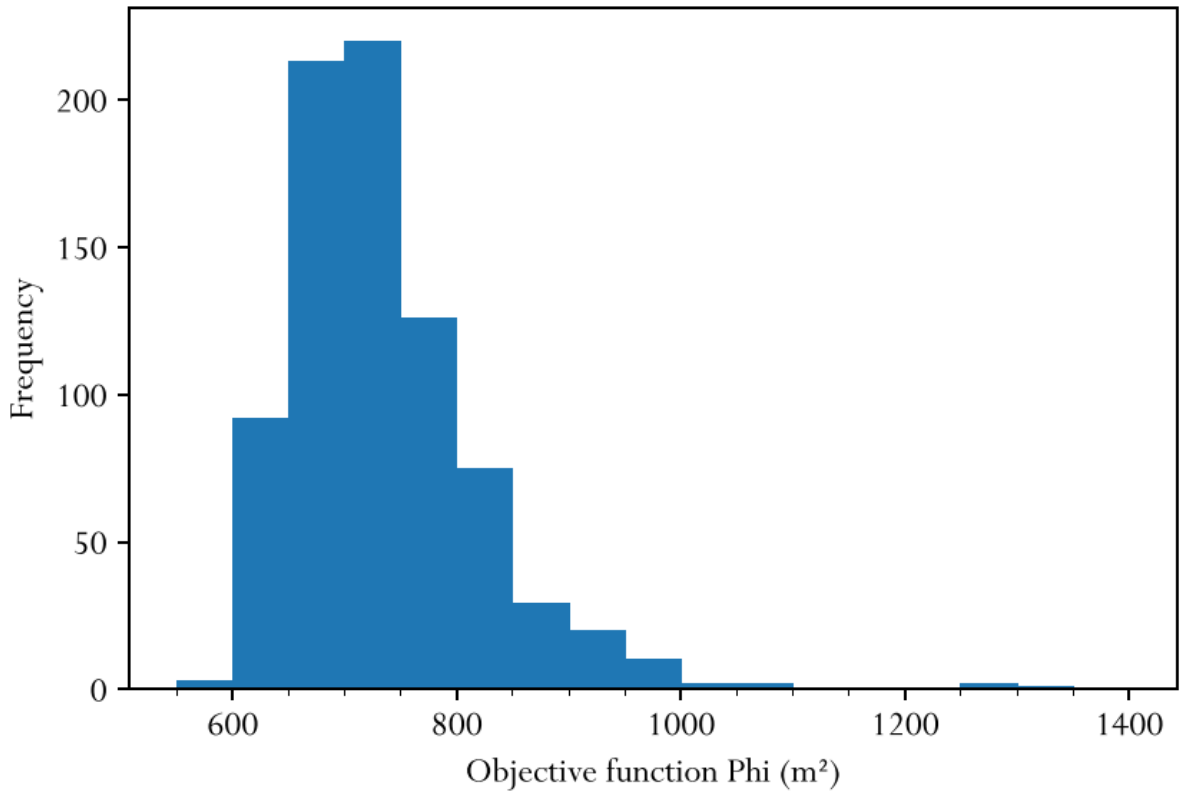


Figure C 48 Distribution of Phi for model runs in iteration #2

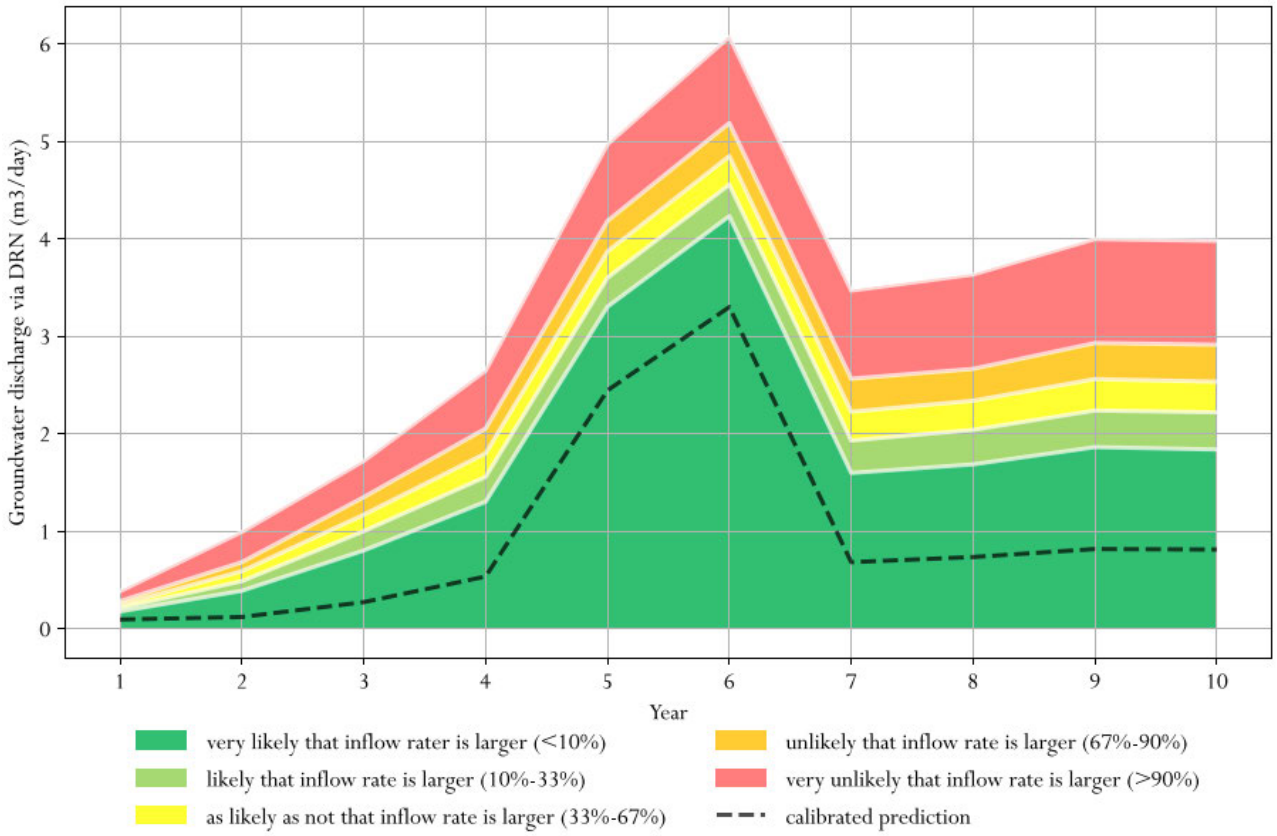
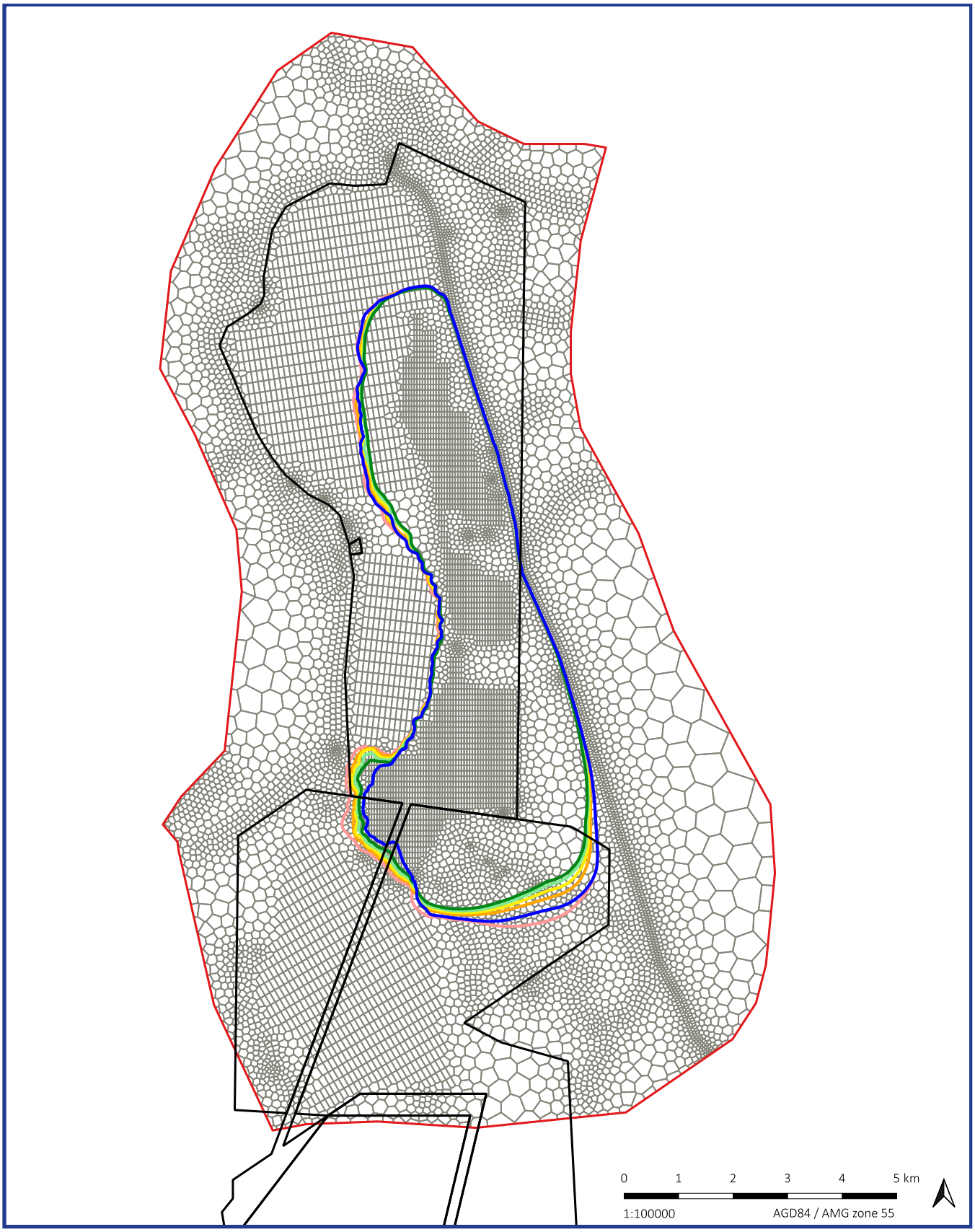


Figure C 49 Uncertainty of underground inflow rate exceedance



Legend

- Model extent
- Curragh Mining Lease Boundary
- 1 m max depressurisation - basecase
- Area of depressurisation less than 10th percentile of 496 realisations
- Area of depressurisation less than 33rd percentile of 496 realisations
- Area of depressurisation less than 67th percentile of 496 realisations
- Area of depressurisation less than 90th percentile of 496 realisations
- Area of depressurisation within all 496 realisations

Uncertainty of 1 m project depressurisation of the Mammoth seam

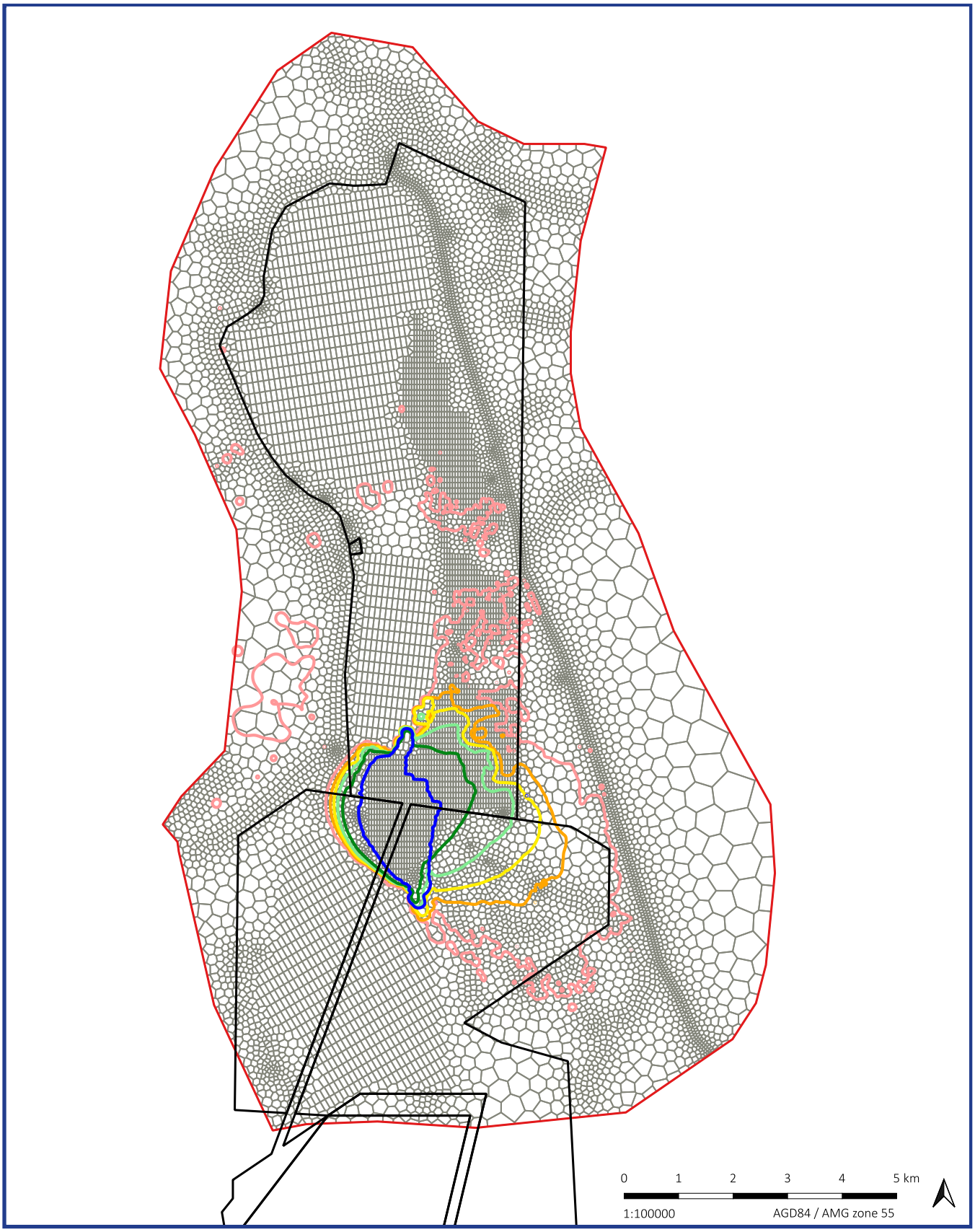
4150A- Curragh Bord and Pillar Mine Project

Figure C50

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Legend

- Model extent
- Curragh Mining Lease Boundary
- 1 m max drawdown - basecase
- Area of drawdown less than 10th percentile of 496 realisations
- Area of drawdown less than 33rd percentile of 496 realisations
- Area of drawdown less than 67th percentile of 496 realisations
- Area of drawdown less than 90th percentile of 496 realisations
- Area of drawdown within all 496 realisations

Uncertainty of 1 m project drawdown for the groundwater table

4150A- Curragh Bord and Pillar Mine Project

Figure C51

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Appendix C 1 Groundwater modelling checklist

Model Classification and Review

1. Model confidence level classification

The degree of confidence with which model predictions can be used are described using a 'confidence classification' scale which is presented as part of the Australian Groundwater Modelling Guidelines (Barnett *et al*. 2012). The classification scale conveys understanding about the model complexity, level of calibration and potential for the predictions to be incorrect. The model can fall into three classes:

- Class 1 – the simplest model, often not calibrated, used as starting points for more complex models, used for prediction of low-value aquifers, least amount of confidence in the modelling results.
- Class 2 – more complex models, prediction capability could vary depending on the location within the model domain, calibration and prediction runs can vary in terms of magnitude of model stresses and time discretisation, used for prediction in medium- or high-value aquifers.
- Class 3 – detailed and complex models, high trust in validity of modelling predictions, used to simulate detailed, small scale processes, used for predictions in high-value aquifers, the highest amount of confidence in the results of the modelling.

Barnett et al. (2012) state that every model should be evaluated using multiple criteria, that is:

- Available data, accuracy of the data, spatial and temporal distribution of the data. Is the dataset sufficiently representing the described system (in place and in time)? Is the dataset giving us sufficient insight into the system behaviour?
- Quality of calibration process undertaken during model development. What type of data was used to calibrate the model? To what level does the model replicate past behaviour given the properties of the model and model inputs (boundary conditions)? Is the higher level of calibration localized in specific area or is it evenly distributed throughout the whole model domain?
- Consistency between the calibration and predictive analysis. Are the calibration run and prediction run consistent with respect to length of the model run, temporal discretisation, model stresses?

A self-assessment of the 'confidence classification' scale has been carried out by **hydrogeologist.com.au**. The model has been classified as a Class 2 model under the Australian Groundwater Modelling Guidelines (Barnett *et al.*, 2012).

2. Review of the model

The Australian Groundwater Modelling Guidelines (Barnett *et al*. 2012) provides a series of checklists by which third party reviewers can assess the suitability of the model. Table 2.1 through to Table 2.7 summarise these checklists and provide commentary on whether the model has addressed these questions, and where in the report these questions are explained.

Table 2.1 Planning

Question	Section
Are the project objectives stated?	Section 1 of the Groundwater Report
Project description and hence objectives are outlined in the main Groundwater Report.	
Are the model objectives stated?	Section C1 of Appendix C
Model objectives are clearly stated.	
Is it clear how the model will contribute to meeting the project objectives?	Section 4.4 of the Groundwater Report
This is described in the main Groundwater Report.	
Is a groundwater model the best option to address the project and model objectives?	Section 4.4 of the Groundwater Report
Yes it is.	
Is the target model confidence-level classification stated and justified?	Section C1 of Appendix C1
A summary of the model classification is provided.	
Are the planned limitations and exclusions of the model stated?	Section C4.1 of Appendix C
The limitations and exclusions are not specifically stated however the qualitative contributions to uncertainty are provided and discussed.	

Table 2.2 Conceptualisation

Question	Section
Has a literature review been completed, including examination of prior investigations?	Section 4.1.3 of the Groundwater Report
Yes it has. This literature review, analysis of the data and the conceptualisation is described in detail in the Groundwater Report.	
Is the aquifer system adequately described?	Section 5 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- hydrostratigraphy including aquifer type (porous, fractured rock …)	Section 5.1.1 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- lateral extent, boundaries and significant internal features such as faults and regional folds	Section 5.1.3 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- aquifer geometry including layer elevations and thicknesses	Section 5 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- confined or unconfined flow and the variation of these conditions in space and time?	Sections 5.6 and 5.10 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
Have data on groundwater stresses been collected and analysed?	Section 5 of the Groundwater Report
Open pit mining at Curragh North is the main stressor. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	

Question	Section
- recharge from rainfall, irrigation, floods, lakes	Section 5.2 of the Groundwater Report, Sections C2.6.1 and C2.9 of Appendix C
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report. Further discussion of recharge is included in the model appendix.	
- river or lake stage heights	Section 5.7 of the Groundwater Report, Sections C2.6.3 and C2.11 of Appendix C
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report. Further discussion of recharge is included in the model appendix.	
- groundwater usage (pumping, returns etc)	N/A
No groundwater usage or pumping data is available.	
- evapotranspiration	Section 5.5 of the Groundwater Report, Sections C2.6.2 and C2.10 of Appendix C
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report. Further discussion of evapotranspiration is included in the model appendix.	
- other type of hydraulic stress	N/A
Not applicable	
Have groundwater level observations been collected and analysed?	Section 5.3 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- selection of representative bore hydrographs	Appendix E
Groundwater level hydrographs are provided as Appendix E.	
- comparison of hydrographs	Section 5.3 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- effect of stresses on hydrographs	Section 5.3 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- watertable maps/piezometric surfaces?	Figures 22 to 25 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- If relevant, are density and barometric effects taken into account in the interpretation of groundwater head and flow data?	N/A
Density and barometric effects are not considered relevant and have not been assessed.	
Have flow observations been collected and analysed?	N/A
Stream gauging is available, no pit inflow data is available.	
- baseflow in rivers	Section 5.7 of the Groundwater Report
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- discharge in springs	N/A
Not applicable. No springs in the model domain.	
- location of diffuse discharge areas?	Section 5.4 of the Groundwater Report
Discharge occurs predominantly via open pit mining.	
Is the measurement error or data uncertainty reported?	N/A
No it is not.	
- measurement error for directly measured quantities (e.g. piezometric level, concentration, flows)	N/A
No it is not.	

Question	Section
- spatial variability/heterogeneity of parameters	Section 5.1.2 of the Groundwater Report, Sections C2.5 and C2.8 of Appendix C
Permian strata has been applied depth dependence. The analysis of data and the conceptualisation is described in detail in the Groundwater Report.	
- interpolation algorithm(s) and uncertainty of gridded data	N/A
No it is not.	
Have consistent data units and geometric datum been used?	Not specifically referenced in the report
Yes it has.	
Is there a clear description of the conceptual model?	Section 5 of the Groundwater Report
Yes there is. The conceptualisation is described in detail in the Groundwater Report.	
- Is there a graphical representation of the conceptual model?	Figures 20 and 21 of the Groundwater Report
Yes there is. The conceptualisation is described in detail in the Groundwater Report.	
- Is the conceptual model based on all available, relevant data?	Sections 4 and 5 of the Groundwater Report
Yes it is. The available data and conceptualisation is described in detail in the Groundwater Report.	
Is the conceptual model consistent with the model objectives and target model confidence level classification?	Section 5 of the Groundwater Report, Section C1 and Appendix C1 of Appendix C
A self assessment of this suggests yes it is.	
Are the relevant flow/transport processes clearly identified within the conceptual model?	Section 5 of the Groundwater Report
Transport processes are not relevant. The flow processes and conceptualisation is described in detail in the Groundwater Report.	
Is justification provided for omission or simplification of processes?	N/A
No flow processes have been omitted. Flow processes have been simplified so far as is reasonably practical for the numerical model.	
Have alternative conceptual models been investigated?	Section 5 of the Groundwater Report
Alternative conceptual models have been assessed however the available data supports the current conceptualisation.	

Table 2.3 Design and construction

Question	Section
Is the design consistent with the conceptual model?	Section C2 of Appendix C
Yes it is.	
Is the choice of numerical method and software appropriate?	Section C2.1 of Appendix C
3D flow model is appropriate for objectives. MODFLOW USG is widely recognised	
- Are the numerical and discretisation methods appropriate?	Section C2.3 of Appendix C
Yes they are.	
- Is the software reputable?	Section C2.1 of Appendix C
MODFLOW USG is widely recognised	
- Is the software included in the archive or are references to the software provided?	N/A
Not applicable	
Are the spatial domain and discretisation appropriate?	Section C2 of Appendix C

Question	Section
Yes they are. Domain is of sufficient size, cell sizes are appropriate, layering is appropriate. All consistent with the conceptual model.	
- Is the model 1D/2D/3D?	Section C2 of Appendix C
3D	
- Is the lateral extent justified?	Section C2.2 of Appendix C
Justification is provided.	
- Is the layer geometry described and justified?	Section C2.4 of Appendix C
Layer geometry is justified and provided.	
- Is the horizontal discretisation appropriate for the objectives, problem setting, conceptual model and target confidence level classification?	Section C2.3 of Appendix C
Mesh geometry is justified and consistent with conceptualisation.	
- Is the vertical discretisation appropriate? Are aquitards divided in multiple layers to model time lags of propagation of responses in the vertical direction?	Section C2.4 of Appendix C
Layering is justified and consistent with conceptualisation.	
Are the temporal domain and discretisation appropriate?	Section C2.3 of Appendix C
Model timing is provided and consistent with historical activities.	
- steady state or transient model?	Section C2.3 of Appendix C
Pre-development SS model into transient calibration and predictive model used.	
- timestepping (stress periods, timesteps)	Section C2.3 of Appendix C
General calibration timeframes are provided.	
Are the boundary conditions plausible and sufficiently unrestrictive?	Section C2.6 of Appendix C
Boundary conditions are described and justified.	
- Is the implementation of boundary conditions consistent with the conceptual model?	Section C2.6 of Appendix C, Section 5 of the Groundwater Report
Boundary conditions are described, justified and consistent with the conceptual model.	
- Are the boundary conditions chosen to have a minimal impact on key model outcomes? How is this ascertained?	Section C2.2 of Appendix C
Model domain is large enough to eliminate significant interaction with model boundaries.	
- Is the calculation of diffuse recharge consistent with model objectives and confidence level?	Section 5.2 of the Groundwater Report, Sections C2.6.1 and C2.9 of Appendix C
Yes it has. The analysis of data and the conceptualisation is described in detail in the Groundwater Report. Further discussion of recharge is included in the model appendix.	
- Are lateral boundaries time-invariant?	Sections C2.6.5 and C2.12 of Appendix C
Yes.	
Are the initial conditions appropriate?	Section C2.6.4 of Appendix C
Initial conditions are based on topography. This is appropriate.	
- Are the initial heads based on interpolation or on groundwater modelling?	Section C2.6.4 of Appendix C
Based on steady state solution.	
- Is the effect of initial conditions on key model outcomes assessed?	N/A
Not assessed	

Question	Section
- How is the initial concentration of solutes obtained (when relevant)?	N/A
Not applicable.	
Is the numerical solution of the model adequate?	N/A
Not reported.	
- Solution method/solver	N/A
Not reported.	
- Convergence criteria	N/A
Not reported.	
- Numerical precision	N/A
Not reported.	

Table 2.4 Calibration and sensitivity

Question	Section
Are all available types of observations used for calibration?	Section C2.7 of Appendix C
Quantitative calibration focusses on groundwater levels, quantitative calibration considers nil baseflow in Blackwater Creek.	
- Groundwater head data.	Appendix C2
Yes	
- Flux observations.	Section C2.7 of Appendix C
Modelled flux compared against observed baseflow in Blackwater Creek	
- Other: environmental tracers, gradients, age, temperature, concentrations etc.	N/A
Not applicable	
Does the calibration methodology conform to best practice?	Section C2.7 of Appendix C
Yes.	
- Parameterisation	Section 5.1.2 of the Groundwater Report, Section C2.8 of Appendix C
Depth dependence is applied where appropriate.	
- Objective function	Section C2.7 of Appendix C
Yes.	
- Identifiability of parameters	N/A
Not provided	
Methodology used for model calibration?	Section C2.7 of Appendix C
Yes.	
Is a sensitivity of key model outcomes assessed?	Section C4 of Appendix C
Uncertainty analysis has been completed rather than sensitivity analysis.	
- against parameters	Section C4 of Appendix C
Uncertainty analysis has been completed rather than sensitivity analysis.	
- against boundary conditions	Section C4 of Appendix C

Question	Section
Uncertainty analysis has been completed rather than sensitivity analysis.	
- against initial conditions	Section C4 of Appendix C
Uncertainty analysis has been completed rather than sensitivity analysis.	
- against stresses	Section C4 of Appendix C
Uncertainty analysis has been completed rather than sensitivity analysis.	
Have the calibration results been adequately reported?	Section C2.7 of Appendix C
Yes	
- Are the graphs showing modelled and observed hydrographs at an appropriate scale?	Appendix C2
Yes	
- Is it clear whether observed or assumed vertical head gradients have been replicated by the model?	Appendix C2
Yes	
- Are calibration statistics reported and illustrated in a reasonable manner?	Section C2.7.3 of Appendix C
Yes	
Are multiple methods of plotting calibration results used to highlight goodness of fit robustly? Is the model sufficiently calibrated?	Section C2.7.3 of Appendix C
Multiple methods are not presented. Model is sufficiently calibrated.	
- spatially	N/A
Information is not presented spatially.	
- temporally	Appendix C2
Yes. Hydrographs are provided.	
Are the calibrated parameters plausible?	Section C2.8 of Appendix C, Section 5.1.2 of Groundwater Report
Calibrated parameters are consistent with observed data.	
Are the water volumes and fluxes in the water balance realistic?	Section C2.13 of Appendix C
Calibrated budgets are consistent with site observations.	
Has the model been verified?	N/A
Model verification has not been completed.	

Table 2.5 Prediction

Question	Section
Are the model predictions designed in a manner that meets the modelling objectives?	Section C3 of Appendix C
Yes.	
Is predictive uncertainty acknowledged and addressed?	Section C4 of Appendix C
Yes.	
Are the assumed climatic stresses appropriate?	Section C3.1 of Appendix C
Long term climatic averages are used in the predictive scenarios.	
Is a null scenario defined?	Section C3.1 of Appendix C
Yes. This is the 'Approved mining operations' scenario.	

Question	Section
Are the scenarios defined in accordance with the model objectives and confidence level classification?	Sections C3.1 and C3.2 of Appendix C
Yes.	
Are the pumping stresses similar in magnitude to those of the calibrated model? If not, is there reference to the associated reduction in model confidence?	Sections C3.1 and C3.2 of Appendix C
Yes they are. Approved mining operations are of similar magnitude with historical mining.	
Are well losses accounted for when estimating maximum pumping rates per well?	N/A
Not applicable	
Is the temporal scale of the predictions commensurate with the calibrated model? If not, is there reference to the associated reduction in model confidence?	Sections C3.1 and C3.2 of Appendix C
Yes it is.	
Are the assumed stresses and timescale appropriate for the stated objectives?	Sections C3.1 and C3.2 of Appendix C
Yes they are.	
Do the prediction results meet the stated objectives?	Sections C3.1 and C3.2 of Appendix C
Yes they do.	
Are the components of the predicted mass balance realistic?	Sections C3.1.1 and C3.2.1 of Appendix C
Yes they are.	
- Are the pumping rates assigned in the input files equal to the modelled pumping rates?	N/A
Not applicable	
- Does predicted seepage to or from a river exceed measured or expected river flow?	Sections C3.1.1 and C3.2.1 of Appendix C
No it does not.	
- Are there any anomalous boundary fluxes due to superposition of head dependent sinks (e.g. evapotranspiration) on head-dependent boundary cells (Type 1 or 3 boundary conditions)?	Sections C3.1.1 and C3.2.1 of Appendix C
No there are not.	
- Is diffuse recharge from rainfall smaller than rainfall?	Sections C3.1.1 and C3.2.1 of Appendix C
Yes.	
- Are model storage changes dominated by anomalous head increases in isolated cells that receive recharge?	Sections C3.1.1 and C3.2.1 of Appendix C
No.	
- Has particle tracking been considered as an alternative to solute transport modelling?	N/A
Not applicable.	

Table 2.6 Uncertainty

Question	Section
Is some qualitative or quantitative measure of uncertainty associated with the prediction reported together with the prediction?	Section C4 of Appendix C
Yes.	
Is the model with minimum prediction-error variance chosen for each prediction?	Section C4 of Appendix C

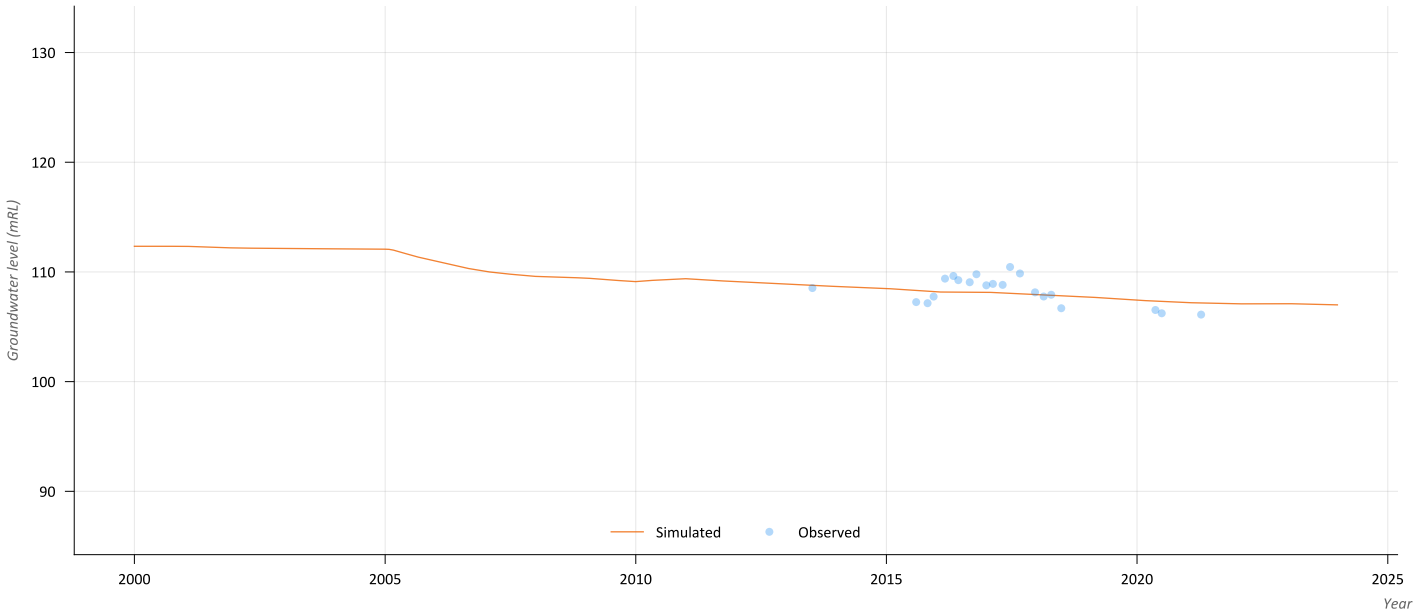
Question	Section
Not reported.	
Are the sources of uncertainty discussed?	Section C4 of Appendix C
Yes.	
- Measurement of uncertainty of observations and parameters	Section C4.1 of Appendix C
Yes.	
- Structural or model uncertainty?	Section C4 of Appendix C
No.	
Is the approach to estimation of uncertainty described and appropriate?	Section C4.2.1 of Appendix C
Uncertainty approach is described and considered appropriate.	
Are there useful depictions of uncertainty?	Section C4.2.4 of Appendix C
Inflows and drawdown uncertainty are presented and commensurate with the level of risk.	

Table 2.7 Compliance checklist

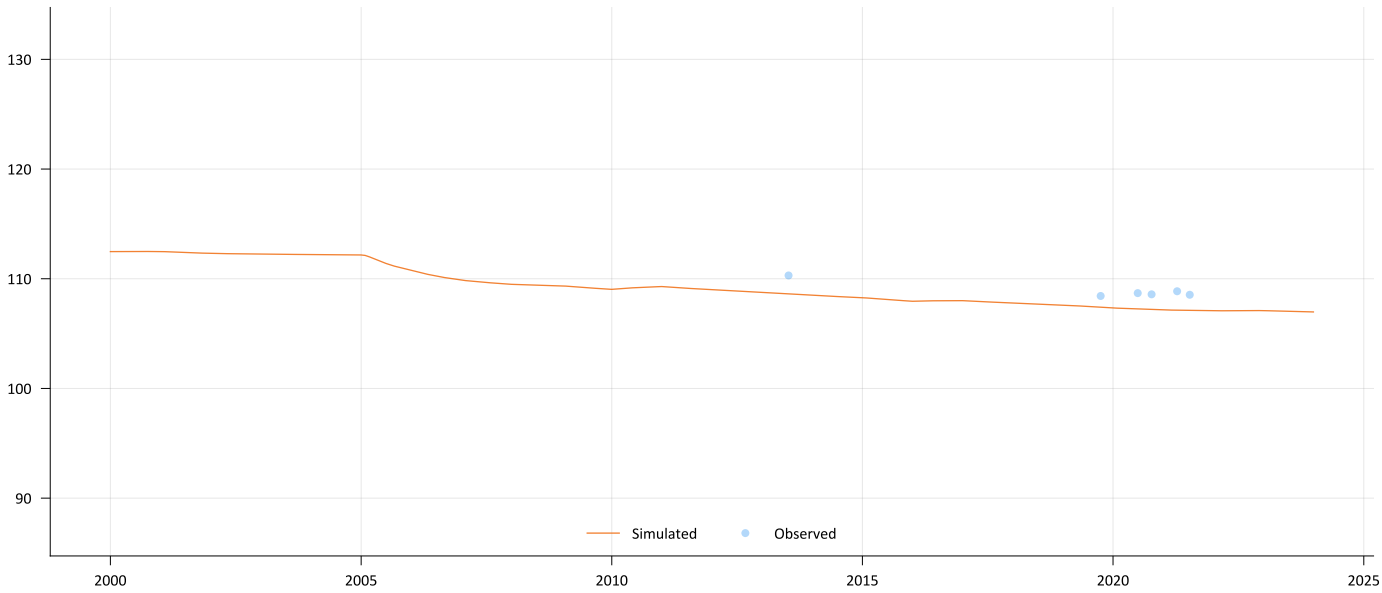
Question	Section
Are the model objectives and model confidence level classification clearly stated?	Section C1 of Appendix C, Appendix C1
Yes.	
Are the objectives satisfied?	Section C1 of Appendix C, Appendix C1
Yes.	
Is the conceptual model consistent with objectives and confidence level classification?	Section C1 of Appendix C, Appendix C1
Yes.	
Is the conceptual model based on all available data, presented clearly and reviewed by an appropriate reviewer?	Sections 4 and 5 of Groundwater Report
Third party review has not been carried out.	
Does the model design conform to best practice?	Section C2 of Appendix C
Yes.	
Is the model calibration satisfactory?	Section C2.7 of Appendix C
Yes.	
Are the calibrated parameter values and estimated fluxes plausible?	Sections C2.8 and C2.13 of Appendix C
Yes.	
Do the model predictions conform to best practice?	Sections C3.1 and C3.2 of Appendix C
Yes.	
Is the uncertainty associated with the predictions reported?	Section C4 of Appendix C
Yes.	
Is the model fit for purpose?	Section C1 of Appendix C, Appendix C1
Yes.	

Appendix C 2 Calibration hydrographs

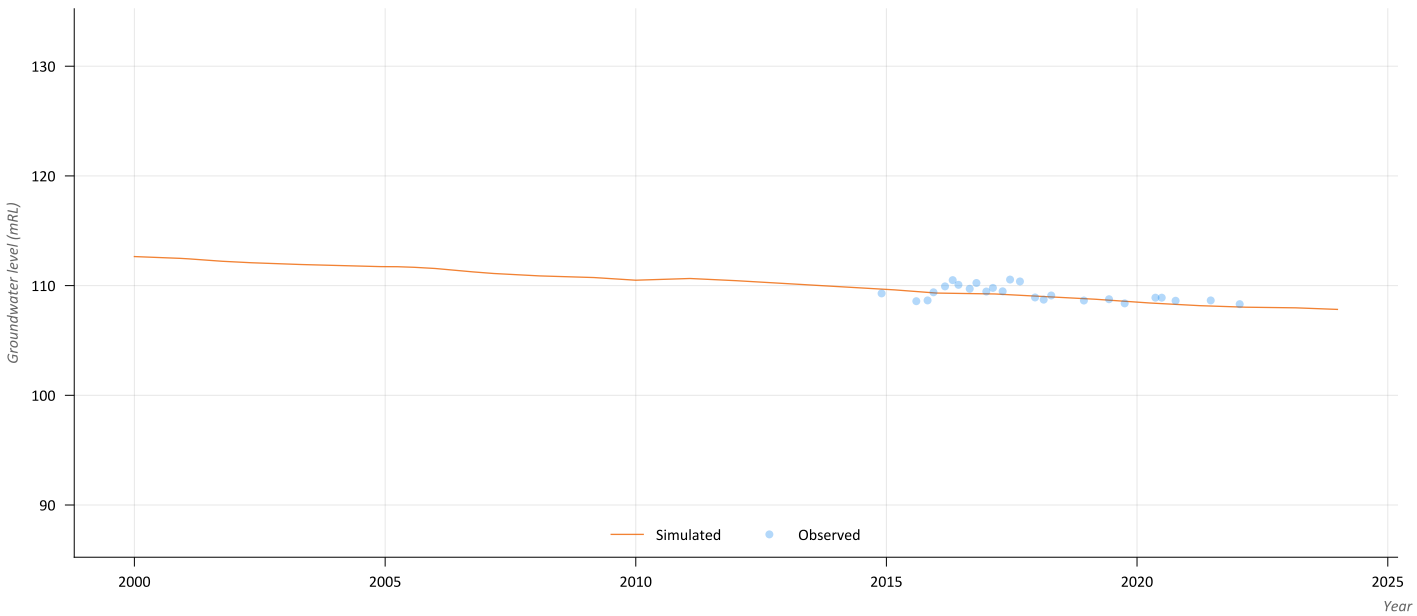
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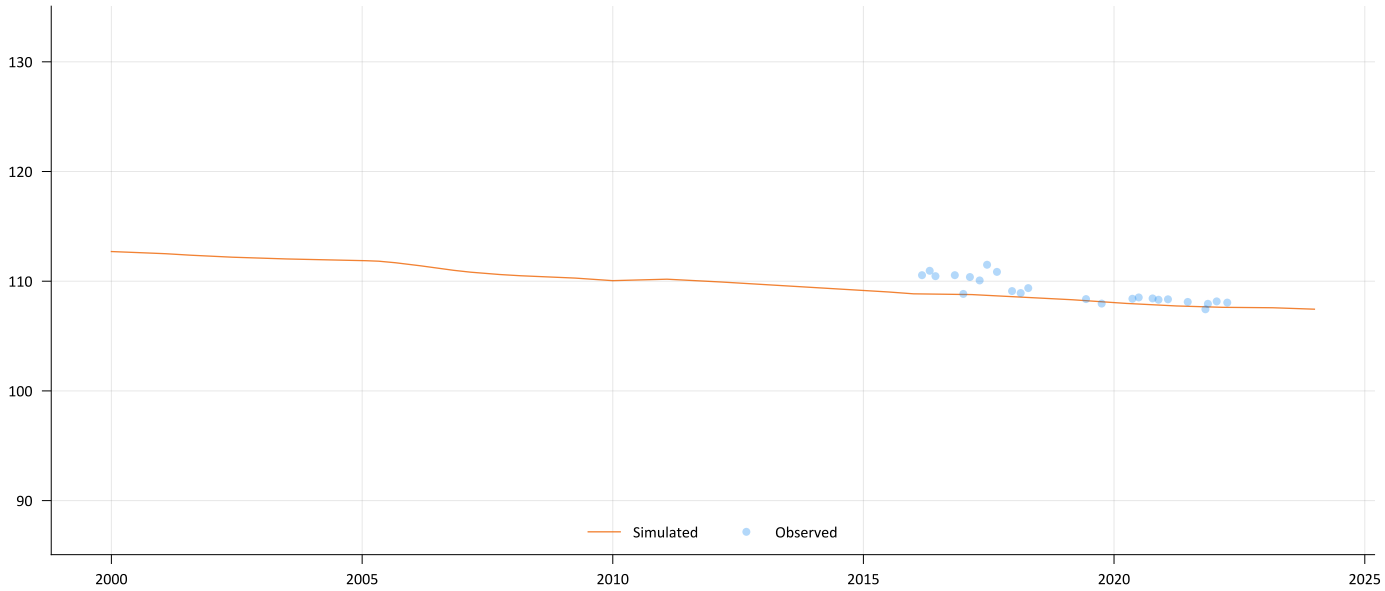
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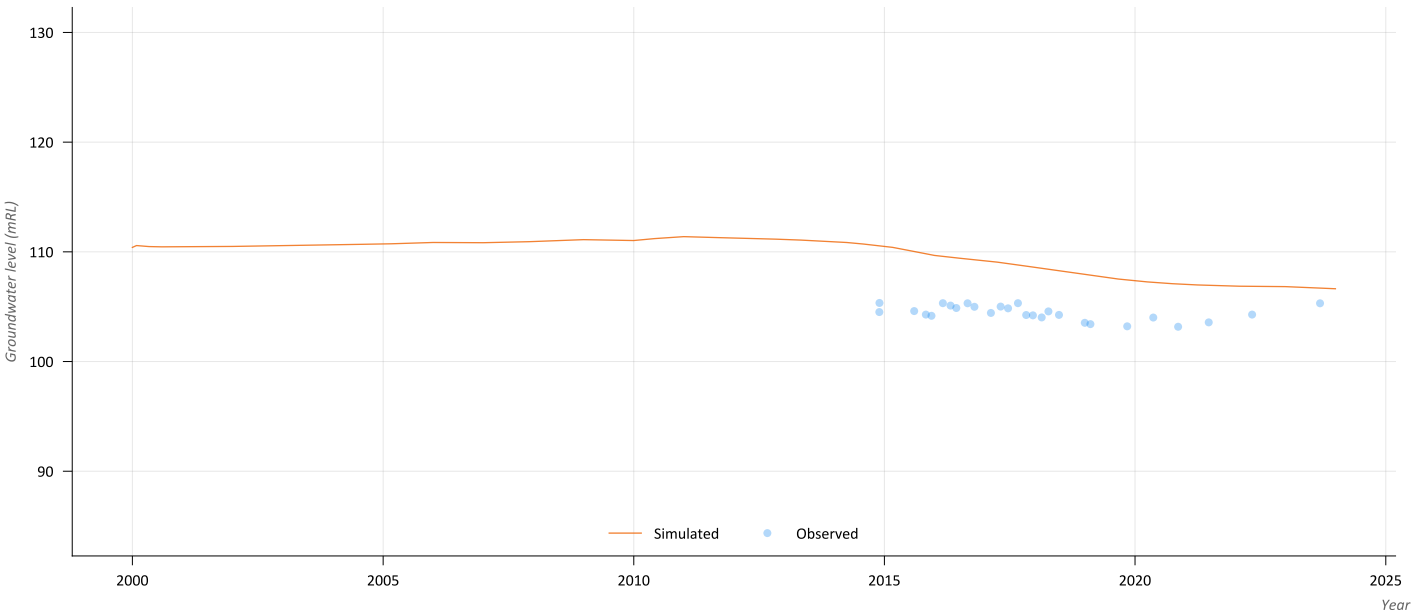
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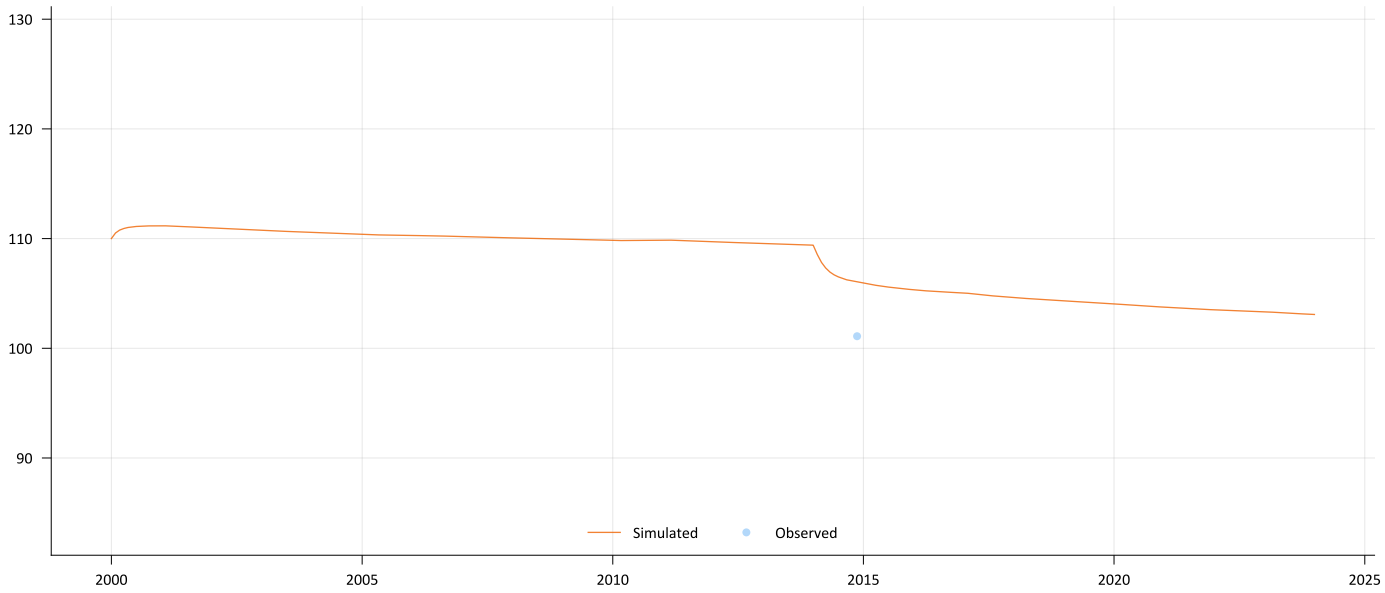
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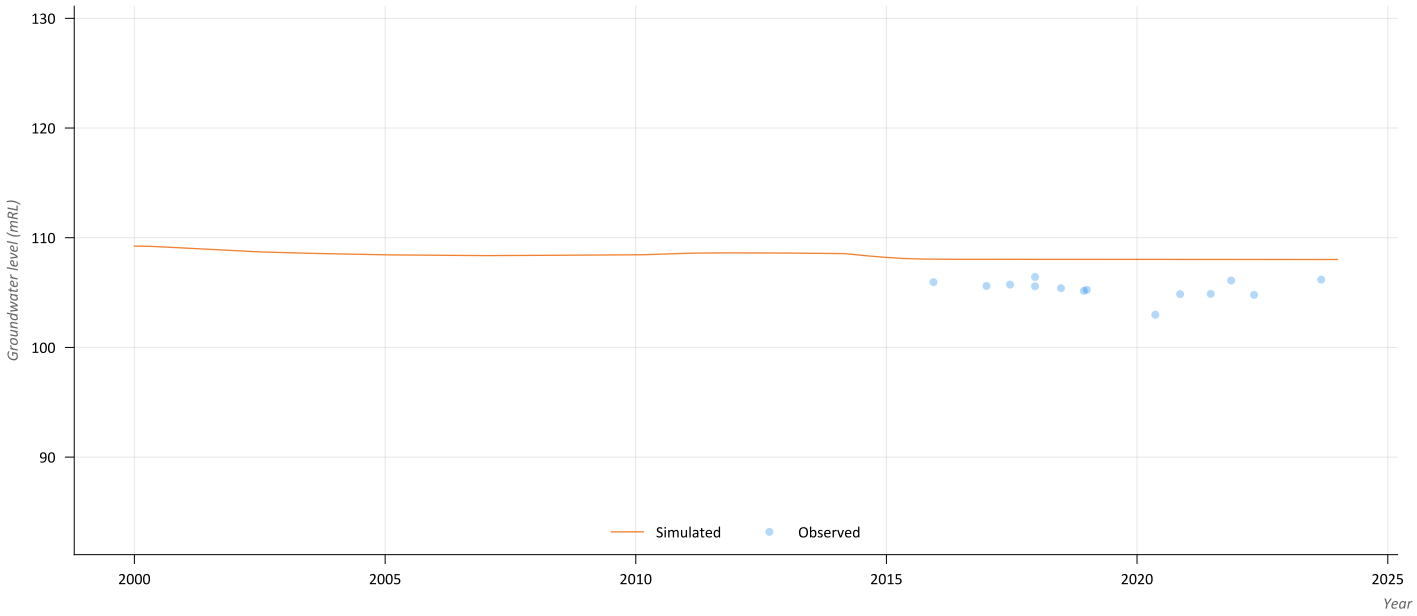
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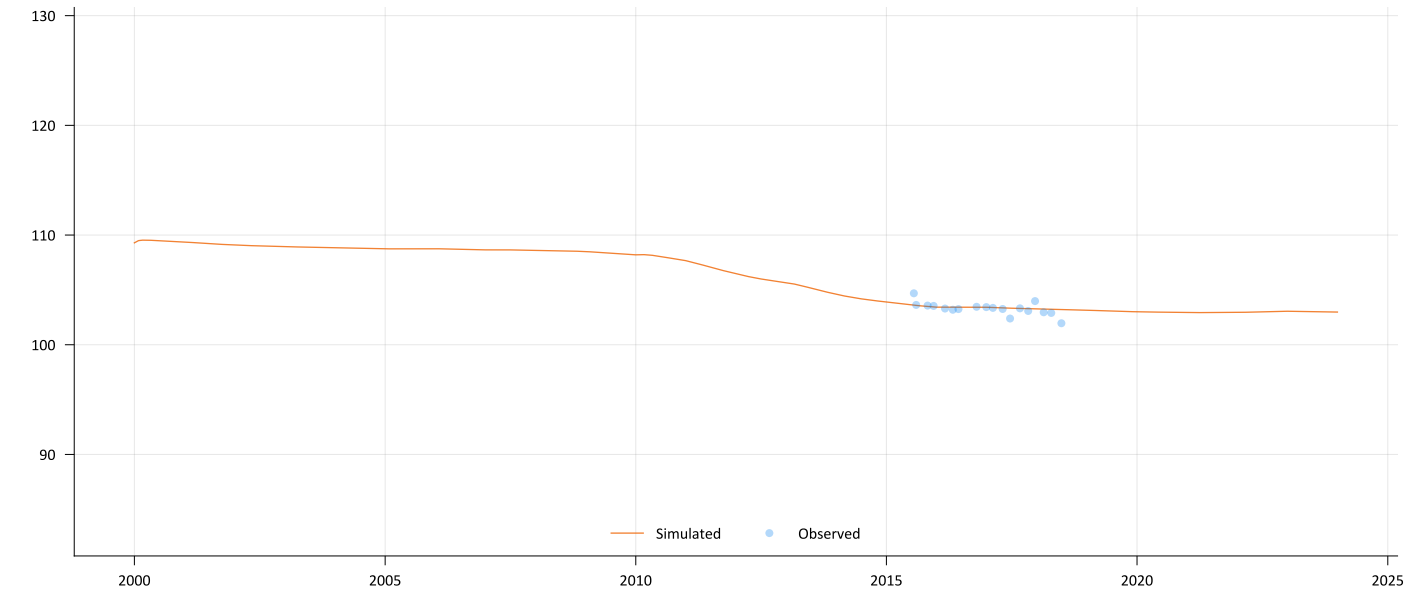
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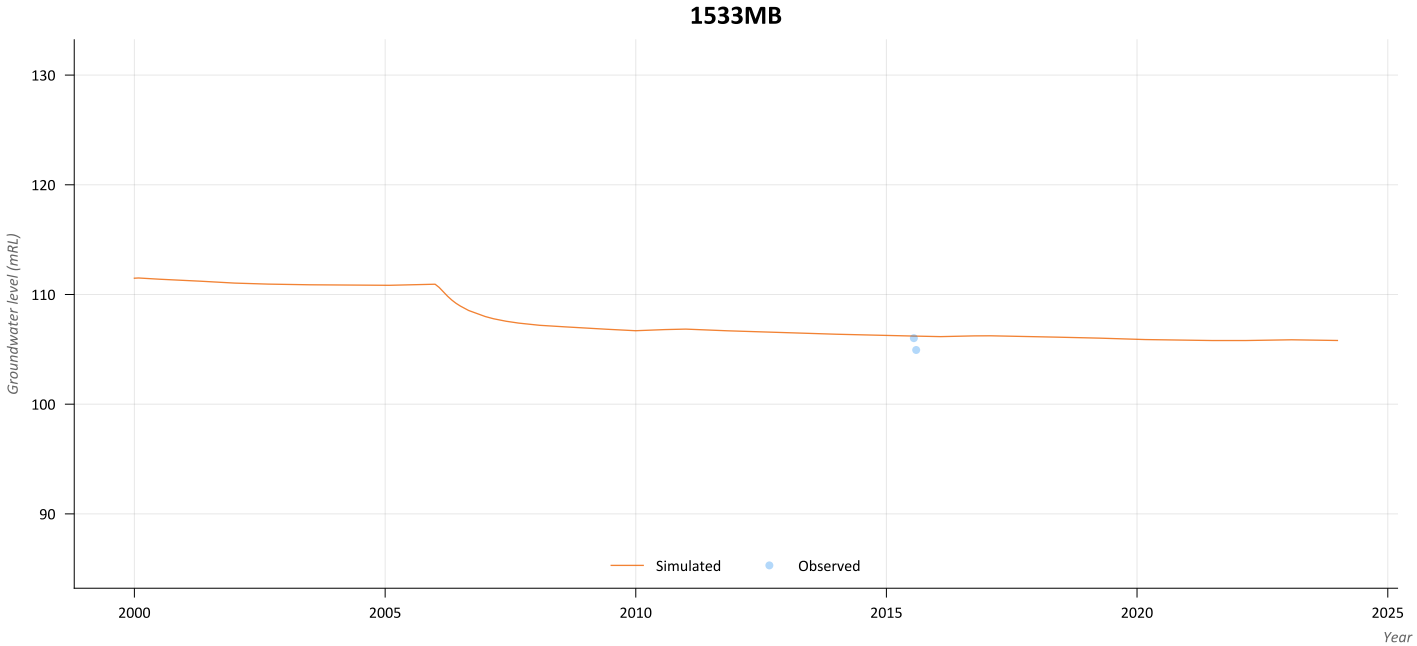
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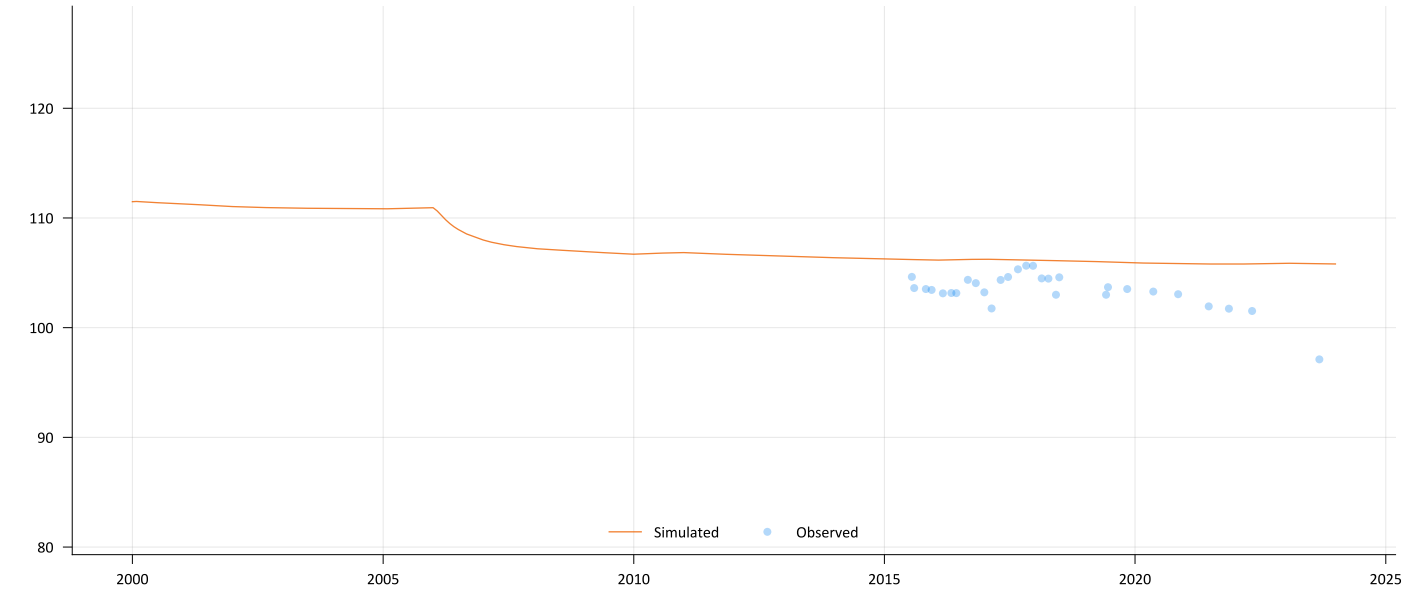
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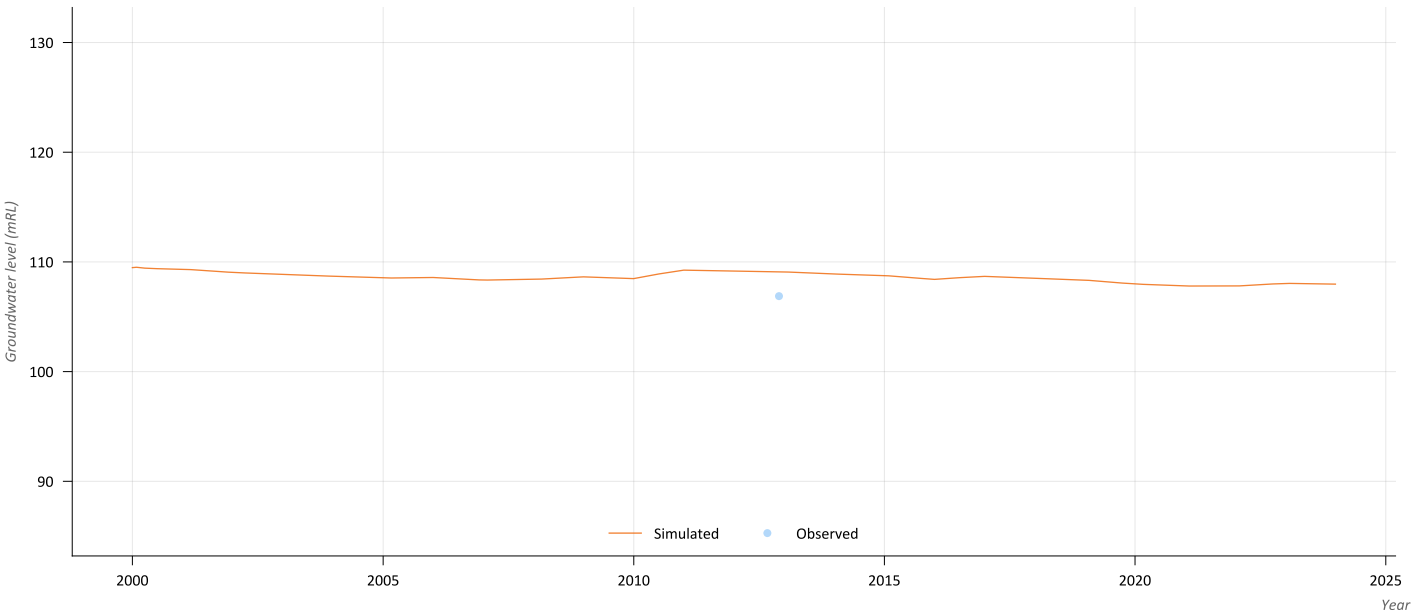
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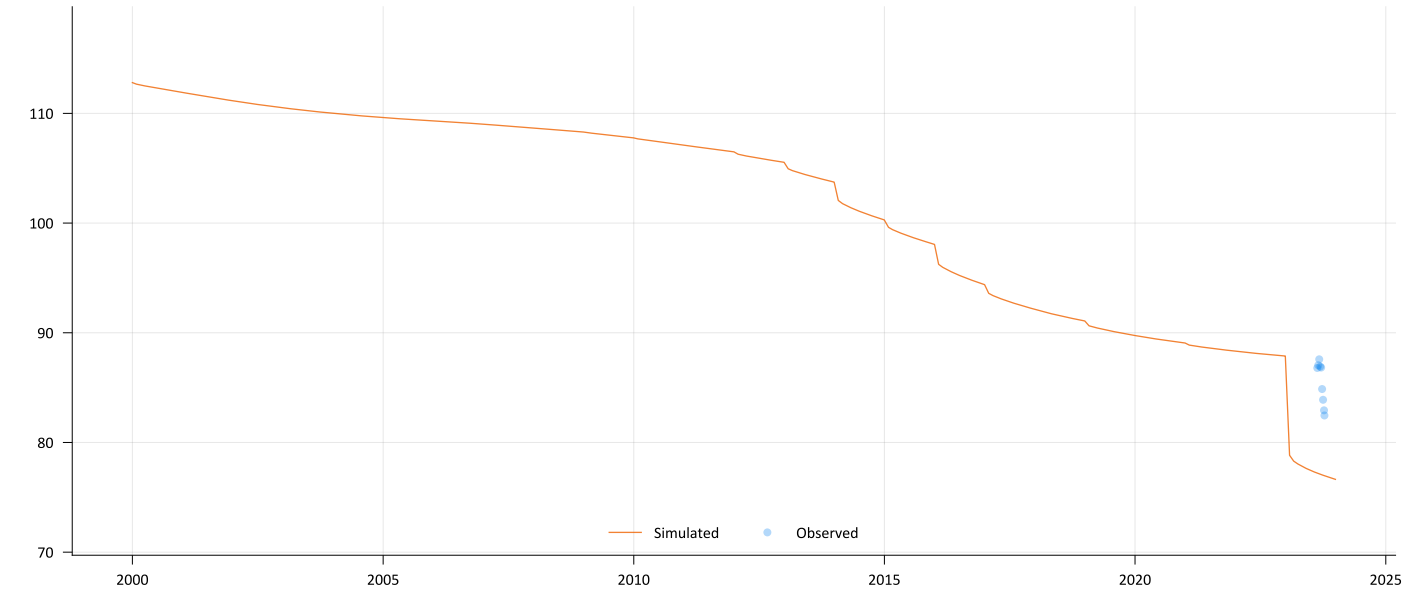
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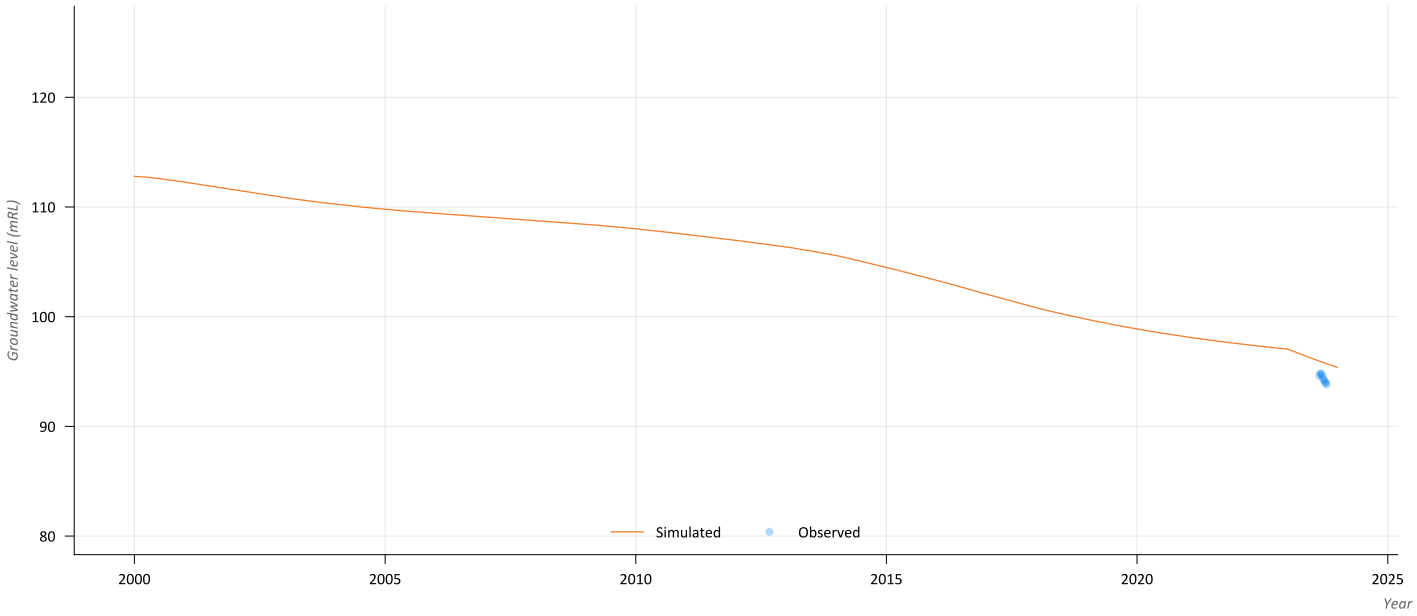
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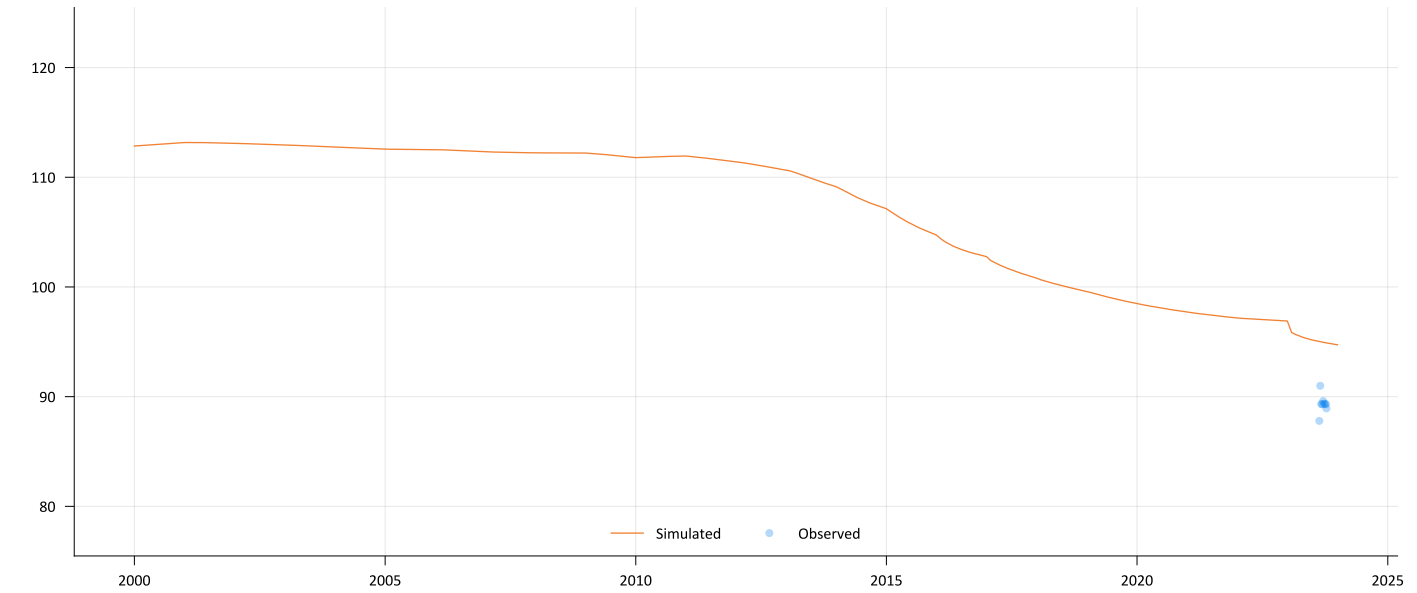
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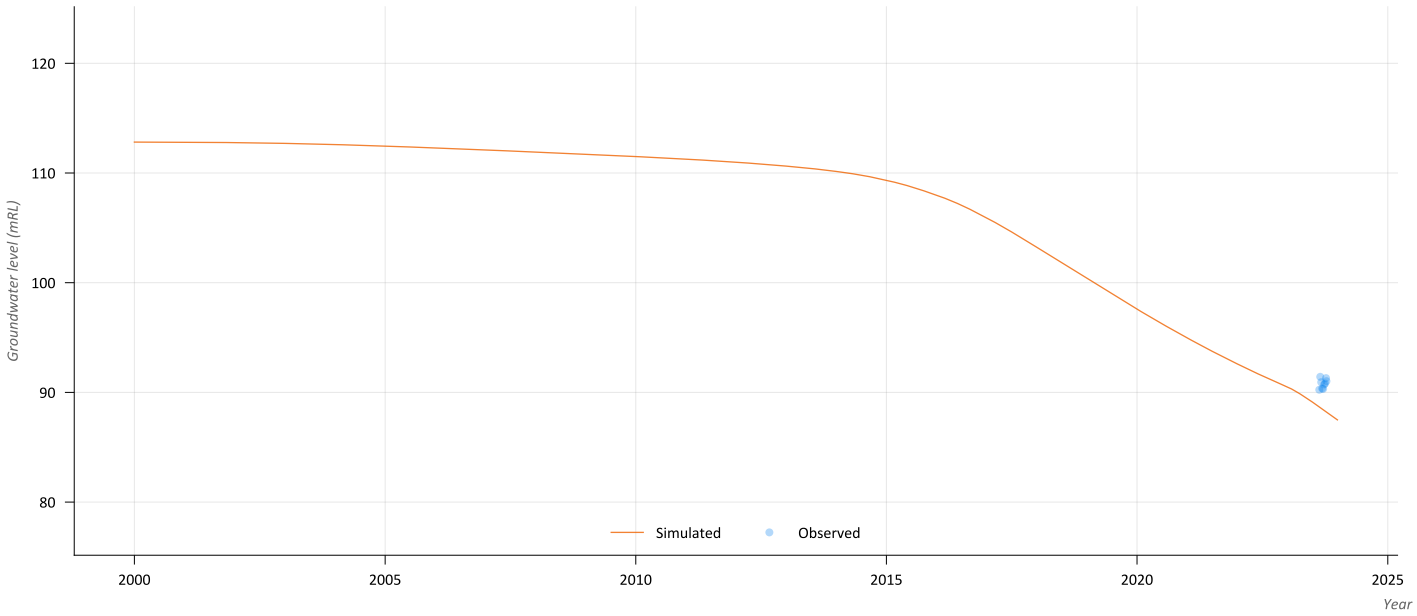
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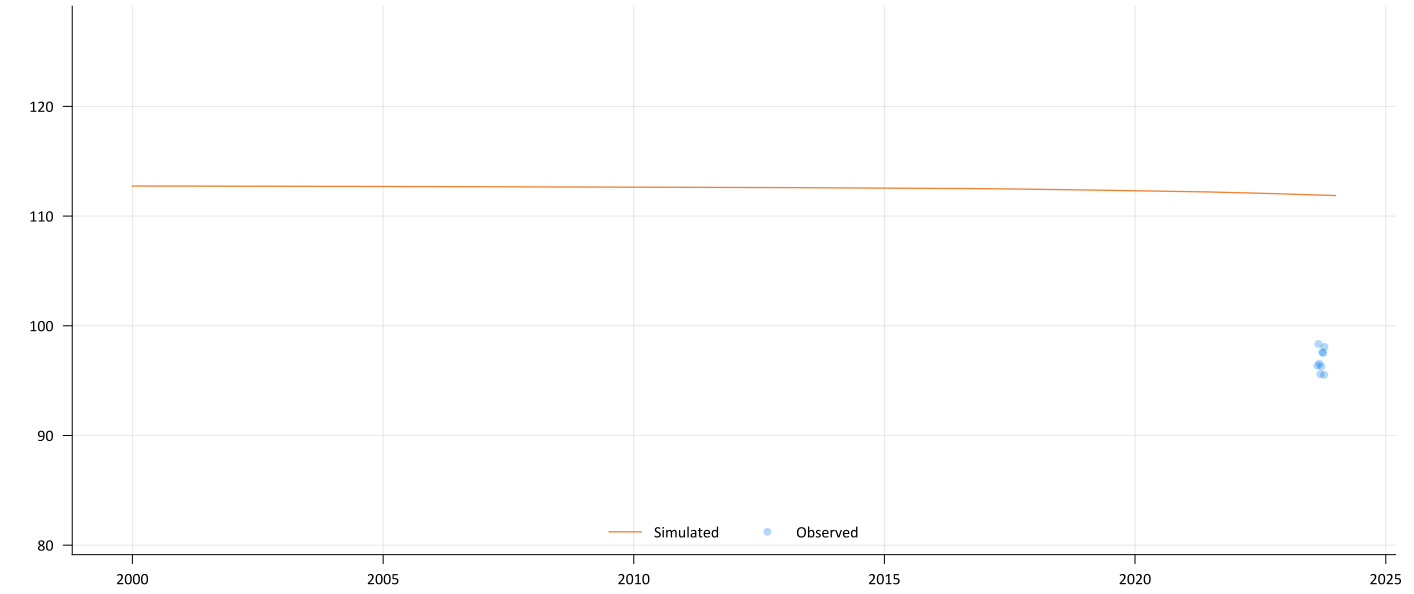
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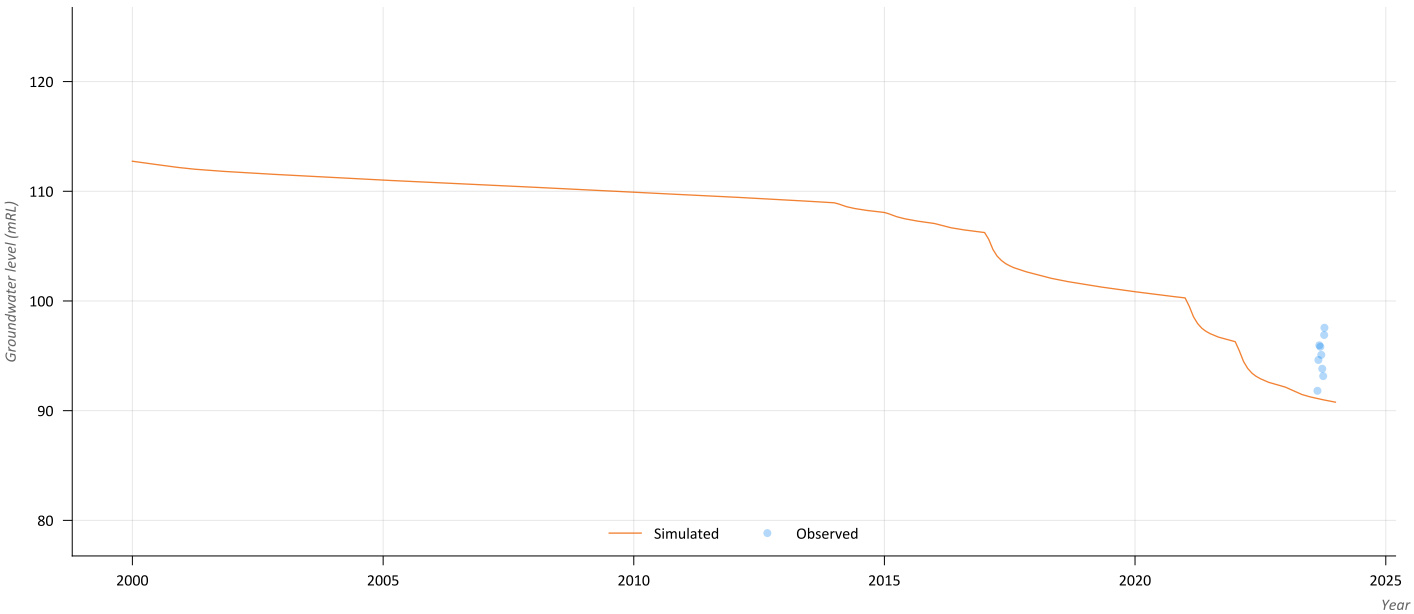
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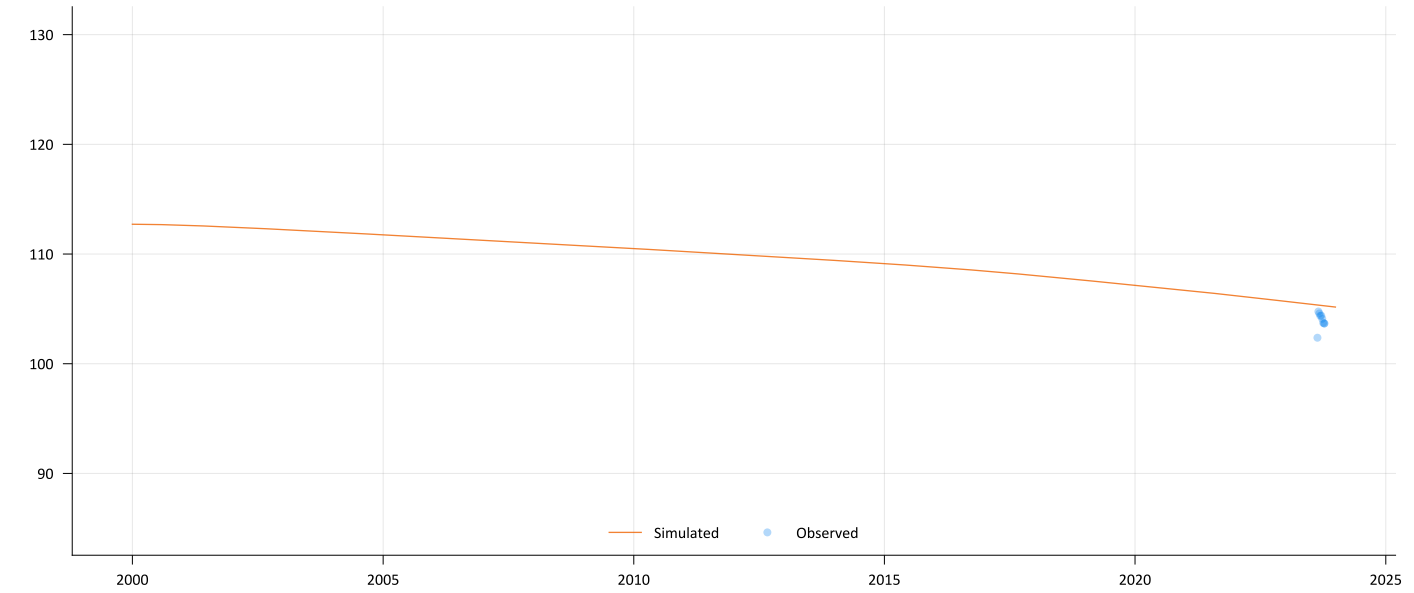
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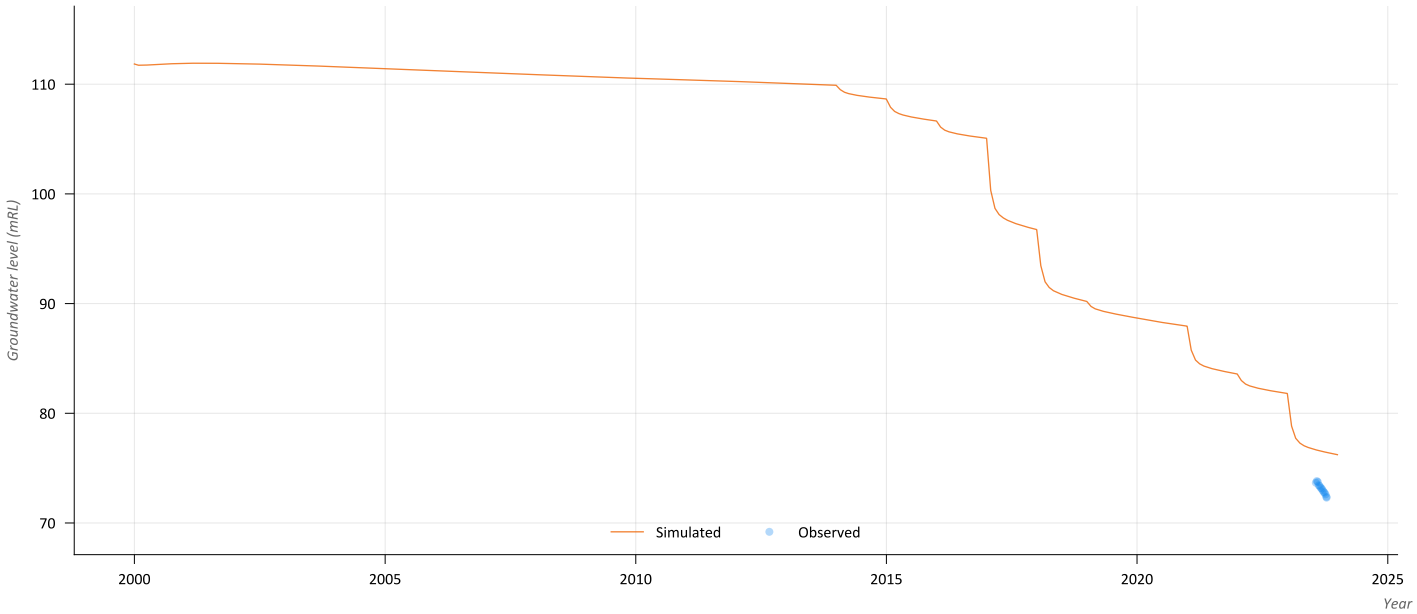
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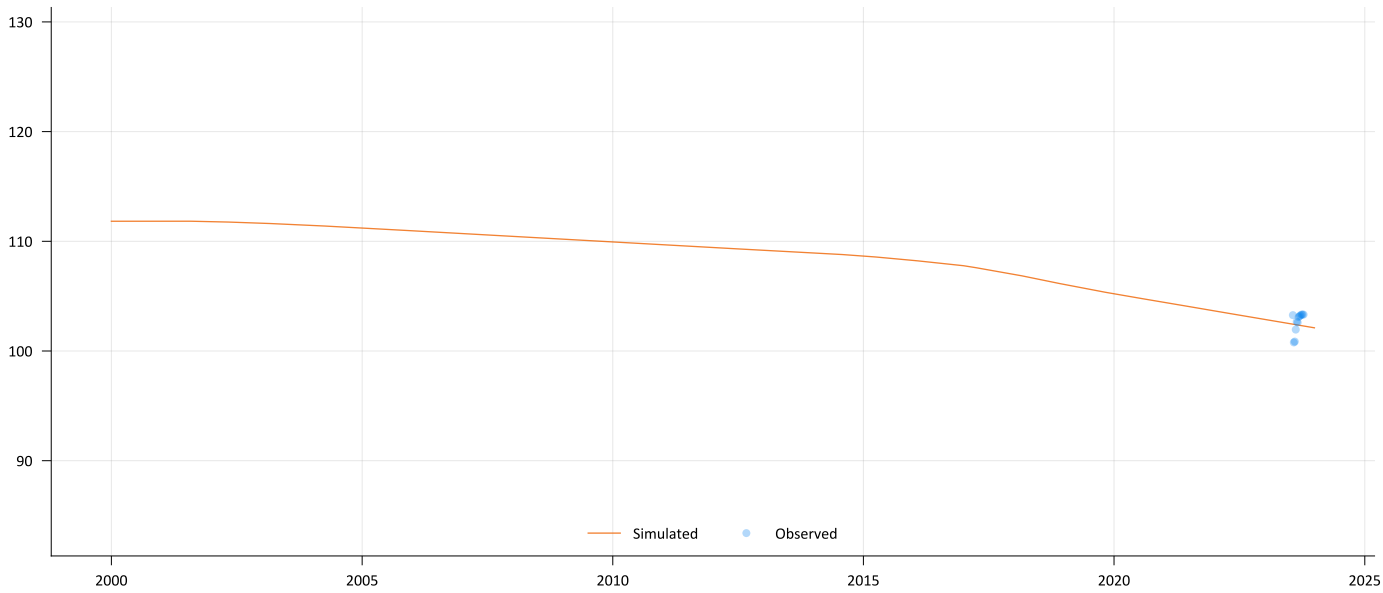
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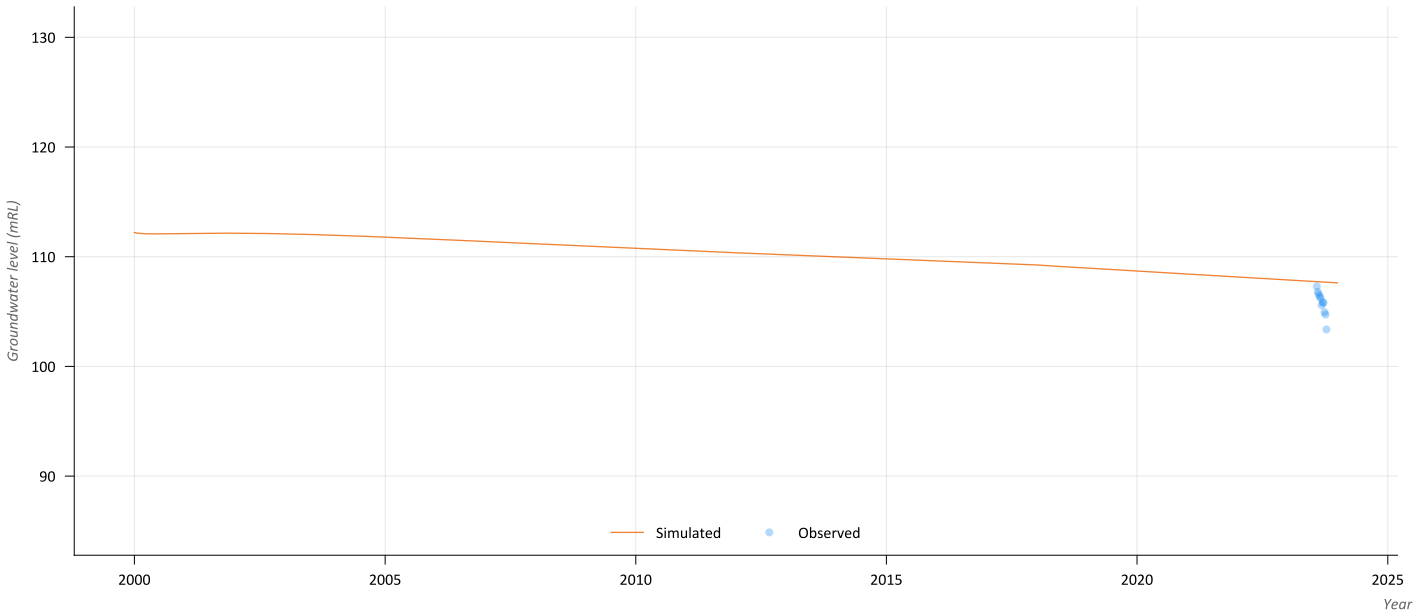
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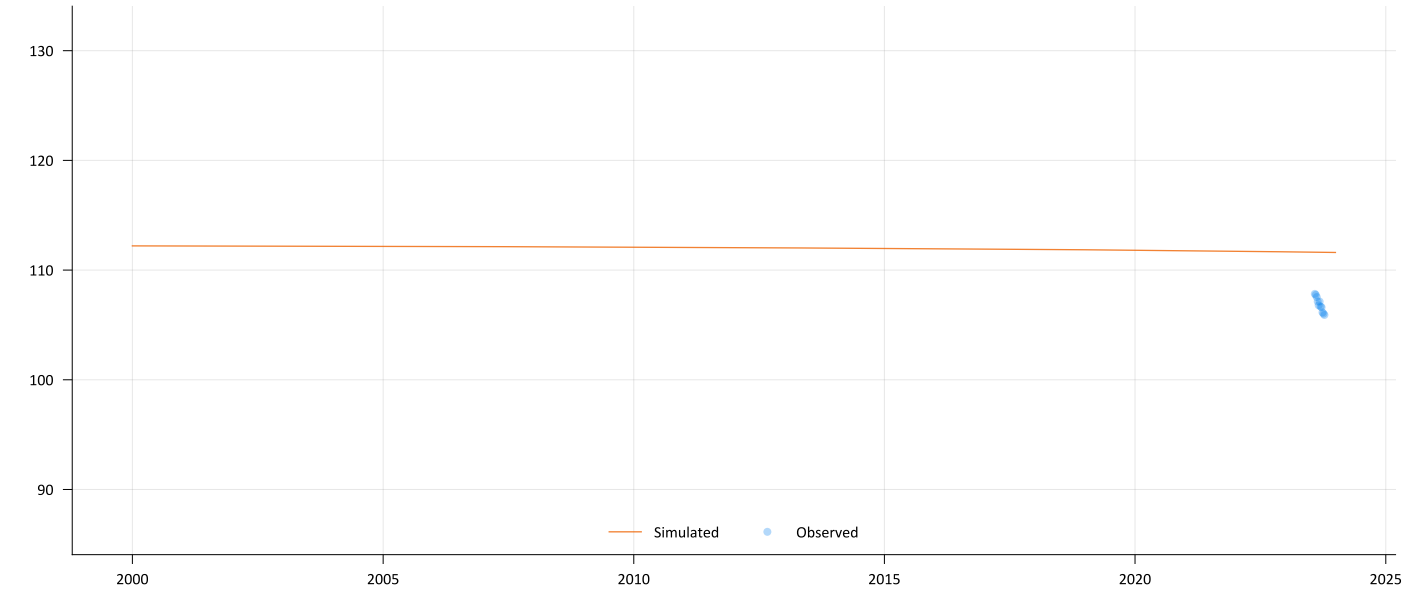
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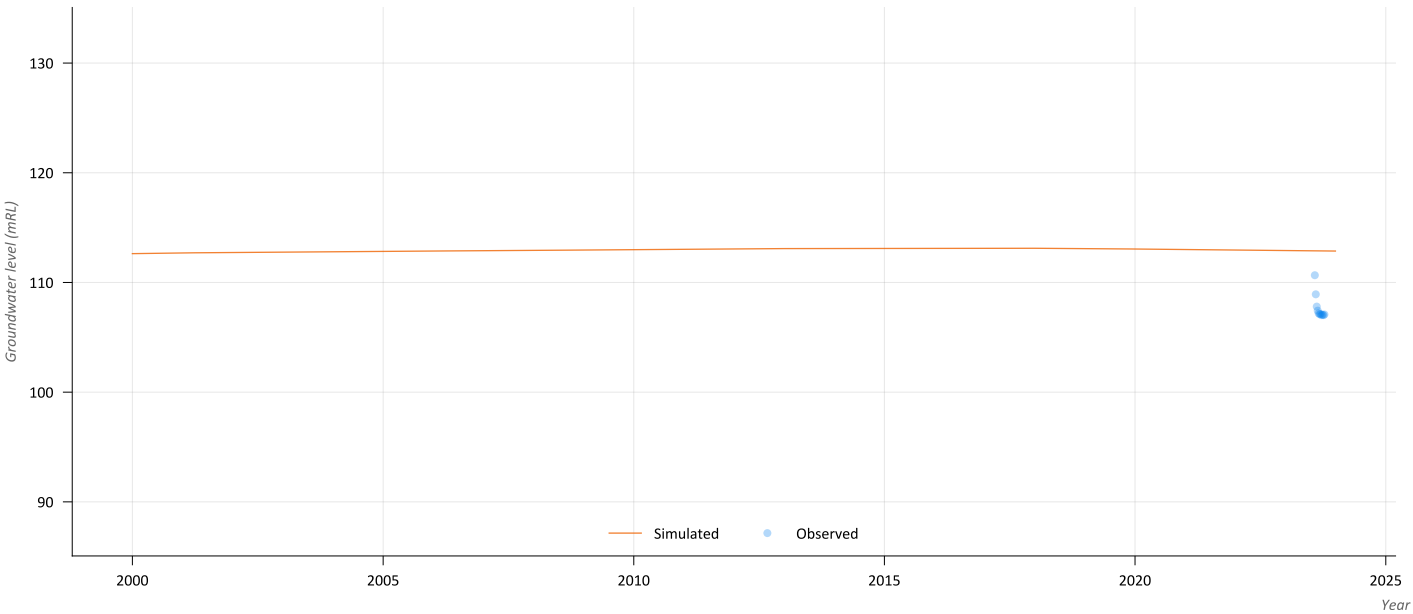
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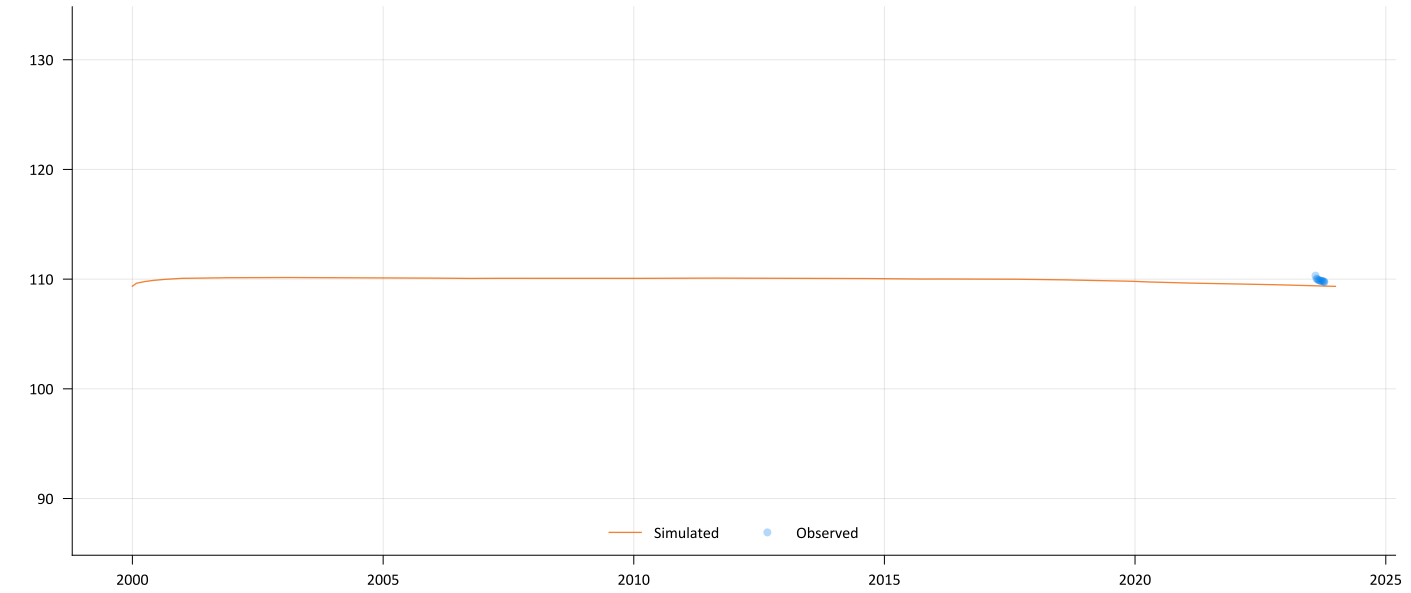
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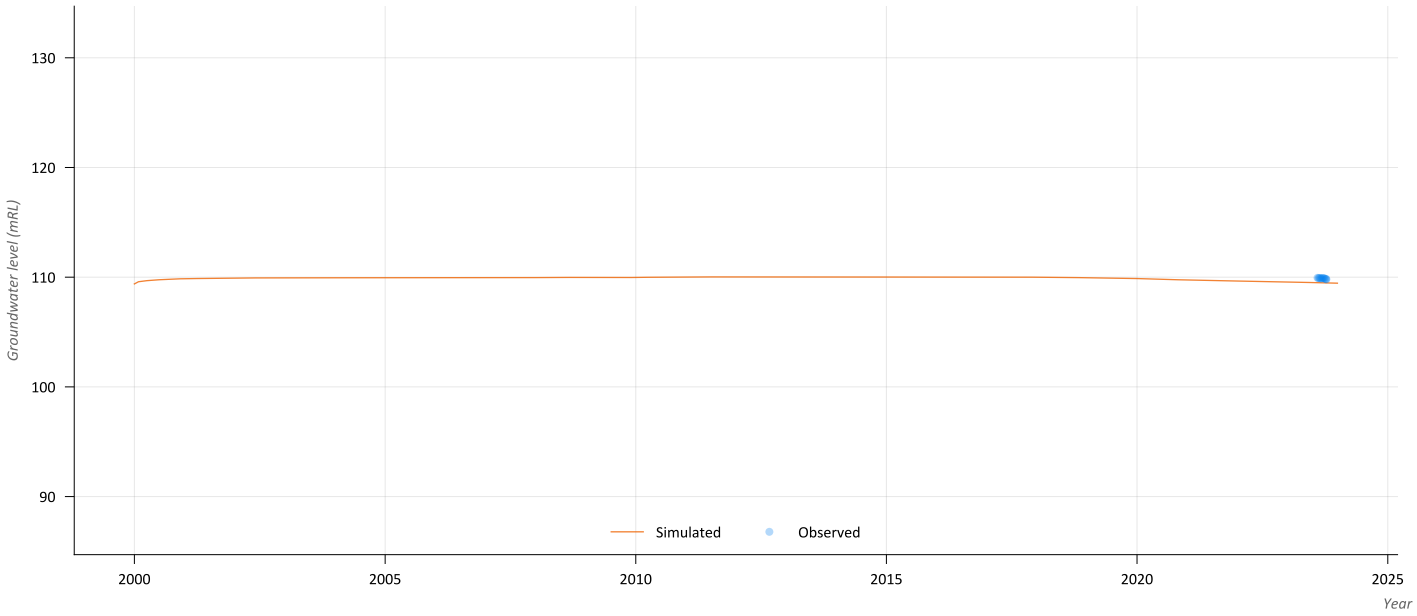
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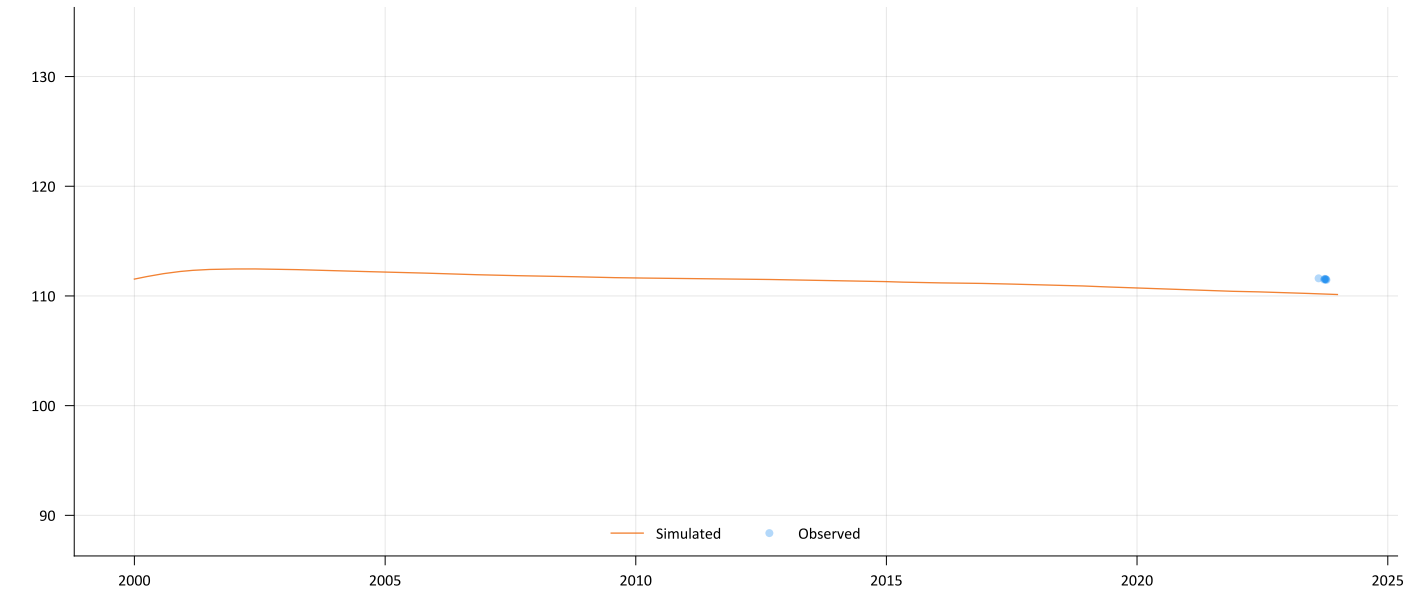
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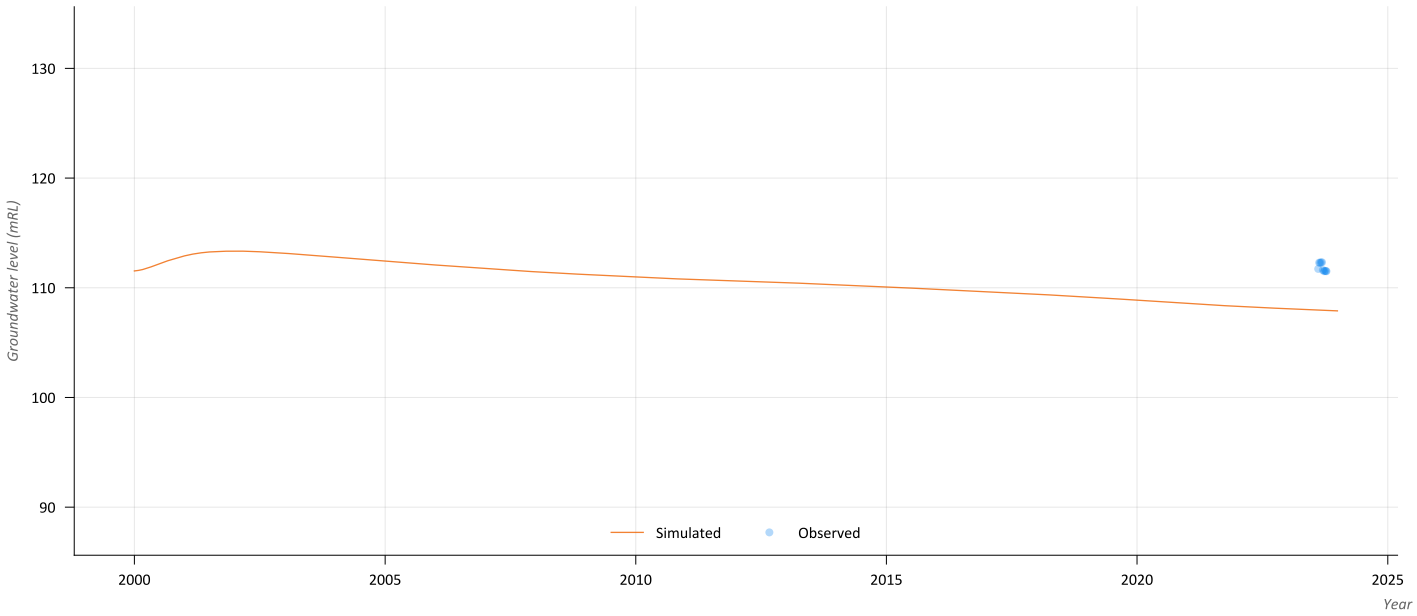
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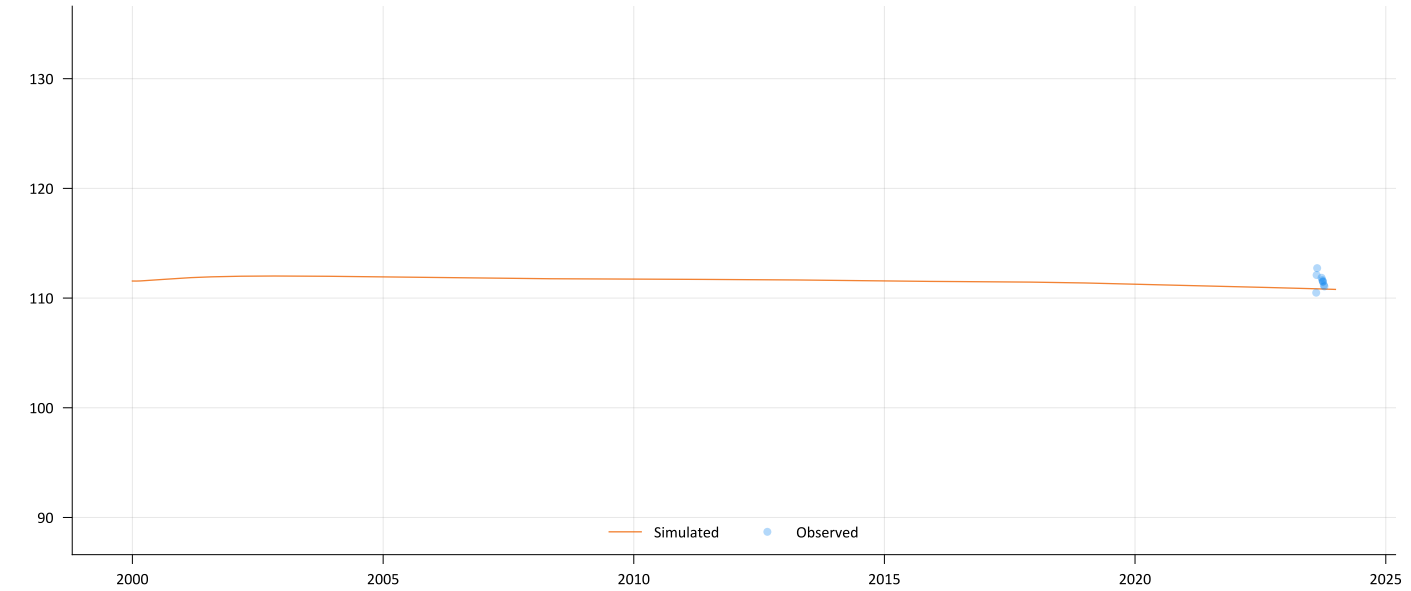
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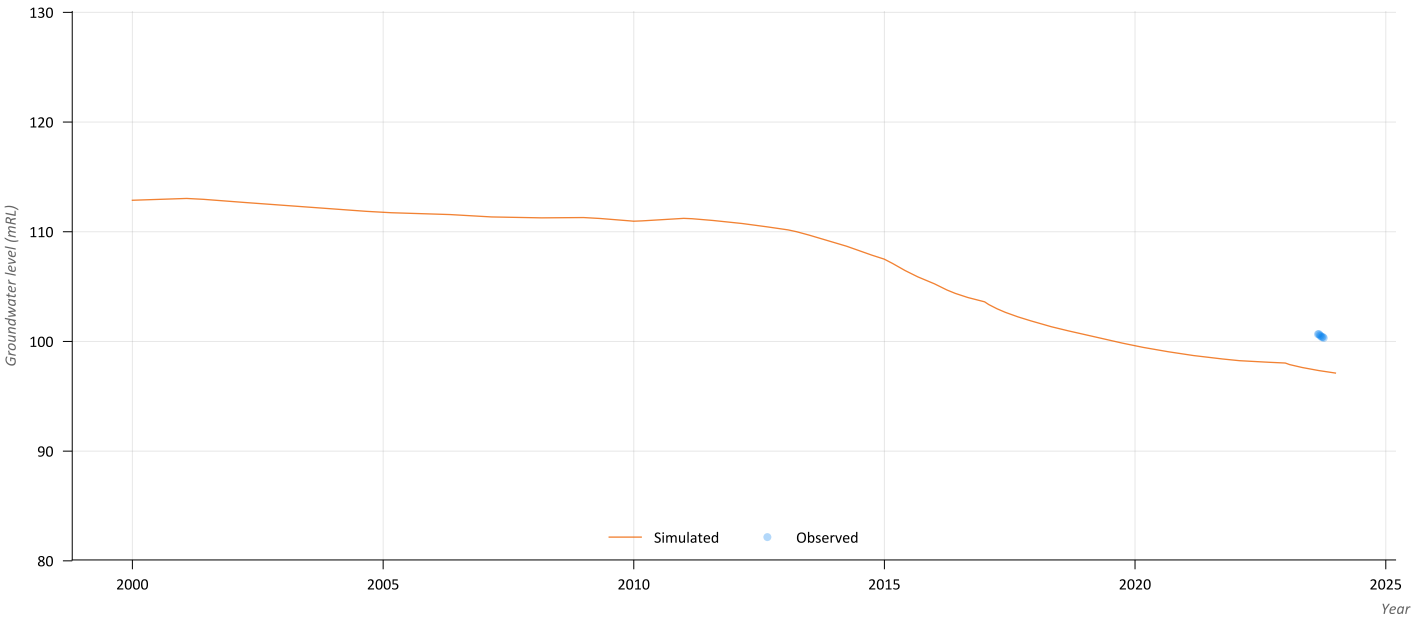
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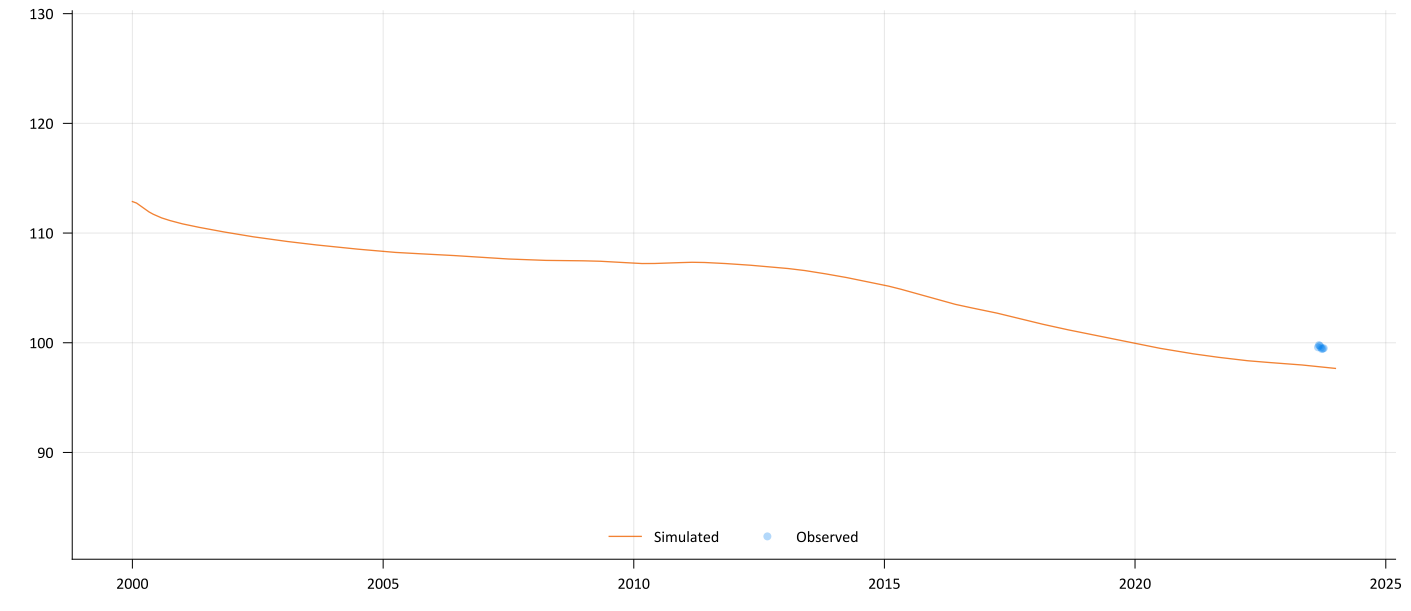
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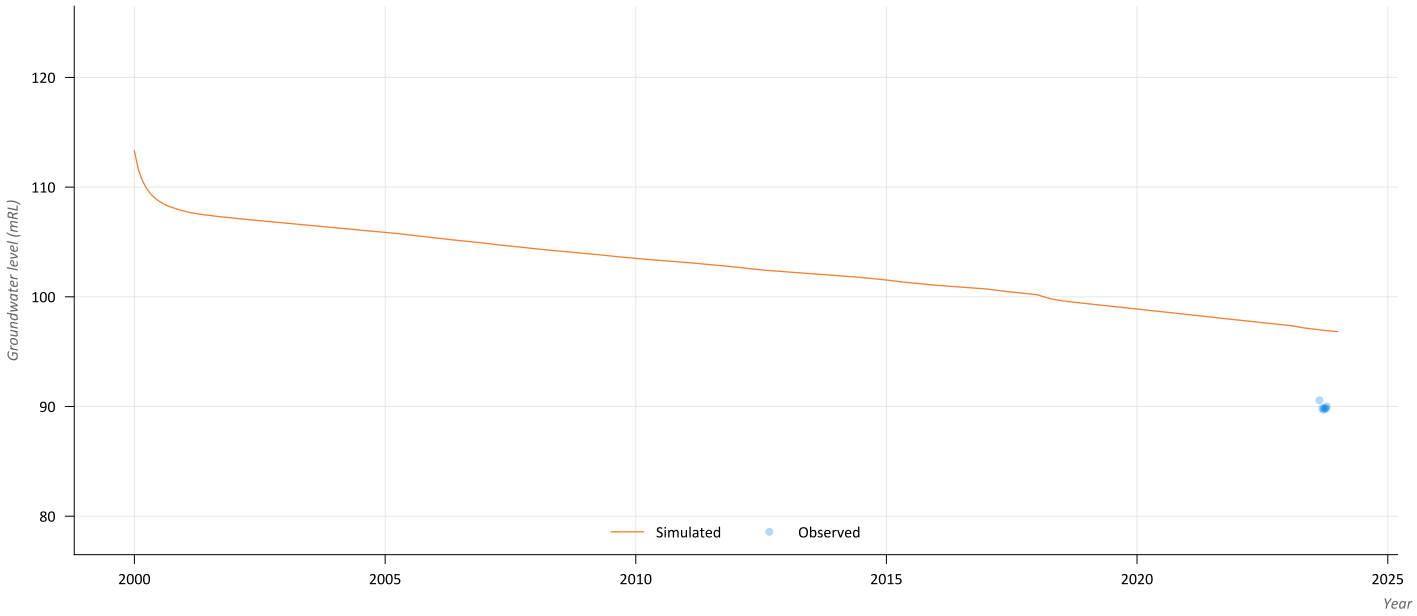
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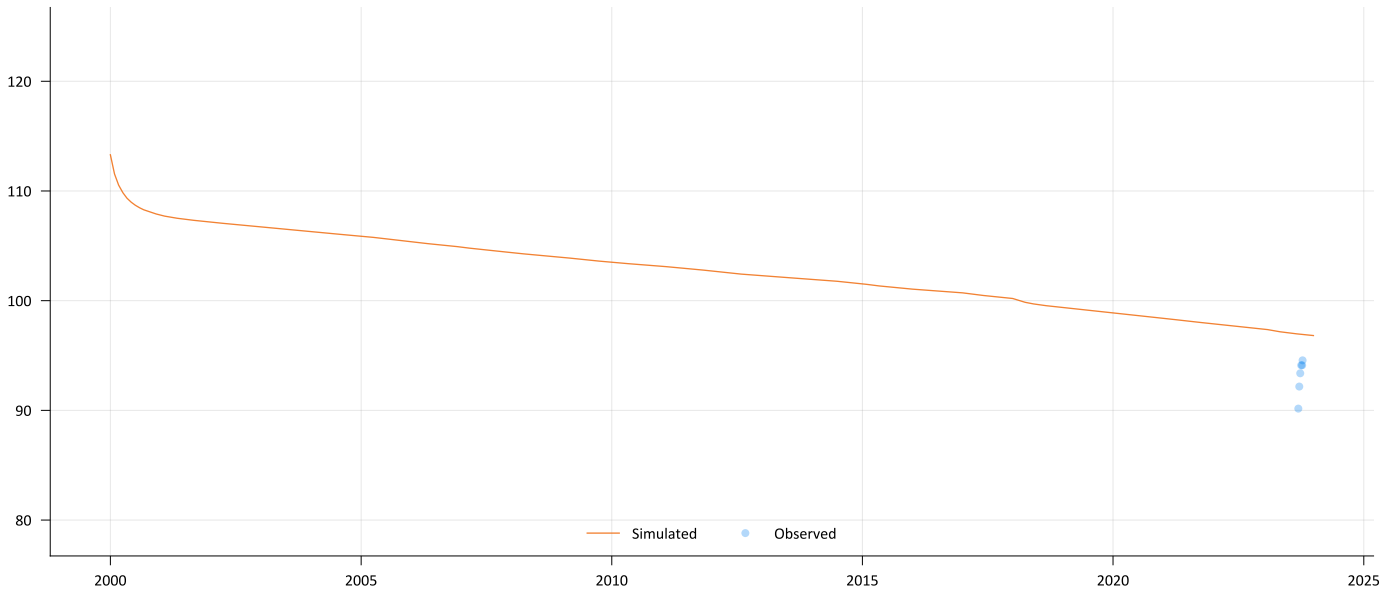
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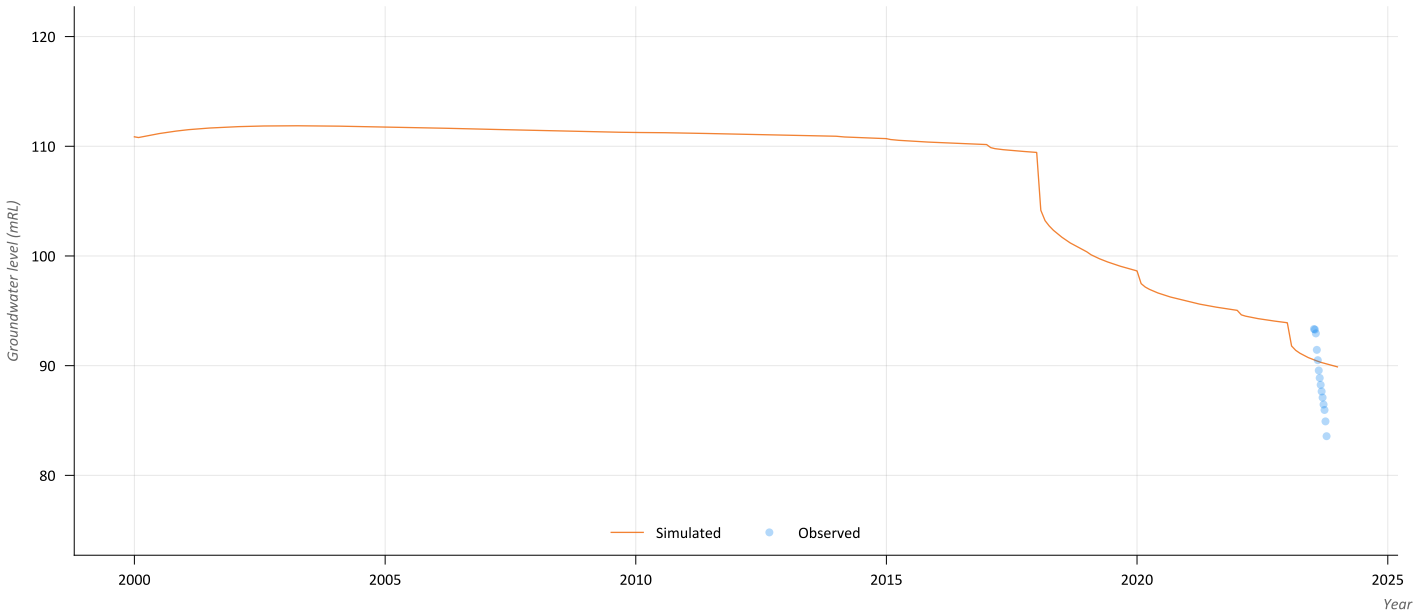
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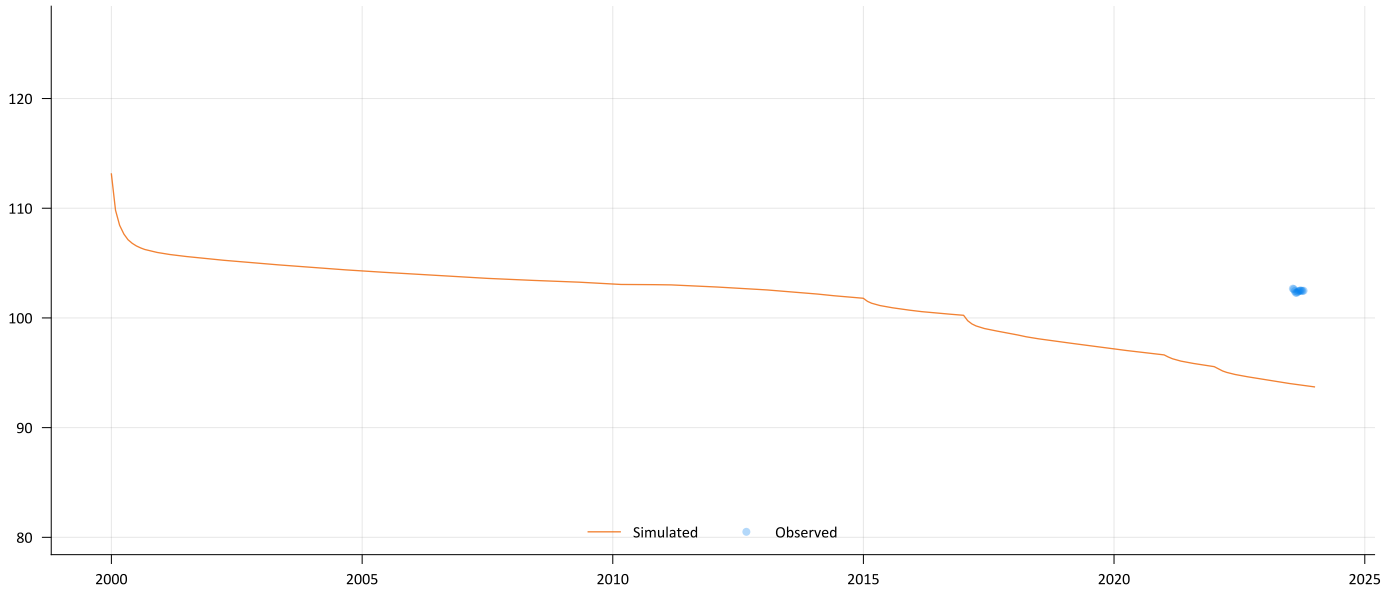
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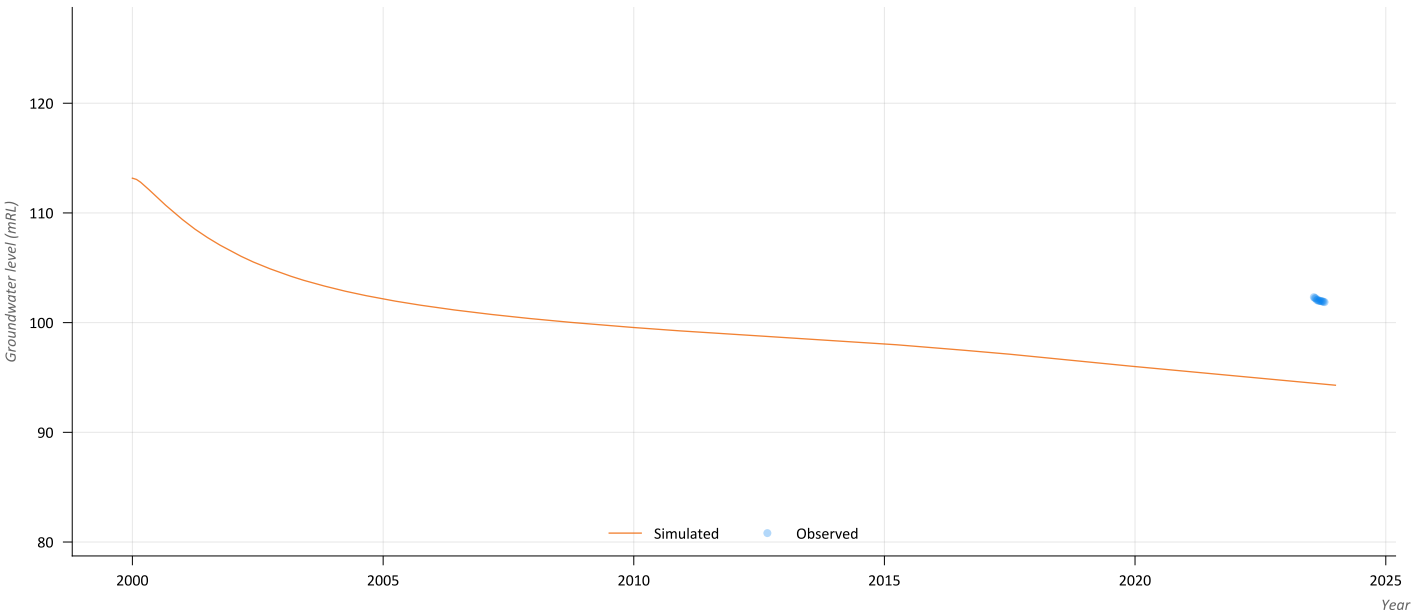
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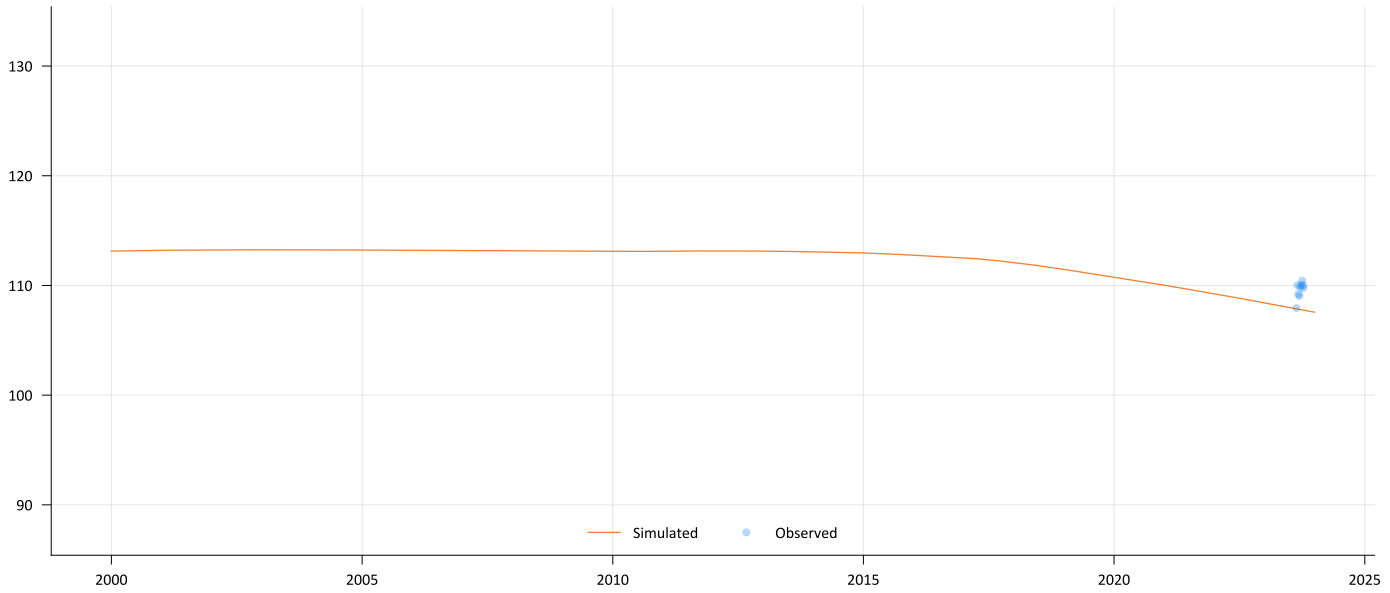
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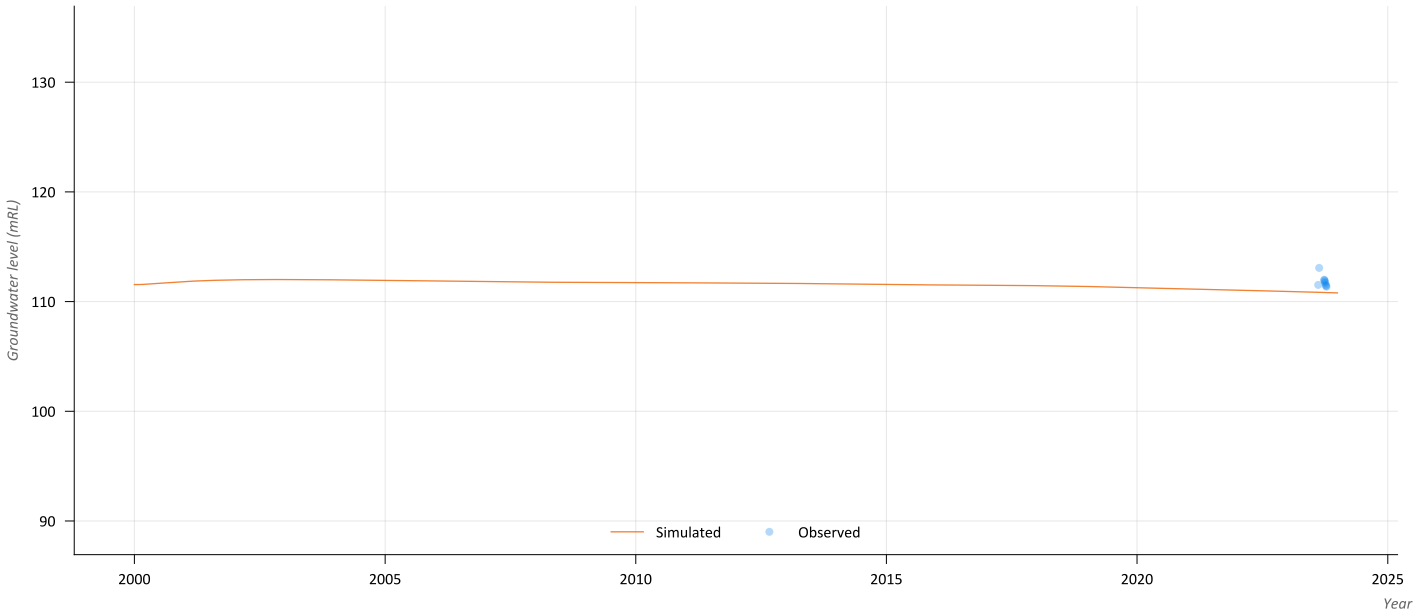
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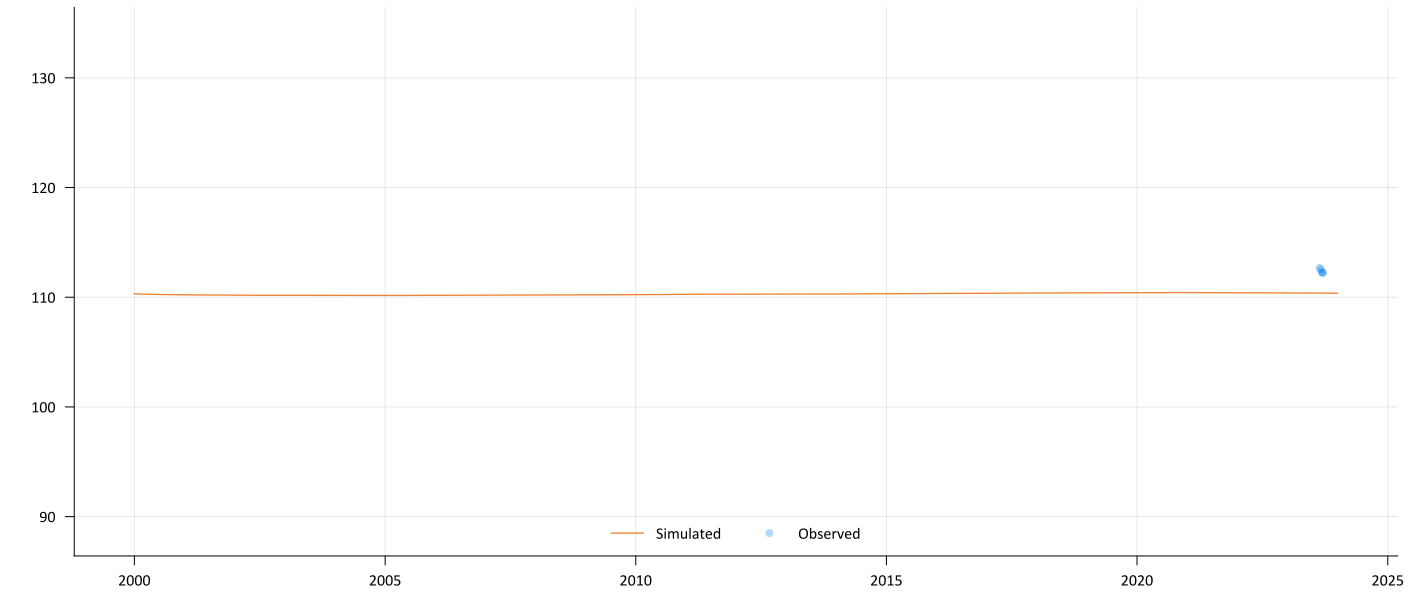
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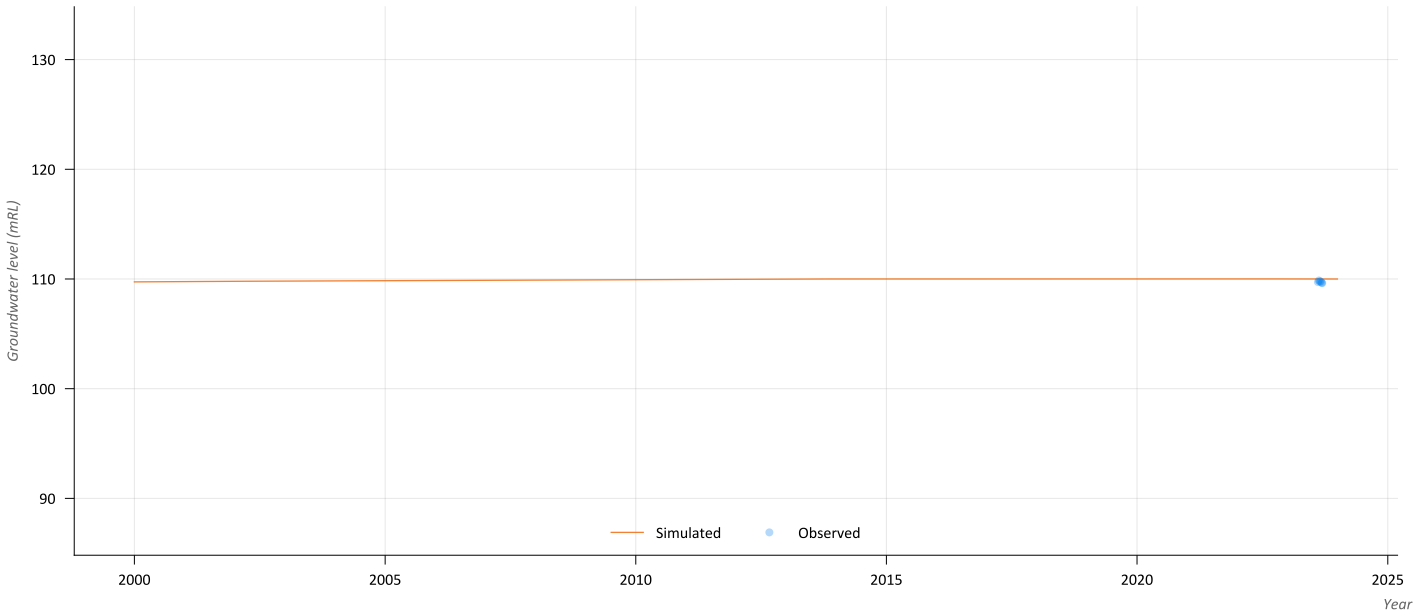
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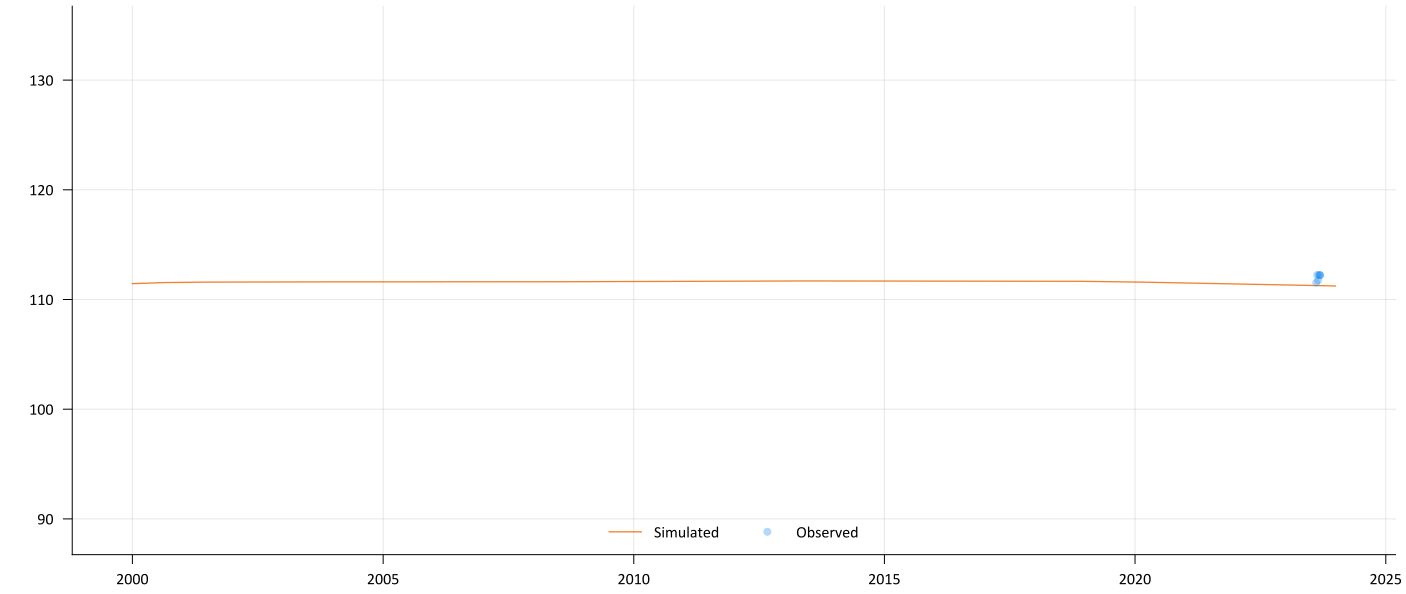
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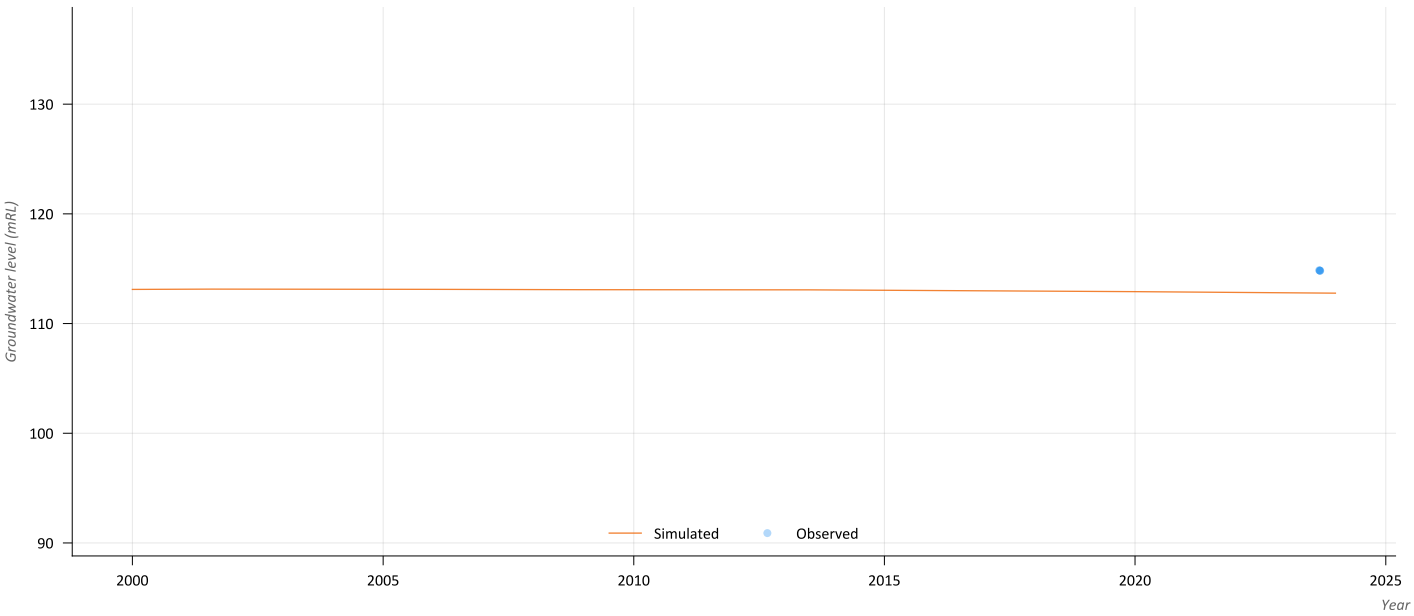
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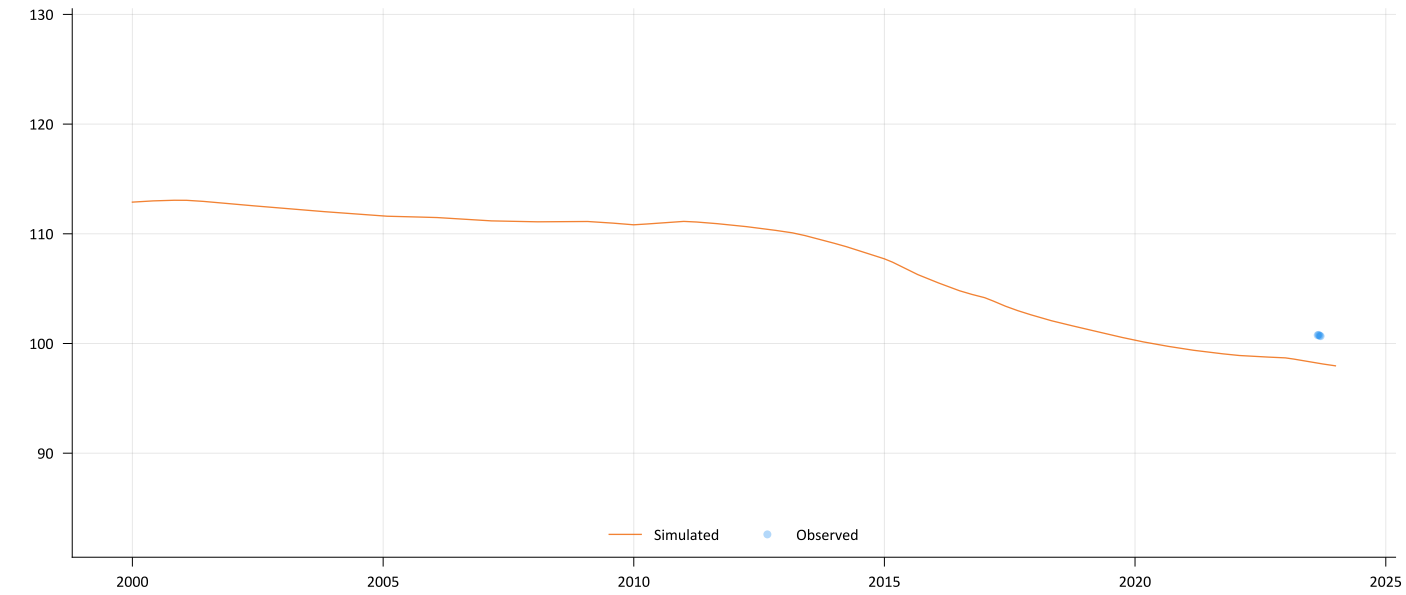
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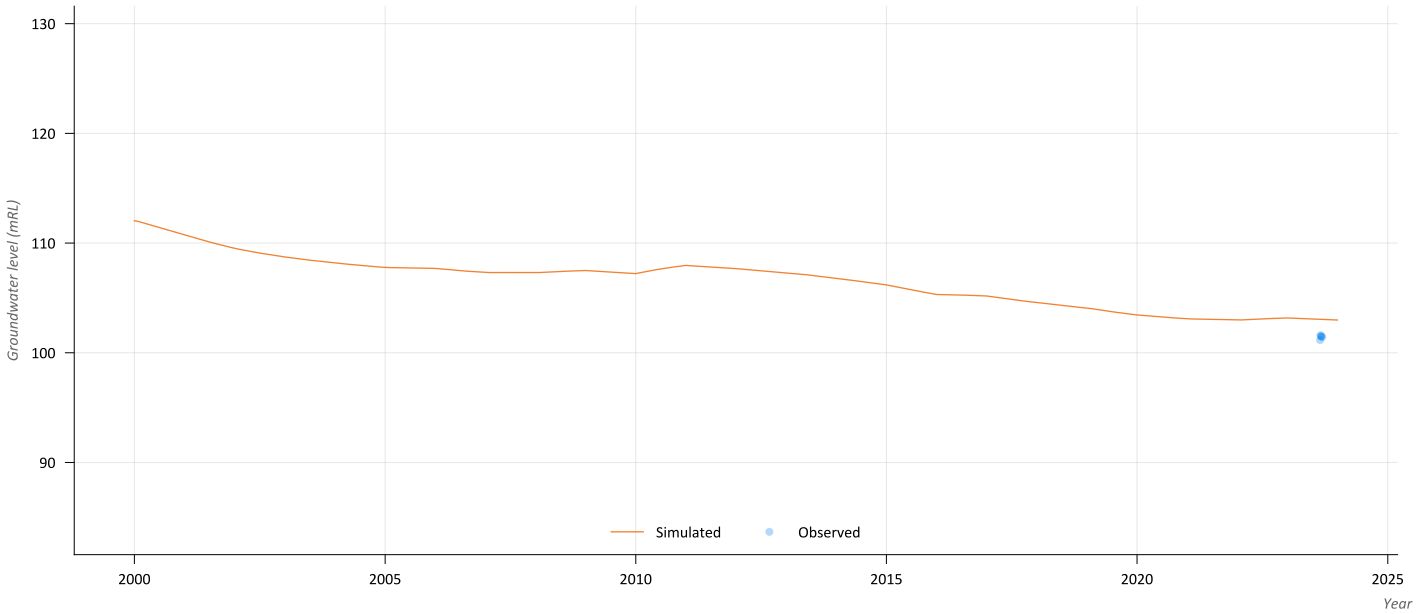
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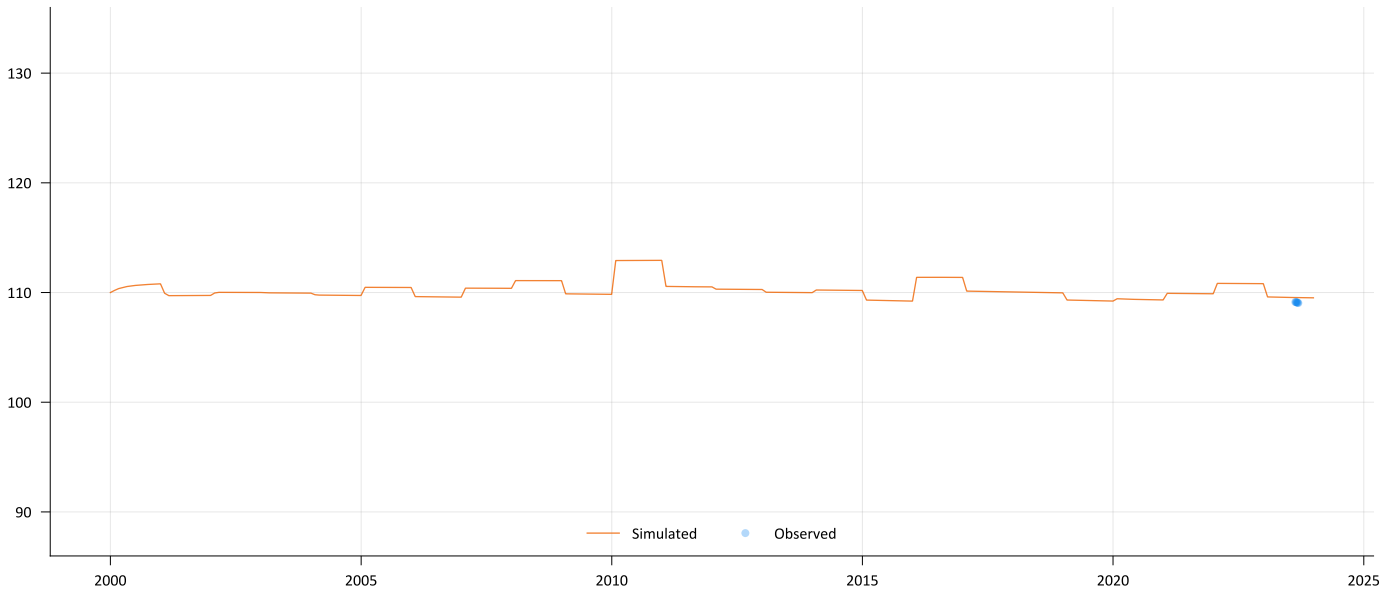
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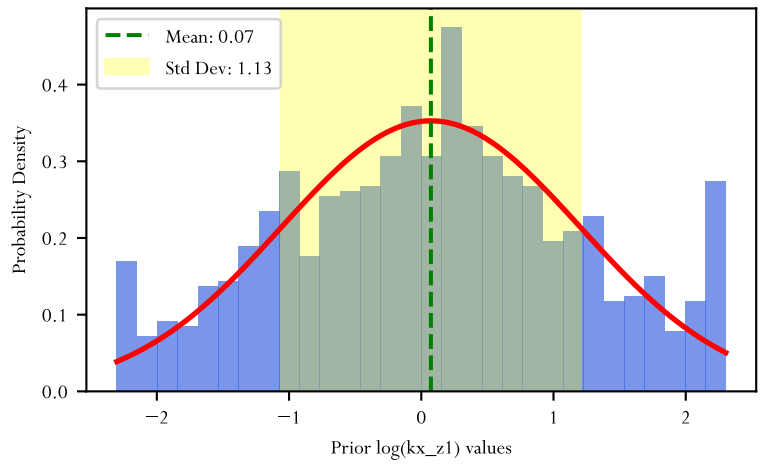
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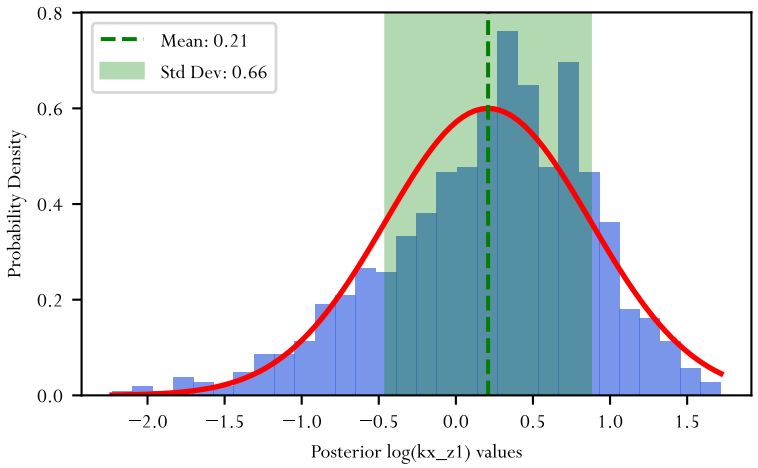

130
120
110
100
90
Groundwater level (mRL)
Simulated
Observed
2000
2005
2010
2015
2020
2025
Year

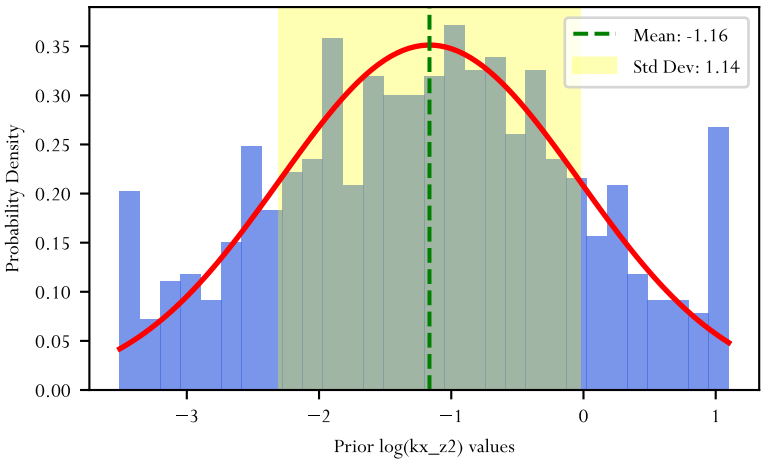
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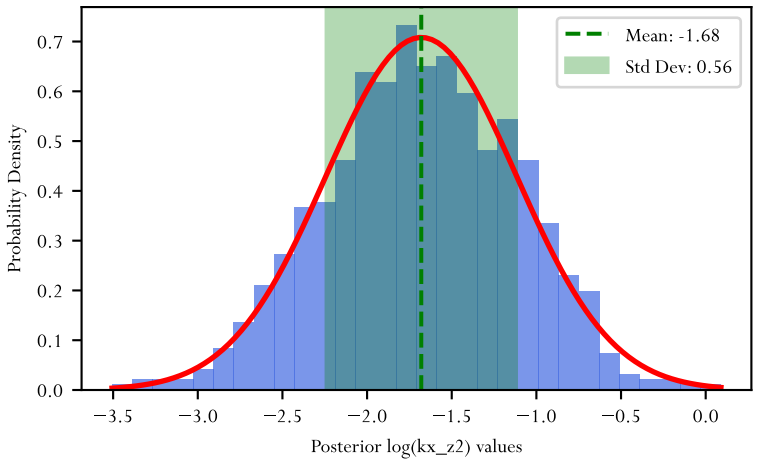

130
120
110
100
90
Simulated
Observed
2000
2005
2010
2015
2020
2025

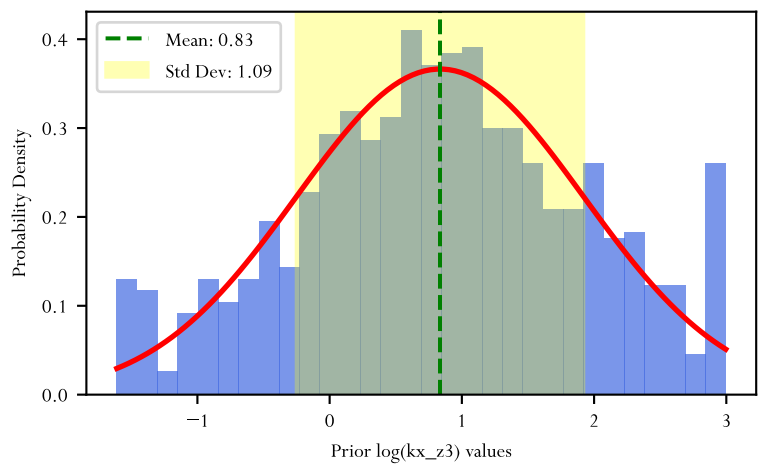
Appendix C 3 Parameter sample distributions

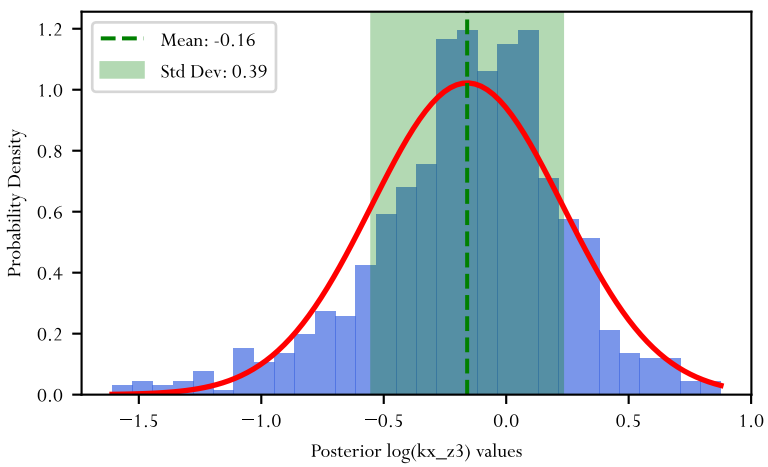

Mean: 0.07
Std Dev: 1.13
Probability Density
Prior log(kx_z1) values

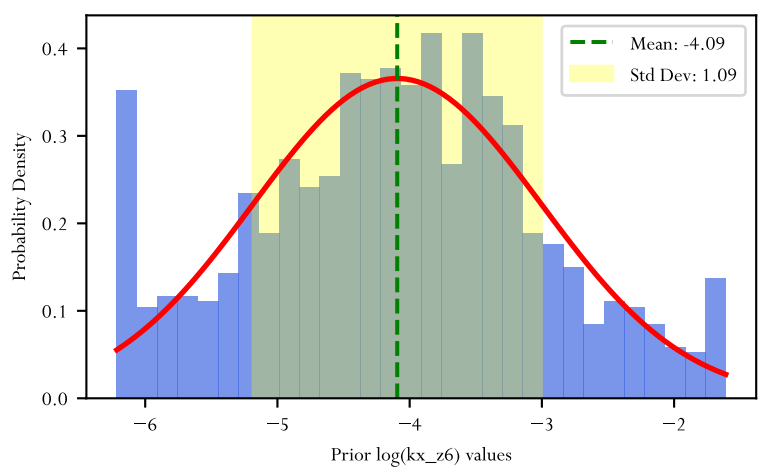

Mean: 0.21
Std Dev: 0.66
Probability Density
Posterior log(kx_z1) values

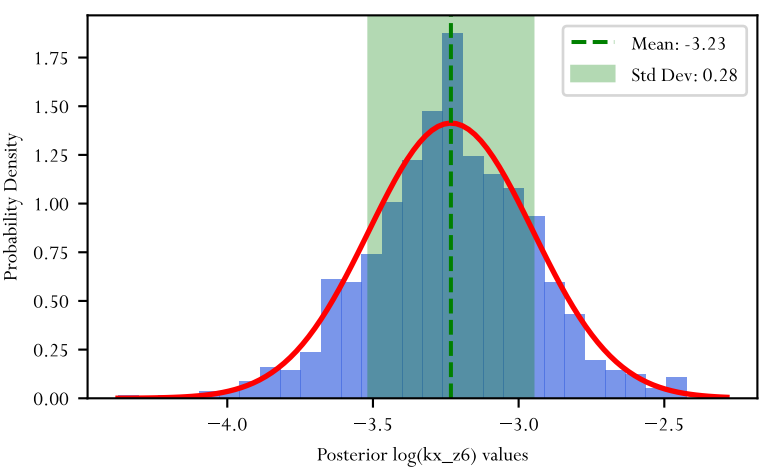

Mean: -1.16
Std Dev: 1.14
Probability Density
Prior log(kx_z2) values

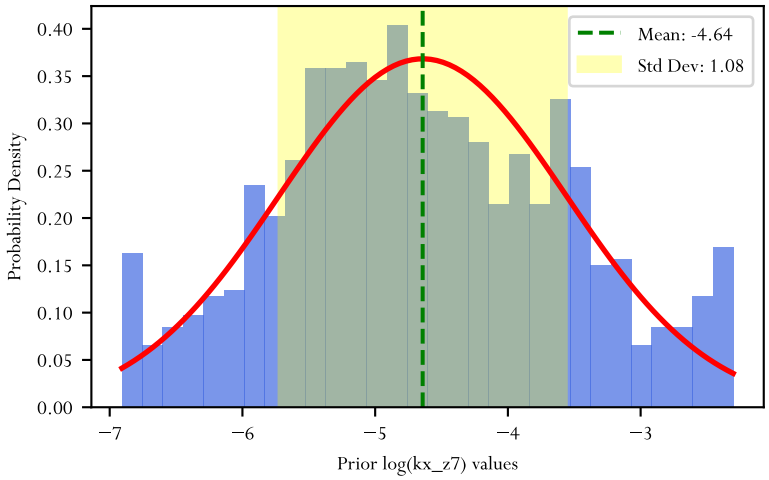

Mean: -1.68
Std Dev: 0.56
Probability Density
Posterior log(kx_z2) values

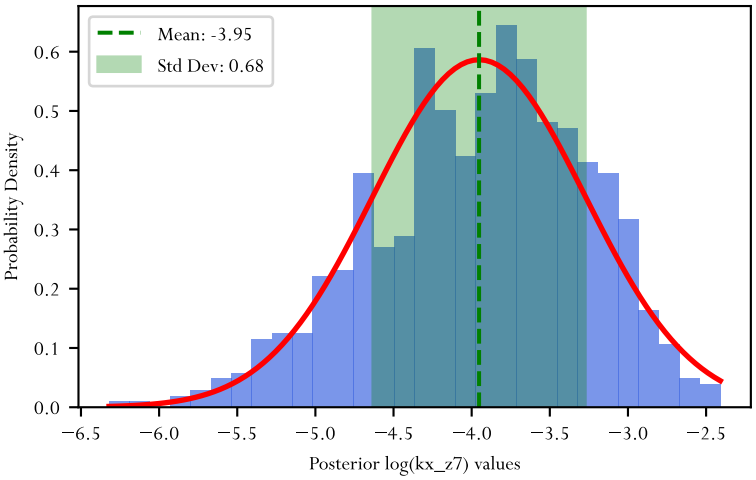

Mean: 0.83
Std Dev: 1.09
Probability Density
Prior log(kx_z3) values

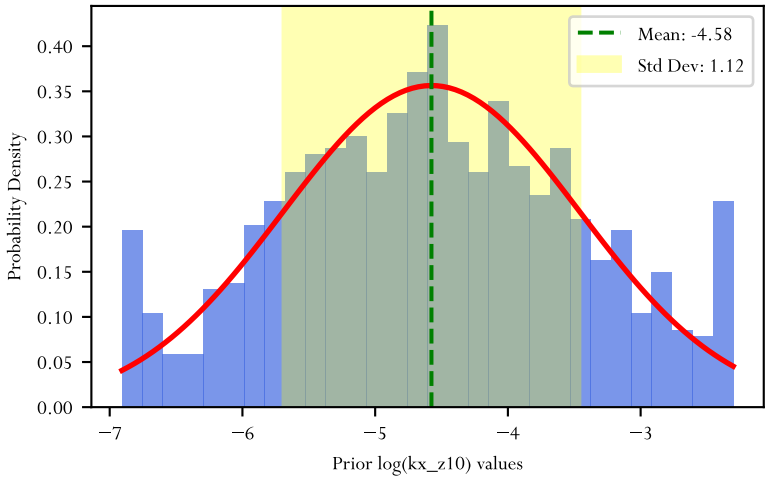

Mean: -0.16
Std Dev: 0.39
Probability Density
Posterior log(kx_z3) values

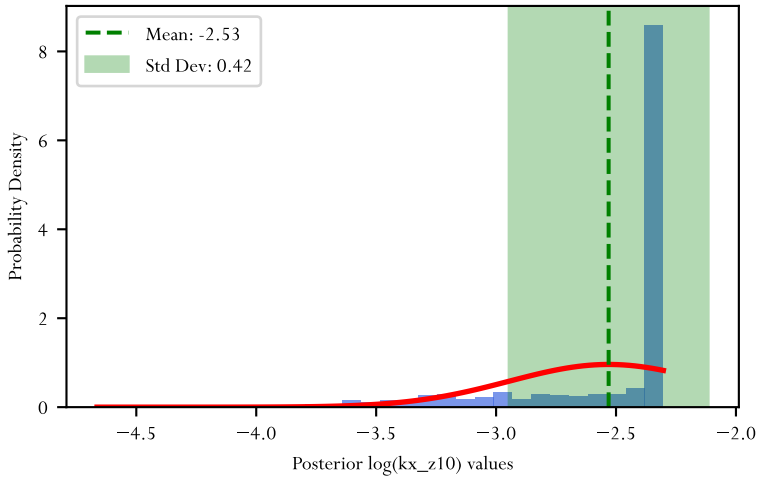

Mean: -4.09
Std Dev: 1.09
Probability Density
Prior log(kx_z6) values

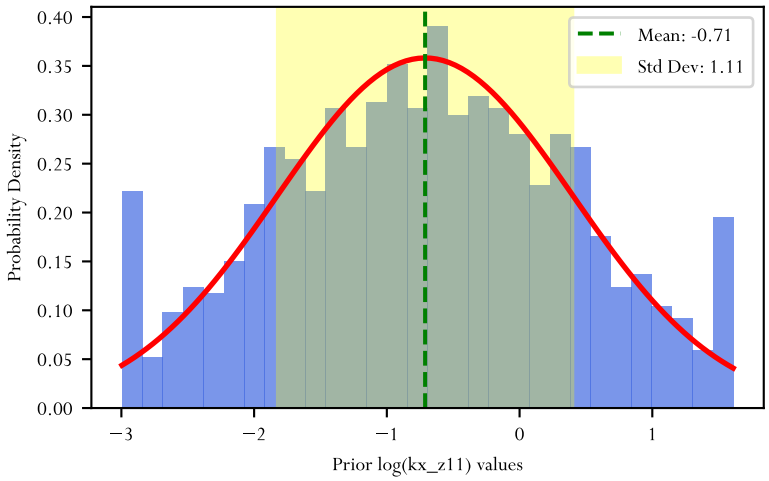

Mean: -3.23
Std Dev: 0.28
Probability Density
Posterior log(kx_z6) values

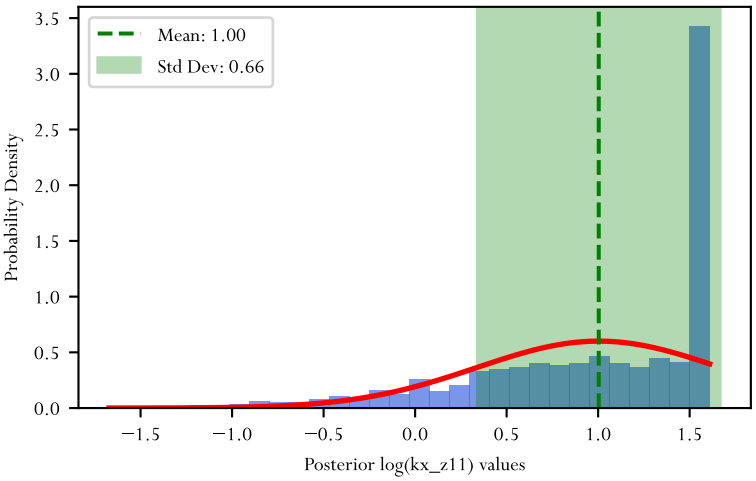

Mean: -4.64
Std Dev: 1.08
Probability Density
Prior log(kx_z7) values

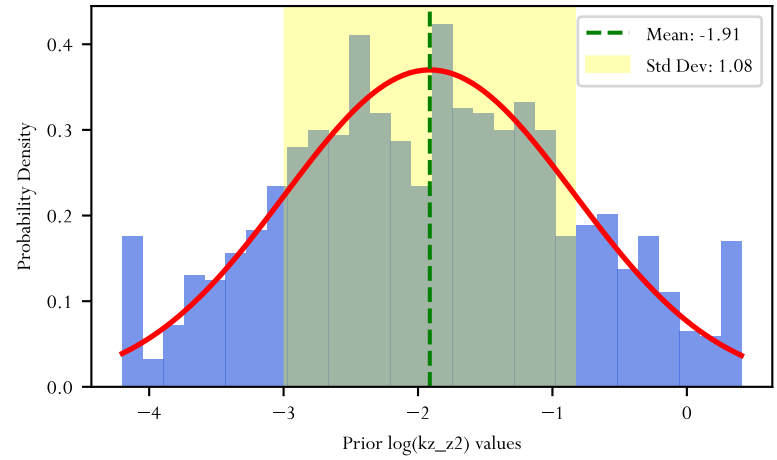

Mean: -3.95
Std Dev: 0.68
Probability Density
Posterior log(kx_z7) values

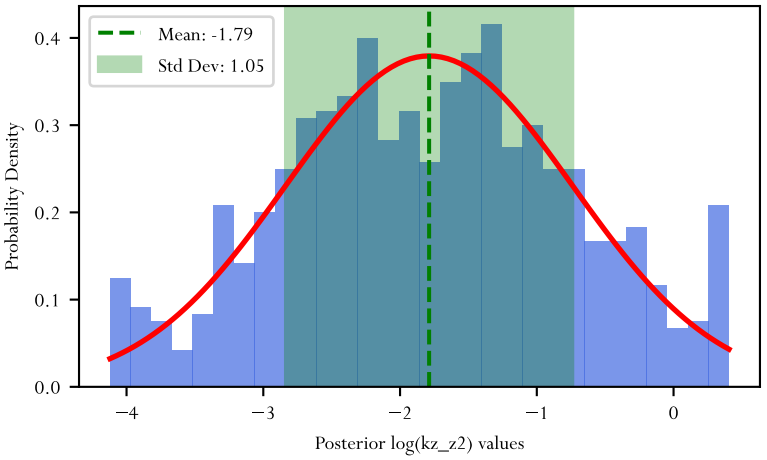

Mean: -4.58
Std Dev: 1.12
Probability Density
Prior log(kx_z10) values

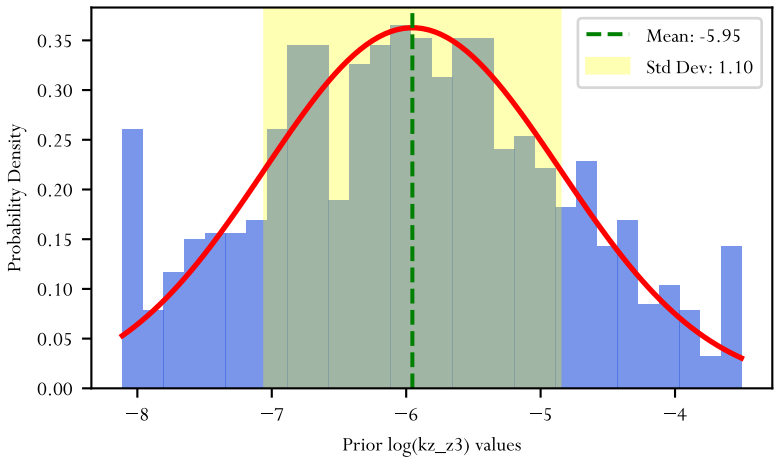

Mean: -2.53
Std Dev: 0.42
Probability Density
Posterior log(kx_z10) values

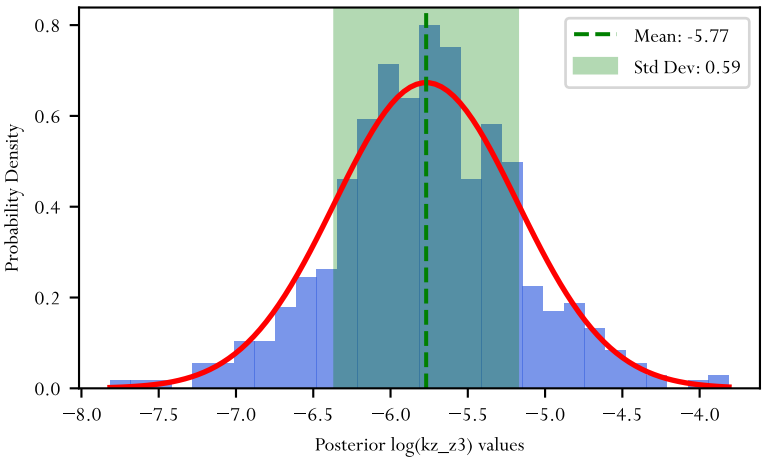

Mean: -0.71
Std Dev: 1.11
Probability Density
Prior log(kx_z11) values

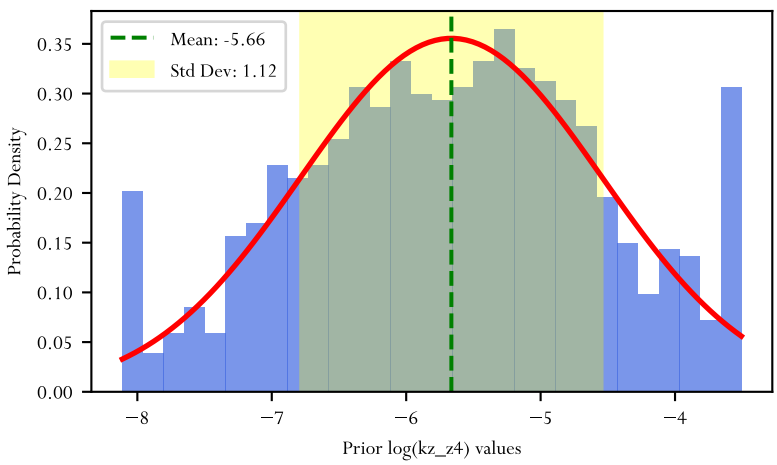

Mean: 1.00
Std Dev: 0.66
Probability Density
Posterior log(kx_z11) values

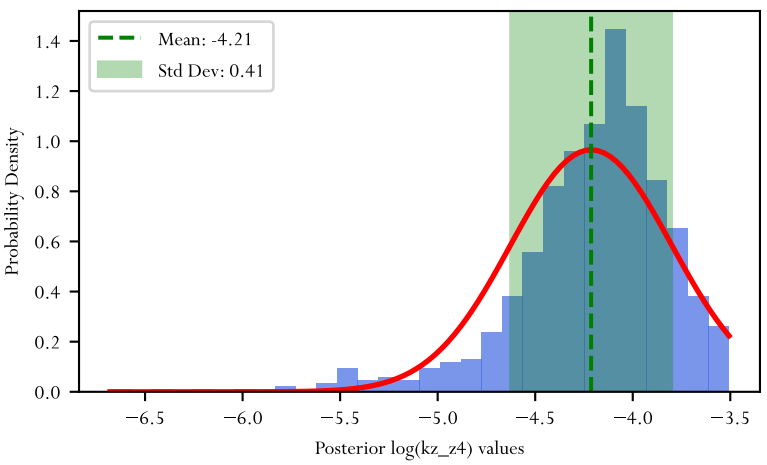

Mean: -1.91
Std Dev: 1.08
Probability Density
Prior log(kz_z2) values

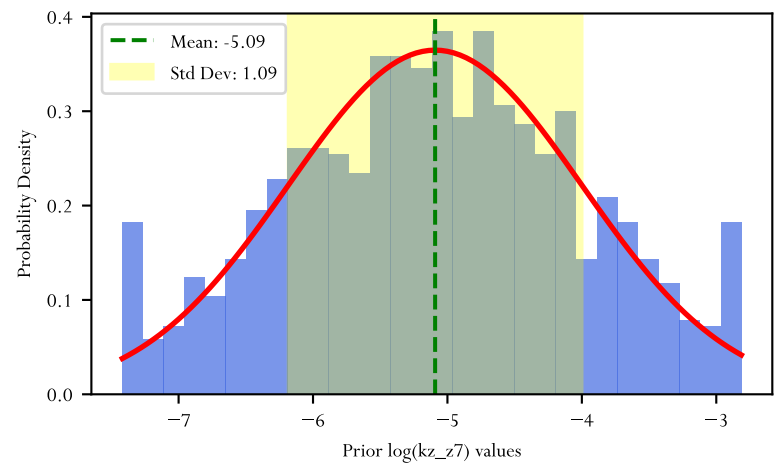

Mean: -1.79
Std Dev: 1.05
Probability Density
Posterior log(kz_z2) values

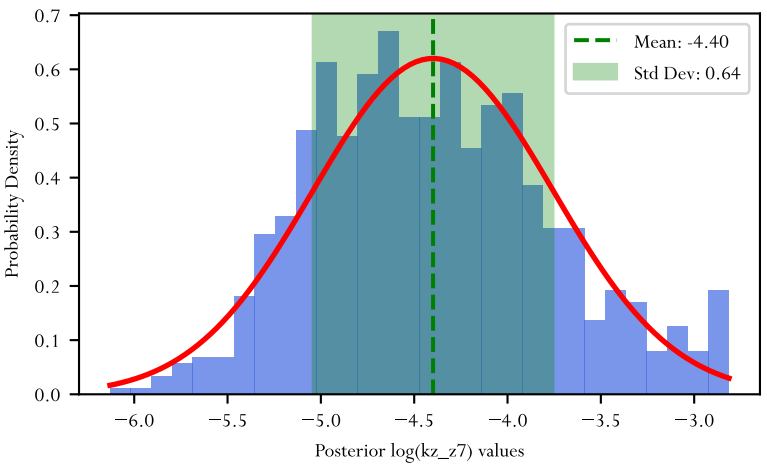

Mean: -5.95
Std Dev: 1.10
Probability Density
Prior log(kz_z3) values

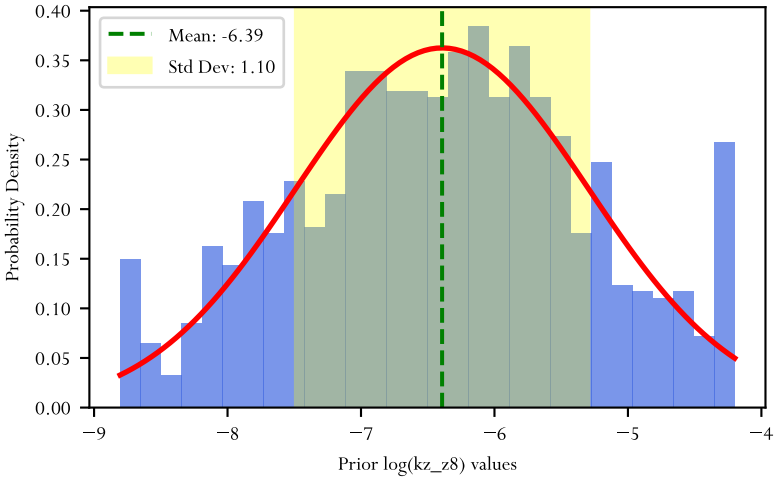

Mean: -5.77
Std Dev: 0.59
Probability Density
Posterior log(kz_z3) values

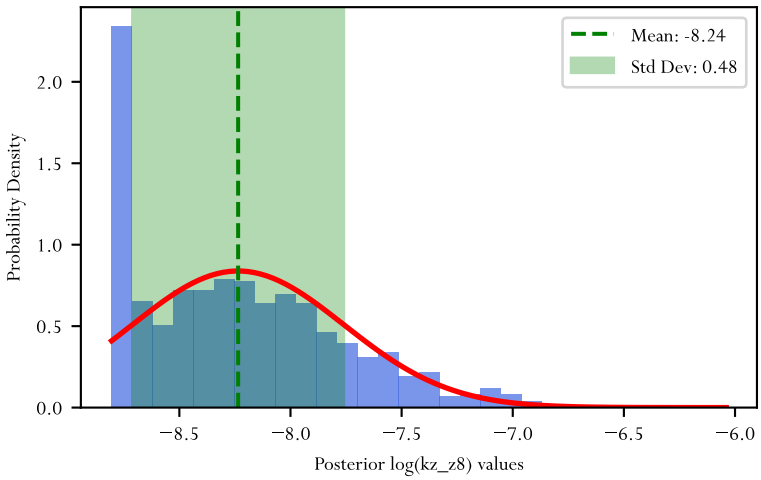

Mean: -5.66
Std Dev: 1.12
Probability Density
Prior log(kz_z4) values

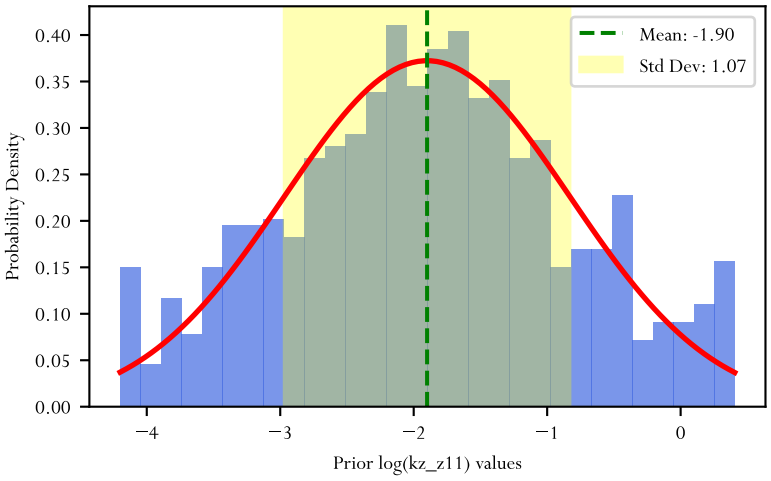

Mean: -4.21
Std Dev: 0.41
Probability Density
Posterior log(kz_z4) values

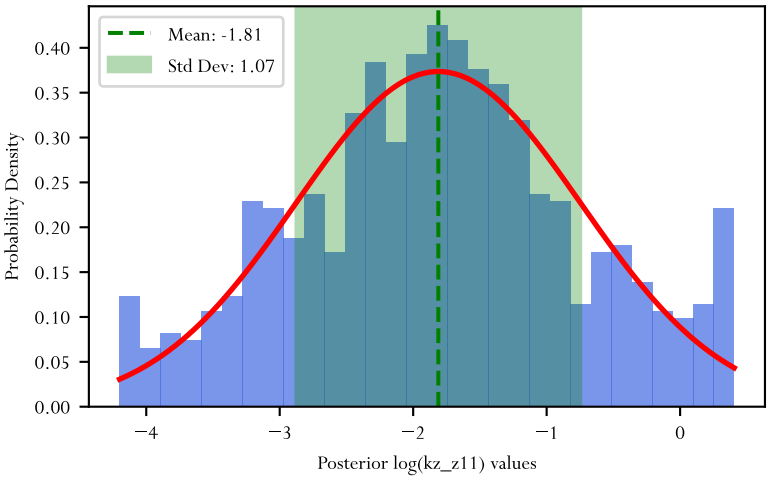

Mean: -5.09
Std Dev: 1.09
Probability Density
Prior log(kz_z7) values

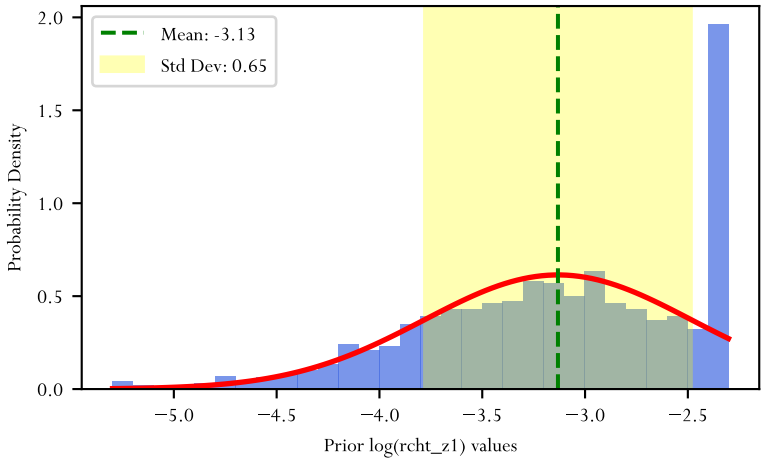

Mean: -4.40
Std Dev: 0.64
Probability Density
Posterior log(kz_z7) values

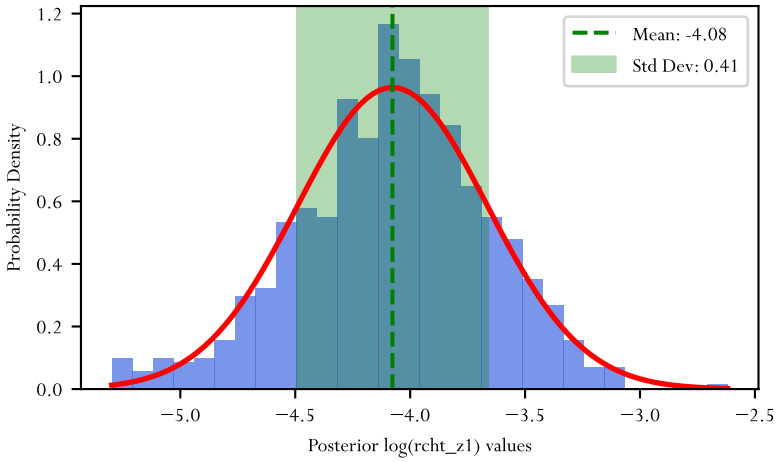

Mean: -6.39
Std Dev: 1.10
Probability Density
Prior log(kz_z8) values

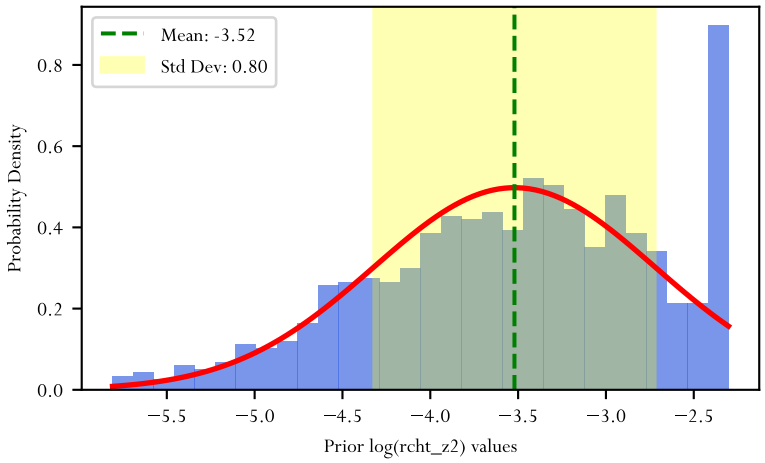

Mean: -8.24
Std Dev: 0.48
Probability Density
Posterior log(kz_z8) values

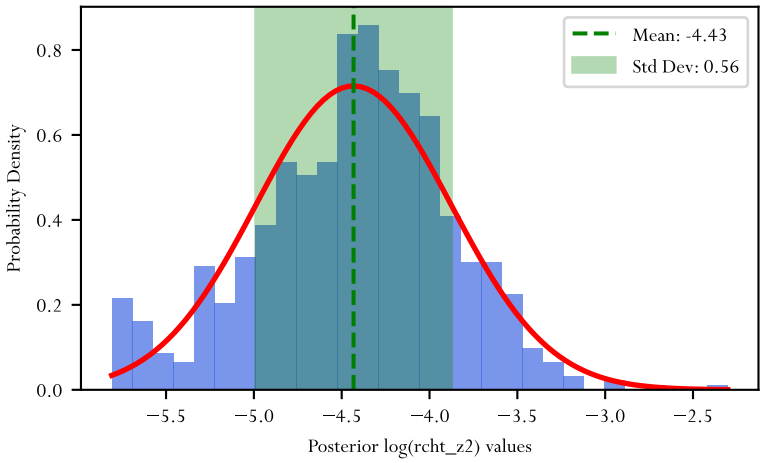

Mean: -1.90
Std Dev: 1.07
Probability Density
Prior log(kz_z11) values

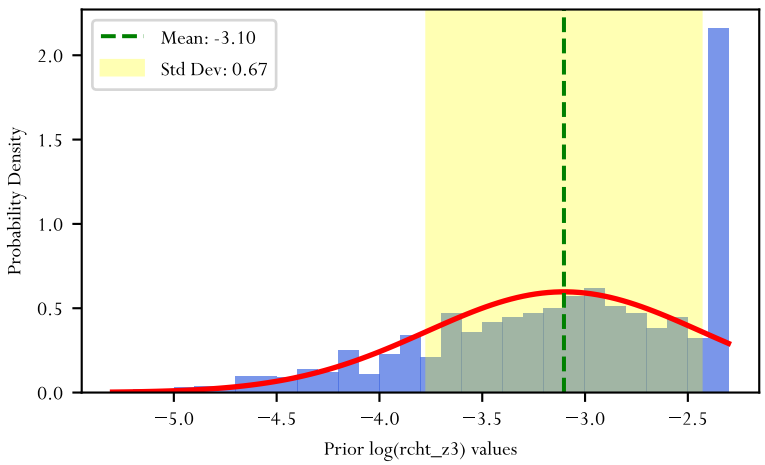

Mean: -1.81
Std Dev: 1.07
Probability Density
Posterior log(kz_z11) values

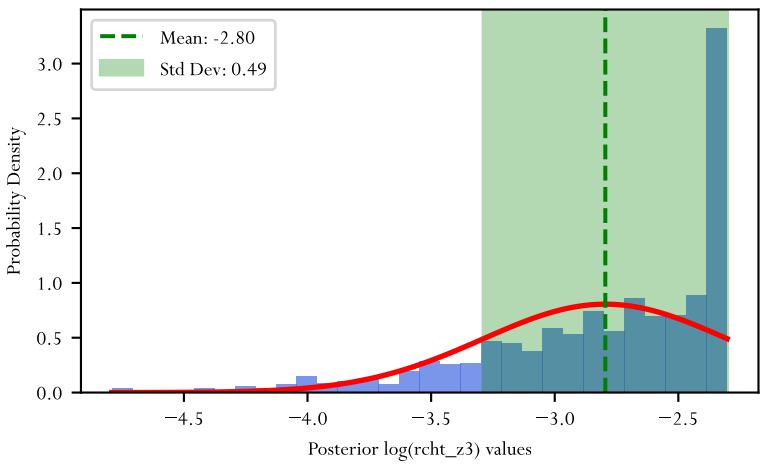

Mean: -3.13
Std Dev: 0.65
Probability Density
Prior log(rcht_z1) values

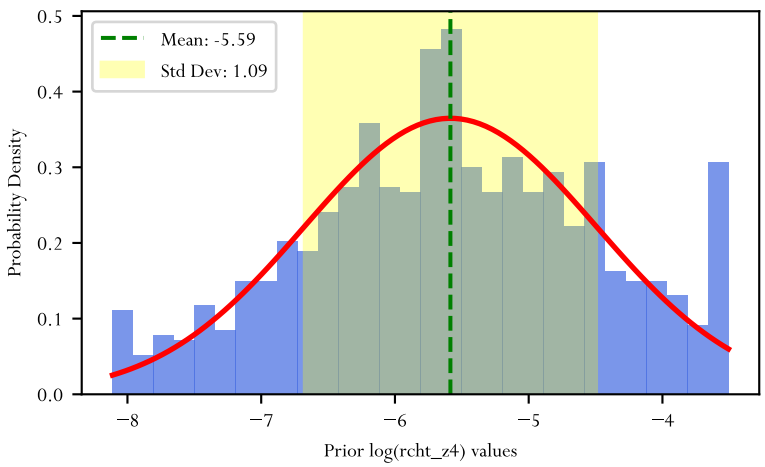

Mean: -4.08
Std Dev: 0.41
Probability Density
Posterior log(rcht_z1) values

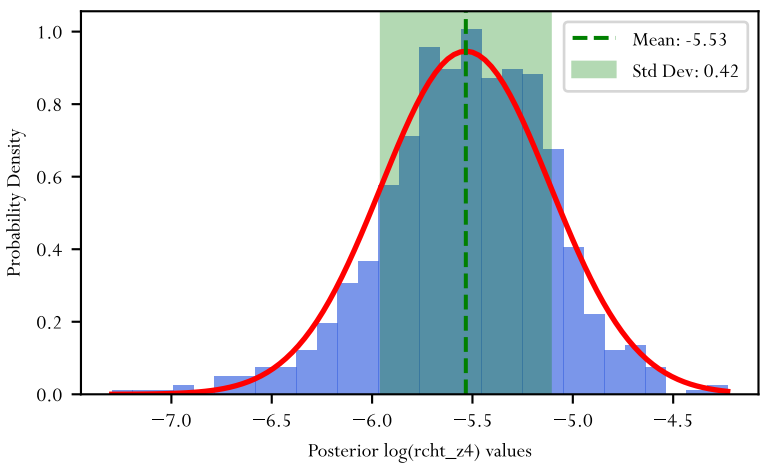

Mean: -3.52
Std Dev: 0.80
Probability Density
Prior log(rcht_z2) values

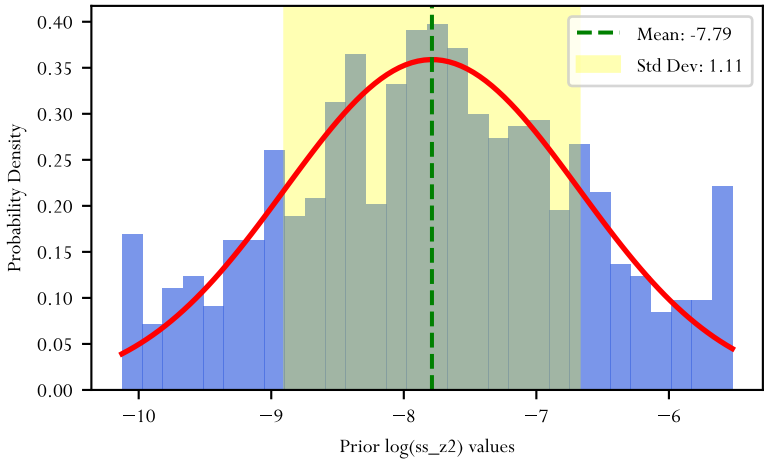

Mean: -4.43
Std Dev: 0.56
Probability Density
Posterior log(rcht_z2) values

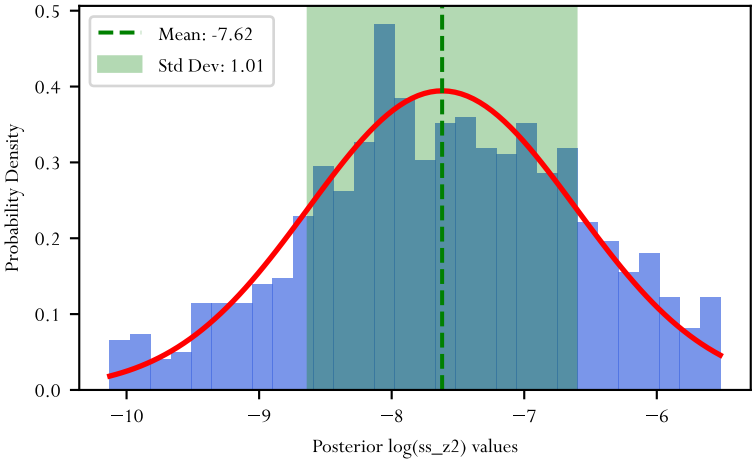

Mean: -3.10
Std Dev: 0.67
Probability Density
Prior log(rcht_z3) values

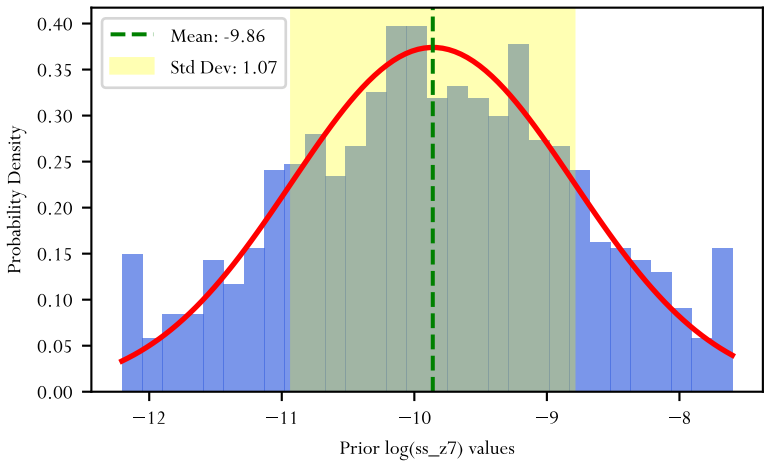

Mean: -2.80
Std Dev: 0.49
Probability Density
Posterior log(rcht_z3) values

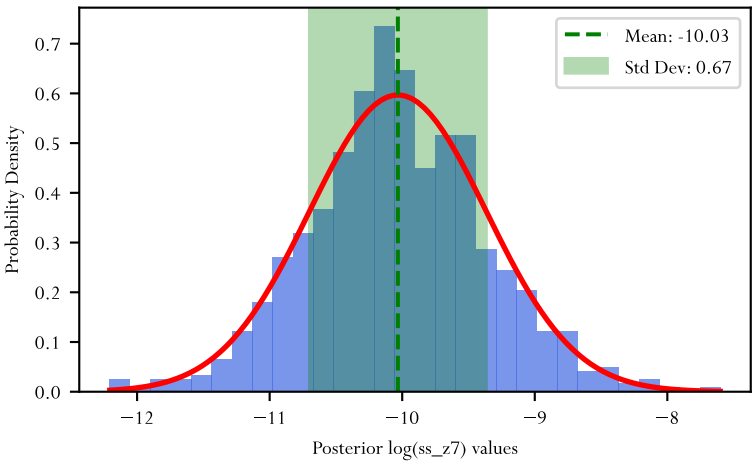

Mean: -5.59
Std Dev: 1.09
Probability Density
Prior log(rcht_z4) values

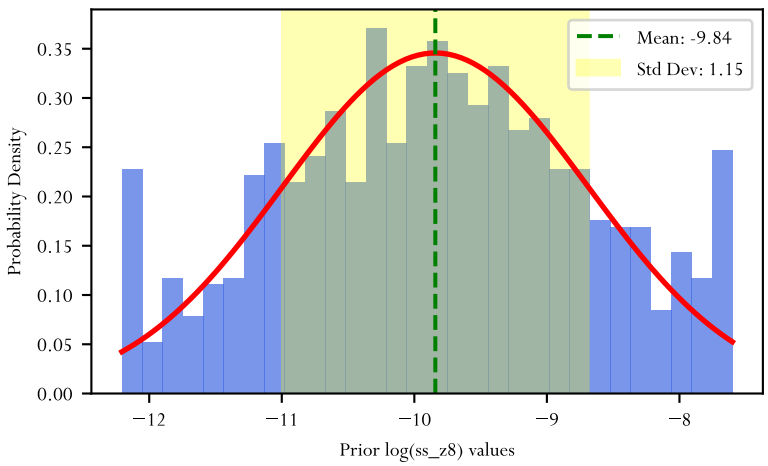

Mean: -5.53
Std Dev: 0.42
Probability Density
Posterior log(rcht_z4) values

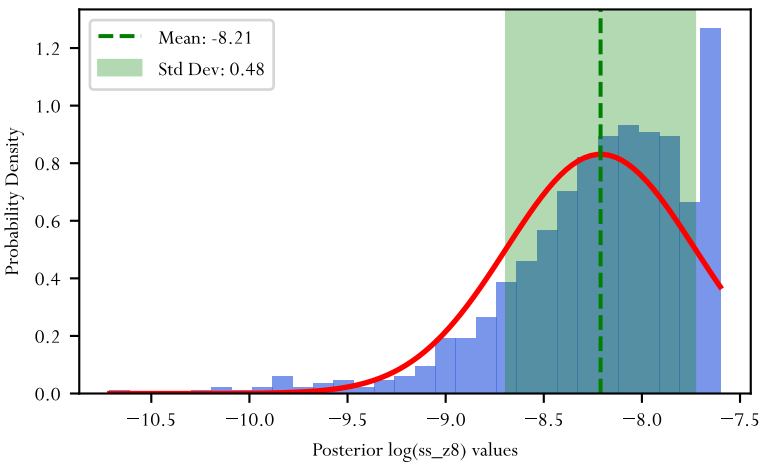

Mean: -7.79
Std Dev: 1.11
Probability Density
Prior log(ss_z2) values

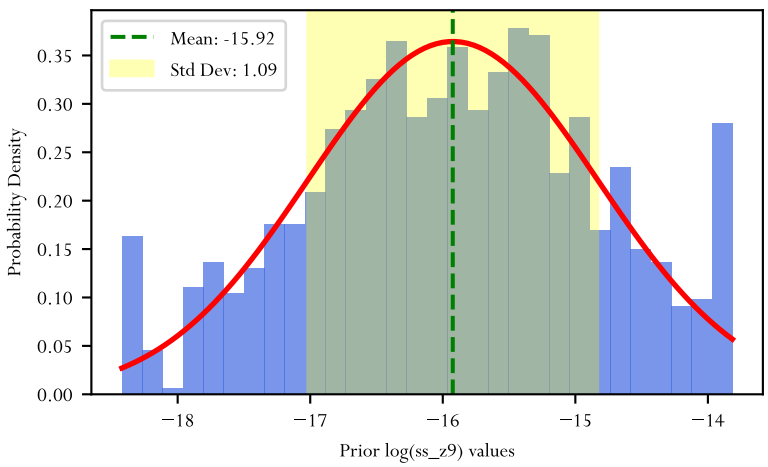

Mean: -7.62
Std Dev: 1.01
Probability Density
Posterior log(ss_z2) values

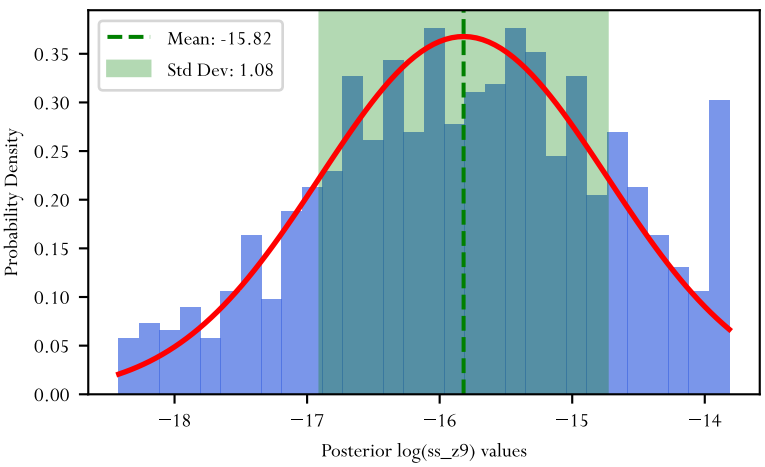

Mean: -9.86
Std Dev: 1.07
Probability Density
Prior log(ss_z7) values

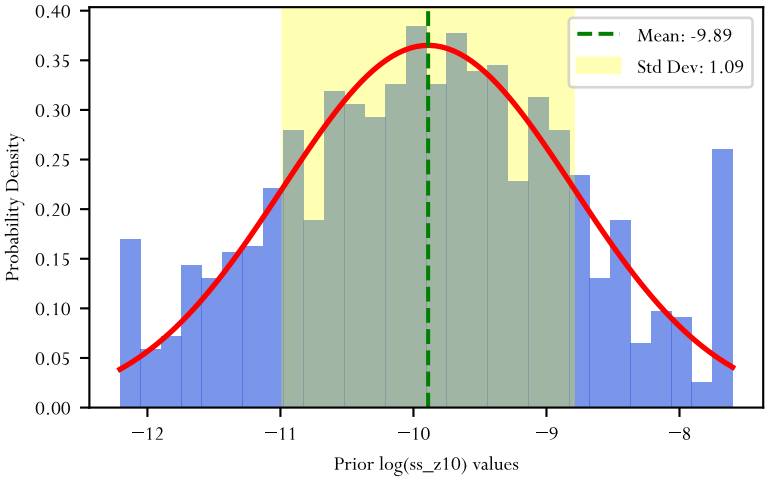

Mean: -10.03
Std Dev: 0.67
Probability Density
Posterior log(ss_z7) values

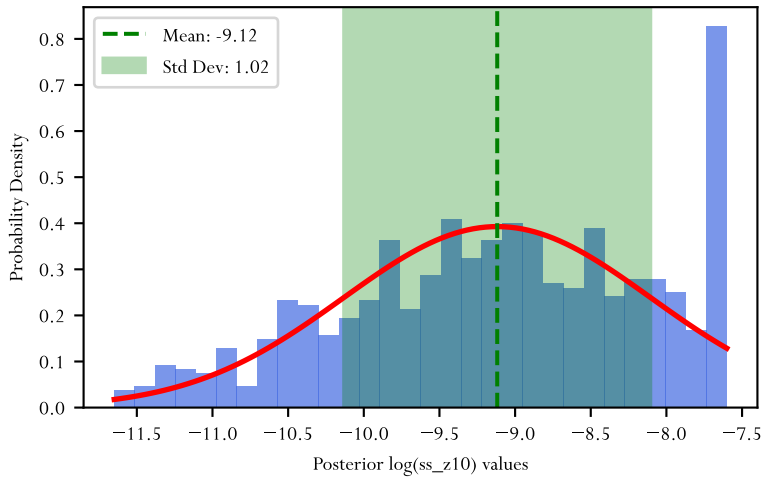

Mean: -9.84
Std Dev: 1.15
Probability Density
Prior log(ss_z8) values

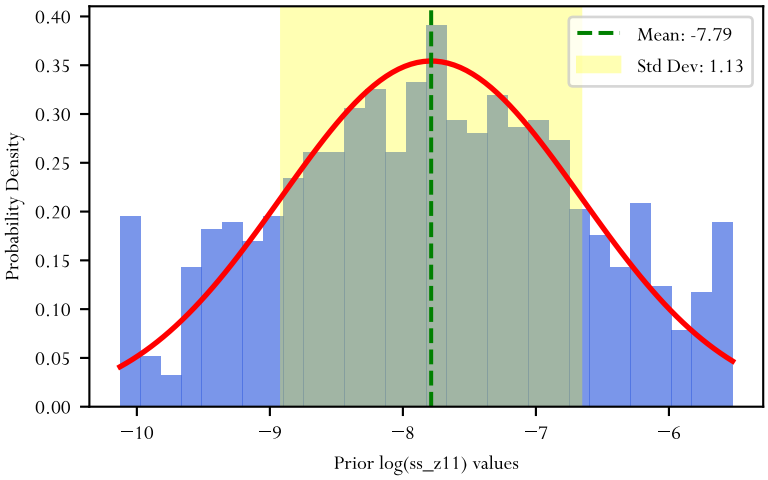

Mean: -8.21
Std Dev: 0.48
Probability Density
Posterior log(ss_z8) values

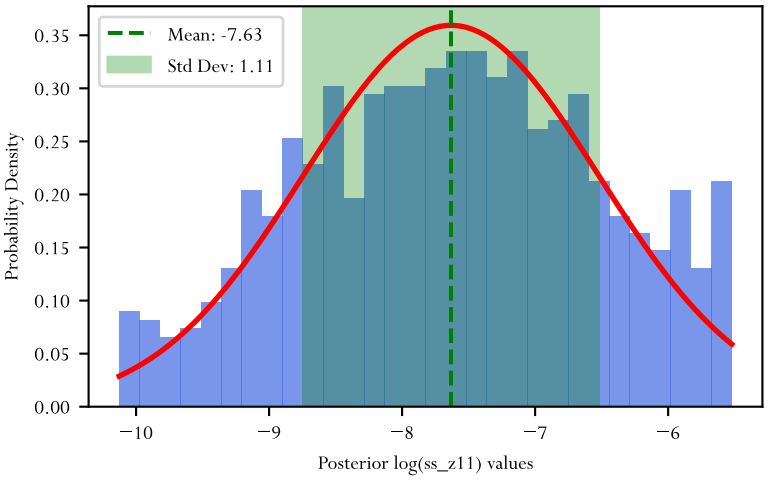

Mean: -15.92
Std Dev: 1.09
Probability Density
Prior log(ss_z9) values

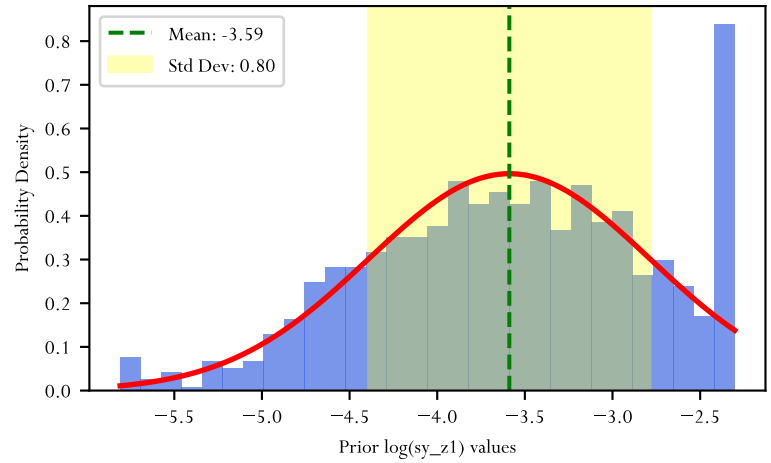

Mean: -15.82
Std Dev: 1.08
Probability Density
Posterior log(ss_z9) values

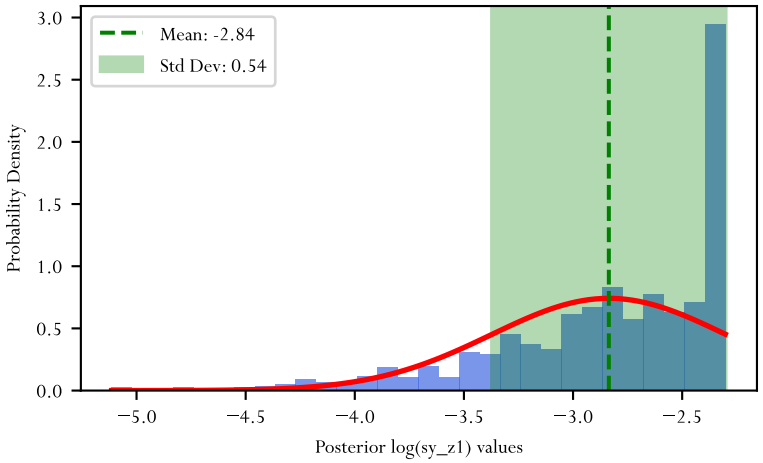

Mean: -9.89
Std Dev: 1.09
Probability Density
Prior log(ss_z10) values

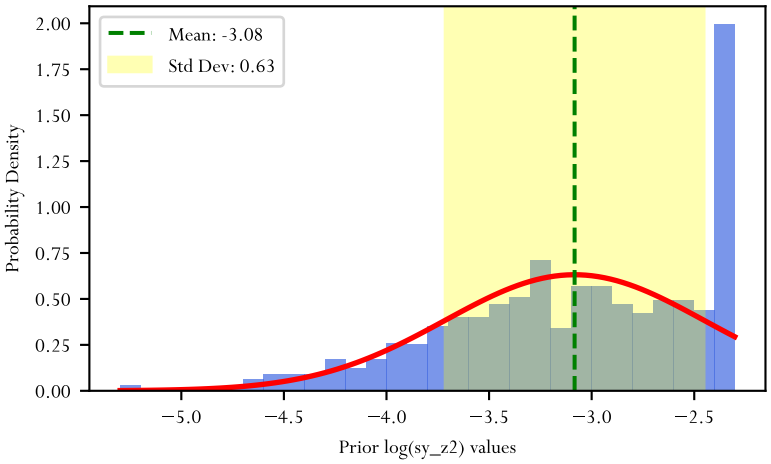

Mean: -9.12
Std Dev: 1.02
Probability Density
Posterior log(ss_z10) values

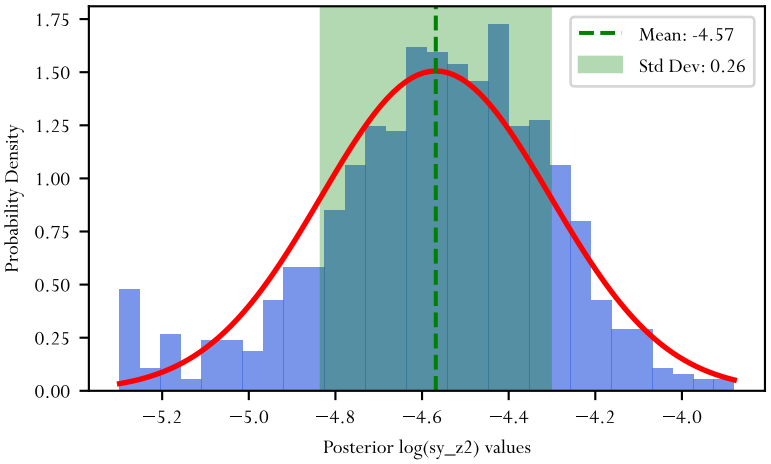

Mean: -7.79
Std Dev: 1.13
Probability Density
Prior log(ss_z11) values

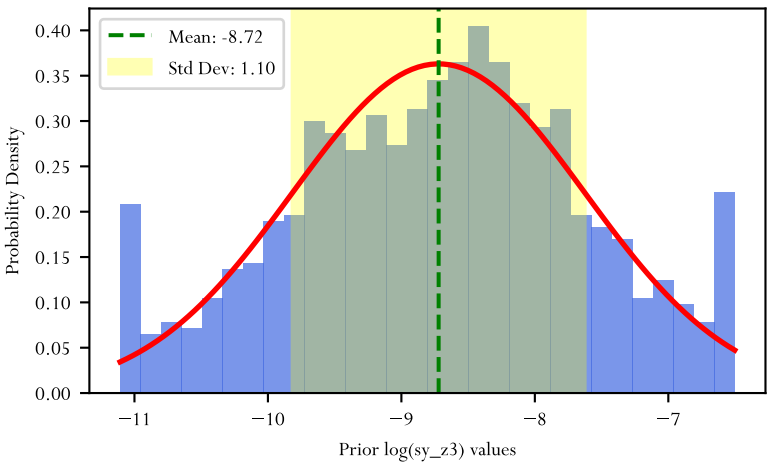

Mean: -7.63
Std Dev: 1.11
Probability Density
Posterior log(ss_z11) values

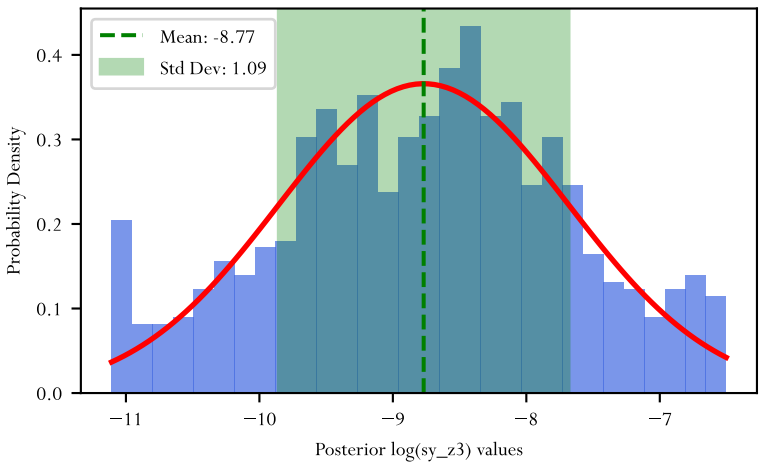

Mean: -3.59
Std Dev: 0.80
Probability Density
Prior log(sy_z1) values

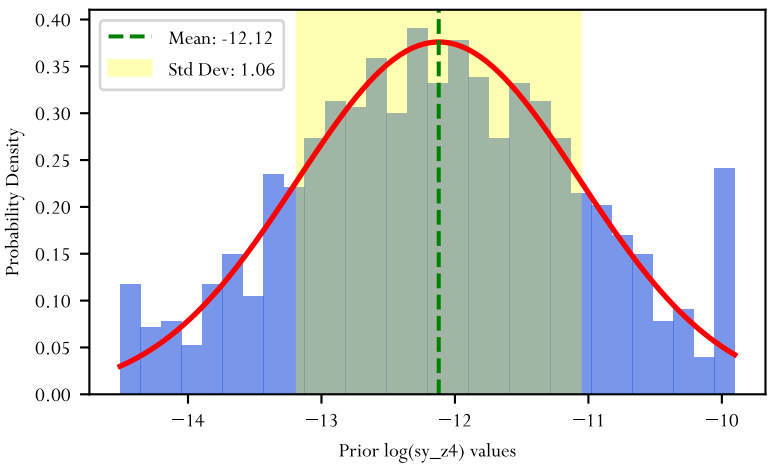

Mean: -2.84
Std Dev: 0.54
Probability Density
Posterior log(sy_z1) values

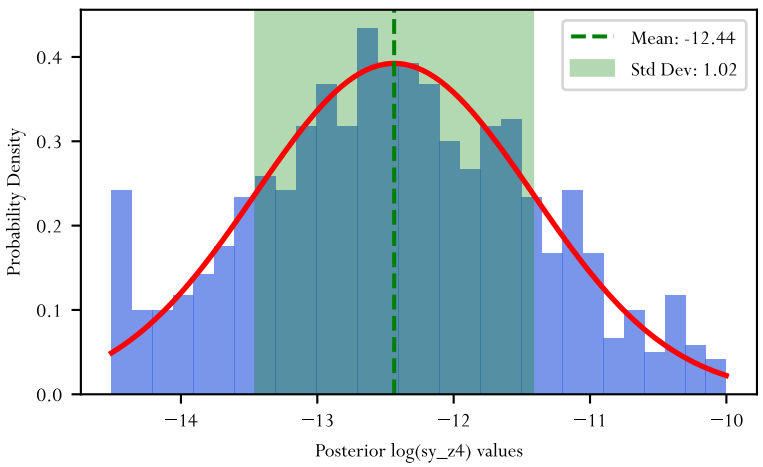

Mean: -3.08
Std Dev: 0.63
Probability Density
Prior log(sy_z2) values

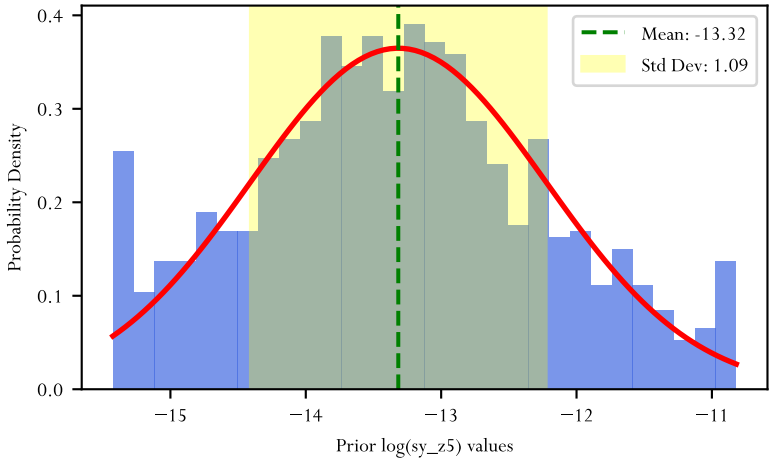

Mean: -4.57
Std Dev: 0.26
Probability Density
Posterior log(sy_z2) values

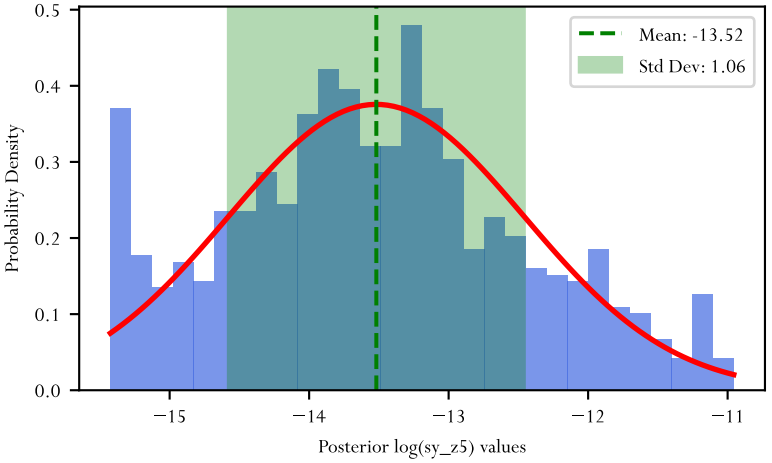

Mean: -8.72
Std Dev: 1.10
Probability Density
Prior log(sy_z3) values

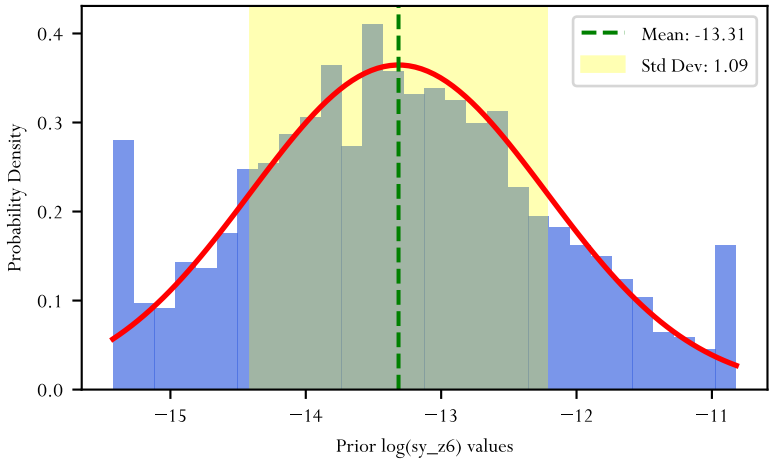

Mean: -8.77
Std Dev: 1.09
Probability Density
Posterior log(sy_z3) values

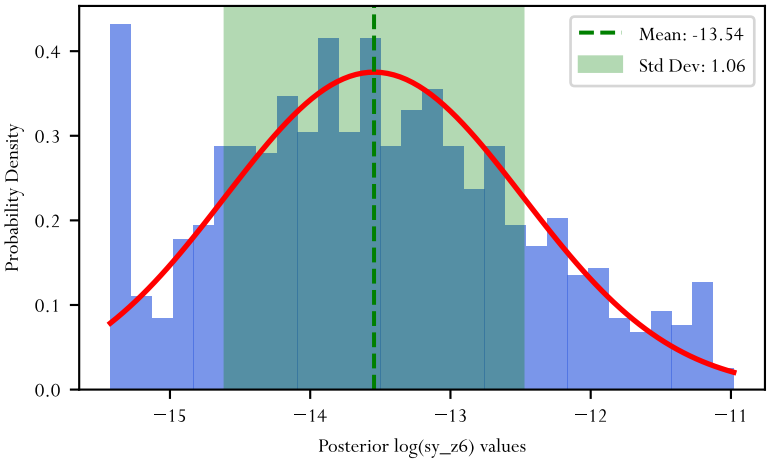

Mean: -12.12
Std Dev: 1.06
Probability Density
Prior log(sy_z4) values

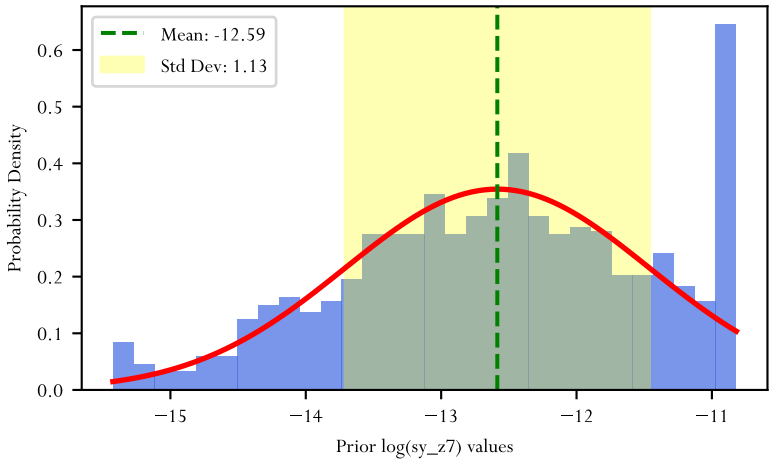

Mean: -12.44
Std Dev: 1.02
Probability Density
Posterior log(sy_z4) values

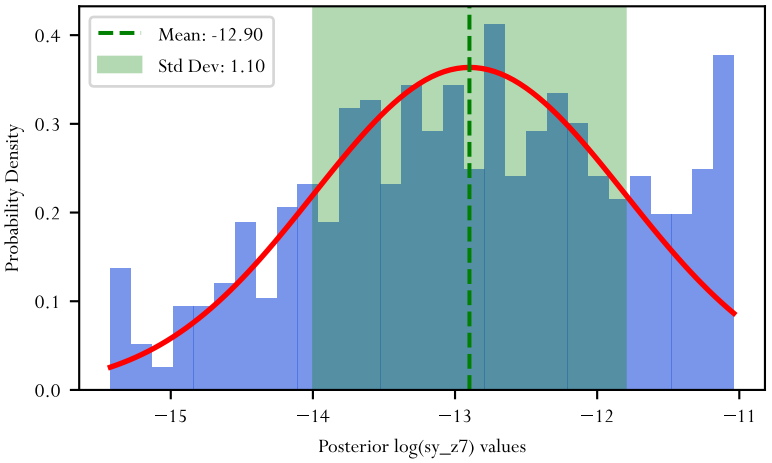

Mean: -13.32
Std Dev: 1.09
Probability Density
Prior log(sy_z5) values

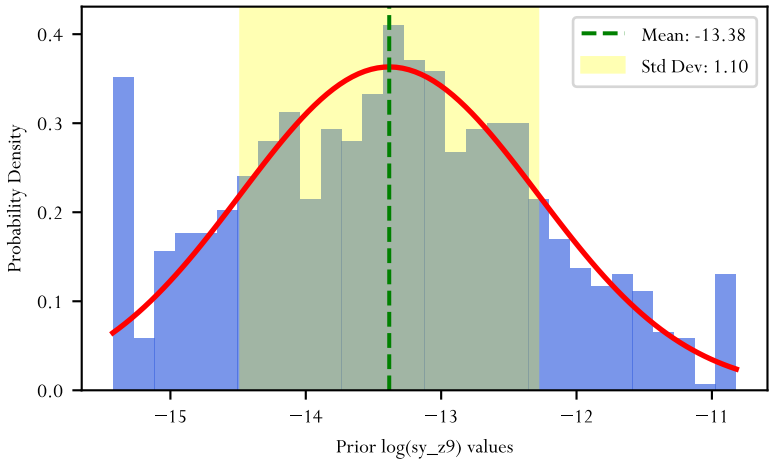

Mean: -13.52
Std Dev: 1.06
Probability Density
Posterior log(sy_z5) values

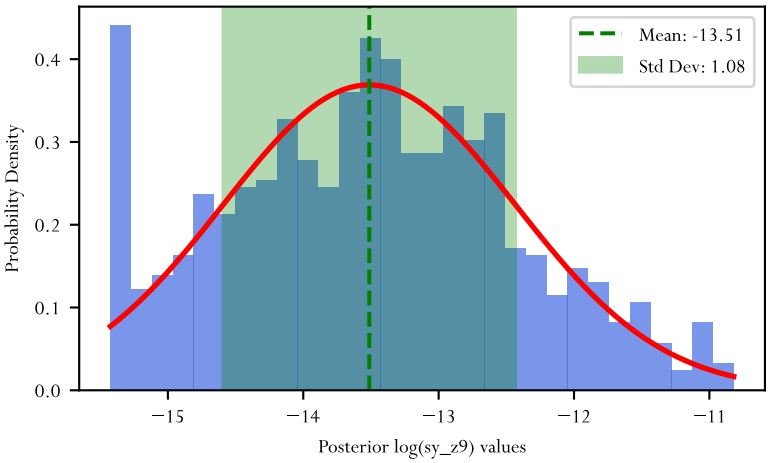

Mean: -13.31
Std Dev: 1.09
Probability Density
Prior log(sy_z6) values

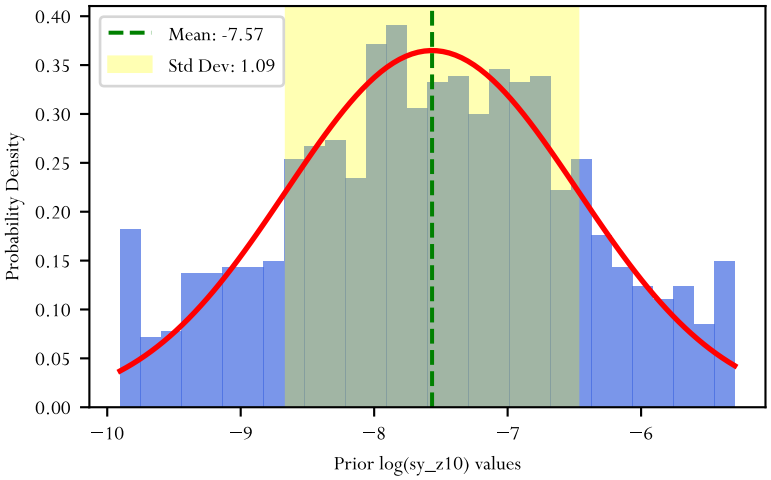

Mean: -13.54
Std Dev: 1.06
Probability Density
Posterior log(sy_z6) values

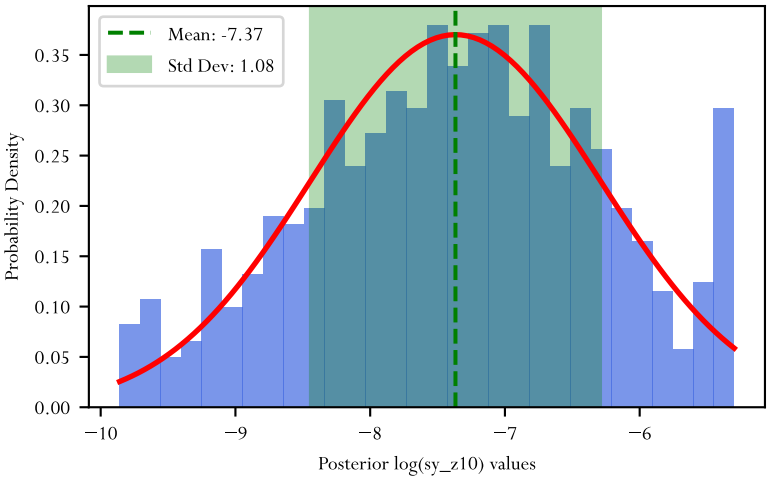

Mean: -12.59
Std Dev: 1.13
Probability Density
Prior log(sy_z7) values

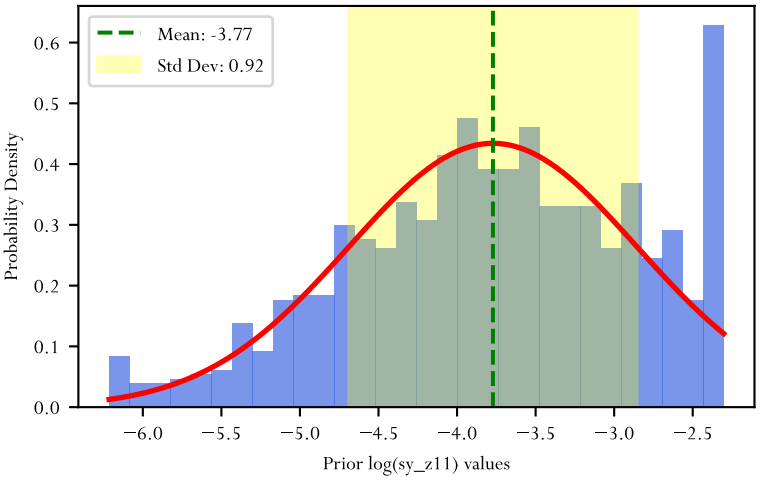

Mean: -12.90
Std Dev: 1.10
Probability Density
Posterior log(sy_z7) values

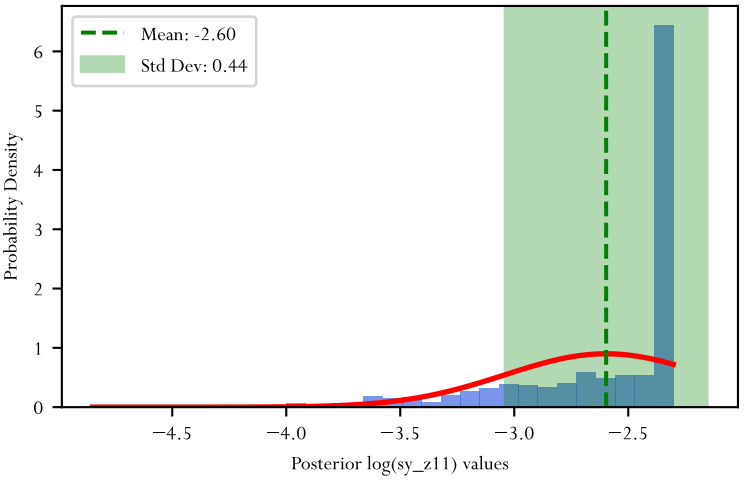

Mean: -13.38
Std Dev: 1.10
Probability Density
Prior log(sy_z9) values


Mean: -13.51
Std Dev: 1.08
Probability Density
Posterior log(sy_z9) values


Mean: -7.57
Std Dev: 1.09
Probability Density
Prior log(sy_z10) values


Mean: -7.37
Std Dev: 1.08
Probability Density
Posterior log(sy_z10) values


Mean: -3.77
Std Dev: 0.92
Probability Density
Prior log(sy_z11) values


Mean: -2.60
Std Dev: 0.44
Probability Density
Posterior log(sy_z11) values

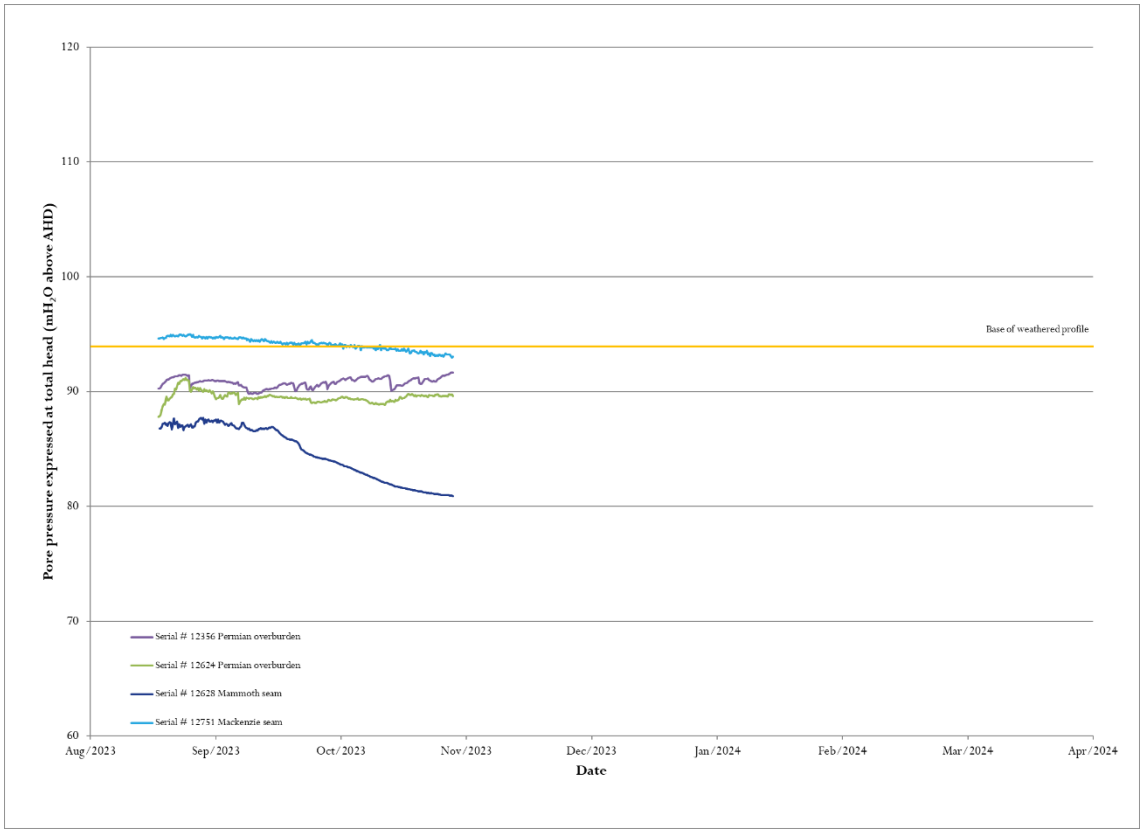
Appendix D Summary of bore data used to develop the conceptual and numerical models

Table D1 Registered water bores

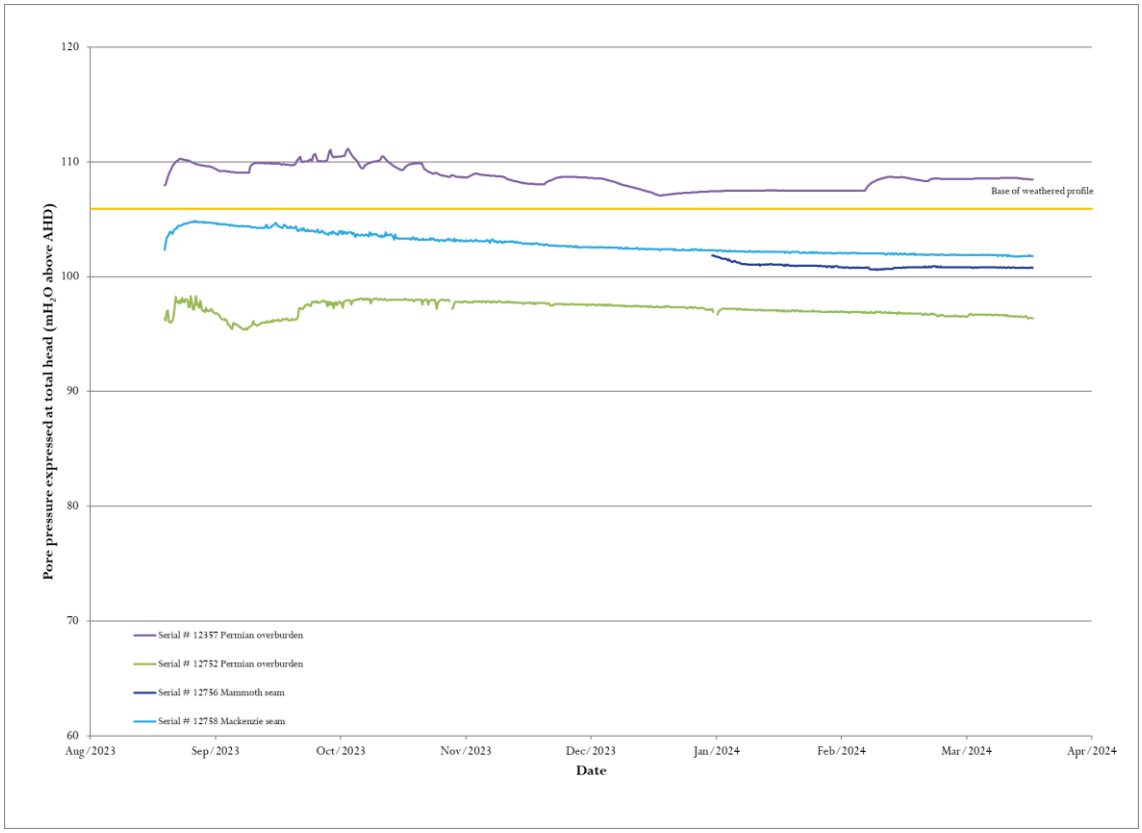
RN	Hole ID	Type	Status	GIS Latitude	GIS Longitude	Easting GDA94 Zone 55	Northing GDA94 Zone 55	Date drilled	Surface Elevation (mAHD)	Screen interval (mbGL)	Base of Casing/hole	Target unit
97709	-	Sub-Artesian Facility	Abandoned but Still Usable	-23.38007174	148.8276055	686789	7413223	12/03/1998 0:00	131.79	-	57.00	-
97710	-	Sub-Artesian Facility	Abandoned and Destroyed	-23.38087612	148.8293892	686971	7413131	13/03/1998 0:00	129.41	-	30.48	-
97711	-	Sub-Artesian Facility	Abandoned and Destroyed	-23.37989682	148.8290045	686933	7413240	13/03/1998 0:00	118.03	-	12.19	-
111877	Duaringa Shire Council	Sub-Artesian Facility	Abandoned and Destroyed	-23.37279725	148.8386773	687931	7414014	28/04/2002 0:00	-	21.30 - 22.80	22.80	Mackenzie River Alluvium
151856	-	Sub-Artesian Facility	Existing	-23.38917305	148.8263302	686646	7412217	1/03/2013 0:00	-	-	70.10	-
151857	-	Sub-Artesian Facility	Abandoned and Destroyed	-23.37649966	148.8380171	687859	7413605	4/03/2012 0:00	-	-	91.40	-
151858	-	Sub-Artesian Facility	Abandoned and Destroyed	-23.37517223	148.8353299	687586	7413756	6/03/2012 0:00	-	-	182.90	-
158166	JMR22WA	Sub-Artesian Facility	Abandoned and Destroyed	-23.22918356	148.9263954	697111	7429802	22/11/2012 0:00	122.20	15.00 - 18.00	19.00	Mackenzie River Alluvium
158168	JMR21WA	Sub-Artesian Facility	Existing	-23.2598222	148.9020596	694576	7426442	24/11/2012 0:00	122.30	15.00 - 18.00	19.00	Mackenzie River Alluvium
158169	JMR25WA	Sub-Artesian Facility	Existing	-23.24967092	148.9193599	696361	7427543	27/11/2012 0:00	122.50	18.00 - 21.00	22.00	Mackenzie River Alluvium
158178	JMR26WA	Sub-Artesian Facility	Existing	-23.26540657	148.9214174	696548	7425797	30/11/2012 0:00	123.4	17.00 - 20.00	22.00	Mackenzie River Alluvium
158200	JMR 4WP	Sub-Artesian Facility	Existing	-23.25469316	148.9143891	695845	7426993	14/12/2009 0:00	124	82.00 - 88.00	88.00	Rangal Coal measures
158201	JMR 4WA	Sub-Artesian Facility	Existing	-23.25469926	148.9143936	695845	7426993	14/12/2009 0:00	123.80	36.00 - 42.00	42.00	Mackenzie River Alluvium
158202	JMR 5WA	Sub-Artesian Facility	Existing	-23.25001002	148.9077613	695173	7427521	13/12/2009 0:00	122.2	11.00 - 17.00	17.00	Mackenzie River Alluvium
158203	JMR 15WA	Sub-Artesian Facility	Existing	-23.2398092	148.9113361	695554	7428646	12/11/2009 0:00	119.30	7.00 - 13.00	13.00	Mackenzie River Alluvium
158204	JMR 15 WP	Sub-Artesian Facility	Existing	-23.23981024	148.9113369	695554	7428646	12/11/2009 0:00	119.30	83.00 - 89.00	89.00	Rangal Coal measures
158206	JMR 16 WA	Sub-Artesian Facility	Existing	-23.23050734	148.9047715	694896	7429685	29/11/2009 0:00	122.10	11.00 - 18.00	18.00	Mackenzie River Alluvium
158207	JMR 16 WP	Sub-Artesian Facility	Existing	-23.23049731	148.9047961	694898	7429686	29/11/2009 0:00	122.10	68.00 - 75.00	75.00	Rangal Coal measures
158208	JMR 17WP	Sub-Artesian Facility	Existing	-23.22585453	148.9117773	695620	7430191	30/11/2009 0:00	121.80	42.00 - 48.00	42.00	Rangal Coal measures
158720	MB1309 NORTHERN	Sub-Artesian Facility	Existing	-23.28881084	148.84877	689082	7423302	11/07/2013 0:00	125.18	12.00 - 18.00	18.00	Mackenzie River Alluvium
158721	MB1312 SOUTHERN	Sub-Artesian Facility	Existing	-23.29046446	148.8494381	689148	7423118	12/07/2013 0:00	126.76	11.00 - 17.00	17.00	Mackenzie River Alluvium
158940	1426MB	Sub-Artesian Facility	Existing	-23.31961804	148.8687803	691085	7419864	25/11/2014 0:00	129.29	12.00 - 26.00	26.00	-
158952	1420MB	Sub-Artesian Facility	Existing	-23.32826624	148.8876637	693004	7418881	19/11/2014 0:00	138.43	1.20 - 15.00	15.00	Duaringa Formation
158953	1419MB	Sub-Artesian Facility	Existing	-23.32871881	148.8884461	693083	7418830	20/11/2014 0:00	138.46	1.20 - 15.00	15.00	Duaringa Formation
158954	1411MB	Sub-Artesian Facility	Existing	-23.29145881	148.8477552	688974	7423010	21/11/2014 0:00	128.84	9.00 - 20.00	20.00	Mackenzie River Alluvium
158955	1430MB	Sub-Artesian Facility	Existing	-23.29672294	148.8692804	691169	7422399	22/11/2014 0:00	127.56	12.00 - 27.00	27.00	Mackenzie River Alluvium
158956	1425MB	Sub-Artesian Facility	Existing	-23.33871525	148.8704541	691229	7417747	24/11/2014 0:00	125.12	16.00 - 19.00	19.00	Mackenzie River Alluvium
158957	1432MB	Sub-Artesian Facility	Existing	-23.3479627	148.8695488	691123	7416724	25/11/2014 0:00	134.75	3.00 - 5.00	5.00	Mackenzie River Alluvium
158958	1428MB	Sub-Artesian Facility	Existing	-23.33174945	148.870721	691266	7418518	26/11/2014 0:00	127.90	13.00 - 26.00	26.00	Mackenzie River Alluvium
158959	1410MB	Sub-Artesian Facility	Existing	-23.29026577	148.846446	688842	7423144	27/11/2014 0:00	126.69	10.00 - 18.00	18.00	Mackenzie River Alluvium
161564	-	Sub-Artesian Facility	Existing	-23.37957274	148.8231169	686331	7413284	8/12/2016 0:00	-	4.50 - 7.50	10.00	Mackenzie River Alluvium
165303	1534MB	Sub-Artesian Facility	Existing	-23.30333881	148.8534484	689540	7421687	20/07/2015 0:00	133.30	26.60 - 32.60	32.60	Rangal Coal measures
165304	1533MB	Sub-Artesian Facility	Existing	-23.30332202	148.8533406	689529	7421689	20/07/2015 0:00	133.20	20.50 - 26.50	26.90	Mackenzie River Alluvium
165305	1531MB	Sub-Artesian Facility	Existing	-23.25943867	148.8767553	691987	7426518	20/07/2015 0:00	126.35	20.50 - 26.50	18.00	Mackenzie River Alluvium
165306	1529MB	Sub-Artesian Facility	Existing	-23.34356108	148.8698586	691161	7417211	20/07/2015 0:00	123.81	32.80 - 38.80	38.80	Rangal Coal measures

RN	Hole ID	Type	Status	GIS Latitude	GIS Longitude	Easting GDA94 Zone 55	Northing GDA94 Zone 55	Date drilled	Surface Elevation (mAHD)	Screen interval (mbGL)	Base of Casing/hole	Target unit
165446	JMR5WP	Sub-Artesian Facility	Existing	-23.24997064	148.9078744	695185	7427525		122.20	83.00 - 89.00	89.00	Rangal Coal measures
165547	1847MB	Sub-Artesian Facility	Existing	-23.32490786	148.8704285	691246	7419276	30/04/2018 0:00	-	76.50 - 85.50	110.00	-
165548	1848MB	Sub-Artesian Facility	Existing	-23.32241427	148.8697874	691184	7419553	30/04/2018 0:00	-	85.50 - 94.50	1140.00	-
190046	2060MB	Sub-Artesian Facility	Existing	-23.30952256	148.8725792	691488	7420977	27/04/2020 0:00	-	18.00 - 24.00	25.00	-
190047	2061MB	Sub-Artesian Facility	Existing	-23.32591743	148.8856375	692800	7419144	28/04/2020 0:00	-	26.50 - 32.50	34.00	-
190127	-	Sub-Artesian Facility	Existing	-23.27112004	148.8860575	692922	7425212	6/06/2020 0:00	-	13.00 - 19.00	20.40	Mackenzie River Alluvium
190159	JC0894P	Sub-Artesian Facility	Abandoned and Destroyed	-23.36098681	148.9599935	700352	7415159	15/07/2020 0:00	148.58	VWP	146.00	-
190160	JPS0197P	Sub-Artesian Facility	Existing	-23.34542436	148.9524307	699602	7416893	16/07/2020 0:00	146.95	VWP	166.50	-
190161	JP0963P	Sub-Artesian Facility	Existing	-23.31731271	148.9315467	697508	7420035	4/08/2020 0:00	138.94	VWP	200.70	-

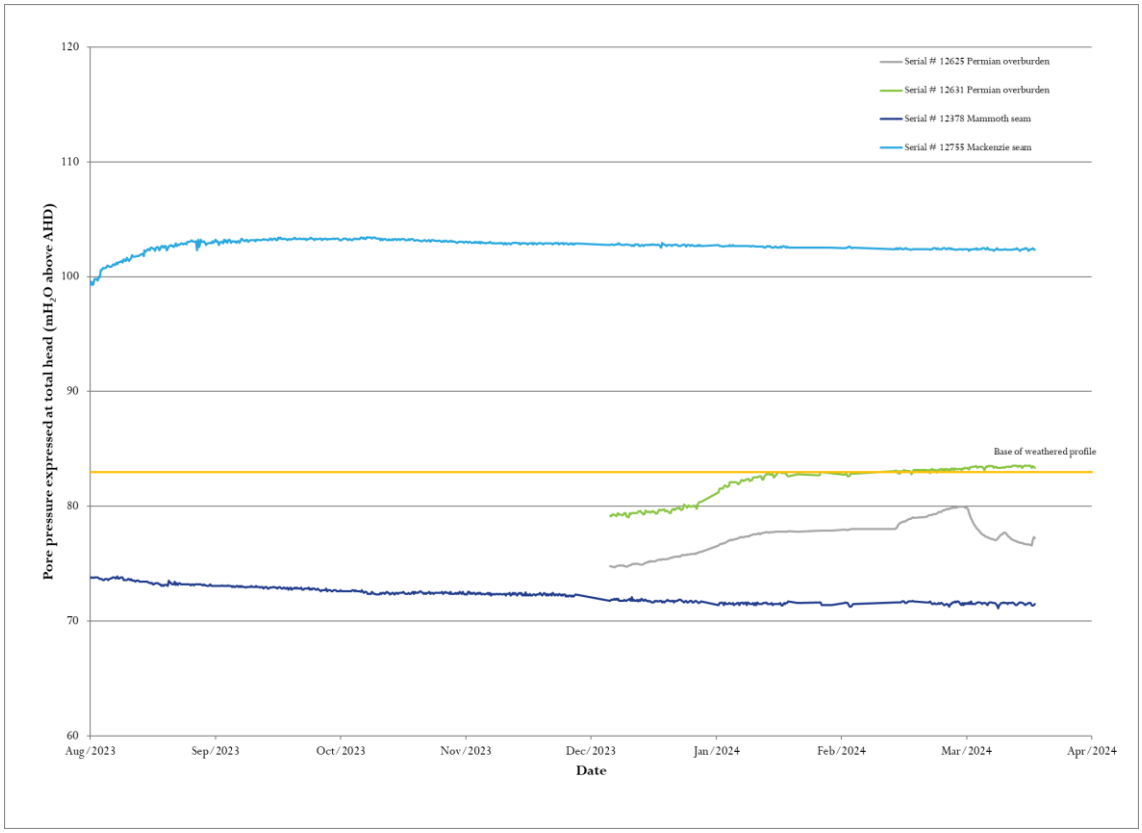
Appendix E Hydrographs



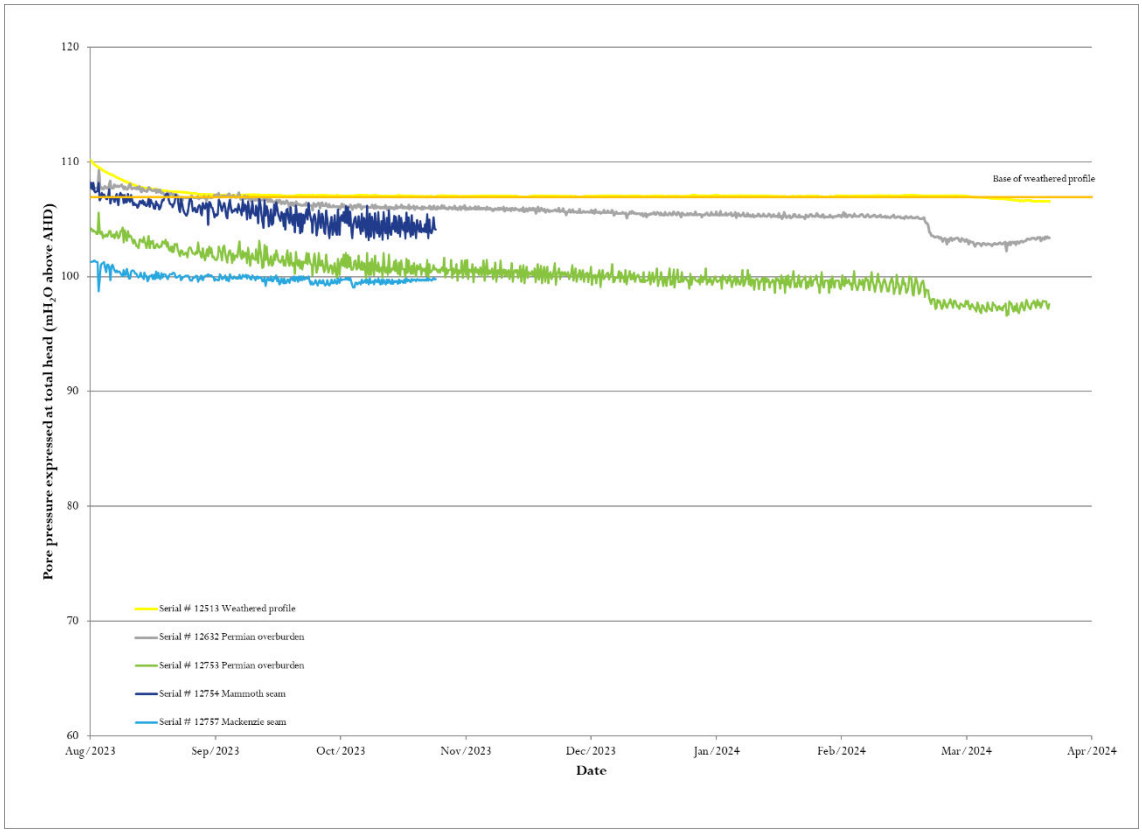
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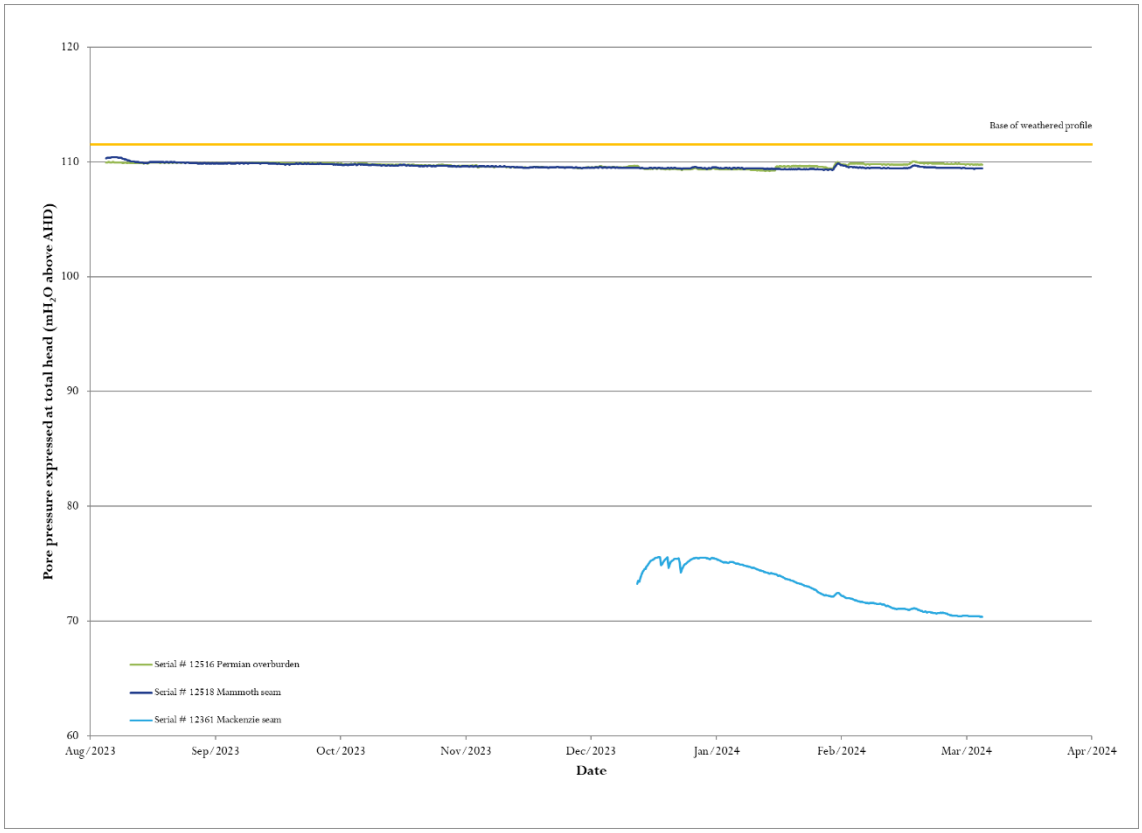
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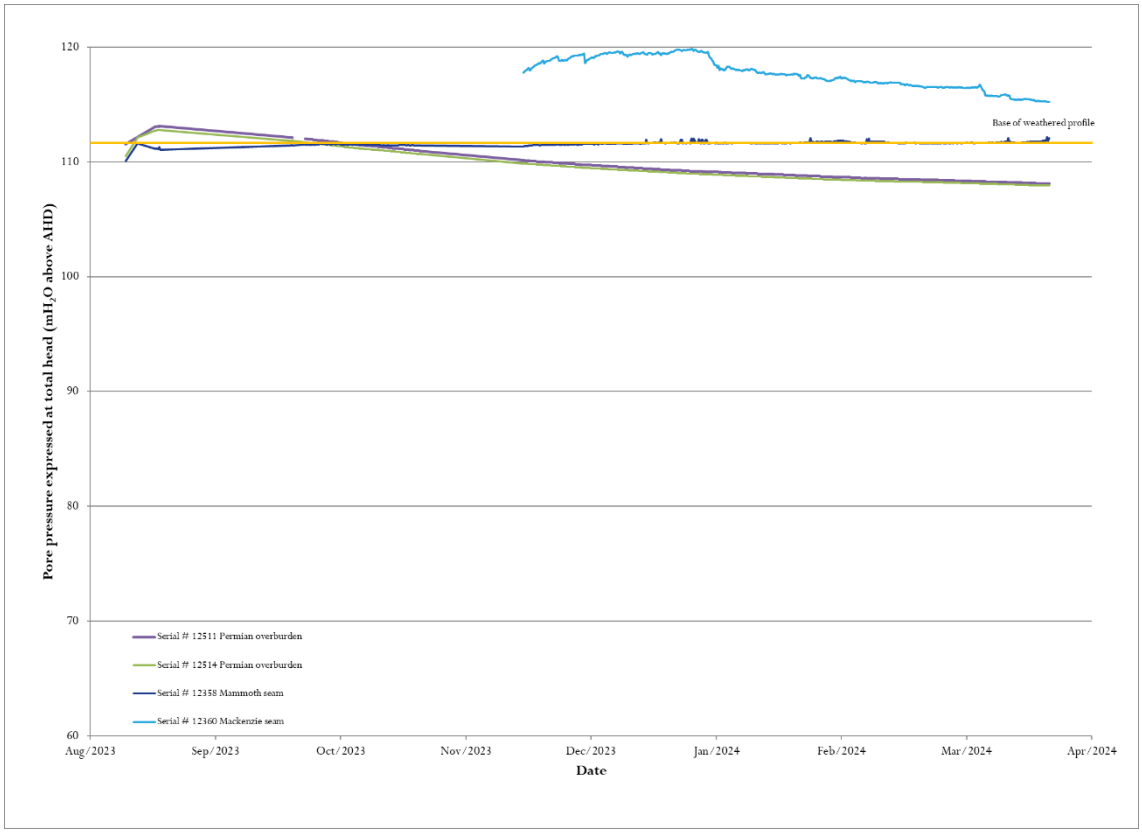
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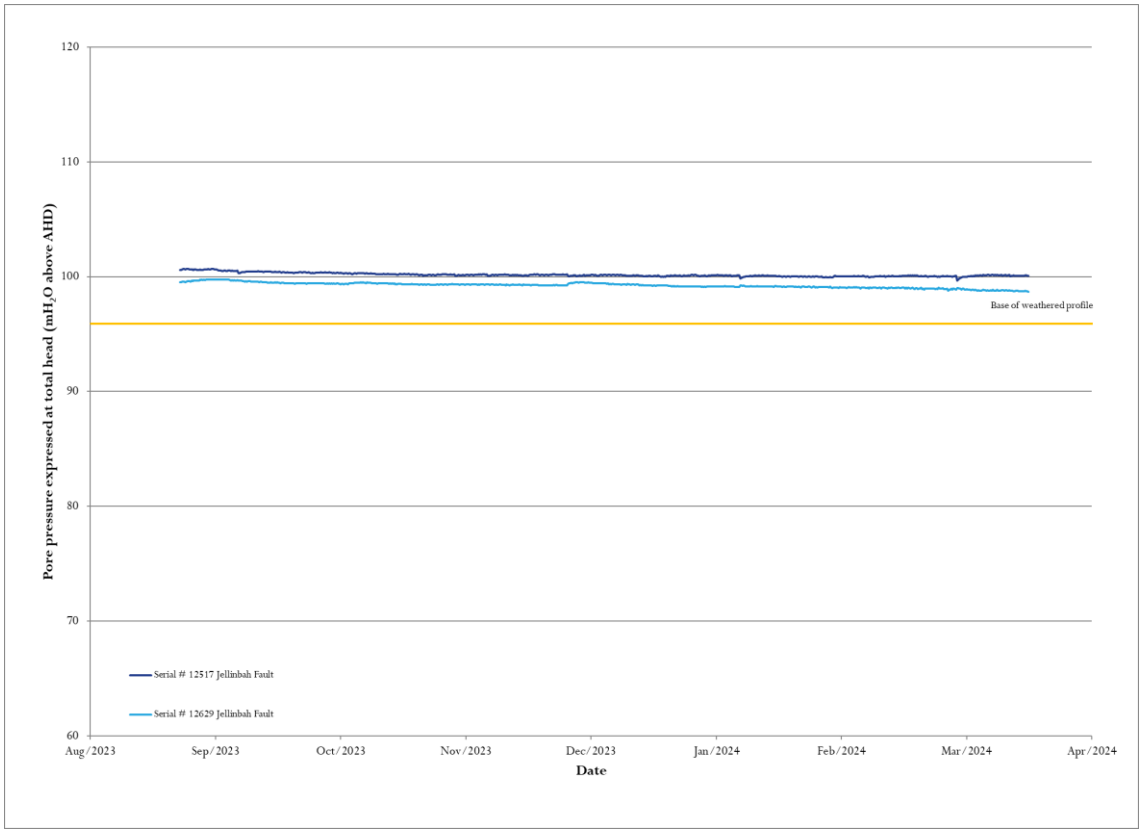
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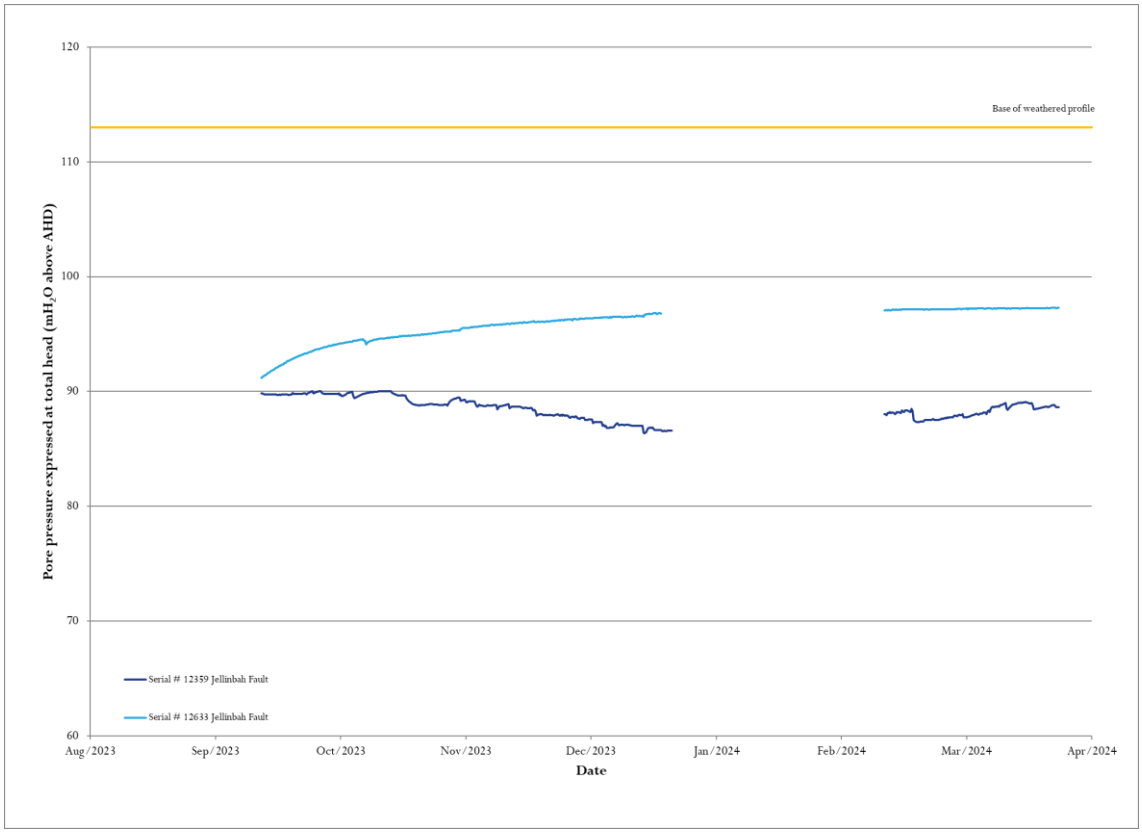
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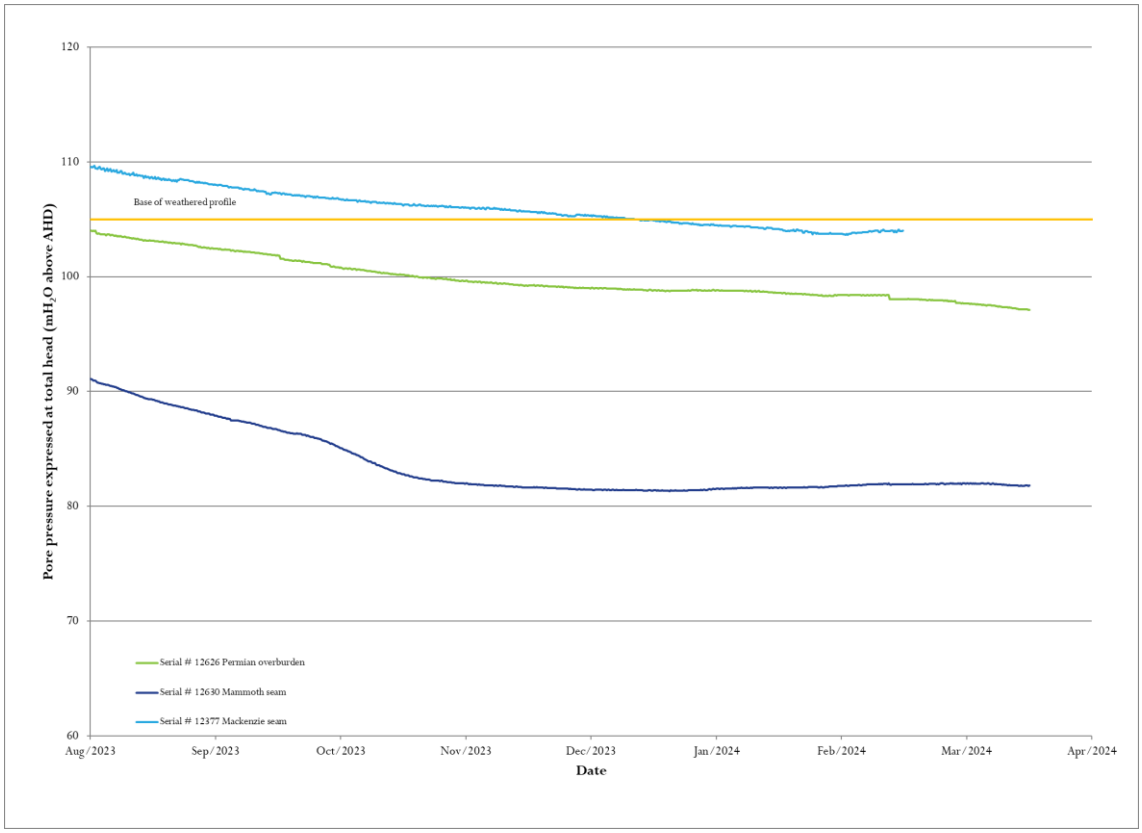
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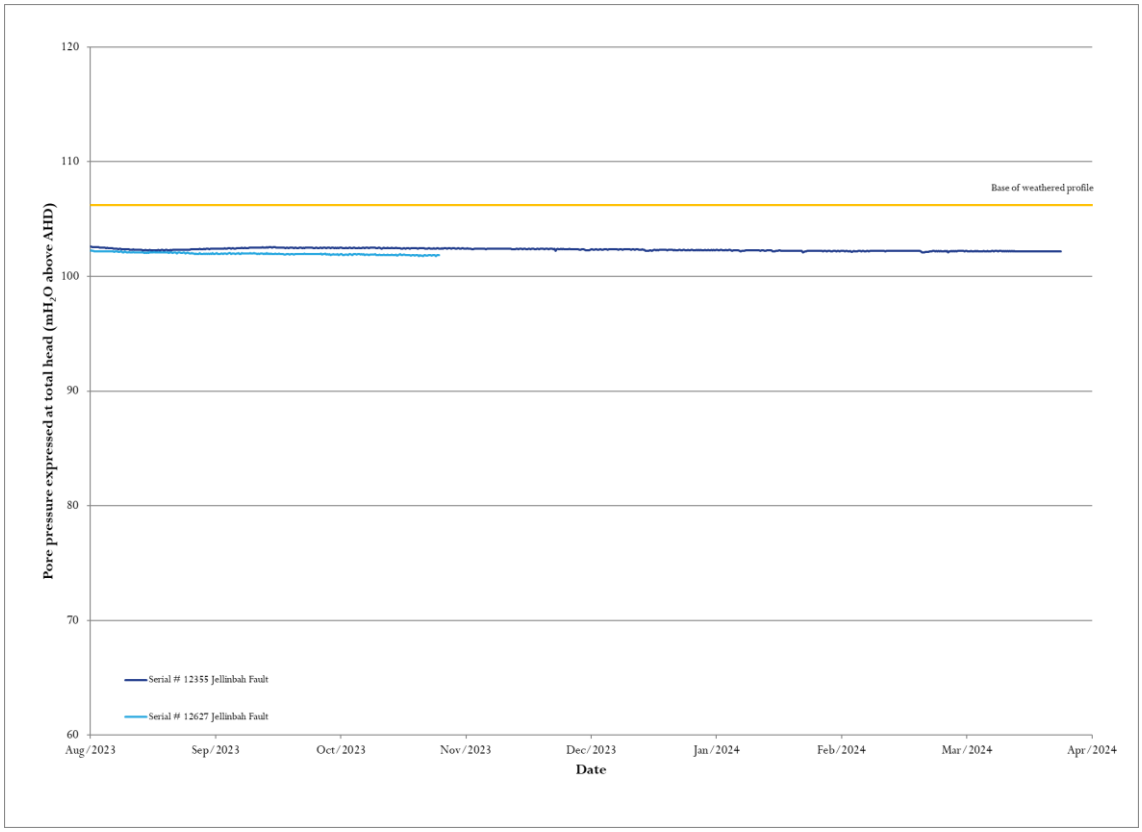
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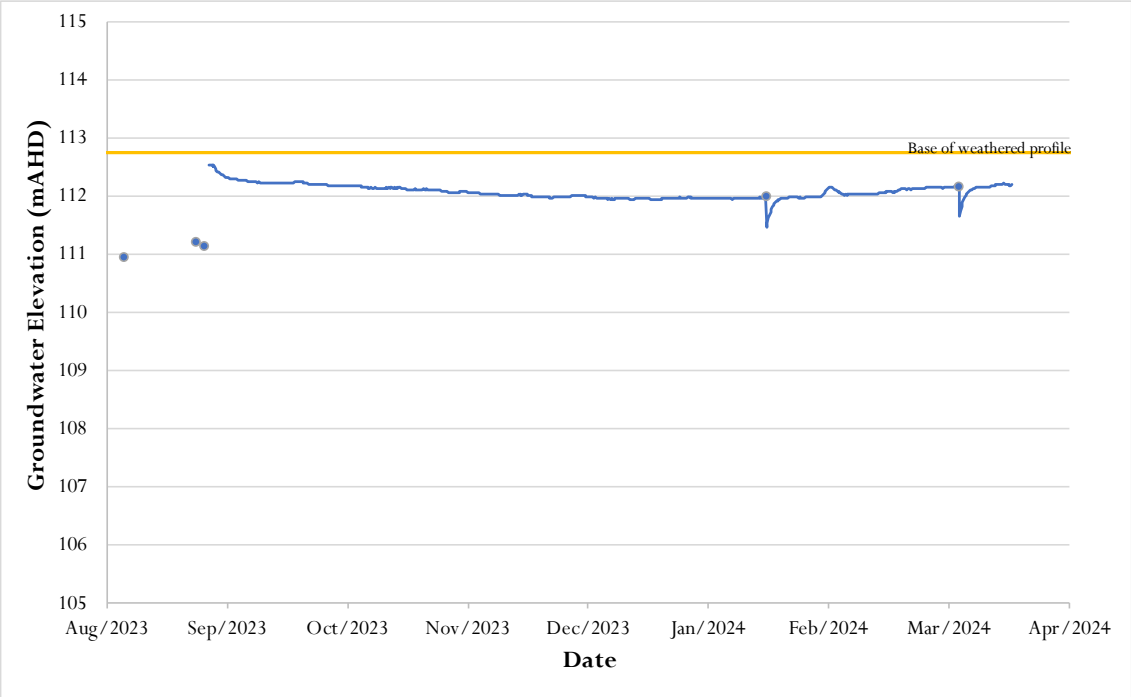
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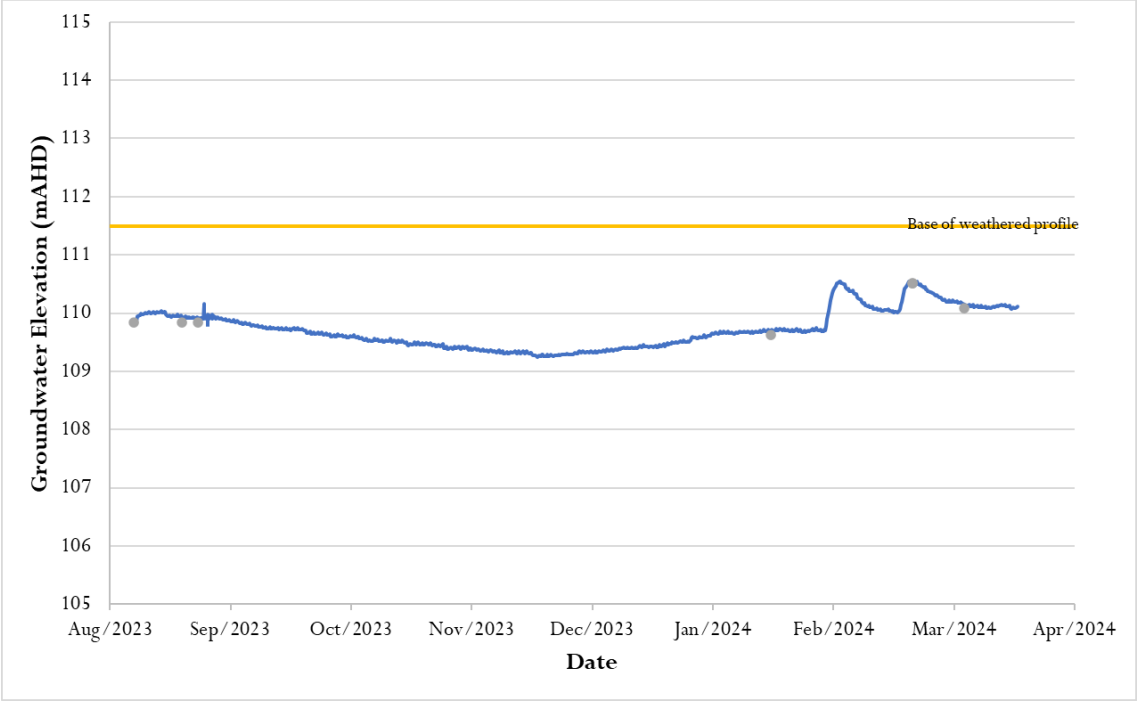
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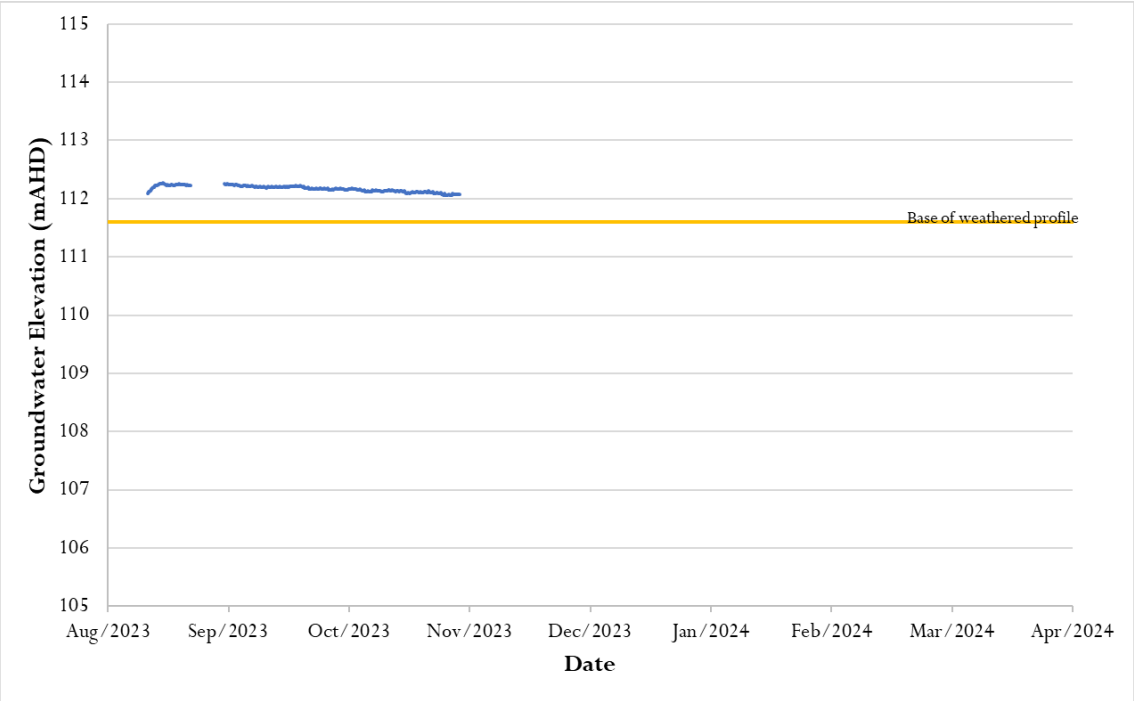
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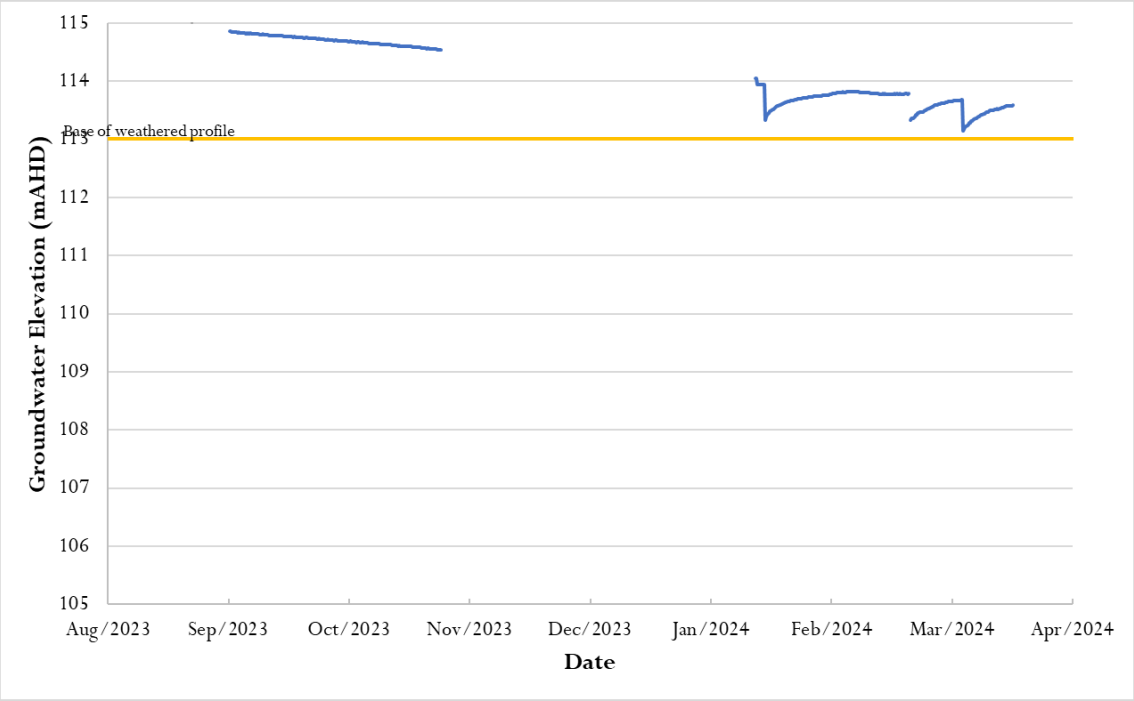
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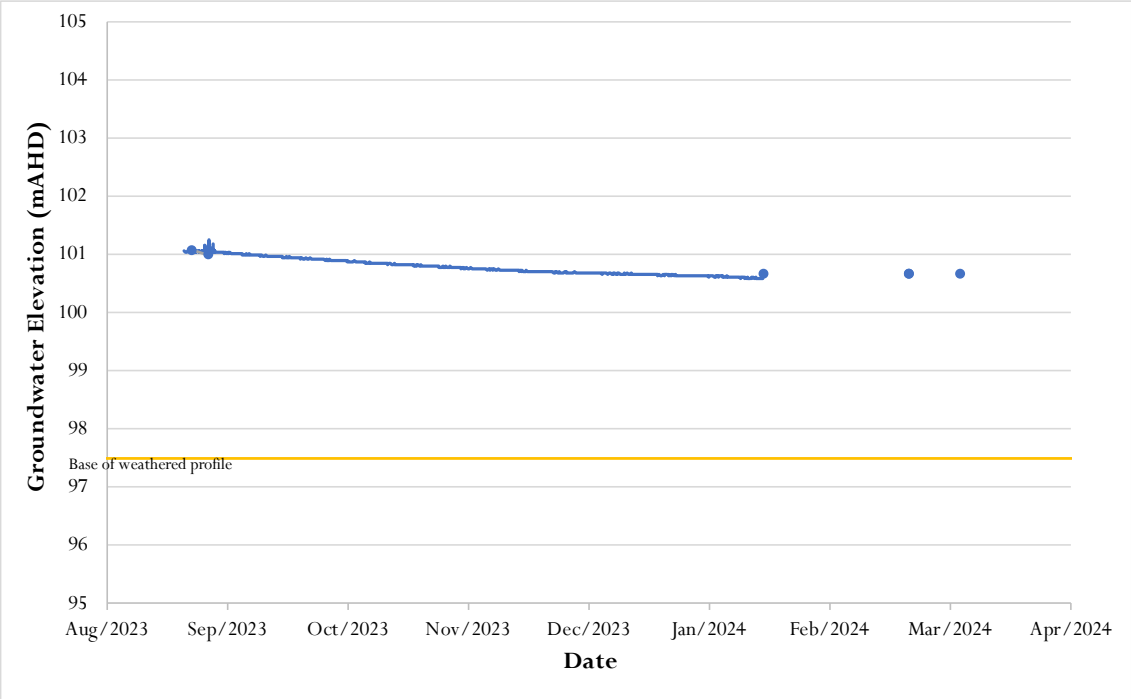
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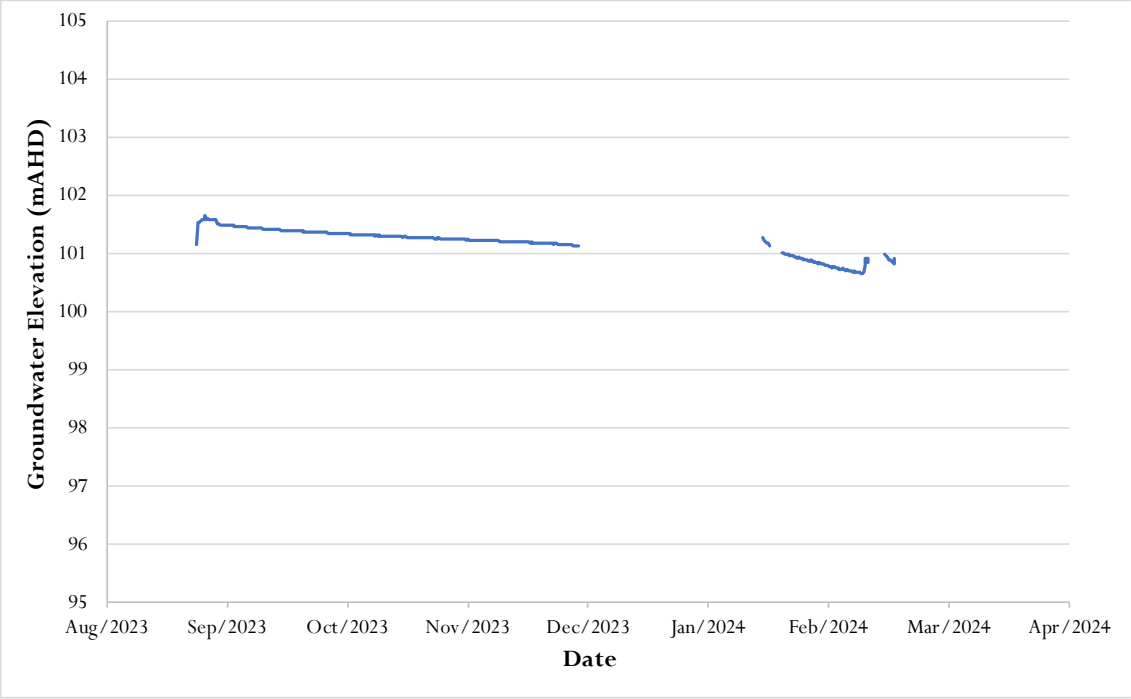
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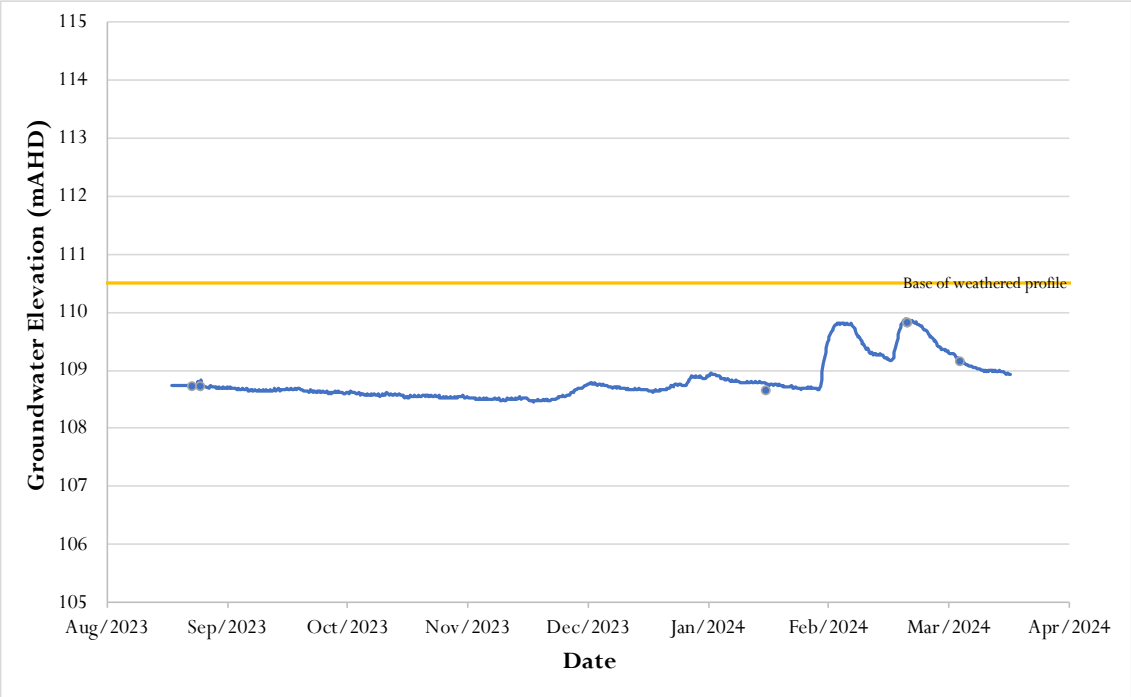
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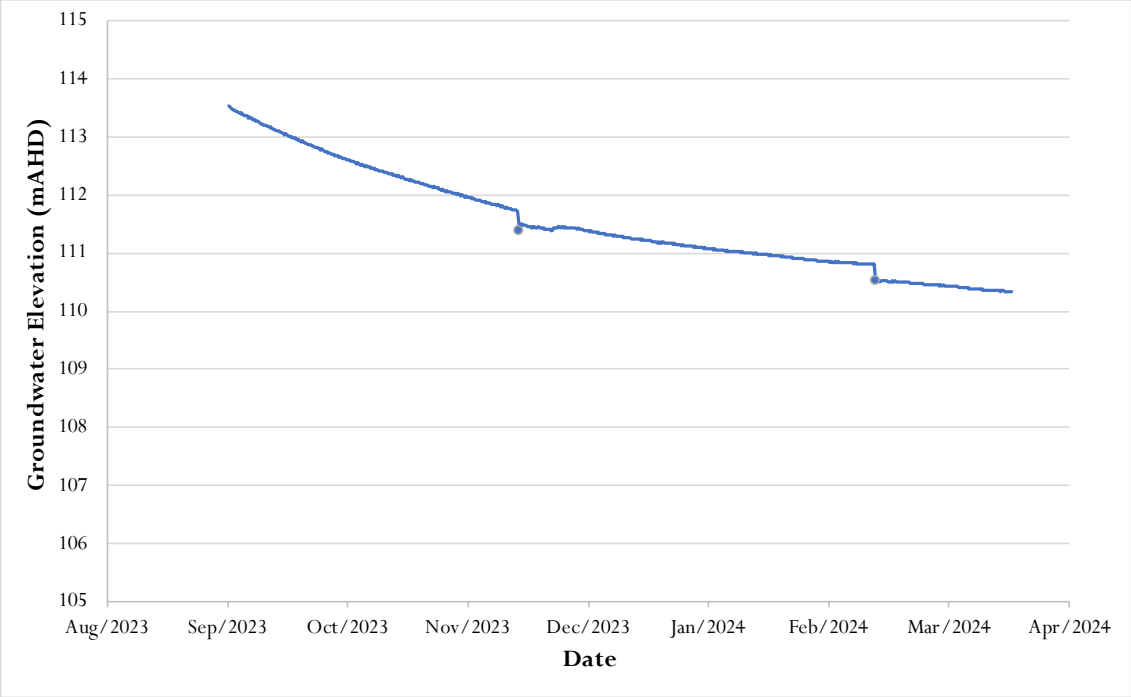
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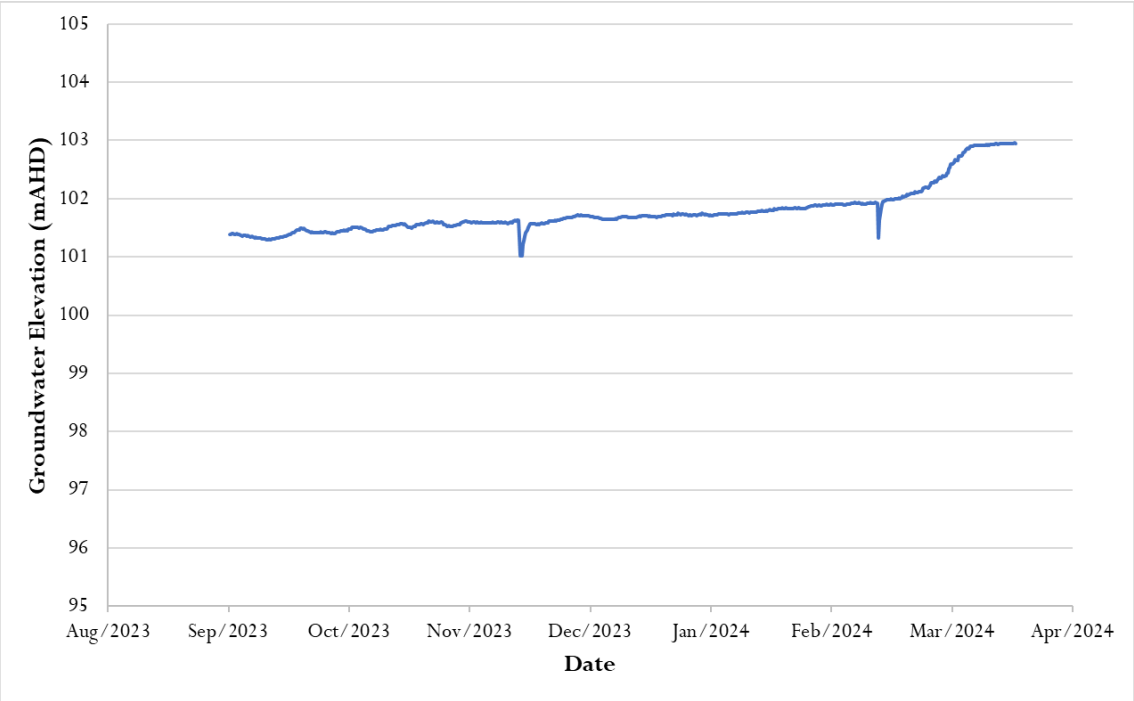
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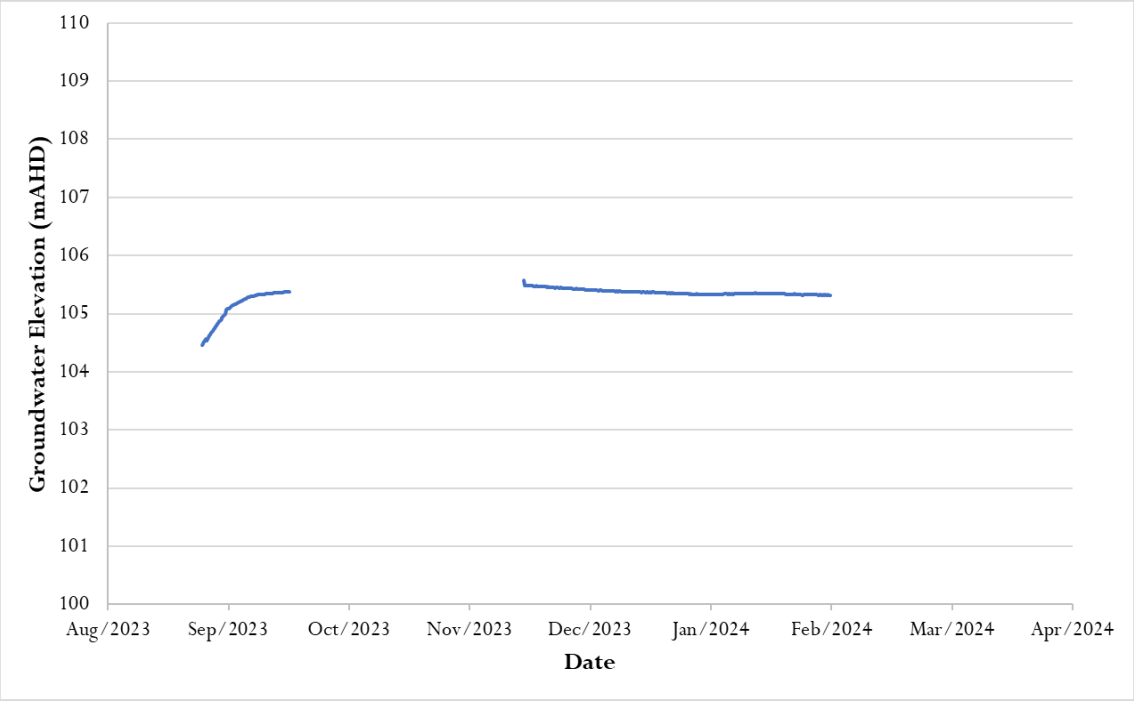
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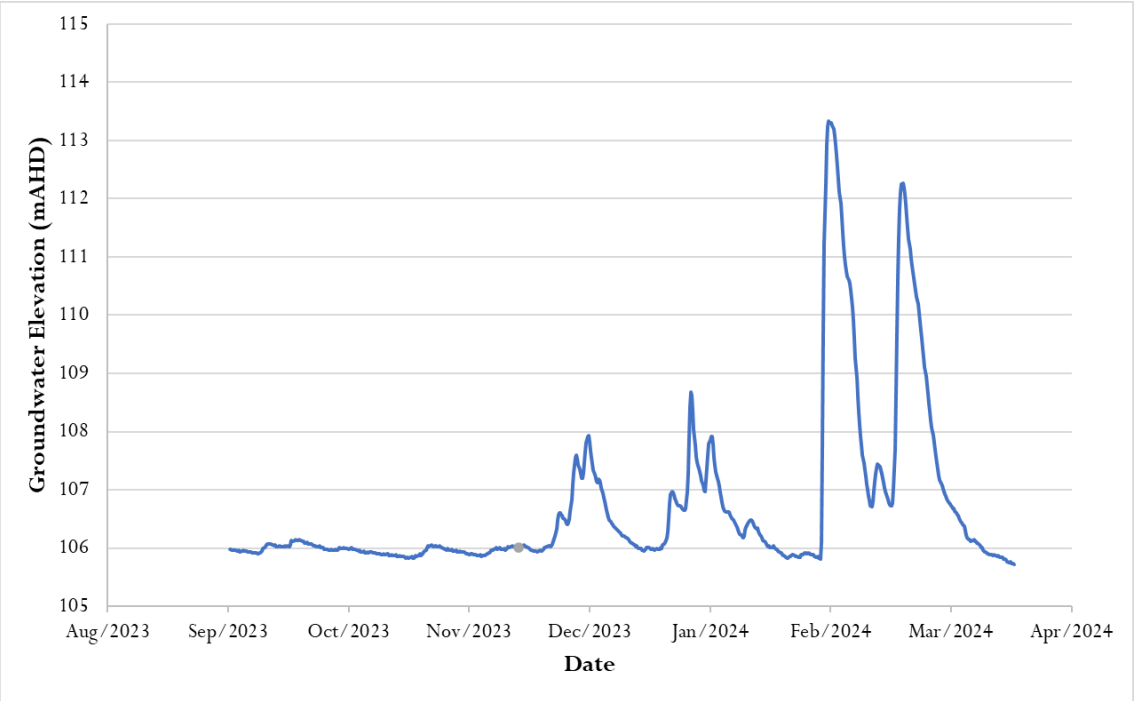
1411


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Groundwater Elevation (mAHD)
Aug/2023
Sep/2023
Oct/2023
Nov/2023
Dec/2023
Jan/2024
Feb/2024
Mar/2024
Apr/2024
Date

1534


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108
107
106
105
104
103
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100
Groundwater Elevation (mAHD)
Aug/2023
Sep/2023
Oct/2023
Nov/2023
Dec/2023
Jan/2024
Feb/2024
Mar/2024
Apr/2024
Date

1426


115
114
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105
Groundwater Elevation (mAHD)
Aug/2023
Sep/2023
Oct/2023
Nov/2023
Dec/2023
Jan/2024
Feb/2024
Mar/2024
Apr/2024
Date

1529

APPENDIX C

Terrestrial Ecology Report

HANSEN
ENVIRONMENTAL
CONSULTING

ECO SOLUTIONS
& MANAGEMENT

CURRAGH BORD AND PILLAR MINE PROJECT
TERRESTRIAL ECOLOGY REPORT

May 2024

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Symbols and Abbreviations

*	(Preceding a plant species name) plant species not native to Australia
±	With or without, more or less
Biosecurity Act	(Queensland) Biosecurity Act 2014
BoM	Bureau of Meteorology
BPA	Biodiversity Planning Assessment
CI	Crown Intercept
DAF	(Queensland) Department of Agriculture and Fisheries
DAWE	Former (Commonwealth) Department of Agriculture, Water and the Environment
DEECCW	(Commonwealth) Department of Climate Change, Energy, the Environment and Water
DESI	(Queensland) Department of Environment, Science and Innovation
DNRM	Former (Queensland) Department of Natural Resources and Mines
DoR	(Queensland) Department of Resources
DotE	Former (Commonwealth) Department of the Environment
EDL	Ecologically Dominant Layer
EEM	Ecological Equivalence Methodology
EHP	(Queensland) Department of Environment and Heritage Protection
EO Act	(Queensland) Environmental Offsets Act 2014
EP Act	(Queensland) Environmental Protection Act 1994
EPBC Act	(Commonwealth) Environment Protection and Biodiversity Conservation Act 1999
ESA	Environmentally Sensitive Area
GBO	General biosecurity obligation
GDE	Groundwater dependent ecosystem

GES	General ecological significance
GPS	Global positioning system
ha	Hectares
HES	High ecological significance
HRA	High risk area
km	Kilometres
ML	Mining lease
MSES	Matters of state environmental significance (EO Act)
NC Act	(Queensland) Nature Conservation Act 1992
NC Regulation	(Queensland) Nature Conservation (Wildlife) Regulation 2006
NC WM Regulation	(Queensland) Nature Conservation (Wildlife Management) Regulation 2006
QEOP	Queensland Environmental Offsets Policy 2014
RE	Regional Ecosystem as defined under the Queensland Vegetation Management Regulation 2000
REDD	Regional Ecosystem Description Database
SRI Guideline	Queensland Environmental Offsets Policy Significant Residual Impact Guideline
VM Act	(Queensland) Vegetation Management Act 1999
WPA	Wetland protection area

Glossary

Term	Definition
Biodiversity Status	This is a Queensland Government classification dependent on condition of remnant vegetation *in addition* to the criteria used to determine class under the Queensland *Vegetation Management Act 1999*. This classification is used for a range of planning and management applications, i.e. to determine environmentally sensitive areas. A regional ecosystem is listed as 'endangered' if: ▪ Less than 10% of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss; or ▪ 10-30% of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 ha; or ▪ It is a rare regional ecosystem subject to a threatening process. A regional ecosystem is listed as 'of concern' if: ▪ 10-30% of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss. A regional ecosystem is listed as 'no concern at present' if: ▪ The degradation criteria listed above for 'endangered' or 'of concern' regional ecosystems is not met.
Benchmark condition	Benchmark condition describes the standard or typical condition of a particular RE in an undisturbed condition and is determined from an average value from mature and long undisturbed reference of 'Best on Offer' site (Eyre et al., 2015). Benchmarks are developed by the Queensland Government for various vegetation communities, but not all at this stage.
Bioregion	A geographically distinct biological region, which is a reporting unit for assessing the status of native ecosystems and their level of protection. Australia is divided into 89 bioregions. Bioregions form part of the regional ecosystem classification code system. The study area is located in the Isaac – Comet Downs sub-region of the Brigalow Belt Bioregion.
Environmentally Sensitive Area (ESA)	Defined under the Environmental Protection Regulation 2008, a Category A Environmentally Sensitive Area is: ▪ a national park, conservation park or forest reserve under the *Nature Conservation Act 1992* ▪ the wet tropics area under the Wet Tropics World Heritage Protection and Management Act 1992 ▪ the Great Barrier Reef Region under the *Great Barrier Reef Marine Park Act 1975*

Term	Definition
	▪ a marine park under the *Marine Parks Act 2004*. A Category B Environmentally Sensitive Area is: ▪ a coordinated conservation area, a wilderness area, a World Heritage management area, an international agreement area, an area of critical habitat or major interest identified under a conservation plan or an area subject to an interim conservation order under the *Nature Conservation Act 1992* ▪ an area subject to the Bonn, Ramsar or Paris Conventions ▪ a zone of a marine park under the *Marine Parks Act 2004* ▪ an area to the seaward side of the highest astronomical tide ▪ a place of cultural heritage significance or a registered place under the *Queensland Heritage Act 1992* ▪ an area recorded in the Aboriginal Cultural Heritage Register under the *Aboriginal Cultural Heritage Act 2003* ▪ a feature protection area, State forest park or scientific area under the *Forestry Act 1959* ▪ a declared fish habitat or place of a marine plant area under the *Fisheries Act 1994* ▪ an endangered regional ecosystem identified in the database known as the 'Regional ecosystem description database'.
Matters of state environmental significance (MSES)	A matter of State environmental significance listed in Schedule 2 of the Queensland Environmental Offsets Regulation 2014, including: ▪ Regulated vegetation ▪ Connectivity areas ▪ Wetlands and watercourses ▪ High preservation areas of wild river areas ▪ Protected wildlife habitat ▪ Protected areas ▪ Highly protected zones of State marine parks ▪ Fish habitat areas ▪ Waterways providing for fish passage ▪ Marine plants ▪ Legally secured offset areas.
NC Act conservation status	Under the *Nature Conservation Act 1992*, native wildlife may be prescribed as: Extinct: ▪ There is no reasonable doubt the last member of the species had died.

Term	Definition
	Extinct in the wild: ▪ The wildlife is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or ▪ The wildlife is not known to survive in its known or expected habitat, in its past range, over a period appropriate for the life cycle or form of the wildlife. Critically endangered: ▪ The wildlife has undergone or is suspected to have undergone a very large reduction in numbers; or ▪ It is likely that a very large reduction in the wildlife's numbers is imminent; or ▪ The wildlife's geographic distribution is precarious for the survival of the wildlife and very restricted; or ▪ The estimated total number of mature individuals is very low and it is likely the number will continue to decline at a very high rate, or continue to decline, and its geographic distribution is precarious for the survival of the wildlife; or ▪ The estimated total number of mature individuals is extremely low; or ▪ The probability of the wildlife' extinction in the wild is at least 50% in the immediate future. Endangered: ▪ There have not been thorough searches conducted for the wildlife and the wildlife has not been seen in the wild over a period that is appropriate for the life cycle or form of the wildlife; or ▪ The habitat or distribution of the wildlife has been reduced to an extent that the wildlife may be in danger of extinction; or ▪ The population size of the wildlife has declined, or is likely to decline, to an extent that the wildlife may be in danger of extinction; or ▪ The survival of the wildlife in the wild is unlikely if a threatening process continues. Vulnerable: ▪ The population is decreasing because of threatening processes; or ▪ The population has been seriously depleted and its protection is not secured; or ▪ The population, while abundant, is at risk because of threatening processes; or ▪ The population is low or localised or depends on limited habitat that is at risk because of threatening processes.

Term	Definition
	Near Threatened: ▪ The population size or distribution of the wildlife is small and may become smaller; or ▪ The population size of the wildlife has declined, or is likely to decline, at a rate higher than the usual rate for population changes for the wildlife; or ▪ The survival of the wildlife in the wild is affected to an extent that the wildlife is in danger of becoming vulnerable. Least Concern: ▪ The Wildlife is common or abundant and is likely to survive in the wild.
Region	The local area surrounding the study area, including the landscape within 25 km of the study area.
Regional ecosystem	A vegetation community within a bioregion that is consistently associated with a particular combination of geology, landform and soils.
Regulated vegetation	Vegetation regulated through the *Planning Act 2017*
Remnant vegetation	Defined under the Queensland *Vegetation Management Act 1999* as, woody vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Significant species and vegetation	Refers to: ▪ Species listed as endangered, vulnerable or near *threatened under the Queensland Nature* Conservation Act 1992 or critically endangered, endangered or vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* ▪ Threatened ecological community listed as critically endangered, endangered or vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* ▪ Regional ecosystems with an endangered or of concern biodiversity status or *Vegetation Management Act 1999* status.
Special least concern	Defined under the Queensland Nature Conservation (Wildlife) Regulation 2006 as:

Term	Definition
	a) the echidna (Tachyglossus aculeatus) b) the platypus (Ornithorhynchus anatinus) c) a least concern bird to which any of the following apply – i. Agreement Between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA) ii. Agreement Between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) iii. Agreement Between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds and Exchanges of Notes (ROKAMBA) iv. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).
Study Area	An area defined for the purposes of this study and shown on Figure 2 and encompasses the entirety of Mining Lease (ML) L700077 and portions of ML 70109 and Mineral Development Lease (MDL) 359.
Vegetation management Act status	This is a statutory classification under the Queensland *Vegetation Management Act 1999*. A regional ecosystem is listed as 'endangered' if: ▪ Remnant vegetation for the regional ecosystem is less than 10% of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation for the regional ecosystem is less than 10,000 ha. A regional ecosystem is listed as 'of concern' if: ▪ Remnant vegetation for the regional ecosystem is 10-30% of its pre-clearing extent across the bioregion; or more than 30% of its pre-clearing extent remains and the remnant vegetation extent for the regional ecosystem is less than 10,000 ha. A regional ecosystem is listed 'least concern' if: ▪ Remnant vegetation for the regional ecosystem is over 30% of its pre-clearing extent across the bioregion, and the remnant vegetation area for the regional ecosystem is greater than 10,000 ha.

1 Introduction

Eco Solutions & Management was commissioned by Hansen Environmental Consulting, on behalf of Coronado Global Resources Inc (Coronado) to complete a terrestrial ecology assessment as part of the Environmental Assessment Report (EAR) for the Curragh Bord and Pillar Mine Project (the project).

1.1 Project description

Curragh Mine is a large-scale open cut coal mine located approximately 6 km north of Blackwater township in Central Queensland (Figure 1). The mine has been operating since 1983 and produces export metallurgical and thermal coal. The mine has an approved production rate of up to 18 Mtpa of Run-of-Mine (ROM) coal and utilises dragline and truck and shovel mining methods.

Curragh Mine currently has two main operational areas, Curragh South and Curragh North. Curragh South is the original mining area and contains key mine infrastructure including the Coal Handling and Preparation Plant (CHPP), rail loop and train loading facility and Mine Industrial Area (MIA).

Curragh North is located at the northern end of Curragh Mine and commenced operations in 2006. Curragh North includes three open cut pits (Pit S, Pit T and Pit U) and large in-pit and out-of-pit overburden emplacement areas (Figure 2). There is a transport corridor from Curragh North to Curragh South that includes an overland conveyor and haul road. ROM coal from Curragh North is transported to the CHPP at Curragh South via the overland conveyor. Mine infrastructure at Curragh North includes:

- MIA including a workshop, vehicle servicing facilities, store and administration buildings;
- ROM coal stockpile area and conveyor loading facility; and
- Mine water management infrastructure including raw water supply, mine water dams, flood protection levees, pumps and pipelines.

The Curragh Central area adjoins the southern end of Curragh North. There are approved open cut mining areas in the Curragh Central area that have not been developed to date. The northern limit of the approved Curragh Central mine disturbance area is shown in Figure 2.

The project involves the development of an underground bord and pillar mine in the Mammoth coal seam accessed from the highwall of Pit S (Figure 2). The proposed underground mining areas are within the existing Curragh North and Curragh Central mining leases. The underground mine will have a mine life of approximately 10 years and a peak production rate of approximately 3.2 Mtpa of ROM coal. The project does not involve an increase in the approved Curragh Mine peak production rate.

The project will utilise existing Curragh Mine infrastructure including:

- Curragh North haul roads and access roads, ROM coal stockpile area, overland conveyor and conveyor loading facility, and power, raw water and mine water supplies.
- Curragh South CHPP, rail loop and train loading facilities, and tailings and rejects storage areas.

New surface infrastructure required for the project will be limited to a MIA located on the pit floor at the southern end of Pit S adjacent to the underground mine portals, and surface connections to existing Curragh North infrastructure for raw water supply, mine water supply and power (Figure 2). The underground mining operations will involve coal seam gas drainage to ensure a safe underground environment. Minor temporary surface gas drainage infrastructure will include gas drainage boreholes and flares.

1.2 Regional context

The study area is located within the Isaac − Comet Downs subregion of the Brigalow Belt Bioregion in central Queensland and within the Mackenzie drainage sub-basin of the Fitzroy Drainage Basin (Figure 1). The region experiences sub-tropical conditions with average temperature ranges recorded in Blackwater between 21.9C and 34.7°C in the summer months, and 9.5°C and 24.1°C in the winter months (BoM, 2024). The region receives an average annual rainfall of approximately 548.4 mm with a pronounced wet season. Approximately 75% of the average rainfall is typically recorded between October and March inclusive (BoM, 2024).

The predominant land uses in the study area locality are cattle grazing, coal mining and coal seam gas activities. There are several national parks and conservation areas in the region, with the closest being the Blackwater Conservation Park, approximately 23 km south of the study area and the Taunton National Park (scientific), approximately 30 km south-east of the study area. There are no World Heritage Areas located in the region.

1.3 Study area

1.3.1 Overview

The study area for the terrestrial ecology assessment encompasses approximately 996.5 ha of land and comprises portions of ML 80110, ML 700007 and ML 700008 (hereafter referred to as the study area) (Figure 2).

A large portion of the proposed underground mining areas and all of the proposed bord and pillar mine surface infrastructure are located within the existing Curragh North mine disturbance areas (Figure 2).

The project terrestrial ecology study area is shown in Figure 2. It includes the following areas, where they are located beyond the extent of the existing and approved open cut mine disturbance areas:

- areas above the proposed underground mine workings
- areas potentially disturbed by gas drainage surface activities
- the Groundwater Dependent Ecosystem (GDE) study area

1.3.2 Description of the study area

The study area has been subject to historic broad-scale clearing, routine maintenance of woody regrowth and pasture improvements to facilitate cattle grazing. Through the northern portion of the study area, vegetation clearing has been undertaken for mining activities including exploration drilling and the

construction of the Curragh North Explosives Reload Areas. The majority of vegetation within the study area is comprised of riparian vegetation primarily associated with Blackwater Creek and its adjacent flood plain. A lineal patch of remnant and regrowth vegetation associated with a 1st order water course is present in the northern portion as well as a remnant lineal patch to the north of Blackwater Creek.

Blackwater Creek (5th order watercourse) dissects the southern portion of the study area in an east west direction and joins to the Mackenzie River to the west of the study area. A number of minor watercourses (1st and 2nd order) that contribute to Blackwater Creek flow through the study area in a generally north to south direction.

Infrastructure within the study area is primarily associated with mining activities and includes haul roads, conveyers, drill pads, access tracks with maintained stock fencing throughout.

1.4 Study objectives

This report assesses the potential impacts of the project on MSES and specifically:

- describes the current regulatory requirements relevant to determining ecological values
- describes the methodologies used during the flora and fauna surveys across the study area, which were designed with reference to the flora and fauna survey guidelines of the Queensland Department of Environment, Science and Innovation (DESI)
- provides a comprehensive flora and fauna inventory of the study area
- assesses the likelihood of occurrence for MSES, and identifies and maps their habitat
- assesses the direct and indirect potential impacts of the project on MSES within the study area
- provides mitigation and management measures to reduce impacts on identified MSES, where necessary
- assesses the likely requirements for offsets under the E*nvironmental Offsets Act 2014* (EO Act).

2 Regulatory framework

2.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Commonwealth Government's principal piece of environmental legislation, and is administered by the Department of Climate Change, Energy, the Environment and Water (DCCEEW). It is designed to protect national environmental assets; known as MNES, which include threatened species of flora and fauna, threatened ecological communities (TECs), migratory species as well as other protected matters. Among other things, it defines the categories of threat for threatened flora and fauna, identifies key threatening processes to their survival and provides for the preparation of recovery plans for threatened flora and fauna.

Approval is required under the EPBC Act for any action (which includes a development, project or activity) that is likely to have a significant impact on MNES (including nationally threatened ecological communities and species, and listed migratory species).

This report provides a detailed assessment of the impacts of the project on MNES.

2.1.1 International treaty obligations on migratory species

MNES migratory species are defined under the following agreements and conventions under the EPBC Act:

- China–Australia Migratory Bird Agreement (CAMBA)
- Japan–Australia Migratory Bird Agreement (JAMBA)
- Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)
- Convention on the conservation of migratory species of wild animals (Bonn Convention).

The JAMBA, CAMBA and ROKAMBA agreements list terrestrial, water and shorebird species which migrate between Australia and the respective countries. In all cases, the majority of listed species are shorebirds (DAWE, 2022b).

All agreements require the parties to protect migratory birds by:

- limiting the circumstances under which migratory birds are taken or traded
- protecting and conserving important habitats
- exchanging information
- building cooperative relationships.

The JAMBA agreement also includes provisions for cooperation on the conservation of threatened birds.

Australian Government and non-government representatives meet every two years with Japanese and Chinese counterparts to review progress in implementing the agreements and to explore new initiatives to conserve migratory birds (DAWE, 2022b).

The ROKAMBA formalises Australia's relationship with the Republic of Korea in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (DAWE, 2022b).

In addition to these bilateral agreements, Australia is also a signatory of the Bonn Convention. This convention aims to conserve terrestrial, aquatic and avian migratory species throughout their range (CMS, 2022).

The MNES relevant to the study area listed above are discussed in Section 4.

2.2 Queensland Vegetation Management Act 1999

The VM Act is administered by the Queensland Department of Resources. The VM Act, in conjunction with the Queensland *Planning Act 2016,* regulates the clearing of native vegetation in Queensland. The VM Act's objectives include the preservation of remnant endangered ecosystems and vegetation in areas of high nature conservation value or lands vulnerable to land degradation. Permits under either the VM Act or Planning Act for vegetation clearing are not required for the project, given it will be located within MLs, and therefore vegetation clearing for the project will be regulated by the EA issued under the *Environmental Protection Act 1994*.

The VM Act provides for the classification of remnant vegetation into regional ecosystems (REs) which form the basis of the assessment of vegetation communities. REs are defined (Sattler & Williams, 1999) as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The Queensland Government maintains RE maps illustrating the distribution of REs throughout Queensland and these are updated periodically to reflect refinements that have been made through ground-truthing these communities.

The Queensland Government RE maps were used for this assessment given that they closely align with the groundtruthed vegetation community assessment conducted for the project.

2.3 Queensland Nature Conservation Act 1992

The NC Act is the key piece of legislation in Queensland relating to the protection and management of biodiversity and threatened species. It establishes a framework for the identification, gazettal and management of protected areas (such as National Parks) and the protection of native flora and fauna (protected wildlife) listed under the Queensland *Nature Conservation (Animals) Regulation 2020* and *Nature Conservation (Plants) Regulation 2020*. The NC Act is administered by DESI.

The NC Act classifies native flora and fauna species into categories of conservation significance including extinct in the wild, endangered, vulnerable, near threatened, special least concern and least concern in recognition of how threatened they are and what action needs to be taken to protect them.

The NC Act classification system for fauna was used in this assessment.

2.4 Queensland Biosecurity Act 2014

The Queensland *Biosecurity Act 2014* (Biosecurity Act) provides a framework for the control and management of pests, weeds, diseases, and contaminants, along with creating an overarching general biosecurity obligation for the State. The key principle of the Act is shared responsibility for the mitigation of biosecurity risks.

The Biosecurity Act lists biosecurity matters as either prohibited or restricted. Prohibited matters are biosecurity matters that are not yet found in Queensland.

Restricted matters are biosecurity matters found in Queensland that require restrictions to reduce, control or contain the matter. The Act details seven categories of restricted matters based on the level on mitigation required. The seven categories of restricted matters are:

- Category 1 and 2 must be reported to the Department of Agriculture and Fisheries (DAF) within 24 hours of becoming aware of their presence
- Category 3 must not be distributed or released into the environment
- Category 4 must not be moved or spread into other areas of the State
- Category 5 are those that have a high risk of negatively impacting the environment, and must not be kept
- Category 6 must not be kept or fed
- Category 7 must be killed and disposed of if caught or found.

Some restricted matters fall into multiple categories, and therefore require several different management measures for their control.

Further to prohibited or restricted matters declared under the Act, the Biosecurity Act also recognises other invasive species (such as Cane Toads) as species which fall under a general biosecurity obligation (GBO). A GBO means that, while there is no legal requirement for control of these pests, reasonable and practical steps must be undertaken to minimise their spread.

The Biosecurity Act is administered by DAF.

Species listed under the Biosecurity Act have been identified in this assessment.

2.5 Queensland Environmental Protection Act 1994

The EP Act is administered by the DESI and was established to protect Queensland's environment, while allowing for development that improves the total quality of life, both now and in the future.

The EP Act uses a number of mechanisms to achieve its objectives, including the following that are relevant to this report:

- requirement for mining projects to obtain an EA prior to operation
- requirement for an environmental impact assessment process in support of an EA application.

This MSES assessment supports an EA amendment application for the project.

2.6 Queensland Environmental Offsets Act 2014

The Queensland *Environmental Offsets Policy (Version 1.13)* (QEOP) came into effect on 25 November 2022. The EO Act, *Environmental Offsets Regulation 2014* (EO Regulation) and the QEOP comprise the Queensland Environmental Offsets Framework. According to this framework, it is necessary to provide offsets for any significant, residual impacts on Matters of State Environmental Significance (MSES).

The EO Regulation prescribes a number of MSES that are potentially relevant to terrestrial ecology. These include:

- regulated vegetation under the VM Act that are:

  - endangered REs
  - of concern REs
  - REs that intersect with wetlands identified on the vegetation management wetlands map
  - REs that comprise an area of essential habitat, in accordance with the VM Act, for protected wildlife
  - REs located within a defined distance from the defining banks of a relevant watercourse
- connectivity areas, comprising remnant REs that contain an area of land that is required for ecosystem functioning (i.e. a connectivity area)
- wetlands in a Wetland Protection Area (WPA) or wetlands of High Ecological Significance (HES) as shown on the map of referrable wetlands
- a designated precinct in a strategic environmental area
- high risk areas identified on the flora survey trigger map that contains flora species that are listed as endangered or vulnerable under the NC Act
- areas not identified as a high risk area on the flora survey trigger map, to the extent that the area contains flora species that are listed as endangered or vulnerable under the NC Act
- a Koala habitat area
- habitat for terrestrial fauna species that are listed as special least concern (as defined within the EO Regulation), vulnerable or endangered under the NC Act
- protected areas
- legally secured offset areas.

High-value regrowth vegetation under the VM Act is not listed as a prescribed environmental matter under the EO Act.

The MSES relevant to the study area listed above are discussed in Section 4.

The *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (SRI Guideline) (EHP, 2014), dated December 2014, has been used to determine if offsets are required for impacts to MSES (Section 5).

3 Methodology

A detailed description of the methodology used to prepare this ecological assessment is provided in Appendix A. A summary of the methodology is as follows:

- Desktop searches of Commonwealth and State databases, State geology mapping, literature reviews, local previous ecology assessments and aerial photography were conducted. Parsons Brinckerhoff undertook a flora and fauna assessment in 2015 (Parsons Brinckerhoff, 2015)which overlaps with the current study area and formed part of the desktop review for the current study. These desktop searches formed the basis for the field work program. Database search results, which include a 25 km buffer around the study area, are provided in Appendix B.
- A combined flora and fauna survey was undertaken over six days in the 2023 dry season (6 to 11 December inclusive).
- Flora surveys were conducted in accordance with the '*Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland, version 6.0'* (Neldner et al., 2022) to collect information on listed flora species, vegetation communities, and habitat types. The seasonal flora surveys comprised:
  - 44 quaternary sites
  - Targeted flora species surveys
  - Random traverses
  - Collection of ancillary information.

  The location of each flora assessment site is shown in Figure 5.
- Fauna surveys were conducted with reference to State fauna survey guidelines to detect/determine the likelihood of occurrence of various fauna species and determine the extent and quality of fauna habitat within the study area. A variety of targeted fauna survey methods were used, including spotlighting, call playback, active searching, bird surveys, Anabat survey sites and incidental observations comprising:
  - Spotlighting: 6 person hours
  - Call playback: 6 sessions
  - Bird surveys: 9 person hours
  - Opportunistic/incidental observations: 90 diurnal and 24 nocturnal person hours
  - Active searches: 9 person hours
  - Anabat recordings: 2 nights.
  - Harp trapping: 2 nights

  The location of each fauna assessment site is shown in Figure 6.
- Likelihood of occurrence assessments based on the species' known ranges, preferred habitat, and study area characteristics (Appendix D). This assessment culminated in MSES and MNES habitat mapping (Figures 10 to 16).

- Habitat assessments based on the quality of the fauna habitat elements present during the field surveys (Appendix A).

The timing of the survey was conducted in early December following significant rainfall recorded in late November (BoM, 2024). While this is outside of the recommended survey timing for the Brigalow Belt Bio region in the Queensland Terrestrial Vertebrate Fauna Survey Guidelines (i.e. September to mid-November and March to mid-May) conditions were considered suitable for the detection of fauna and to assess habitat quality and likelihood of occurrence.

Ecological surveys may fail to record all species of flora and fauna present in a study area for a variety of reasons, including seasonal absence, large home ranges, reduced activity or lack of reproductive material for flora during certain seasons. Furthermore, the ecology and nature of some significant and/or cryptic species means that such species are potentially not recorded during short survey periods. This assessment overcomes these limitations by assessing impacts not only on species recorded during the field surveys, but also on species that are assessed as potentially present (based on known distribution and habitat availability).

4 Results

This section provides the findings of both the desktop searches and the field survey results including the MSES that were recorded, or are likely to be present, within the study area.

The results of the desktop searches are provided in Appendix B and the species recorded within the site are detailed in Appendices E and F. Likelihood of occurrence assessments are provided in Appendix D.

4.1 Regulated vegetation

Some areas of remnant vegetation mapped within the study area are listed as MSES − Regulated vegetation under the EO Act where they:

- contain endangered or of concern REs; or
- intersect with mapped vegetation management watercourses or wetlands
- contribute to a connectivity area.

The presence/absence of each of these MSES is described in the following sections.

The Biodiversity Planning Assessment mapping and the presence of state and regional corridors are also discussed in this section for completeness, but they are not MSES.

4.1.1 Overview

The field flora survey found that the vegetation present within the study area was found to closely align with Queensland Herbarium vegetation mapping (version 13). As a result, the Queensland Herbarium mapping has been used for this assessment.

A large portion of the study area is mapped as non-remnant vegetation in the form of cleared and maintained cattle pasture. Mapped remnant vegetation is primarily associated with Blackwater Creek and its flood plain in the south of the study area, with small linear patches of vegetation north of Blackwater Creek (Figure 3).

The mapped vegetation associated with Blackwater Creek comprises riparian vegetation dominated by Queensland Blue Gum (*Eucalyptus tereticornis*) (RE 11.3.25) and Coolabah (*Eucalyptus coolabah*) woodland (RE 11.3.3). The Blackwater Creek flood plain comprises Brigalow (*Acacia harpophylla*) open woodland (RE 11.3.1) and Coolabah woodland (RE 11.3.3). The linear patch north of Blackwater Creek supports an isolated remnant Brigalow woodland (RE 11.4.9) and Eucalypt and *Corymbia* woodland (RE 11.4.2). Non-remnant areas of the study area which are dominant throughout the central portion support improved pasture that was mostly dominated by Buffel Grass (**Cenchrus ciliaris*) and scattered remnant trees including Poplar Box (*Eucalyptus populnea*), Brigalow, Coolabah and Dawson Gum (*Eucalyptus cambageana*)

No high-risk areas (HRAs) are mapped within the ecology study area on the Protected Plants Flora Survey Trigger Map (Appendix B).

4.1.2 VM Act listed communities

In accordance with the guidance note *How to Address Environmentally Sensitive Areas and Offset Requirements in an Application for an Environmental Authority*

for Resource Activities (DES, 2020a), ground truthing surveys were undertaken to accurately assess the RE type, condition and the ecological value of the vegetation in the study area.

A total of 467.6 ha of remnant vegetation (category B) comprising two endangered, three of concern and two least concern REs were identified within the study area. An additional 2.3 ha of high value regrowth vegetation (category C) comprising two endangered and six of concern REs was identified within the study area. Details of these REs is presented below in Table 1.

As indicated in Table 1, a total of 256.1 ha of endangered remnant REs 11.3.1 (253.4 ha) and 11.4.9a (2.1 ha) with a further 126.6 ha of of concern remnant vegetation (REs 11.3.3, 11.3.3c, 11.4.2) is mapped within the study area. Additionally, high value regrowth vegetation comprising endangered REs (0.6 ha) and of concern REs (1.5 ha) have been mapped within the study area. The endangered and of concern REs are MSES under the EO Act.

4.1.3 EPBC Act Threatened Ecological Communities

The Queensland herbarium vegetation mapping identified communities that were consistent with one TEC listed under the EPBC Act as detailed below.

Brigalow TEC

Areas of Brigalow vegetation were recorded within the study area and all of these patches, although not all necessarily meeting remnant or regrowth status, exhibit the key diagnostic features and meet the condition thresholds of the EPBC Act listed endangered Brigalow TEC. These patches are comprised of vegetation representing REs 11.3.1 and 11.4.9a and are shown on Figure 4. A total of 282.4 ha of Brigalow TEC has been identified in the study area (Figure 4).

Table 1: Mapped regional ecosystems in the study area

RE Code	Short description[1]	Status		Wetland values	Area (ha)	
		VM Act	Bio-diversity		Remnant	High-value regrowth
11.3.1	Brigalow (*Acacia harpophylla) and/or* Belah (*Casuarina cristata)* open forest on alluvial plains.	E	E	NA	254.0	0.4
11.3.25	Queensland Blue Gum *(Eucalyptus tereticornis)* or Forest Red Gum *(Eucalyptus camaldulensis)* woodland fringing drainage lines.	LC	OC	Riverine	84.9	0.1
11.3.3	Coolabah (*Eucalyptus coolabah*) woodland on alluvial plains.	OC	OC	N/A	95.2	0.9
11.3.3c	Coolabah (*Eucalyptus coolabah*) woodland to open woodland (to scattered trees) with a sedge or grass understorey in back swamps and old channels.	OC	OC	N/A	17.0	0.0
11.4.1	Semi-evergreen vine thicket +/- Belah (*Casuarina cristata*) on Cainozoic clay plains	E	E	N/A	0.0	0.04
11.4.2	Eucalyptus species and/or Corymbia species grassy or shrubby woodland on Cainozoic clay plains	OC	OC	N/A	14.4	0.7
11.4.9a	*Acacia harpophylla, Lysiphyllum carronii* +/- *Casuarina cristata* open forest to woodland on level to gently undulating Cainozoic plains	E	E	Contains Palustrine	2.1	0.2
Total					467.6	2.3

[1] Short description, VM Act and Biodiversity status taken from the REDD (Queensland Herbarium, 2021).

[2] Status: E, Endangered; OC, Of concern; LC, Least concern; NC, No concern at present; NL, Not listed.

4.1.4 Watercourse vegetation

In accordance with the EO Act, remnant REs that occur within certain distances of watercourses are classified as MSES.

As referred to in Section 1.3, a number of drainage features occur within the study area which support remnant vegetation (Figure 8). Appendix 3 of the Queensland Environmental Offsets Policy (QEOP), lists the following defined distances for measuring regulated vegetation near watercourses in non-coastal bioregions, in which the study area is located:

- stream order 1 or 2 = 25 m from the defining bank
- stream order 3 or 4 = 50 m from the defining bank
- stream order 5 or greater = 100 m from the defining bank (DES, 2020b).

Using these distances, a total of 132.5 ha of remnant endangered REs 11.3.1 (21.0 ha) and 11.4.9a (0.8 ha), of concern REs 11.3.3 (43.3 ha), 11.3.3c (10.5 ha), 11.4.2 (4.6 ha) and least concern RE 11.3.25 (52.3 ha) occur within proximity (as defined above) to drainage features within the study area. The majority of this vegetation is associated with Blackwater Creek in the southern portions of the study area.

4.1.5 Wetland vegetation communities

Vegetation management wetlands have been mapped in one location within the study area, the first is in remnant vegetation associated with Blackwater Creek (RE 11.3.25/11.3.3/11.3.3c) (Figure 3). Under the VM Act, Category A, B, C or R vegetation that is within 100 m of the defining bank of a wetland identified on the vegetation management map is considered MSES. A total of 136.2 ha of vegetation management wetland vegetation has been mapped within the study area comprising:

- 54.5 ha of remnant RE 11.3.3
- 13.6 ha of remnant RE 11.3.3c
- 68.1 ha of remnant RE 11.3.25
- 0.3 ha of high value regrowth RE 11.3.1
- 1.0 ha of high value regrowth RE 11.3.3

Two of the vegetation communities, REs 11.4.9 and 11.3.25 that have been mapped within the study area are recognised as potentially containing palustrine wetlands and riverine attributes, respectively. These vegetation communities, as represented within the study area, are unlikely to hold water for extended periods and the vegetation is not considered to be adapted to, nor depend on, living in wet conditions. These vegetation communities are therefore, not considered to be wetlands under the VM Act and therefore are not MSES.

4.1.6 Connectivity areas

Connectivity areas are defined under the EO Act as −

A patch of land is considered a connectivity area when:

- *the area is of sufficient size or configured in a way that maintains ecosystem functioning; and*
- *the regional ecosystem will remain despite a threatening process within the meaning of the section 12 of the NC Act.*

Only remnant (i.e. Category B) REs are considered to contribute to connectivity areas. The majority of mapped remnant vegetation in the study area has the potential to contribute to a connectivity area. These communities connect with larger polygons of remnant vegetation in the surrounding area.

4.1.7 Biodiversity planning assessment mapping

DESI has prepared a Biodiversity Planning Assessment (BPA) for the region. Large portions of the mapped remnant vegetation within the study area have been identified on the BPA as having state biodiversity significance (Figure 7). Most of these areas correlate with vegetation that has been mapped as either supporting remnant endangered vegetation (RE 11.3.1, 11.4.9, 11.4.1) (Figure 3) or forming part of a state ecological corridor. The riparian vegetation associated with Blackwater Creek (REs 11.3.3/11.3.25) located in the southern portion of the study area has been identified as forming part of a regionally significant ecological corridor. Patches of woodland vegetation throughout the study area mapped as RE 11.4.2 have been mapped as regionally significant on the BPA as well as scattered areas which have been mapped as supporting non-remnant vegetation.

4.2 Flora species

4.2.1 Overview

A total of 79 flora species were recorded during the field surveys representing 32 families and 61 genera. The dominant family group was Poaceae (15 species) with the next most prominent family groups being; Myrtaceae (9 species) and Malvaceae (6 species). The species inventory included 15 exotic species, which accounts for 18% of the total number of flora species recorded. A list of the flora species recorded during the field survey is presented in Appendix E.

4.2.2 Significant flora

No threatened flora species, prescribed under the NC Act or the EPBC Act, were recorded in the study area during the field surveys.

Based on a review of database search results, field surveys and habitat identified in the study area, an assessment of the likelihood of NC Act and EPBC Act listed species occurring in the study area has been undertaken, and is provided in Appendix D. This assessment identified the following flora listed under the NC Act as potentially occurring within the study area.

Solanum elachophyllum (no common name)

Species overview

Solanum elachophyllum is listed as endangered under the NC Act.

Solanum elachophyllum is a perennial sub-shrub with underground rhizomes that can send up more or less shoots depending on seasonal conditions (Fensham et al., 2017). The species grows on fertile cracking-clay soils primarily in Brigalow habitats but has also been known to occur in vegetation types which include Napunyah (*Eucalyptus thozetiana*) woodland, Brigalow woodland to open forest with an understorey of Wilga and Belah (*Casuarina cristata*), Southern Bonewood (*Macropteranthes leichhardtii*) thicket, Dawson River Gum woodland with Narrow-leaved Ironbark (*Eucalyptus crebra*) and *Eucalyptus tenuipes* (Bean, 2004; CSIRO, 2016).

A recent unpublished study by Fensham et al. proposes the species has undergone a 96.5% decline in all remnant Brigalow habitat in Queensland. This study estimates that the current population within all remnant Brigalow habitats is approximately 3,049,000 individuals (and 2,378,000 in remnant Brigalow habitat with >50% cover, i.e. viable long term habitat) occupying an area of 44,200 ha at an average density of 68.98 individuals per hectare (Fensham et al., 2017).

Presence in the study area

Possible

This species was not recorded within the study area. Potentially suitable habitat for this species was identified at three disjunct locations in remnant and regrowth RE 11.4.9 and a remnant polygon mapped as RE 11.3.1/11.3.25 (50/50). A total of 1.5 ha of potential *Solanum elachophyllum* habitat has been mapped within the study area (Figure 9).

The area of RE 11.3.25/11.3.3 which has been mapped as potential *Solanum elachophyllum* habitat was located in a swale on the upper bank of Blackwater Creek in the south-east of the study area. This area did support cracking clay soils to a minor degree indicating some clay content in the soil at the surface horizon. In all other areas of this RE type, the surface soils were observed to be sandy and well drained. As such, not all areas of RE 11.3.25/11.3.3 has been considered habitat.

Solanum adenophorum (no common name)

Species overview

Solanum elachophyllum is listed as endangered under the NC Act.

Solanum adenophorum is a perennial herb growing to 40cm high. *Solanum adenophorum* is endemic to the Dingo - Nebo - Clermont area in central-eastern Queensland. Solanum adenophorum occurs mostly in brigalow woodland and on very gently inclined slopes. It also occurs in gidgee (*Acacia cambagei*) scrub on deep cracking clay soils. (Bean 2004).

Presence and habitat in the project area

Possible

This species was not recorded within the study area. Potentially suitable habitat for this species was identified at three disjunct locations in remnant and regrowth RE 11.4.9 and a remnant polygon mapped as RE 11.3.25/11.3.3 (50/50). A total of 1.5 ha of potential *Solanum adenophorum* habitat has been mapped within the study area (Figure 9).

As with *Solaunum elachophllum*, only a small portion of the 11.3.25/11.3.3 mapped within the study area (which was found to support a minor degree of cracking clay soil) has been considered as potentially suitable *Solanum adenophorum* habitat.

4.2.3 Exotic species

A total of 15 exotic flora species were recorded in the study area during the field surveys. Three of these exotic flora species, namely Velvety Tree Pear (**Opuntia tomentosa*), Harissia Cactus (**Harrisia martini*) and Parkinsonia (**Parkinsonia aculeata*) are listed as Category 3 restricted invasive plants under Queensland's *Biosecurity Act 2014*. Large infestations of Parkinsonia were observed in some locations within the study area.

Of the 12 non-restricted exotic species recorded in the study area, Buffel Grass was prevalent throughout the study area and present in all vegetation communities. Green Panic (**Megathyrsus maximis* var. *pubiglumis*) was also commonly encountered throughout the study area, particularly in proximity to watercourses. These 12 species are listed below and in Appendix E.

- Buffel Grass (**Cenchrus ciliaris*)
- Nutgrass (**Cyperus rotundus*)
- Flannel Weed (**Sida cordifolia*)
- Spiked Malvastrum (**Malvastrum americanum var. americanum*)
- Creeping Woodsorrel (**Oxalis corniculata*)
- Green Panic (**Megathyrsus maximus var. pubiglumis*)
- Mimosa Bush (**Vachellia farnesiana*)
- Hairy Commelina (**Commelina benghalensis*)
- Cobblers Pegs (**Bidens bipinnata*)
- Angleton Grass (*Dichanthium aristatum)
- Indian Bluegrass (**Bothriochloa pertusa*)
- Red Natal Grass (**Melinis repens*)

4.3 Fauna

4.3.1 Overview

A total of 84 species of terrestrial vertebrate fauna were recorded during the field surveys of the study area. Native species included 49 birds, 17 mammals (including 11 microbats), 12 reptiles and 6 amphibians. Four introduced species of fauna were recorded during the field surveys including three mammals and one amphibian (Section 5.3.3). A complete list of species recorded is provided in Appendix F and threatened and special least concern species are discussed in Section 4.3.3.

The following section describes the observed fauna values of the study area and assesses identified and potential MSES and MNES within the study area.

4.3.2 Fauna habitat overview

The majority of the study area has been cleared of woody vegetation with these areas predominately supporting exotic grasses associated with agricultural grazing. Habitats of the study area are limited to the remnant and regrowth vegetation associated with Blackwater Creek, two vegetated 1st order watercourses and small, isolated patches of vegetation in the north and east. All of the habitats within the study area have been impacted to some extent by vegetation clearing/thinning and influenced by historic cattle grazing.

Remnant and high-value regrowth vegetation communities present provide habitat for a range of native fauna species, including species of conservation significance. The following major habitat types occur within the study area:

- Riparian vegetation dominated by eucalypt species (11.3.25, 11.3.3) – These areas were typically of moderate habitat value due to the presence of large or hollow bearing trees, presence of ephemeral water courses and habitat connectivity. Ground habitat such as fallen timber and areas of deep leaf litter were present in moderate to low abundance. The value of these habitats has been impacted to a degree by vegetation thinning (particularly away from Blackwater Creek), erosion and a dense cover of exotic grass. This habitat type has been considered suitable habitat for a number of conservation significant species including the Koala, Greater Glider, Yellow-bellied Glider, Squatter Pigeon and the Ornamental Snake.
- Vegetation in areas of sandy soils dominated by Brigalow (11.3.1) – This habitat type was of moderate habitat value due to the presence of a dense Brigalow canopy, moderate abundance of fallen timber, moderate to abundant areas of deep leaf litter and a moderate degree of habitat connectivity. These areas have been impacted by vegetation thinning with large trees sparse to absent. Additionally, the groundcover in this habitat type was dominated by exotic grass species. This habitat type has been considered suitable habitat for the Squatter Pigeon and Ornamental Snake and marginal habitat for arboreal species such as the Koala, Greater Glider and Yellow-bellied Glider.
- Brigalow or eucalypt woodland on heavy clay soils (11.4.1, 11.4.2, 11.4.9a) – Habitat quality in these areas was generally of low quality, primarily as a result of very small patch sizes and lack of habitat connectivity. Gilgai formations were present in moderate abundance which provide habitat for conservation significant species including the Ornamental Snake and Australian Painted Snipe. However, other habitat attributes such large trees, fallen timber and areas of deep leaf litter were typically sparse. The groundcover in these areas were dominated by exotic grasses.
- Cleared areas of gilgai – Areas of the study area supported gilgai mounds and depressions dominated by exotic grasses with occasional native shrubs. These areas were generally considered to be of low to moderate habitat value as they lacked intact vegetation, had sparse to absent fallen timber and lacked deep leaf litter. However, the gilgai provide suitable habitat for species that use these wetland habitats; specifically the Ornamental Snake and the Australian Painted Snipe.

The extent of historic clearing across the study area and surrounds has significantly reduced the connectivity values of the fauna habitats present.

However, there is connectivity of remnant habitats to the via the narrow corridor of vegetation associated with the Mackenzie River to the west.

4.3.3 Threatened and special least concern fauna

Desktop searches identified one critically endangered species, nine endangered species, ten vulnerable species, and one species of special least concern. The Queensland Government has mapped large areas of the mapped remnant vegetation within the study area as essential habitat for the Ornamental Snake (Figure 3).

The Squatter Pigeon (southern) was the only threatened species listed under the NC Act and EPBC Act recorded from the study area. This species was recorded at one location in the central portion of the study area (Figure 14).

No other threatened fauna species, prescribed under the NC Act or EPBC Act, were recorded in the study area during the field surveys. The Short-beaked Echidna, which is prescribed as special least concern under the NC Act was recorded at one location in the southern portion of the study area. (Figure 15).

Based on a review of database search results, seasonal fauna surveys and habitat identified in the study area, an assessment of the likelihood of NC Act and EPBC Act listed species occurring in the study area has been undertaken, and is provided in Appendix D. This assessment identified the following fauna listed under the NC Act and EPBC Act as potentially occurring within the study area.

Possible to occur:

- Australian Painted Snipe (endangered)
- Koala (endangered)
- Greater Glider (endangered)
- Yellow-bellied Glider (vulnerable)
- Ornamental Snake (vulnerable)

These species are discussed in more detail in the following sections. In discussing the habitat requirements of these species, guidelines and information produced by the Commonwealth Government have been drawn upon where comparable information at the State level is lacking. Habitat definitions for this assessment have been developed in accordance with both the NC Act and the EPBC Act.

Squatter Pigeon (southern)

Species overview

The Squatter Pigeon (southern) is listed as vulnerable under the NC Act and EPBC Act. The Queensland Government has mapped essential habitat for this species over the majority of the mapped remnant and high-value regrowth vegetation in the study area (Figure 14). This species is known to inhabit tropical dry, open sclerophyll woodlands and occasionally open savannah. It appears to favour sandy soil dissected with low gravelly ridges and is less common on heavy soils with dense grass cover. It is nearly always found in close association with permanent water (Higgins & Davies, 1996). This species is also often recorded from areas that do not support remnant vegetation, but in these areas, it seems to be associated with clear, disturbed sites such as tracks and stockyards (DCCEEW

2024; S. Marston pers. obs.). These habitat areas are likely to provide breeding, foraging and dispersal habitat.

Presence and habitat within the study area

Known to Occur (Appendix D)

This species was recorded at one location in the northern portion of the study area (Figure 14) and there are numerous published records of this species within 5 km of the study area (CSIRO 2024).

With reference to the Species Profile and Threat (SPRAT) profile (DCCEEW, 2024b) for this species, the following habitat has been identified within the study area, based on the findings of the field survey.

- Breeding and foraging habitat – remnant grassy woodlands dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* tree species, on sandy or gravelly soils (including but not limited to areas mapped as Queensland land zones 3, 5 or 7) within 1 kilometre of a waterbody (Figure 14).
- Foraging only habitat – remnant grassy woodlands dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* tree species, on sandy or gravelly soils (including but not limited to areas mapped as Queensland land zones 3, 5 or 7) within 3 kilometres of a waterbody (Figure 14).
- Dispersal habitat – forest or woodland occurring between patches of foraging or breeding habitat which facilitates movement between patches of foraging habitat, breeding habitat and/or waterbodies. Includes cleared and disturbed/degraded areas with scattered trees within 100 m of foraging and breeding habitats (Figure 14).

Within and immediately surrounding the study area, suitable waterbodies for this species include the Mackenzie River, Blackwater Creek and a number of constructed dams for both agriculture and mining. The locations of suitable waterbodies within and immediately surrounding the study area are shown on Figure 14.

The following areas of Squatter Pigeon habitat occur within the study area (Figure 14):

- 465.3 ha of breeding and foraging habitat
- 4.4 ha of foraging only habitat.
- 3.3 ha of dispersal habitat

Koala

Species overview

The Koala is listed as endangered under the NC Act and EPBC Act. It is widespread in sclerophyll forest and woodland on foothills and plains on both sides of the Great Dividing Range from about Chillagoe, Queensland to Mt Lofty Ranges in South Australia (Menkhorst & Knight, 2011). In Queensland, the species is thought to occur in nine bioregions; Einasleigh Uplands, Wet Tropics, Desert Uplands, Central Mackay Coast, Mitchell Grass Downs, Mulga Lands, Brigalow Belt North, Brigalow Belt South and South East Queensland. In many locations Koalas are of low density, widespread and fragmented.

Koalas in Queensland use a range of habitats, including moist coastal forests, southern and central western sub-humid woodlands, and a number of eucalypt woodlands adjacent to waterbodies in the semi-arid western parts of the state In the northwest of Queensland, studies have found that Koalas are patchily distributed, associated with creek-lines, areas of higher tree species richness and with higher abundance correlating with leaf-moisture content (DCCEEW 2022).

The diet of the Koala is highly specialised and relies on species of the *Eucalyptus*, *Corymbia* and *Angophora* genus, with primary food species comprising as few as two species in any given location (DCCEEW 2022). The abundance of primary food trees is thought to influence the density of Koalas in a population (Phillips & Callaghan, 2011).

Home ranges for this species have been found to be highly variable and dependant on life history stage, soil fertility, habitat quality and nutritional requirements, whereby home ranges can vary between 3 and 500 ha in different locations (DAWE, 2022a). Habitat modelling, described in the *Conservation Advice for Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory* (Koala Conservation Advice), has shown that habitats for this species occur where the mean maximum summer temperatures are 23-26^{O}C and mean annual rainfall between 700 and 1,500 mm. modelling also showed that Koala occupancy is strongly dependent on annual rainfall and the distance to water features (DAWE, 2022a). The availability of refuge habitat has shown to be an important component of Koala habitat particularly in drier climates with high average temperatures. Refuge habitat have been described as patches that are resilient to drying conditions due to favourable hydrological systems, e.g. drainage lines and riparian zones (DAWE, 2022a).

The study area is located within Koala District C on the Koala Conservation Plan mapping. There are no Koala habitat areas mapped within or adjacent to the study area. As stated in Section 2.8.5, at present Koala habitat areas have only been identified by the Queensland Government within Koala District A.

Presence and habitat within the study area

Possible (Appendix D)

This species was not recorded in the study area during the field survey and no evidence of this species, in the form of scats or scratches, was observed. However, Koalas are known from the region and suitable foraging and refuge habitat is present in the study area, particularly in the riparian vegetation associated with Blackwater Creek. Additionally, the study area is connected to areas of riparian vegetation associated with the Mackenzie River to the west.

The Queensland Government provides a broad definition of what constitutes Koala habitat in the *Nature Conservation (Koala) Conservation Plan* 2017 (NC Act 1992) and is categorised as:

- an area of vegetation in which Koalas live and that includes a Koala habitat tree; or
- an area of vegetation that consists primarily of Koala habitat trees and which is reasonably suitable for sustaining koalas; or
- a partially or completely cleared area used by Koalas to cross from an area of habitat to another.

The DCCEEW have also provided information as to what constitutes Koala habitat in the Conservation Advice and Listing Advice (DAWE 2022, TSSC 2012).

Habitat mapping for the Koala within the study area has been undertaken in accordance with information provided in the NC Act, Conservation Advice and Listing Advice for the Koala and the experience of our ecologists in detecting the species in habitats throughout central Queensland. Koala habitat has therefore been categorised as:

- any forest or woodland containing species that are Koala food trees, or any shrubland with emergent food trees. Food trees are defined according to the Conservation Advice as those of the following genus: Angophora, Corymbia and Eucalyptus.

The DCCEEW provides an information sheet for this species *A review of koala habitat assessment criteria and methods* (Youngentob et al., 2021), in which locally important Koala tree (LIKT) species and ancillary habitat trees are listed for each Koala management bioregion, including the Brigalow Belt. All remnant woodland REs in the study area are considered to provide habitat for the Koala due to the presence of defined Koala habitat trees for the Brigalow Belt Bioregion, (including locally important and ancillary habitat trees), listed below:

- RE 11.3.1 – Brigalow, Dawson Gum (*Eucalyptus cambageana*), Coolabah (*Eucalyptus coolabah*)
- RE 11.3.3/11.3.25 – Queensland Blue Gum (*Eucalyptus tereticornis*), Coolabah, Poplar Box (*Eucalyptus populnea*), Brigalow, Black Tea-tree (*Melaleuca bracteata*), Carbean (*Corymbia tessellaris*), RE 11.3.25 –
- RE 11.4.2 – Narrow-leaved Ironbark (*Eucalyptus crebra*), Dawson Gum, Poplar Box, Clarkson's Bloodwood (*Corymbia clarksoniana*), Dallachy's Gum (*Corymbia dallachiana*).
- RE 11.4.9a – Poplar Box, Dawson Gum, Brigalow

Figure 10 shows areas that have been mapped as suitable habitat in accordance with the above habitat definitions for the Koala in the study area, which equates to 498.1 ha of potential habitat.

Greater Glider

Species overview

The Greater Glider is listed as endangered under the NC Act and EPBC Act. The Greater Glider is a nocturnal species and uses tree hollows during the day to rest (van Dyck & Strahan, 2008). It may glide over distances of up to 100 m, however, it appears to have low dispersal ability through disturbed vegetation and typically small home ranges of 1 to 4 ha. The species has an almost exclusive diet of eucalypt leaves and occasionally flowers or buds (van Dyck & Strahan, 2008; DCCEEW, 2023a). Although it is known to feed on a range of eucalypt species, it is likely to only forage on, or den in, one or two species in any one area (van Dyck & Strahan, 2008; Eyre, 2002; Smith et al., 2007).

The Greater Glider occurs in a range of eucalypt-dominated habitats, including low open forests on the coast to tall forests in the ranges and low woodland westwards of the Dividing Range. It does not use rainforest habitats (van Dyck & Strahan, 2008; van Dyck et al., 2013). This species favours taller, montane, moist eucalypt

forests with relatively old trees and abundant hollows and a diversity of eucalypt species (DCCEEW 2023r).

Likelihood of occurrence in the study area

Possible (Figure 11)

This species was not recorded in the study area during the field survey. However, the species is known to occur in the area in vegetation types that occur within the study area. The approved conservation advice for this species (DCCEEW 2023r) indicates that eucalypt forests or woodlands that contain hollow-bearing trees with the density of at least one suitably sized hollow/ha are considered as habitat for the Greater Glider in southern Queensland.

Given the above, approximately 492.9 ha of habitat for the Greater Glider has been identified in the study area (Figure 11) consisting of:

- all remnant vegetation communities that support eucalypt species and have a tree hollow density of greater than 1 suitably sized hollow/ha (i.e. REs, 11.3.3/11.3.25, 11.4.2, 11.4.9a. However, relatively small (i.e. <50 ha) patches of remnant vegetation that are separated from other patches of vegetation by more than 100 m of cleared land have not been included as habitat for this species.
- Areas of mapped remnant or regrowth vegetation that support foraging habitat but lack hollow bearing trees have been mapped as Greater Glider habitat in areas where it is contiguous with vegetation that does support tree hollows (i.e. areas of RE 11.3.1 immediately adjacent areas of 11.3.3/11.3.25).

Remaining areas of woodland vegetation with one or more of the following characteristics have not been included as Greater Glider habitat:

- relatively small (i.e. <10 ha) patches of vegetation that are separated from other patches of vegetation by more than 100 m of cleared land. The conservation advice for the species notes that it is sensitive to fragmentation and while it has been found in patches that are <10 ha in the southern part of its range, it is likely to require larger patches in Queensland (DCCEEW, 2023a)
- habitat trees (i.e. eucalypts) were not present within the vegetation community
- the vegetation was not mature enough to have developed hollows and not directly adjacent vegetation that supports hollows, and/or
- the area was highly disturbed and fragmented area, with poor or no connectivity to other areas of mapped Greater Glider habitat.

Yellow-bellied Glider

Species overview

The Yellow-bellied Glider is listed as vulnerable under the NC Act and the EPBC Act. The distribution of the Yellow-bellied Glider in Queensland is primarily coastal, extending southward along the eastern seaboard from north of Mackay and continuing through the NSW-Qld border. However, isolated subpopulations are found inland in the Blackdown and Canarvon Ranges of central Qld (Eyre 2004).

The Yellow-bellied Glider occurs in eucalypt-dominated woodlands and forests, including both wet and dry sclerophyll forests (Kavanagh et al. 1995).The Yellow-bellied Glider is nocturnal and shelters in hollows found in large, old trees, usually more than one meter in diameter (TSSC, 2022). Hollow-bearing trees are a critical habitat feature for the species (TSSC, 2022). The diet of the Yellow-bellied Glider comprises of sap drawn from incisions in the trunks of a limited number of trees typically of the genus Eucalyptus or Corymbia. The species also feeds on insects, spiders, eucalypt nectar and pollen, insect exudates and manna (TSSC, 2022). Smooth-barked eucalypts are important due to the range of foraging substrates (and therefore food resources) they provide, as loose bark hanging in strips from these trees provides shelter for insect prey (Eyre and Smith 1997).Yellow-bellied gliders (south-eastern) also require some level of floristic diversity to provide a year-round food supply, and they are unlikely to persist in forests dominated by only one or two tree species (TSSC, 2022).

The species shows a preference for large patches of mature old growth forest that provide suitable trees for foraging and shelter with foraging (TSSC, 2022). The species has very low dispersal capabilities over spaces larger than its gliding distance (TSSC, 2022). The Conservation Advice indicates that management should be guided by the average gliding performance, which was reported as being on average 25 m (TSSC, 2022).

Likelihood of occurrence in the project area

Possible (Appendix D)

No evidence of the Yellow-bellied Glider was detected in the study area during the fauna survey. However, the species is known to occur in the area within vegetation types that occur within the study area. The Yellow-bellied Glider was recorded by Eco Solutions & Management along Blackwater Creek in 2018 during fauna spotter catcher works for the Curragh South Mine.

Areas of vegetation dominated by eucalyptus species occur throughout the Blackwater Creek system and associated floodplain. Other areas of broadly suitable habitat are present in the form of vegetated 1st order watercourses and eucalypt open woodland on alluvial soils.

Given the above, approximately 492.9 ha of habitat for the Yellow-bellied Glider has been identified in the study area (Figure 11) consisting of:

- all remnant vegetation communities that support eucalypt species and tree hollows (i.e. REs, 11.3.3/11.3.25, 11.4.2, 11.4.9a. However, relatively small (i.e. <50 ha) patches of remnant vegetation that are separated from other patches of vegetation by more than 100 m of cleared land have not been included as habitat for this species.
- areas of mapped remnant or regrowth vegetation that support foraging habitat but lack hollow bearing trees has been mapped as Yellow-bellied Glider habitat in areas where it is contiguous with vegetation that does support tree hollows (i.e. areas of RE 11.3.1 immediately adjacent areas of 11.3.3/11.3.25).

Remaining areas of woodland vegetation with one or more of the following characteristics have not been included as Yellow-bellied Glider habitat:

- relatively small (i.e. <50 ha) patches of vegetation that are separated from other patches of vegetation by more than 100 m of cleared land. The

conservation advice for the species notes that it is sensitive to fragmentation and the species requires large home ranges

- habitat trees (i.e. eucalypts) were not present within the vegetation community
- the vegetation was not mature enough to have developed hollows and not directly adjacent vegetation that supports hollows, and/or
- the area was highly disturbed and fragmented area, with poor or no connectivity to areas of mapped Greater Glider habitat.

Ornamental Snake

Species overview

The Ornamental Snake is listed as vulnerable under the NC Act and EPBC Act. The Ornamental Snake is found in close association with frogs, which form the majority of its prey. It is known to prefer woodlands and open forests associated with moist areas, particularly gilgai (melon-hole) mounds and depressions with clay soils but is also known from lake margins, wetlands and waterways (DCCEEW, 2024a).

The SPRAT Profile and Draft Referral Guidelines for the nationally listed Brigalow Belt reptiles specifically describe 'pure grassland associated with gilgais' and 'cleared areas formerly mapped as open-forests to woodlands associated with gilgai formations and wetlands i.e. REs 11.3.3, 11.4.3, 11.4.6, 11.4.8, 11.4.9 and 11.5.16' as suitable habitat for this species (SEWPaC, 2011; DCCEEW, 2024a).

The Ornamental Snake requires microhabitat features such as cracking clay soils, rotting logs or stumps, coarse woody debris, leaf litter or surface rock. These features are required because they either support the prey food of this species (i.e. frogs) or provide refuge habitat for the Ornamental Snake (DCCEEW, 2023b).

Presence and habitat in the project area

Possible (Figure 13)

This species was not detected in the study area during the field survey. However, there are numerous published records of the species in the area and habitat types known to support the species were identified in the study area.

Gilgai formations were identified in cleared vegetation in the southern portions of the study area. Gilgai are known habitat for the Ornamental Snake and this species is known to persist in heavily modified environments where gilgais remain.

Areas of RE 11.4.9 were found to support gilgai and some areas of fallen timber and deep leaf litter. A lineal patch of 11.4.2 associated with a 1st order watercourse was found to support heavy clay soils and abundant fallen timber.

Ephemeral wetland habitats were identified in areas of RE 11.3.1 in proximity to Blackwater Creek and its tributaries. These areas and surrounding Brigalow woodland have also been mapped as habitat for this species.

Riparian vegetation (RE 11.3.25) does not clearly align with the Draft Referral Guidelines for the nationally listed Brigalow Belt reptiles, whereby there is no gilgai and sparse fallen timber present (SEWPaC 2011). However, this species had been recorded on numerous occasions by Eco Solutions and Management in the Brigalow Belt within RE 11.3.25 where gilgai or heavy clay soils (landzone 4) are

in proximity (Figure 13). As such, the riparian vegetation (RE 11.3.3/11.3.25) associated with Blackwater creek has been considered habitat for this species

Overall, approximately 461.7 ha of Ornamental Snake habitat has been identified within the study area, as shown on Figure 13.

Australian Painted Snipe

Species overview

The Australian Painted Snipe (*Rostratula australis*) is listed as endangered under the NC Act and EPBC Act. This secretive, cryptic, crepuscular (active at dawn, dusk and during the night) species occurs in terrestrial shallow wetlands, both ephemeral and permanent, usually freshwater but occasionally brackish. They also use inundated grasslands, salt-marsh, dams, rice crops, sewage farms and bore drains with rank emergent tussocks of grass, sedges, rushes or reeds or samphire, and often with scattered clumps of Lignum, canegrass or sometimes tea trees. This species has been known to use wetland areas lined with trees, or that have some scattered fallen or washed-up timber (DCCEEW, 2024c).

Wetland habitat suitable for breeding is noted as being critical to the survival of the Australian Painted Snipe in the listing advice for the species. Breeding habitat is described in the advice as:

> "continuous reed beds, stand of reed-like vegetation, rice fields and areas with no surrounding low cover… Nests are made among tall rank tussocks, frequently on small, muddy islands or mounds surrounded by shallow fresh water, sometimes on shores of swamps or on banks of channels. Nesting typically occurs in ephemeral wetlands that are drying out after an influx of water, provided they have complex shorelines and a combination of very shallow water, exposed mud and dense low cover" (TSSC, 2013).

The SPRAT Profile for the species also recognises dense low cover and sometimes some tall dense cover is also present in breeding habitat (DCCEEW, 2024c).

Likelihood of occurrence in the project area

Possible (Appendix D)

This species was not recorded within the study area during the fauna survey. However, the species has been recorded in the broader area and the ephemeral wetlands and riparian vegetation of Blackwater Creek provide suitable seasonal habitat for this species.

Small areas of gilgai within regrowth Brigalow that were identified in the southern portions of the study area are considered suitable habitat for this species. Cleared gilgai habitats are likely to provide seasonal foraging habitat as they support some wetland features and this species is known to use heavily disturbed areas that exhibit wetland characteristics, including cleared gilgai. However, cleared gilgai habitat are not considered to provide suitable breeding habitat. There is also a small ephemeral wetland located within the northern portions of the study area.

In total, approximately 181.1 ha of potential habitat is mapped in the in the study area for the Australian Painted Snipe (Figure 12)

Short-beaked Echidna

Species overview

The Short-beaked Echidna occurs in almost all terrestrial habitats except intensively managed farmland. It shelters in logs, crevices, burrows or piles of litter and feeds on ants, termites and other soil invertebrates, particularly beetle larvae (Menkhorst & Knight, 2011).

Presence and habitat in the study area

PRESENT

This species was recorded at one location in the south-east of the study area in the riparian vegetation associated with Blackwater Creek (Figure 15). This species is known from a wide range of habitats including grazing land and is likely to occur throughout the study area. However, areas of remnant woodland vegetation are likely to be of greater habitat value for this species due to the presence of fallen timber and leaf litter that provides habitat for invertebrates. While the species will potentially disperse across areas of intensely managed farmland these landscapes lack many of the habitat features preferred by this species for shelter and breeding, and therefore have not been included as habitat. Approximately 469.7 ha of foraging habitat is present in the study area for this species.

4.3.4 Feral animals

Four feral animals were recorded during the seasonal field surveys in the study area (Appendix F). These species are listed under the Queensland *Biosecurity Act 2014*. Table 2 provides a description of the presence of feral animals in the study area. Survey site locations are shown on Figure 4.

Table 2: Feral animals in the study area

Species	Status	Abundance and occurrence in the study area
Cane Toad (*Rhinella marina*)	General biosecurity obligation	The Cane Toad was observed in moderate numbers and was recorded at supplementary sites; S1, S8, S9 and S12.
Dingo, Domestic Dog (*Canis lupus*)	Restricted (Categories 3,4 and 6)	This species was observed opportunistically on one occasion
Pig (*Sus scrofa*)	Restricted (Categories 3,4 and 6)	Signs of this species were observed in moderate abundance
European Rabbit (*Oryctolagus cuniculus*)	Restricted (Categories 3,4, 5 and 6)	This species was observed in moderate numbers while driving throughout the study area.

4.4 Summary of MSES and MNES

Based on the desktop and field surveys undertaken for the project, the MSES and MNES outlined in Table 3 have been identified as being present or likely to be present in the study area.

Table 3: Summary of MSES and MNES

MSES / MNES	Status[1]			Likelihood of occurrence	Total area in the study area[2] (ha)
	VM Act	NC Act	EPBC Act		
Protected wildlife habitat					
Solanum elachophyllum (no common name)	N/A	E	N/A	Possible	1.5
Solanum adenophorum (no common name)	N/A	E	N/A	Possible	1.5
Squatter Pigeon (southern) (*Geophaps scripta scripta)*	N/A	V	V	Present	473.0
Koala (*Phascolarctos cinereus*)	N/A	E	E	Possible	497.1
Greater Glider (*Petauroides volans*)	N/A	E	E	Possible	492.9
Yellow-bellied Glider (*Petaurus australis australis*)	N/A	V	E	Possible	492.9
Ornamental Snake (*Denisonia maculata*)	N/A	V	V	Possible	461.7
Australian Painted Snipe (*Rostratula australis*)	N/A	E	E	Possible	181.1
Short-beaked Echidna (*Tachyglossus aculeatus*)	N/A	SL	N/A	Present	469.7
Regulated vegetation					
11.3.1[3]	E	N/A	N/A	Present	253.9
11.3.3[3]	OC	N/A	N/A	Present	95.2
11.3.3c[3]	OC	N/A	N/A	Present	17.0
11.4.2[3]	OC	N/A	N/A	Present	14.4
11.4.9a[3]	E	N/A	N/A	Present	2.1
Watercourse RE	OC, E	N/A	N/A	Present	132.5
Wetland vegetation	OC, E	N/A	N/A	Present	136.2
Connectivity areas					
Remnant vegetation communities	E,OC,LC	N/A	N/A	Present	467.6
Threatened ecological communities					
Brigalow (*Acacia harpophylla* dominant and co-dominant)	N/A	N/A	E	Present	282.4

[1]Status:

- VM Act – E, Endangered; OC, Of concern; LC, Least concern; NA, Not applicable
- NC Act - E, Endangered; V, Vulnerable; SL, Special least concern; Mi, Migratory; NA, Not applicable.
- EPBC Act – CE, Critically Endangered; E, Endangered; V, Vulnerable; NA, Not applicable

[2] Total areas should not be combined, totals may overlap.
[3]Areas of a specific RE within a mixed polygon have been derived using the polygon ratios provided on the Queensland Herbarium vegetation mapping (version 13) (Figure 3).

The following MSES do not occur within the study area:

- High Ecological Value (HEV) wetlands or HEV waterways
- a designated precinct in a strategic environmental area
- a high risk area (HRA) on the flora survey trigger map
- areas not identified as a high risk area on the flora survey trigger map, to the extent that the area contains flora species that are listed as endangered or vulnerable under the NC Act
- a koala habitat area
- protected areas
- legally secured offset area.

The following MNES do not occur within the study area:

- migratory species protected under international agreements
- Ramsar wetlands of international importance.

5 Impact assessment

5.1 Project Impacts

As shown in Figure 2, all new underground mine surface infrastructure required for the project will be located within existing Curragh North mine disturbance areas and the majority of the surface infrastructure will be located in the MIA on the pit floor at the southern end of Pit S. Consequently, the construction of project surface infrastructure will not result in any additional impacts on prescribed environmental matters.

Surface activities associated with the life-of-mine gas drainage program are anticipated to involve in the order of 20 new surface boreholes and associated cleared pads for borehole drilling and gas drainage activities. The majority of these new surface boreholes will also be located within existing Curragh North mine disturbance areas. It is expected that up to approximately 8 new boreholes will be required in the terrestrial ecology study area in areas not previously disturbed or approved to be disturbed. As indicated in Section 4, there are significant areas at the southern end of ML 80110 that have been cleared of vegetation for grazing and do not contain any areas of prescribed environmental matters. Coronado has confirmed that any new gas drainage borehole pads and associated access track connections can be located in these areas and hence will not impact on any prescribed environmental matters.

A specialist subsidence assessment has been completed for the project (EAR Appendix A). The subsidence assessment concluded that the bord and pillar mining will not result in any sub-surface cracking and that the maximum surface subsidence above the underground bord and pillar mining areas will be less than 50 mm. The report concluded that this level of subsidence will not give rise to any significant surface effects, including surface cracking or surface ponding, and will not be distinguishable from natural variations in ground surface levels due to seasonal changes in surface soil moisture content. Hence surface subsidence will not impact any prescribed environmental matters.

Overall, the project is not predicted to have any additional impacts on any prescribed environmental matters.

5.2 Management measures

Curragh Mine has a range of existing management measures and procedures that will be applied to the project to mitigate and manage potential impacts to prescribed environmental matters. These include:

- Permit to Disturb procedure – this procedure involves obtaining approval from the environmental officer prior to the commencement of any disturbance. The procedure ensures proposed disturbance areas are permissible in accordance with existing approvals and the application of appropriate controls during disturbance activities including use of spotter catchers for vegetation clearing, erosion and sediment control and weed control.
- Erosion and Sediment Control Plan – this management plan requires the installation of erosion and sediment control measures, where necessary, to minimise erosion and the release of sediment from disturbed areas.

- Progressive Rehabilitation and Closure Plan (PRCP) – new disturbance areas associated with the project will be required to be rehabilitated in accordance with the Curragh Mine PRCP. The rehabilitation methods for the project are described in Section 3 of the EAR.

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Figures

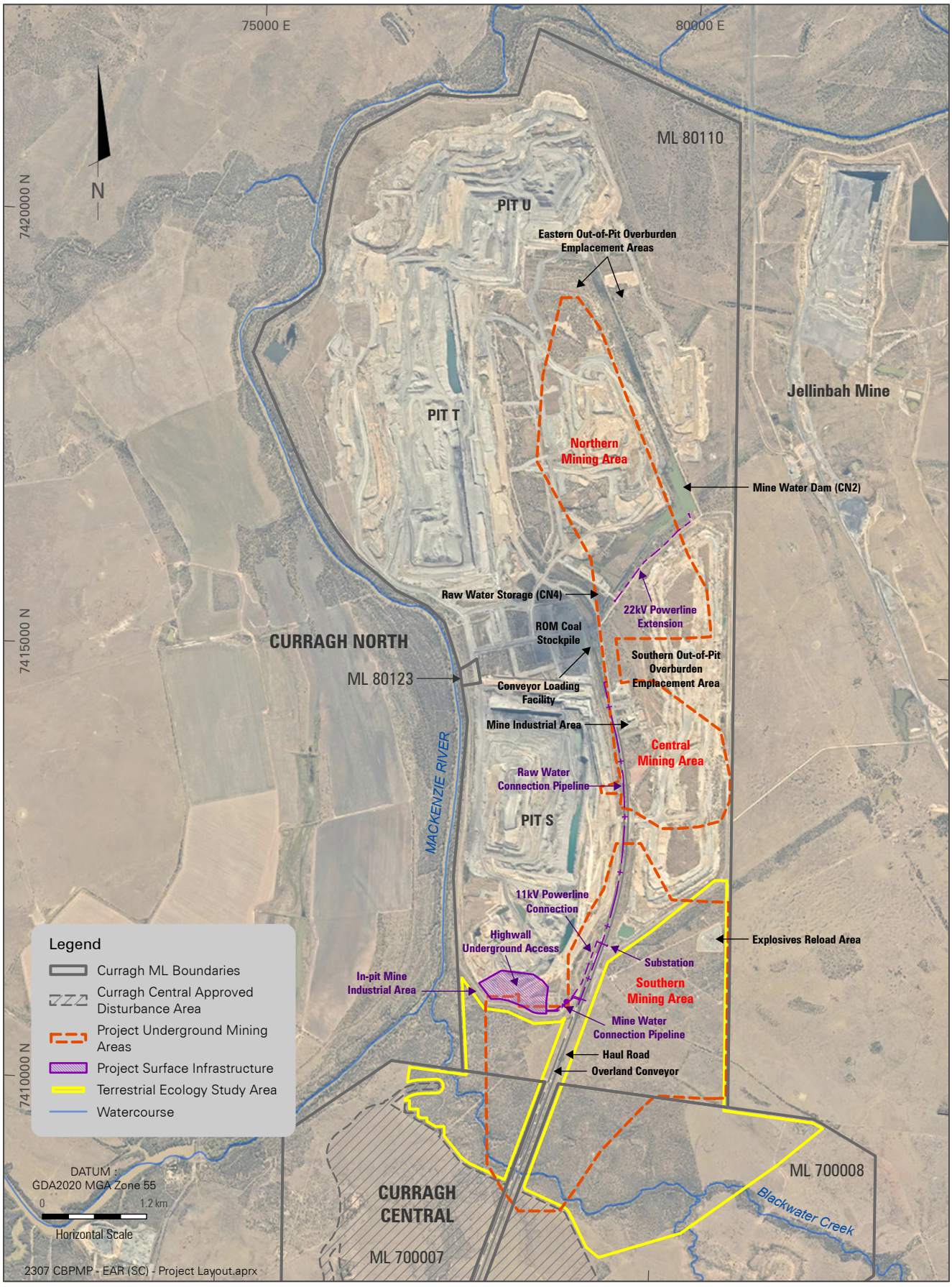


HANSEN ENVIRONMENTAL CONSULTING

CURRAGH BORD AND PILLAR MINE PROJECT

Location Plan

FIGURE 1

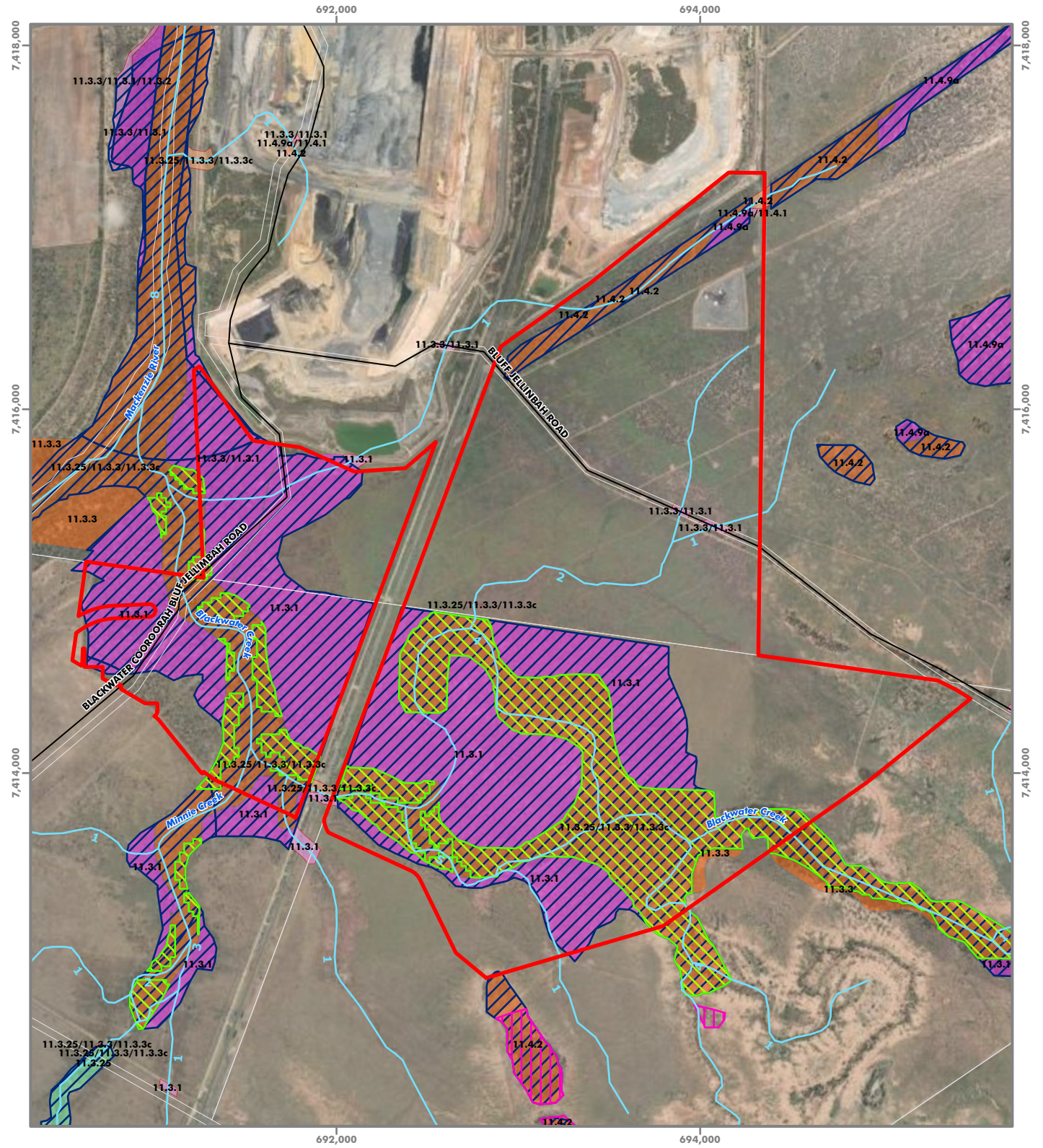


CURRAGH BORD AND PILLAR MINE PROJECT

HANSEN ENVIRONMENTAL CONSULTING

Project Layout

FIGURE 2



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary
- Vegetation Management Essential Habitat - V12.04
- Vegetation Management Wetlands Map - V9.04
- Flora Survey Trigger Map High Risk Area

Vegetation Management Regional Ecosystem Map - V13.0

- Category A or B containing endangered regional ecosystems
- Category A or B containing of concern regional ecosystems
- Category A or B that is of least concern regional ecosystems
- Category C or R containing endangered regional ecosystems
- Category C or R containing of concern regional ecosystems

Figure 3 : State government vegetation mapping

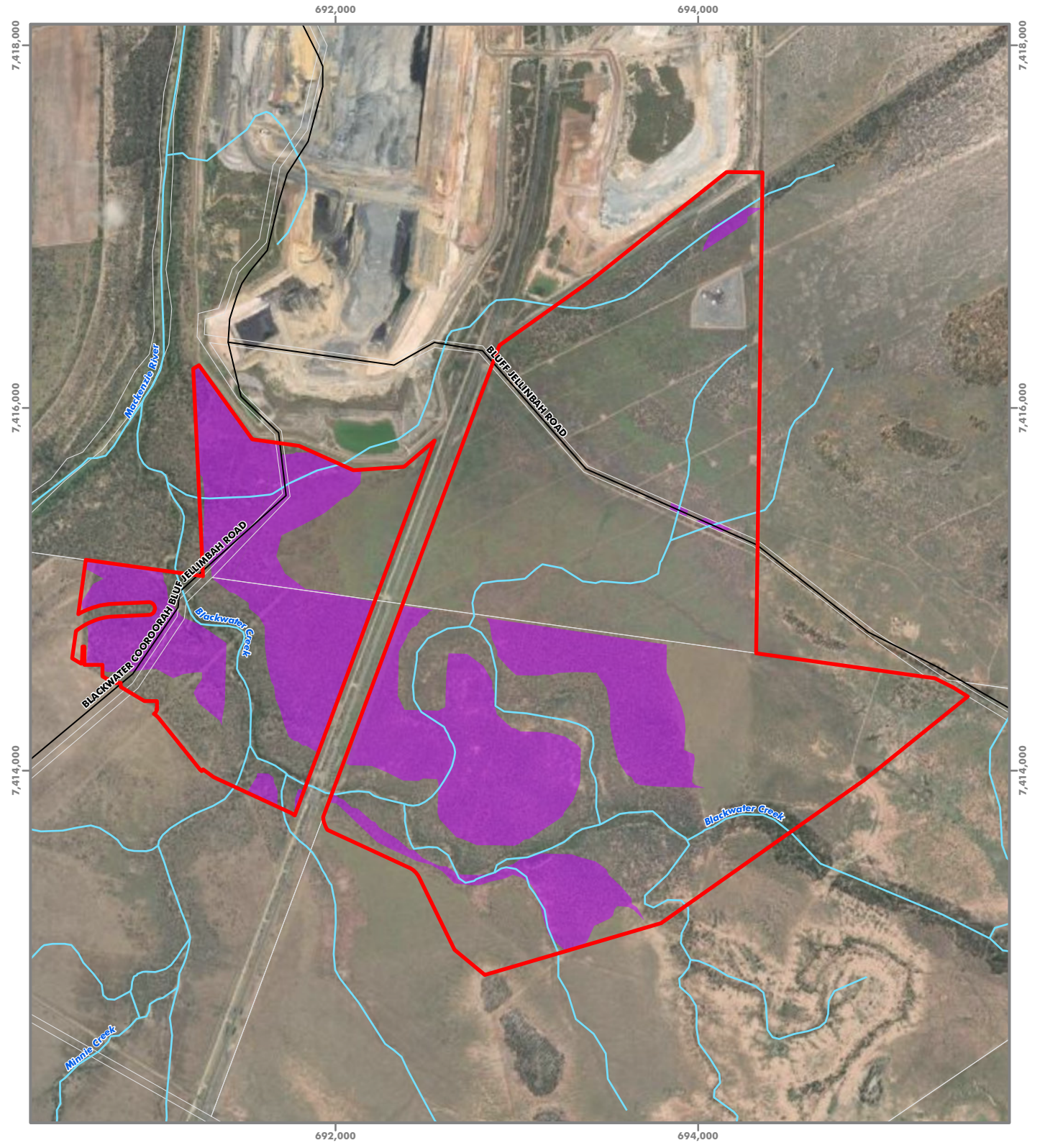
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Terrestrial Ecology Report

Map Number: 23031_TER_03_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Threatened Ecological Communities

- Brigalow TEC

Figure 4 : Threatened Ecological Communities

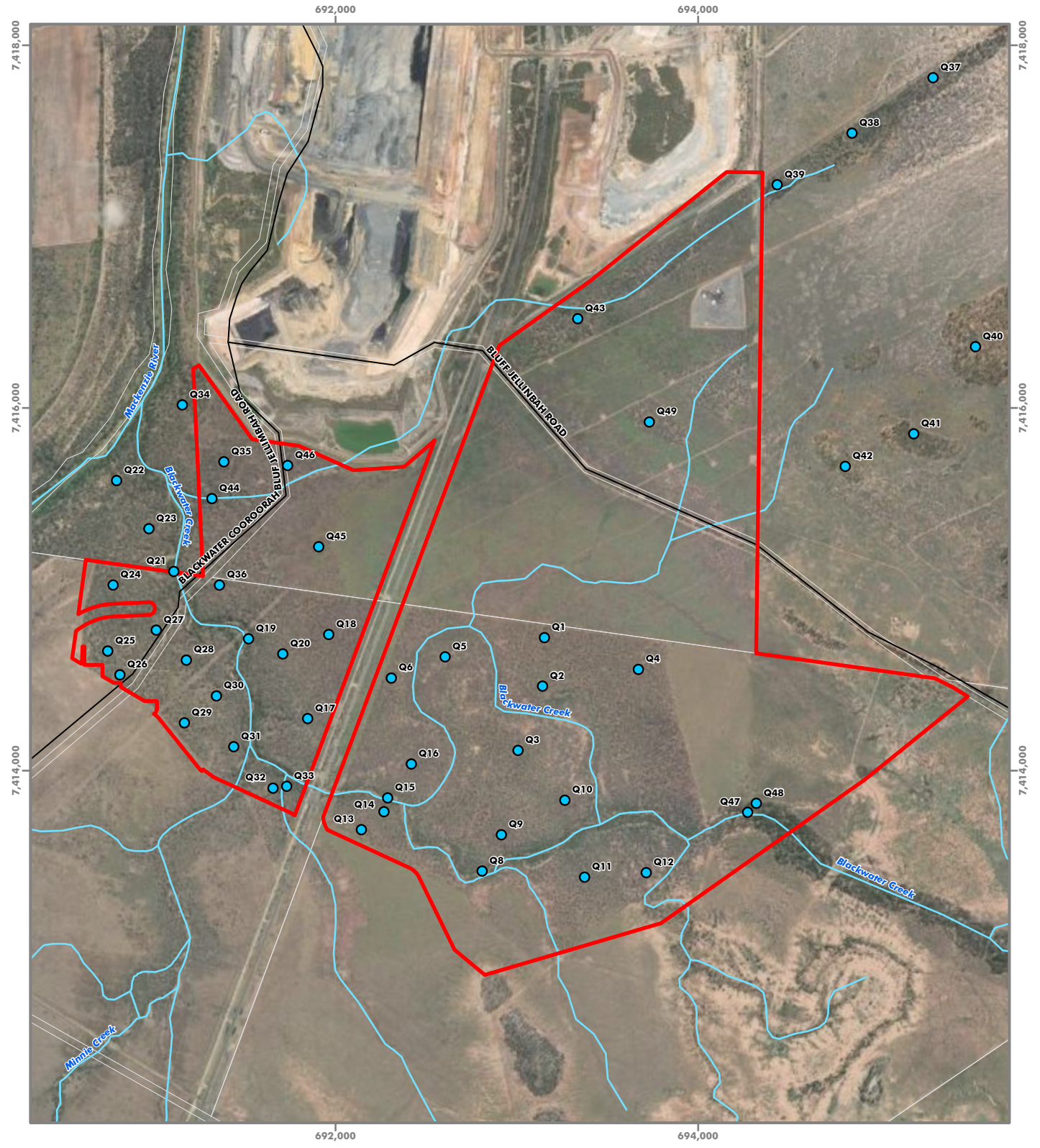
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Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

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Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Vegetation assessment sites

- Quaternary site

Figure 5 : Flora survey sites

Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_06_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Fauna survey sites

- Supplementary site
- Harp trap
- Anabat site

Figure 6 : Fauna survey sites

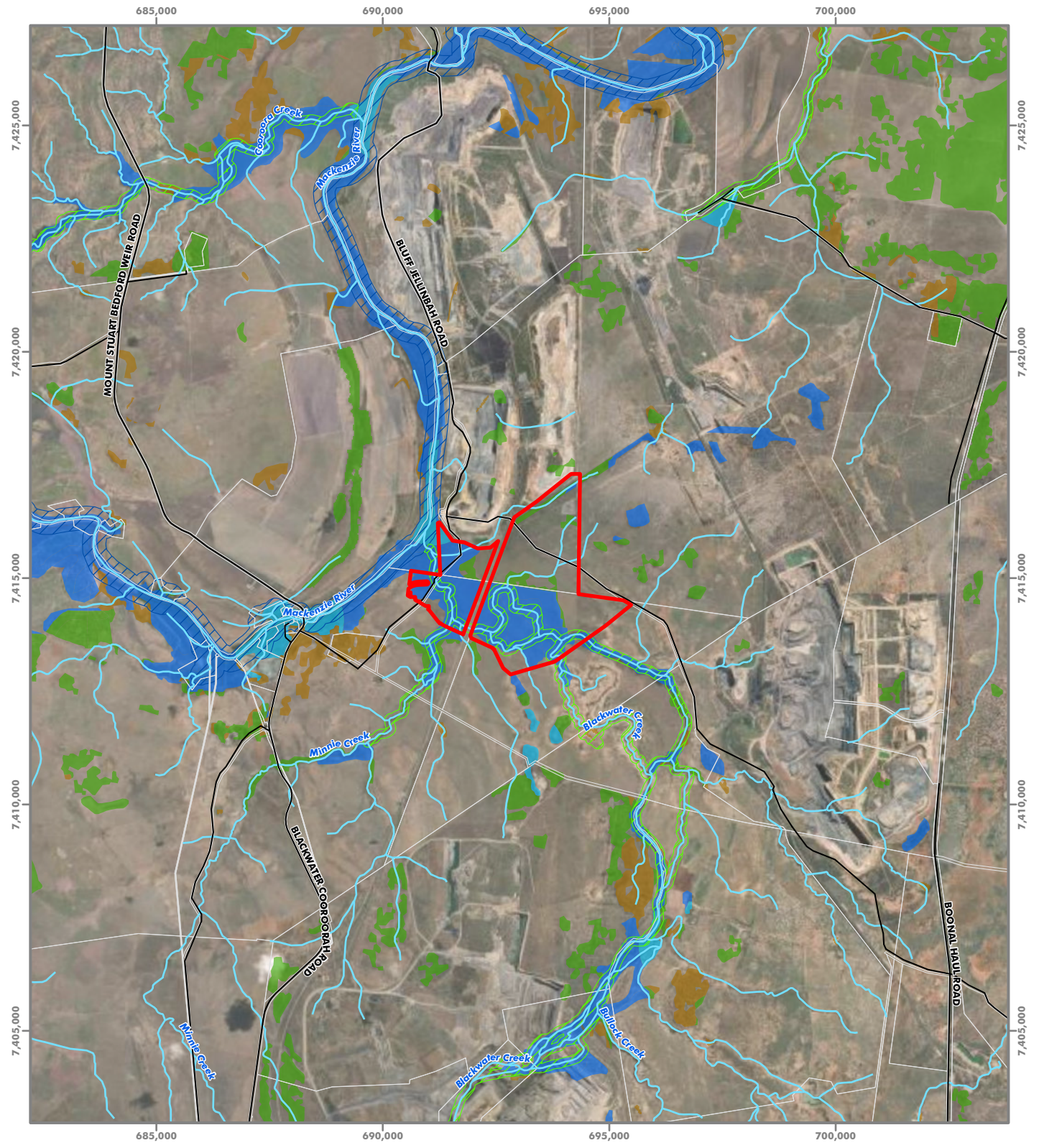
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0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Biodiversity Significance

- State Habitat for EVNT taxa
- State
- Regional
- Local or Other Values

Ecological Corridors

- State
- Regional

Figure 7 : Biodiversity Planning Assessment mapping

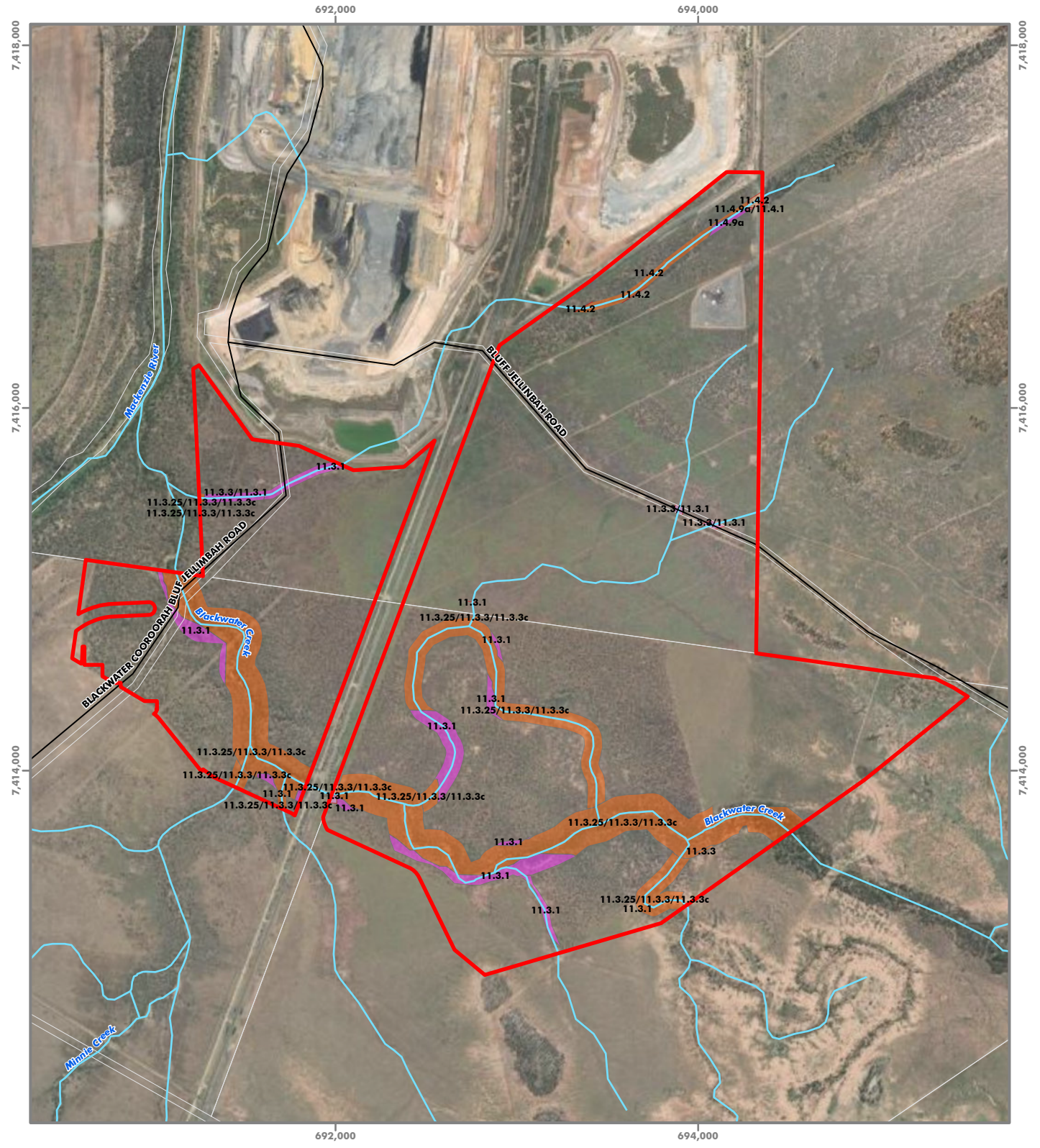
Curragh Board and Pillar Project
Terrestrial Ecology Report

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Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 2 4 6
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Vegetation Management Regional Ecosystem Map - V13.0

- Category A or B containing endangered regional ecosystems
- Category A or B containing of concern regional ecosystems
- Category C or R containing endangered regional ecosystems
- Category C or R containing of concern regional ecosystems

Figure 8 : Waterway vegetation

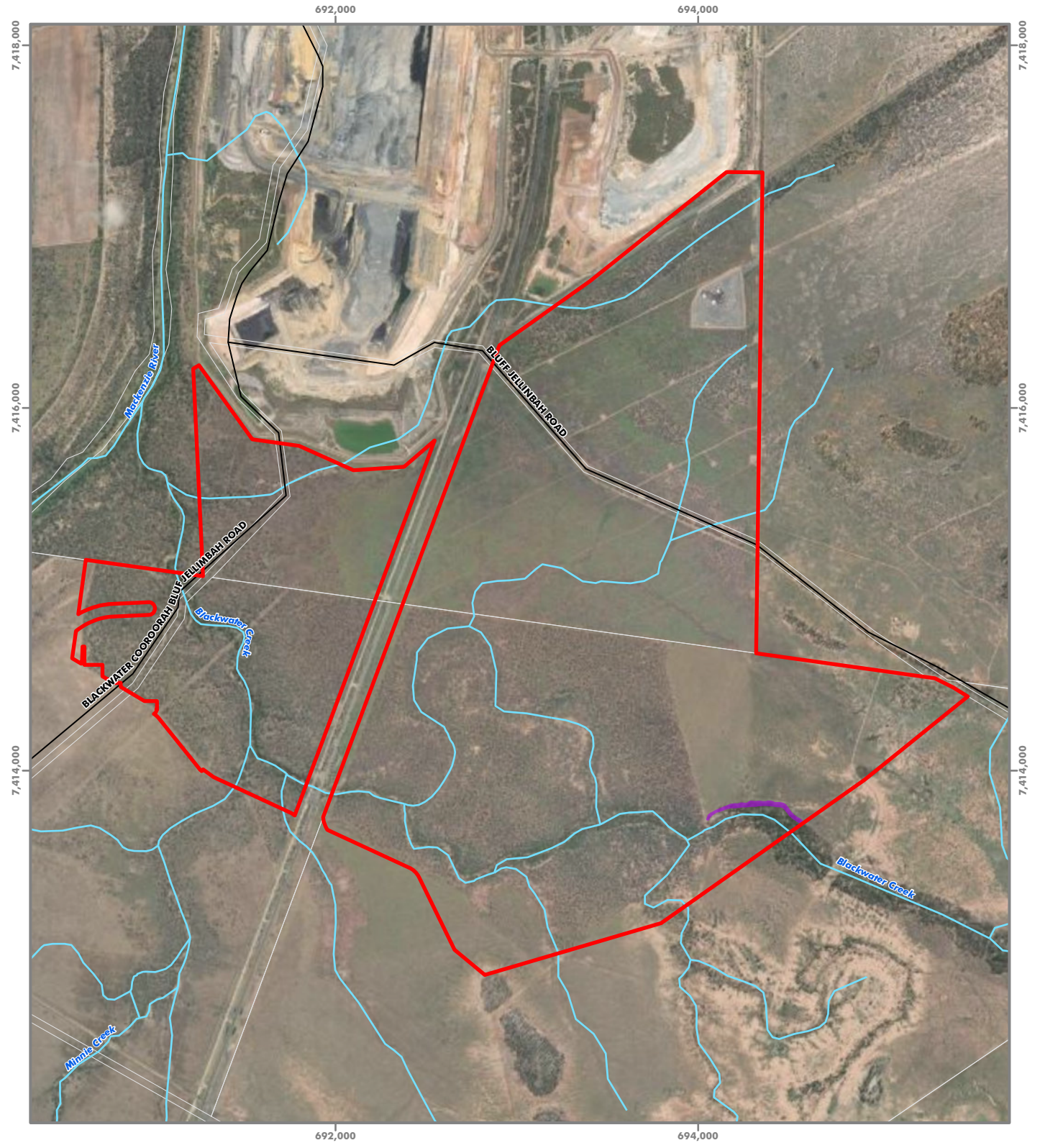
Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_09_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

***Solanum elachophyllum* (no common name) - Endangered (EPBC Act and NC Act)**
***Solanum adenophorum* (no common name) - Endangered (EPBC Act and NC Act)**

- Habitat mapping

Figure 9 : Threatened flora habitat mapping

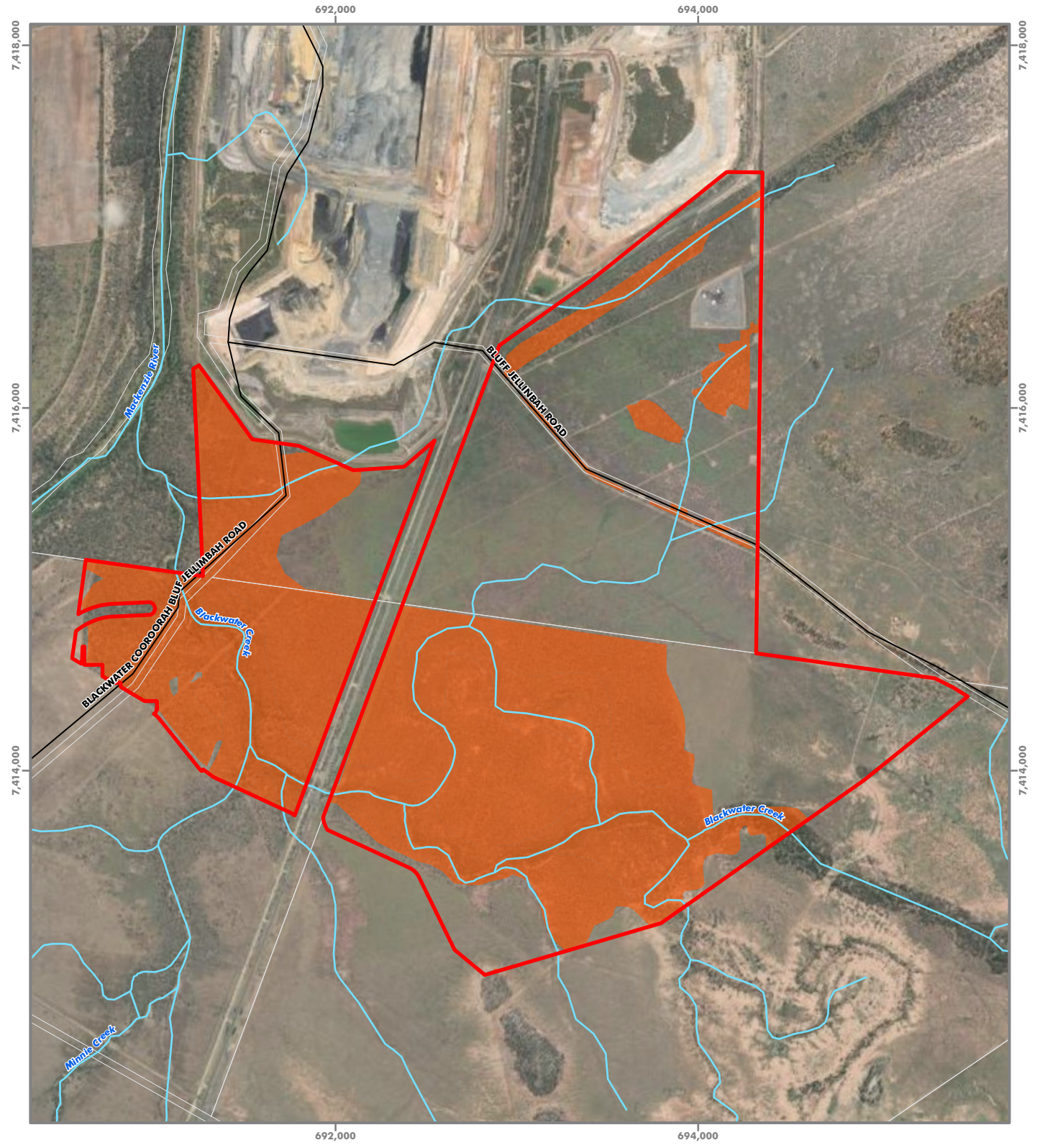
Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_10_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2023

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Koala (*Phascolarctos cinereus*) – Endangered (EPBC Act and NC Act)

- Habitat mapping

Figure 10 : Koala habitat mapping

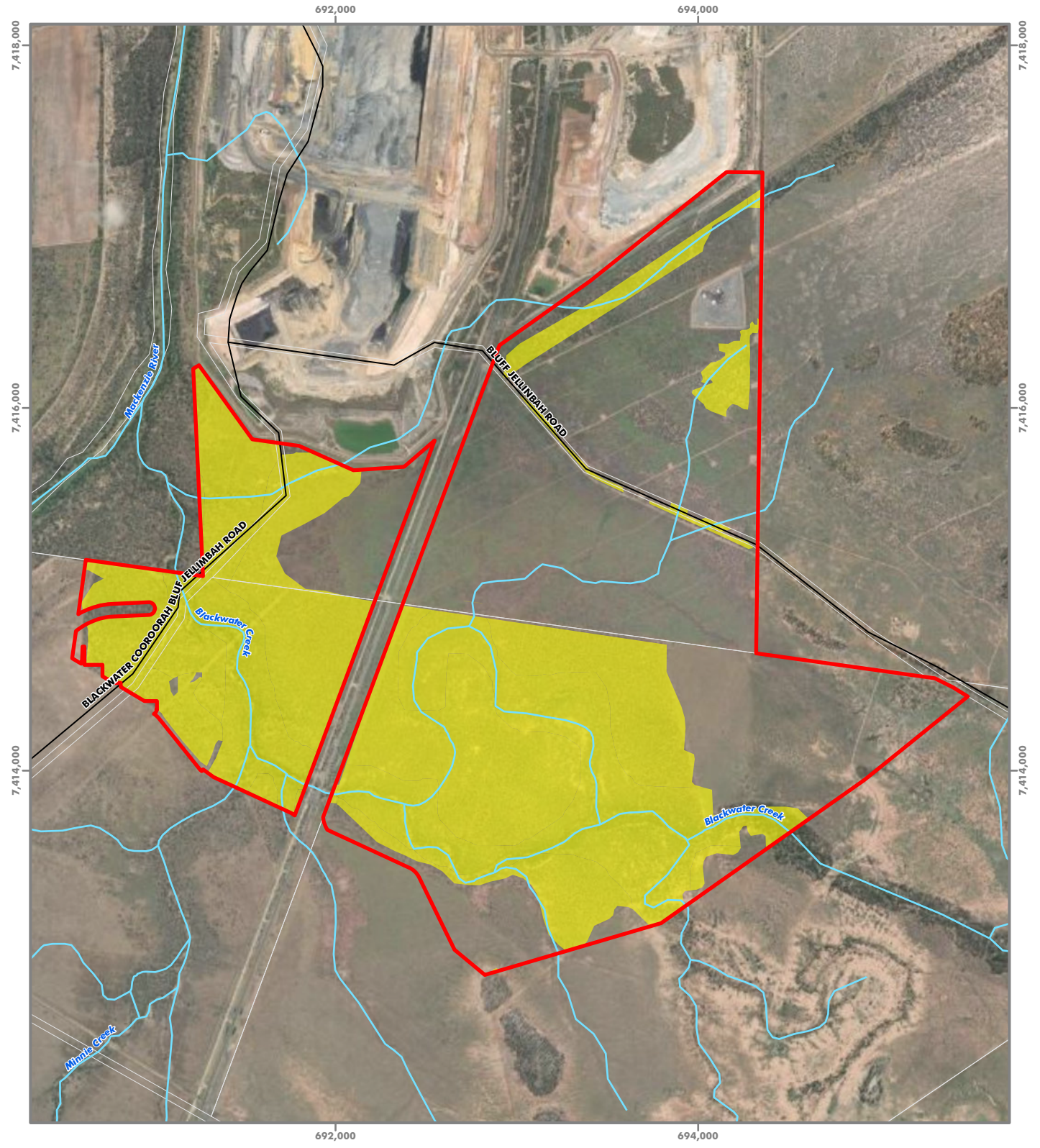
Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_11_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Greater Glider (*Petauroides volans*) – Endangered (EPBC Act and NC Act),
Yellow-bellied Glider (south-eastern) (*Petaurus australis australis*) - Vulnerable (EPBC Act and NC Act)

- Habitat mapping

Figure 11 : Greater Glider and Yellow-bellied Glider habitat mapping

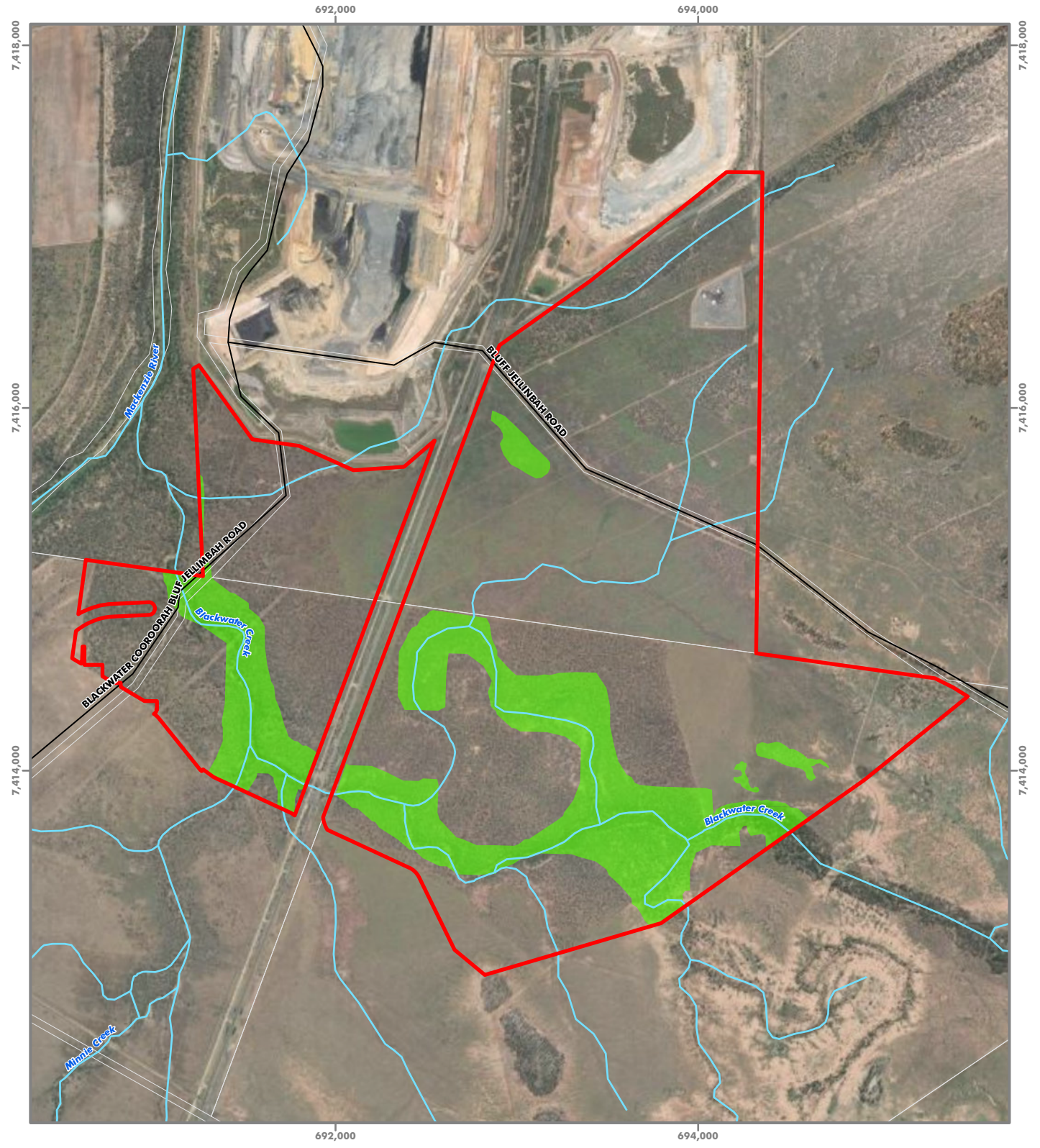
Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_12_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Australian Painted Snipe (*Rostratula australis*) - Endangered (EPBC Act and NC Act)

- Habitat mapping

Figure 12 : Australian Painted Snipe Habitat mapping

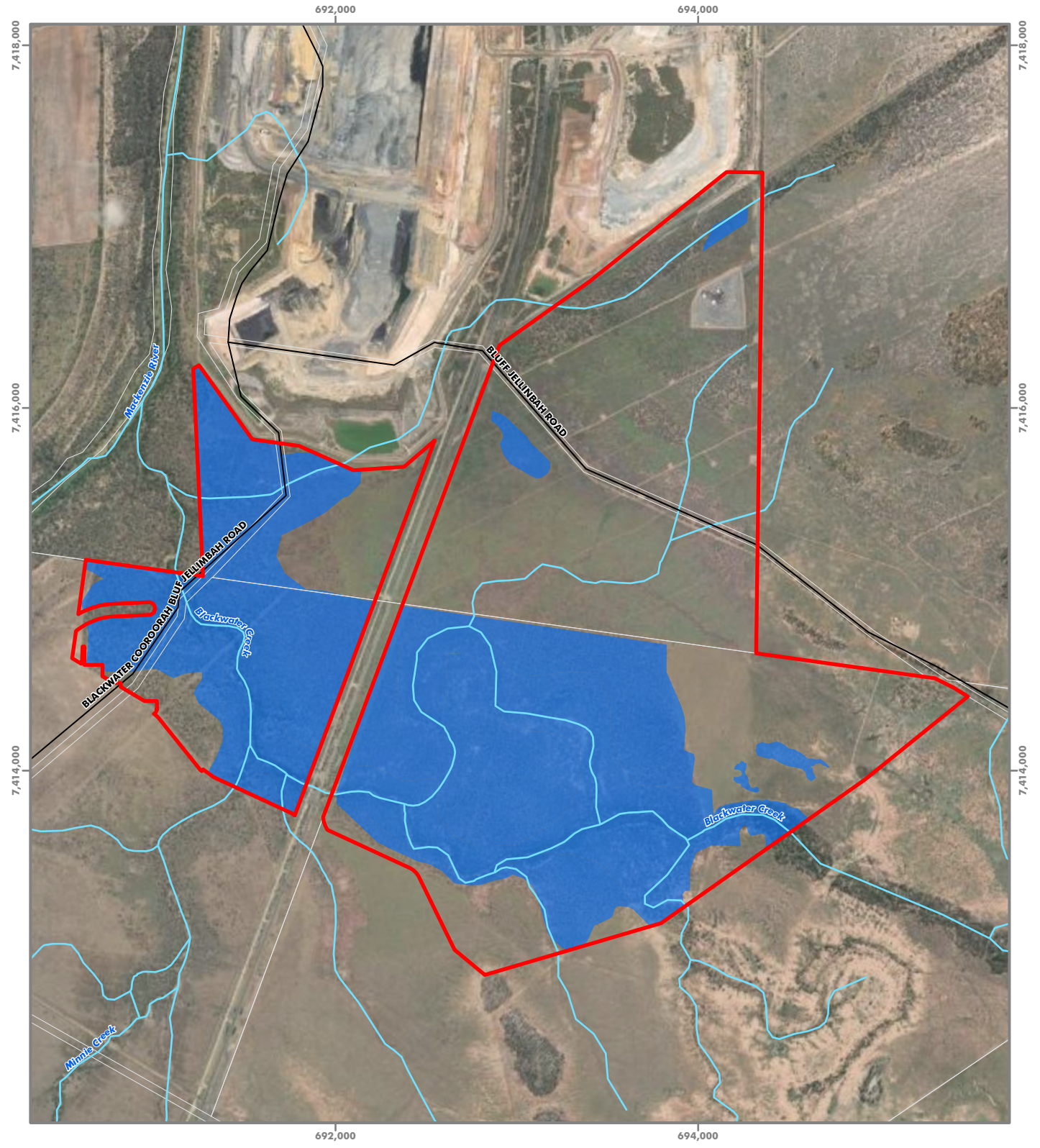
Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_13_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Ornamental Snake (*Denisonia maculata*) – Vulnerable (EPBC Act and NC Act)

- Habitat mapping

Figure 13 : Ornamental Snake habitat mapping

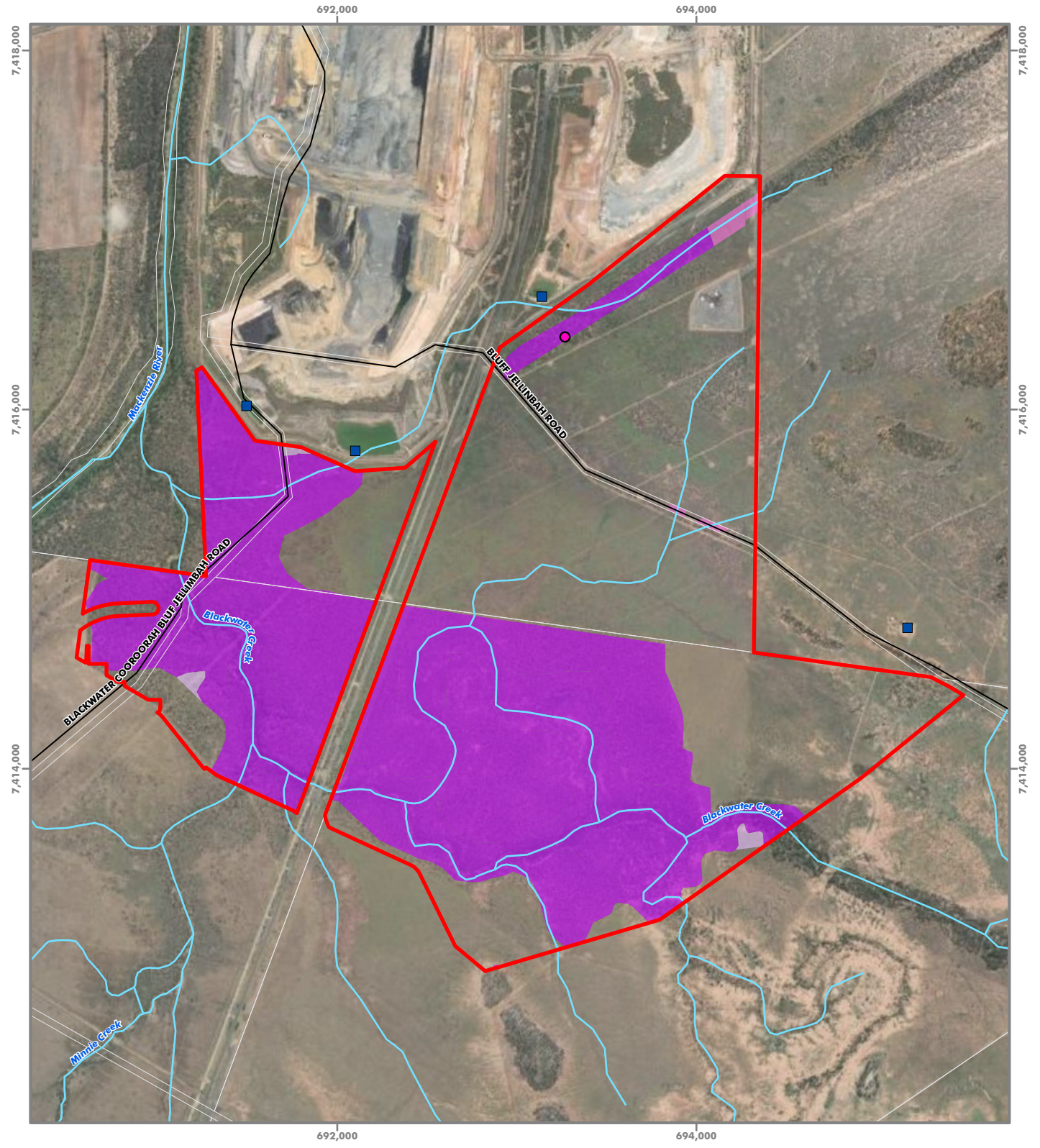
Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_14_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary
- Water point

Squatter Pigeon (southern) (*Geophaps scripta scripta*) – Vulnerable (EPBC Act and NC Act)

- Recorded location
- Breeding and foraging habitat
- Foraging habitat
- Dispersal habitat

Figure 14 : Squatter Pigeon habitat mapping and records

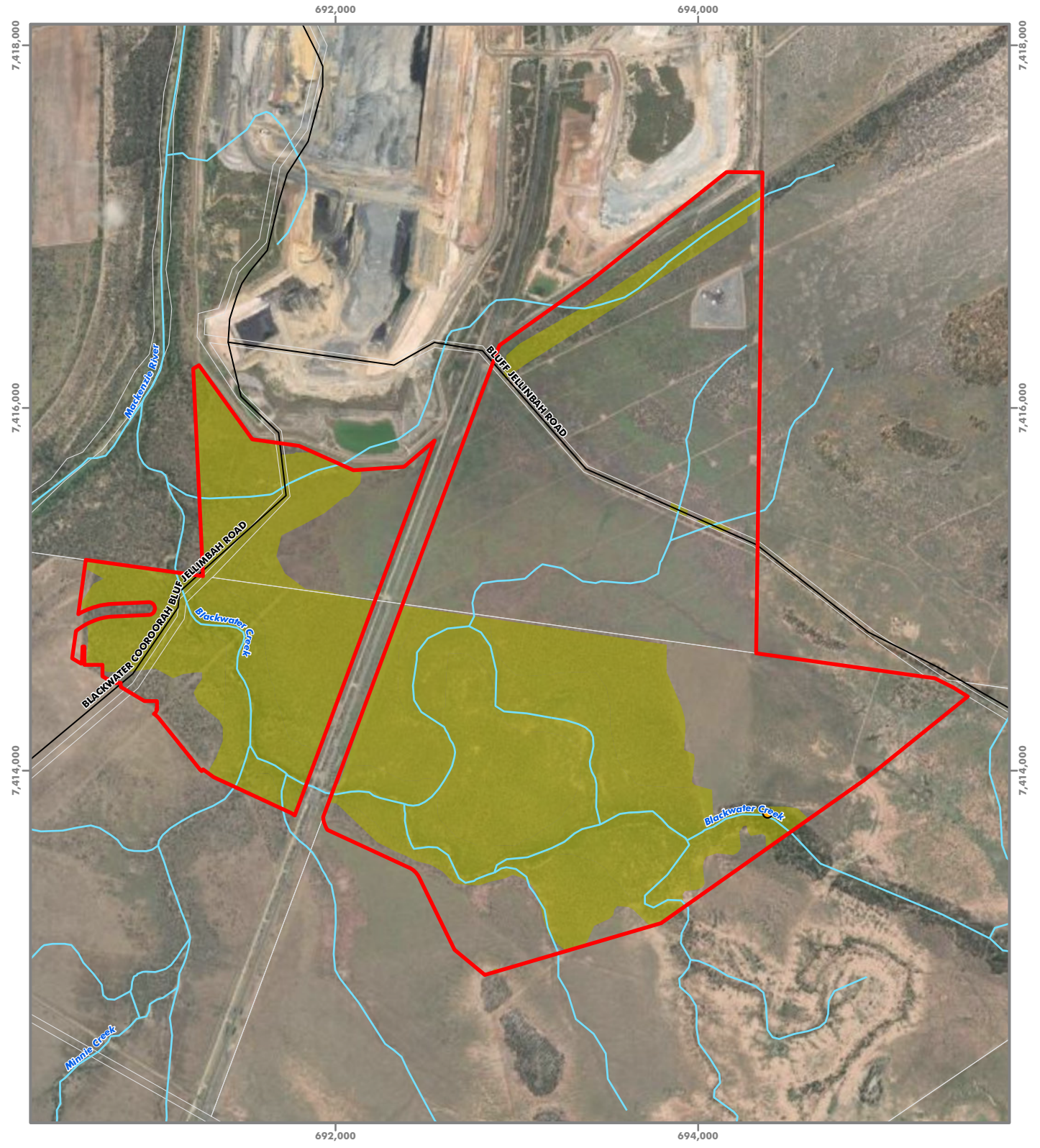
Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_15_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT



Legend

- Ecology Survey Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Short-beaked Echidna (*Tachyglossus aculeatus*) - special least concern (NC Act)

- Recorded location
- Habitat mapping

Figure 15 : Short-beaked Echidna habitat mapping and records

Curragh Board and Pillar Project
Terrestrial Ecology Report

Map Number: 23031_TER_16_A
Date: 03 May 2024
Map Projection: GDA 1994 MGA Zone 55
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2024

0 0.5 1 1.5
Kilometres

N

ECO SOLUTIONS & MANAGEMENT

Appendix A

Detailed Methodology

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This appendix provides a detailed description of the methodologies used in the preparation of this ecological assessment.

A1 Nomenclature

A1.1 Flora

Taxonomy and nomenclature for flora species within this report follows the *Census of the Queensland flora and fungi 2022* (Laidlaw 2022). In the first occurrence in the text, common names (if one exists) were followed by its scientific name. Common names for flora were derived from Harden et al. (Harden et al., 2018), Harden et al. (Harden et al., 2007), Brooker and Kleinig (Brooker & Kleinig, 2008), Maslin (Maslin 2001), Hacker (Hacker, 1990), Tothill and Hacker (Tothill & Hacker, 1996), Sharp and Simon (Sharp & Simon, 2002), and Auld and Medd (Auld & Medd, 2002). Use of an asterisk (*) indicates the species is not native to Queensland, e.g. Common Lantana (**Lantana camara*). Following the first in-text reference, species were referred to by common name only, where one exists.

A1.2 Fauna

Taxonomy and nomenclature for fauna species within this report are derived from the Queensland Governments WildNet database (DESI 2024a) and/or the *Sightings* mobile application (Macdonald 2013) in conjunction with the following references:

- amphibians − Tyler and Knight (Tyler and Knight 2020)
- reptiles − Wilson and Swann (Wilson and Swan 2020)
- birds − Pizzey et al. (Pizzey et al. 2012)
- mammals (except bats) − Menkhorst and Knight (Menkhorst & Knight, 2011)
- bats − Churchill (Churchill, 2009).

Common names were used where a species has an accepted common name with the scientific name provided at the first instance of the name appearing in the text. Common names for fauna were sourced from the references listed above or where no common name is provided, searches were made for other widely accepted common names.

A2 Desktop study

A2.1 Database searches and government mapping

Database searches were undertaken for the study area to identify records or potential occurrences of threatened, near threatened, migratory and/or special least concern flora and fauna species. Database searches were undertaken within a 25 km radius of the study area. The search radius is considered to be representative of the broader region.

Desktop searches covered the following databases and government mapping sources.

- EPBC Act Protected Matters Search Tool, accessed January 2024 (DCCEEW 2024) (Appendix B)
- Queensland Wildlife Online database, accessed January 2024 (DESI 2024a) (Appendix B)
- The Atlas of Living Australia[1], accessed January 2024 (CSIRO 2024)
- Vegetation Management regional ecosystem map Version 13.00, and Essential Habitat Map Version 12, maps at 1:100 000 scale (DR 2023). Essential habitat is mapped by the DES and is vegetation in which a species that is endangered, vulnerable or near threatened has been known to occur.
- Protected Plants Flora Survey Trigger Map, accessed January 2024 (DESI 2024b) (Appendix B).
- Geological Survey of Queensland 1:100 000 mapping (NRM 2011)
- Atlas of Groundwater Dependent Ecosystems (BoM 2024a). The Commonwealth Bureau of Meteorology (BoM) has produced a Groundwater Dependent Ecosystem Atlas, which provides ecological and hydrogeological information on known GDEs and ecosystems that could potentially use groundwater. The GDE Atlas collates information from a number of sources into a central database, including published research and interpreted remote sensing data.
- Queensland Wetland Data Springs Mapping (DESI 2024c). The Queensland Government has prepared the Queensland Wetland Data Springs mapping, which show the location of springs in the state. These springs are dependent on the surface expression of groundwater and their locations are used to infer the location of potential GDEs.
- Map of Referable Wetlands, accessed August 2020 and June 2023 (DESI 2024d). DESI has a range of policies and programs to manage wetlands. As part of a broader policy of wetland protection, and in accordance with schedule 12, part 2 of the Queensland Environmental Protection Regulation 2008 (EP Regulation), the DESI has prepared a map of referable wetlands. The map of referable wetlands includes:
  - WPAs, which comprise:
    - wetlands of high ecological significance (HES) located within Great Barrier Reef catchments
    - trigger areas that represent the area of hydrological influence of HES wetlands. Outside urban areas, the trigger area is 500 m from the edge of a HES wetland
  - wetlands of general ecological significance (GES).

[1] The Atlas of Living Australia is a publicly available database that is populated by a wide range of contributors including 'citizen-based' contributors. The database does not allow for every individual observation to be validated, therefore, this database has been used as secondary supporting information.

  - WPAs and HES wetlands contain wetland environmental values as listed under section 81A of the EP Regulation. WPAs are derived using a mapping method developed by the DESi called the Aquatic Biodiversity Assessment and Mapping Method. Significant residual impacts on WPAs are required to be offset in accordance with the Queensland Environmental Offsets Framework.

- Queensland Government Vegetation Management Wetlands map (DESI 2024e)
- Queensland Government Vegetation Management Watercourse map (DESI 2024f).

The Biodiversity Assessment and Mapping Methodology (BAMM) has been prepared to provide a consistent approach for assessing biodiversity values at the landscape scale in Queensland using vegetation mapping data generated or approved by the Queensland Herbarium as a fundamental basis (Queensland herbarium Science and Technology 2018). It is being used by EHP to generate Biodiversity Planning Assessments (BPAs) for each of Queensland's bioregions, including the Brigalow Belt Bioregion where the project is located.

BPAs are developed in two stages:

1) diagnostic criteria: involves the integration of ecological criteria using BAMM to determine the relative Biodiversity Significance
2) supplementary/expert panel criteria: allows for the refinement of the mapped information from Stage 1 by incorporating local knowledge and expert opinion.

The methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes.

Three biodiversity significance levels are mapped for any given region as follows:

- State biodiversity significance - areas assessed as being significant for biodiversity at the bioregional or state scales
- Regional biodiversity significance - areas assessed as being significant for biodiversity at the sub-bioregional scale
- Local biodiversity significant and/or other values - local values that are of significance at the local government scale.

The BPA mapping is for planning purposes and does not provide any specific statutory protection.

A2.2 Literature review and previous studies

Available literature was reviewed to establish whether findings of recent and nearby studies are relevant to the vegetation and habitat that occurs in the study area. Studies within, adjacent to or in the region, i.e. 25 km of the study area, were reviewed where available. The location of the study area in relation to other mines within the Moranbah region is illustrated in Figure 2.

A2.3 Review of aerial photography

The most recent aerial photography was used for this assessment. Digital Globe photography was viewed in relation to relevant biodiversity spatial layers. Aerial photography was used to identify features for ground-truthing during the field surveys, to identify appropriate survey locations and for determining and characterising potential terrestrial flora and fauna habitats.

A2.4 Regional ecosystem mapping

The Queensland Government produces regulated vegetation maps and supporting RE maps showing the distribution of remnant REs throughout Queensland. These published maps are produced using Landsat satellite imagery, aerial photography and field-based ground-truthing. Review of version 7 (statutory regulated vegetation mapping) RE maps was undertaken prior to field surveys to assist in the verification of RE types mapped in the study area. The Queensland Herbarium has also produced non-statutory RE mapping, *Pre-clearing and 2019 remnant regional ecosystems − Version 13* (DESI 2004).

A2.5 Geological mapping

A review of geological mapping of the study area was undertaken in order to gain an understanding of the geology within the study area and to provide an indication of likely land zones for assigning REs.

A3 Terrestrial ecology field surveys

A3.1 Survey team

Two ecologists undertook the field surveys and preparation of this terrestrial ecology assessment. The team and their qualifications are outlined in Table A1.

Table A1: Ecology survey team

Team Member	Title	Years of experience	Qualifications	Role
Steve Marston	Principal Ecologist	25	BEnvEng (Hons) MWildMgt	Lead, technical review
Craig Marston	Principal Botanist	10	BSc (Hons)	Flora field survey lead and report review
Michael O'Connor	Ecologist	10	BEnvSc	Fauna field surveys and reporting

A3.2 Permits

Field surveys were undertaken under the following permits and approvals:

- Scientific Purposes Permit: WA0027391 (valid from 26 October 2020 to 25 October 2025)
- Animal Ethics Committee Approval: CA2021/08/1525 (valid from 1 September 2021 to 25 August 2024).

A3.3 Coordinate system and map datum

Positional data was collected using a geographic positioning system with an accuracy of 3 to 5 m. Positional locations were recorded using the Latitude and Longitude coordinate system. All locations presented in this report are within zone 55K. The map datum used was WGS84.

A3.4 Survey timing

A combined flora and fauna field survey was conducted in order to field-validate the type, distribution and remnant status of vegetation communities and develop an inventory of flora and fauna species present. The field survey was conducted over six days from the 6th December to 11th December 2023 inclusive.

A3.5 Climatic conditions

As of 2013 climatic data has been collected at the Bureau of Meteorology (BoM) weather station at the Blackwater Airport (Station No.: 035134). From 2010 to 1995 climatic data was recorded at the Blackwater Water Treatment Plant (Station No.: 035290) and from 1995 to 1895 rainfall data was recorded at the Blackwater Post Office (Station No.:035009).

A3.5.1 Rainfall patterns

Monthly rainfall averages recorded at the BoM Blackwater Post Office weather station (1895 to 1995) and Blackwater Airport weather station (2013 to current) are provided in Table A2. Given the rainfall records at the Post Office station cover a period of 100 years, the data is considered to reflect regional rainfall patterns. Actual monthly rainfall totals recorded from 2022 to 2023 at the BoM Blackwater Airport weather station are also provided in Table A2. This data was used to show average regional rainfall information at the time of the surveys and in the preceding year.

As can be seen from Table A2, actual rainfall was typically below average in 2023 leading up the field survey with no rainfall recorded between August and October. However, significant rainfall was recorded in the month prior to the field survey with over 135 mm (over twice the monthly average) recorded in November (Table A2).

Table A2: Monthly recorded rainfall for the local area

Month	Blackwater Post Office Weather Station (035009) mean rainfall (mm)	Blackwater Airport Weather Station (035134) mean rainfall (mm)	Blackwater Airport Weather Station (035134)	
			Actual total rainfall 2022 (mm)	Actual total rainfall 2023 (mm)
January	97.1	88.3	37.6	*136.0*
February	88.5	76.0	120.6	*2.2*
March	55.4	69.0	123.6	*2.0*
April	31.7	13.3	29.4	*0.0*
May	32.9	20.5	80.4	*0.0*
June	27.5	16.8	43.8	*0.2*
July	26.4	30.2	95.6	*62.6*
August	16.8	14.5	46.0	*0.0*
September	22.8	19.1	31.6	*0.0*
October	41.3	54.2	85.8	*0.0*
November	57.1	53.2	73.0	*135.4*
December	78.8	72.9	79.4	*178.6*

Source: (BoM 2024b)
Note: data in italics have not been fully quality controlled.

A3.5.2 Weather conditions during the surveys

Daily weather conditions recorded at the BoM's weather station at Blackwater Airport for the two weeks preceding, as well as during the period of the field survey, are presented in Table A3.

Weather conditions during the survey period were characterised by dry, hot days with maximum daily temperatures between 28.9°C and 34.7°C, and warm evenings within minimum daily temperatures between 19.6°C and 21.3°C. While no rainfall was recorded during the survey period, approximately 118 mm of rainfall was recorded in the two weeks prior to the survey. Despite the rainfall, standing or flowing water was limited to the main channel of Blackwater Creek with gilgai and minor watercourses dry at the time of the survey. Consequently, conditions were favourable for the detection of amphibians and wetland birds in

the riparian vegetation associated with Blackwater Creek but less favourable in habitats outside of these areas. The higher minimum temperatures that occurred preceding and during the survey provided suitable conditions for the detection reptiles and amphibians. The rainfall prior to the survey was considered sufficient to stimulate some germination and emergence of groundcover species.

Table A3: Daily weather conditions (Weather Station 034035)

Date	Temp Min (ºC)	Temp Max(ºC)	Rainfall (mm)
22 November 2023	21.9	34.8	0
23 November 2023	20.8	27.2	21.6
24 November 2023	20	30.2	54
25 November 2023	19.8	28	4.8
26 November 2023	20	28.6	4.6
27 November 2023	21.2	23.3	0.4
28 November 2023	20.4	29.7	19.2
29 November 2023	20.7	38	7.2
30 November 2023	17.4	38.1	0
1 December 2023	20.7	33.2	3.2
2 December 2023	21.9	35.3	3.6
3 December 2023	22.6	36.4	0
4 December 2023	21.2	36.7	0
5 December 2023	22.8	34.6	0
6 December 2023	21.3	34.4	0
7 December 2023	20.1	34.7	0
8 December 2023	19.6	34.6	0
9 December 2023	20.3	34	0
10 December 2023	20.6	33.5	0
11 December 2023	20.5	28.9	0

Source: (BoM 2024b)

A3.6 Flora field survey methods

The flora field survey methods described in this section were developed based on the results of database searches for the study area, as presented in Appendix B.

A3.6.1 Site selection

The field flora survey methods were developed in order to:

- validate existing Queensland government RE vegetation mapping, and better define the distribution and proportionate composition of REs within mixed polygons of more than one RE type
- target threatened flora species and vegetation communities identified from database searches and their habitats
- produce a comprehensive floral inventory for all vegetation assessment sites and the study area as a whole.

The field flora survey was carried out in compliance with the *Methodology for surveying and mapping of regional ecosystems and vegetation communities in Queensland, Versions 6.0* (Neldner et al. 2022). Assessment sites were performed throughout the study area so as to thoroughly assess Queensland Government mapped remnant vegetation.

The validation and mapping of remnant vegetation was undertaken at a total of 44 quaternary assessment sites (Figure 3).

The quaternary site method provides information relating to the vegetative structure and composition to assist in mapping the extent and distribution of the identified REs within the study area. Data recorded at each quaternary site included:

- precise location (with reference to a handheld GPS)
- ground-cover, mid-stratum and canopy species composition and abundance
- structural characteristics of the EDL
- Soil and geology characteristics
- condition and other relevant observations
- limited photographs of the community.

The remnant status of existing vegetation was determined by comparing the existing predominant canopy with the undisturbed predominant canopy. The Queensland Herbarium defines the predominant canopy under the VM Act, as the Ecologically Dominant Layer (EDL), namely, that stratum of the vegetation that contains the most above ground biomass. The EDL can be defined in terms of growth form, height, cover density and species. In the majority of cases, the EDL is equivalent to the upper stratum (Walker and Hopkins 1990).

The crown cover definitions and associated crown separation descriptions (e.g. sparse) were also applied to the lower strata to allow a consistent description of the spatial distribution of the respective vegetation layers.

The landform description upon which the field-validated vegetation communities occurred was based on simple erosional landform patterns characterised by relief and modal slope and described by (McDonald et al., 1990).

A3.6.2 Targeted species surveys

Significant flora species (i.e. endangered, vulnerable and near threatened (EVNT) flora) listed under the NC Act that were recorded or predicted to occur from database searches (Appendix C) were reviewed and, where relevant, formed the focus of targeted flora species surveys. Detailed traverses of habitat that was considered suitable for significant flora species were undertaken.

A3.6.3 Vegetation mapping

Queensland Government mapped REs in the study area were validated in the field using the survey data as previously described, and utilised the latest geology mapping (NRM 2011). The boundaries of vegetation types were mapped in the field using a GPS and/or aerial photograph interpretation.

A3.6.4 Random traverses

In addition to quaternary assessment sites, large portions of the study area were traversed on foot and the random meander technique applied (Cropper 1993). The purpose of random traverses was to ensure adequate site coverage and to establish a comprehensive floral species list. This method is also essential for the detection of cryptic, pest and other significant species. This method was supplemented with 'educated walks' (Garrard et al. 2008) in habitat areas that possessed a higher likelihood of supporting threatened flora species.

A3.6.5 Ancillary information

Other field characteristics such as areas of weed infestation, habitat areas for significant species and regional connectivity were recorded and described. Photographic records were taken throughout the study area, capturing each community type, habitat type and the broader landscape.

A3.6.6 Flora inventory and abundance

An overall flora species list, including native and introduced species, was compiled for the study area. Relative abundance of flora species was assessed on a site-by-site basis.

In relation to vegetation structure, abundance estimates were determined for species within each stratum of the community, with particular focus on the EDL as it is by these species that the community is defined, and from this, the RE determined (Neldner et al. 2020; 2019; 2012).

A3.7 Fauna field survey methods

The fauna field survey methods described in this section were developed based on the results of database searches for the search area, as presented in Appendix B.

A3.7.1 Overview of survey effort

A variety of targeted fauna survey methods were used, including spotlighting, call playback, active searching, Harp trapping, Anabat survey sites and observation (e.g. bird surveys and opportunistic observations).

Sites selected for each of the survey methods were determined through desktop review of aerial photography, RE and high-value regrowth vegetation mapping and database search results in order to stratify survey effort across major habitat types for species likely to occur in the study area.

The survey was then refined, where necessary, in the field once an on-ground appreciation for the vegetation communities and habitat features (e.g. locations of gilgai etc.) could be obtained.

Table A4 details the survey effort conducted during the survey. The following sections describe the methods used during the surveys and locations of the survey sites.

Table A4: Fauna survey effort

Survey technique	Survey effort	Target fauna
Spotlighting	6 person hours on foot and 2 hours from a slow moving vehicle	Mammals (including Koala, Greater Glider, Yellow-bellied Glider), reptiles (including Ornamental Snake), nocturnal birds
Call playback	6 sessions	Owls, Koala, Yellow-bellied Glider
Bird survey	9 person hours	Birds (including Squatter Pigeon, Australian Painted Snipe, Migratory birds)
Active searching	6 person hours	All conservation significant species, including small mammals reptiles, and birds
Harp trapping	2 trap nights	Microbats
Anabat	2 nights	Microbats
Opportunistic / incidental observations	90 diurnal person hours and 24 nocturnal person hours	All species

A3.7.3 Supplementary survey sites

Twelve supplementary survey sites were completed during the field surveys (Figure 6). Techniques employed at supplementary sites included spotlighting, call playback, bird survey and/or active searching.

A description of the location, survey techniques and vegetation types of the supplementary survey sites is provided in Table A5.

Table A5: Description of supplementary survey sites

Survey site ID	Survey techniques	Vegetation description
S1	Bird survey, active search, spotlight and call playback	Coolabah (*Eucalyptus coolabah*) woodland with a shrub layer of Yellow Wood (*Terminalia oblongata*) and ground cover dominated by Buffel Grass (**Cenchrus ciliaris*). Sparse abundance of hollows, mostly in stags (dead standing trees), moderate to low abundance of fallen timber and areas of deep leaf litter.
S2	Bird survey, and active search.	Brigalow (*Acacia harpophylla*) open woodland with sparse emergent Coolabah, a sparse to mid-dense of Yellow Wood and Brigalow and a dense ground cover of *Buffel Grass.
S3	Bird survey, and active search.	Riparian vegetation associated with Blackwater Creek with Queensland Blue Gum (*Eucalyptus tereticornis*) in the channe and Coolabah on the upper banks. Blank Tea-tree (*Melaleuca bracteata*) present as a shrub layer to sub-canopy and dense in places. Ground cover dominated by exotic grasses including Green Panic (**Megathyrsus maximus*). Moderate abundance of hollow bearing trees, fallen timber and areas of deep leaf litter.
S4	Bird survey, and active search.	Brigalow woodland with sparse emergent Coolabah, shrub layer of Yellow Wood and sparse ground cover of exotic grass. Very sparse hollow bearing trees, moderate abundance of fallen timber and abundant areas of deep leaf litter.
S5	Bird survey, and active search.	Brigalow and Coolabah open woodland with occasional Bauhinia (*Lysiphyllum hookeri*). Sparse tree hollows that are predominately in stags, abundant fallen timber and moderate abundance of deep leaf litter.
S6	Bird survey, active search, spotlight and call playback	Riparian vegetation associated with Blackwater Creek with Queensland Blue Gum (*Eucalyptus tereticornis*) in the channel and Coolabah on the upper banks. Ground cover dominated by exotic grasses including Green Panic (**Megathyrsus maximus*). Moderate abundance of hollow bearing trees, fallen timber and areas of deep leaf litter
S7	Bird survey, active search, spotlight and call playback	Brigalow woodland with sparse emergent Coolabah, shrub layer of Yellow Wood and ground cover of predominately exotic grass. Sparse hollow bearing trees, moderate to sparse abundance of fallen timber and abundant areas of deep leaf litter.
S8	Bird survey, and active search.	Lineal patch of low Brigalow tending to vine thicket species following drainage line. Dense shrub layer in places of Bauhinia and Yellow Wood with a ground cover of mostly exotic grasses. Sparse hollows (mostly small diameter on edge). Abundant fallen timber and deep leaf litter.

Survey site ID	Survey techniques	Vegetation description
S9	Spotlight and call playback	Riparian vegetation associated with Blackwater Creek with Queensland Blue Gum in the channel and Coolabah on the upper banks, some very large trees present. Ground cover dominated by exotic grasses including Green Panic. Swales present on the upper banks that are fringed with Brigalow and occasional Belah (*Casuarina cristata*). Moderate abundance of hollow bearing trees, sparse to moderate fallen timber and moderate abundance of areas of deep leaf litter.
S10	Spotlight and call playback	Cleared, non-remnant vegetation with sparse but well developed gilgai. Ground cover comprises dense Buffel in the higher areas with aquatic vegetation present in gilgai. No tree hollows, fallen timber or areas of deep leaf litter.
S11	Bird survey, and active search	Coolabah open grassy woodland with a sparse shrub layer of Yellow Wood and mostly exotic grasses with native grass interspaced. Some wetland/drainage features in the east. Sparse to moderate abundance of hollow bearing trees, sparse fallen timber and sparse areas of deep leaf litter.
S12	Spotlight and call playback	High value regrowth tending to remnant Brigalow woodland with a sparse ground cover of exotic grass. Small shallow gilgai throughout with native aquatic species occurring in the ground cover of gilgai. Sparse to absent hollow bearing trees, sparse fallen timber and sparse to moderate areas of deep leaf litter.

A3.7.4 Spotlighting

Spotlighting was undertaken on foot for 1 person hour at 6 of the 12 supplementary survey sites (Table A5 and Figure 6). Fauna was located from eye shine or direct observation and identified. The distinctive calls of some fauna were also used to identify their presence.

A3.7.5 Call playback

Call playback involved broadcasting a recorded call of an owl or arboreal mammal through a megaphone in an effort to elicit a territorial response from any animals that hear the call. Animals either call in response to the recording and/or move into the location that the call was played from. The call is played and then approximately 2 to 3 minutes are spent listening for a response and looking for animals that have moved into the area without calling. Call playback was undertaken at the systematic trap sites and an additional 12 supplementary sites. Following the call playback session, spotlighting was conducted of the immediate area to locate any owls that had flown into the area without calling and had not been seen during the call playback.

The calls of the following species were played:

- Barking Owl (*Ninox connivens*)
- Masked Owl (*Tyto novaehollandiae*)
- Barn Owl (*Tyto alba*)

- Koala *(Phascolarctos cinereus*)
- Yellow-bellied Glider (*Petaurus australis*)

A3.7.6 Bird surveys

Bird surveys, with records made of all birds seen and heard, were conducted at 9 supplementary sites resulting in a total survey time of 9 person hours. Opportunistic records of birds were also made while undertaking other activities throughout the study area. Approximately 90 person hours were spent on site undertaking opportunistic diurnal bird observations during the field survey.

A3.7.7 Active searches

Active searching was conducted to detect reptiles, frogs and small ground dwelling mammals. It involved the searching of suitable microhabitat such as logs, bark, deep leaf litter, surface rocks and shedding bark. Active searching was undertaken at 9 supplementary sites with a total survey time of 9 person hours (Tables A5).

A3.7.8 Harp trap sites

Suitable harp trap sites were limited within the study area and as such, harp trap survey effort was reduced. One harp trap was set up at one location for two nights resulting in a total of two harp trap nights. The harp trap site was in a flyway along a small waterway. Harp traps comprise two banks of vertical microfilament line offset from one another. Bats fly into one of these wires and drop into a bag beneath the trap where they can be collected for identification. Captured bats were kept in a quiet cool location and released on the night following their capture.

A3.7.9 Anabat

The Anabat surveys involved the use of an Anabat Swift detector to record the echolocation calls of micro bats as they forage. A sonogram was then produced using software that allows for comparison against reference calls for identification. Unfortunately, some species of bat have very similar and/or quiet calls and cannot be positively distinguished via Anabat (e.g. *Nyctophilus* species). Therefore, a probability rating is provided for calls identified. All Anabat calls were analysed by Greg Ford, a specialist in analysing Anabat recordings.

An Anabat unit was deployed for one night from dusk until dawn at two locations (Figure 6) and survey effort totalled two nights. Anabat survey sites were selected on the basis of having suitable flyways, flowering trees that attract insects or water that attracts insects and bats.

A3.7.10 Opportunistic observations

Records of fauna were also made opportunistically while undertaking other activities, such as moving between trap sites, throughout the survey period. A total of 90 diurnal and 24 nocturnal person hours were spent onsite.

A3.7.11 Habitat assessment

The quality of fauna habitat in the study area was assessed on the basis of the following criteria:

- Unlikely: Many fauna habitat elements in low quality areas have been removed or altered such as mature, hollow-bearing trees, fallen timber and deep leaf litter. Remnants are often small in size, support substantial weed infestations of high or moderate threat weeds (e.g. Buffel Grass) and are poorly connected to other areas of remnant vegetation.
- Possible: Some habitat components are present but others are lacking. For example, a remnant may have a reasonably intact understorey but lack mature canopy species and fallen timber. Some weed infestations are present but are relatively small in size or comprise species of low to moderate threat. Linkages with other remnant habitats in the landscape may be lacking or somewhat tenuous.
- High: Most habitat components are present (e.g. old-growth trees, fallen timber, lack of weeds and deep leaf litter), the remnant is large enough to support species that are typically associated with large intact areas of habitat and it is well connected or contiguous with other areas of native vegetation.

These criteria were adapted for treeless habitat types such as grasslands as appropriate.

A4 Field survey standards

A number of guidelines have been consulted in the development of methods for the field surveys, particularly with regard to survey timing and techniques employed to target threatened and migratory species most likely to occur within the study area.

Threatened species survey guidelines used to inform the requirements of the terrestrial flora and fauna survey included both Commonwealth and Queensland guidelines as follows:

- Queensland guidelines:
  - *Flora Survey Guidelines – Protected Plants Nature Conservation Act 1992, Versions 2.01* (DESI 2024g)
  - *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland, Version 4.0* (DESI n.d.).
- Commonwealth guidelines:
  - *Survey guidelines for Australia's threatened birds* (DEWHA 2010a)
  - *Survey guidelines for Australia's threatened bats* (DEWHA 2010b)
  - *Survey guidelines for Australia's threatened reptiles* (SEWPaC 2011a)
  - *Survey guidelines for Australia's threatened mammals* (SEWPaC 2011b)
  - Conserv*ation Advice for Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory* (DAWE 2022)
  - *A review of koala habitat assessment criteria and methods* (Youngentob et al. 2021)
  - *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (SEWPaC 2011c)
  - *Referral guideline for 14 birds listed as migratory species under the EPBC Act - Draft* (DotE 2015)
  - *Species profile and threats (SPRAT) databases for relevant EPBC Act listed species and communities, accessed on 3 November 2017, 6 August 2020 and 28 July 2022*
  - *Approved Conservation Advice for the Brigalow TEC* (TSSC 2013).

The Commonwealth guidelines provide specific survey guidelines for individual threatened flora and fauna species and ecological communities listed under the EPBC Act, while the Queensland survey guidelines provide general guidance on survey methodology and minimum effort advice for detection of all species.

A5 Likelihood of occurrence

A5.1 Significant species assessment

Database searches identified threatened species that potentially occur in the study area. The likelihood of these species occurring was then assessed based on the results of the field surveys.

The likelihood of species occurring in the study area was classified using the criteria presented in Table A6. The assessment was based on the species' known ranges and habitat preferences, which were assessed against the characteristics of the study area observed during field surveys.

Table A6: Criteria to assess potential for species to occur in the study area

Likelihood to occur	Definition
Present	The species was recorded in the study area during the field surveys.
High	The species was not recorded within the study area during the field surveys but is known to occur within the surrounding area, and habitat of suitable quality exists within the study area.
Possible	The species was not recorded in the study area during the field surveys, although it is known to occur in the wider region. Habitat was identified for the species in the study area during the field surveys; however, it is marginal, fragmented and/or small in size, or degraded.
Unlikely	The species was not recorded in the study area during the field surveys. The species is either: a) unlikely to occur in the wider region and due to the lack of, or extremely poor quality habitat in the study area, the species is not expected to occur in the study area; or b) may forage periodically in the wider region and may overfly the study area, but the habitat in the study area is generally not suitable.

A6 Significant species habitat mapping

Habitat mapping was undertaken for significant flora and fauna species that were recorded as being present in the study area or that were assessed as the potential to occur in the study area.

Habitat mapping was based on RE mapping to assign areas of habitat based on known habitat preferences, field observations from the study area and previous experience, where applicable.

A7 Assessment of impacts

For MSES listed under the EO Act, the significance of impacts was assessed in accordance with the Queensland Significant Residual Impact Guidelines (SRI Guideline) (EHP 2014). The Landscape Fragmentation and Connectivity (LFC) Tool, referred to in the SRI Guideline, was used to assess impacts to connectivity.

A conservative, risk-based approach was adopted to determine the need for a significance assessment of species under EO Act (i.e., an assessment of impacts using SRI Guidelines). This approach considers both the likelihood of occurrence of

the species within the study area and the potential for habitat loss or disturbance (directly or indirectly) resulting from the project's impacts. This approach considers both the likelihood of occurrence of the species within the study area and the potential for habitat loss or disturbance (directly or indirectly) resulting from the project's impacts. This approach ensures that potential impacts from the project on conservation significant species, which were recorded within the study area or had a moderate or high likelihood to occur within the study area were considered. The criteria for determining if a significance assessment is required are presented in Table A7.

Table A7: Requirement for significant impact assessment criteria

Likelihood to occur	No potential for habitat loss or disturbance from the project	Potential for habitat loss or disturbance from the project
Present	NO	YES
High	NO	YES
Moderate	NO	YES
Low	NO	NO

A8 Limitations

The project timeframe has not allowed for seasonal surveys to be undertaken for the study area. Only dry season surveys were undertaken for the study area.

Standardised trapping techniques were not used in the study area due to the limited native vegetation and habitat diversity within this study area. Instead, areas of native vegetation were assessed using targeted techniques, for their habitat values for particular species and their potential to represent threatened communities.

The timing of the survey coincided with optimal conditions for the identification of many flora species, particularly grasses and herbaceous species, which usually require reproductive material for identification.

The fauna surveys were conducted within the optimal post-wet season survey timing for the Brigalow Belt bioregion (i.e. March to mid-May) according to the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Queensland Herbarium 2018). This is most relevant for detection of the Brigalow Belt reptiles (Ornamental Snake Grey Snake and Dunmall's Snake). Conditions during the survey were conducive to the detection of these species. Nonetheless, ecological surveys often fail to record all species of flora and fauna present on a site for a variety of reasons, including seasonal absence or reduced activity during certain seasons or very large home ranges of some animals. Furthermore, the ecology and nature of significant and/or cryptic species means that such species are potentially not recorded during short survey periods. This assessment overcomes these limitations by assessing impacts not only on species recorded during the field surveys, but also on species that are potentially present (based on known distribution and habitat availability).

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Appendix B

Database Search Results

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 05-Jan-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	27
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	24
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area	In feature area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area	In buffer area only
Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin	Endangered	Community likely to occur within area	In feature area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area	In feature area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area	In buffer area only
Weeping Myall Woodlands	Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Falco hypoleucos](#) Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Geophaps scripta scripta](#) Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Grantiella picta](#) Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In feature area
[Neochmia ruficauda ruficauda](#) Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area	In feature area
[Poephila cincta cincta](#) Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area	In feature area
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
[Stagonopleura guttata](#) Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area	In feature area
MAMMAL			
[Dasyurus hallucatus](#) Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area	In feature area
[Macroderma gigas](#) Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In feature area
[Nyctophilus corbeni](#) Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area	In feature area
[Onychogalea fraenata](#) Bridled Nail-tail Wallaby, Bridled Nailtail Wallaby [239]	Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Petauroides volans			
Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area	In feature area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)			
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat likely to occur within area	In feature area
Pteropus poliocephalus			
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
PLANT			
Cadellia pentastylis			
Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Dichanthium queenslandicum			
King Blue-grass [5481]	Endangered	Species or species habitat may occur within area	In feature area
Dichanthium setosum			
bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Eucalyptus raveretiana			
Black Ironbox [16344]	Vulnerable	Species or species habitat known to occur within area	In feature area
REPTILE			
Delma torquata			
Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area	In feature area
Denisonia maculata			
Ornamental Snake [1193]	Vulnerable	Species or species habitat known to occur within area	In feature area
Egernia rugosa			
Yakka Skink [1420]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Elseya albagula			
Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Furina dunmalli			
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Hemiaspis damelii			
Grey Snake [1179]	Endangered	Species or species habitat may occur within area	In feature area
Rheodytes leukops			
Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat known to occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Cuculus optatus			
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca			
Satin Flycatcher [612]		Species or species habitat may occur within area	In feature area
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat may occur within area	In buffer area only
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Calidris acuminata](#)			
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
[Calidris ferruginea](#)			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Calidris melanotos](#)			
Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
[Gallinago hardwickii](#)			
Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area	In feature area
[Pandion haliaetus](#)			
Osprey [952]		Species or species habitat likely to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - BLACKWATER TRAINING DEPOT [30270]	QLD	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
[Actitis hypoleucos](#)			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
[Anseranas semipalmata](#)			
Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Bubulcus ibis as Ardea ibis](#) Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
[Chalcites osculans as Chrysococcyx osculans](#) Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area	In feature area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Myiagra cyanoleuca			
Satin Flycatcher [612]		Species or species habitat may occur within area overfly marine area	In feature area
Pandion haliaetus			
Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat may occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Blackwater	Conservation Park	QLD	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Development and operation of the Star Coal Project Bulk Sample Project	2023/09502		Completed	In buffer area only
Action clearly unacceptable				
Galilee Coal Project including development of coal mine, 495km railway, port and	2008/4366	Action Clearly Unacceptable	Completed	In buffer area only
Controlled action				
Blackwater creek diversion and coal mine	2007/3925	Controlled Action	Post-Approval	In buffer area only
Blackwater to Gladstone Gas Pipeline Project	2011/6034	Controlled Action	Completed	In buffer area only
Bowen Gas Project	2012/6377	Controlled Action	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Construct and operate a coal gasification plant and carbon dioxide capture and storage	2006/3040	Controlled Action	Completed	In buffer area only
Curragh Extension Project, Blackwater, QLD	2015/7508	Controlled Action	Post-Approval	In feature area
Curragh North Coal Mine	2003/1096	Controlled Action	Post-Approval	In feature area
install & operate gas pipeline	2005/2059	Controlled Action	Post-Approval	In buffer area only
Jellinbah Coal Mine-Central North Extension, QLD	2018/8139	Controlled Action	Post-Approval	In feature area
Norwich Park & Blackwater CSG Fields & supporting infrastructure Bowen Basin	2011/6032	Controlled Action	Completed	In feature area
Norwich Park to Blackwater Gas Pipeline	2011/6031	Controlled Action	Completed	In buffer area only
Walton Coal Project, Bowen Basin, Qld	2017/8077	Controlled Action	Assessment Approach	In buffer area only
Washpool Coal Mine Project	2009/5240	Controlled Action	Completed	In buffer area only
ZeroGen Integrated Gasification Combined Cycle Power Plant and CO2 Capture, Transport and Storage	2009/5195	Controlled Action	Completed	In feature area
Not controlled action				
Blackwater to Emerald Dual Circuit 132kV Powerline, QLD	2012/6480	Not Controlled Action	Completed	In buffer area only
Curragh North Pit U Expansion Project	2010/5458	Not Controlled Action	Completed	In feature area
Development and operation of a new multi-seam underground coal mine with associated on-site infrastr	2011/5811	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Mackenzie North Project, QLD	2011/5873	Not Controlled Action	Completed	In buffer area only
Open Cut Coal MIne	2001/276	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
275kV transmission line	2002/795	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Blackwater to Rolleston 132 kV transmission line	2002/880	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Curragh West Project	2011/6187	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Queensland Government

WildNet species list

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Queensland status: All
Records: All
Date: All
Latitude: -23.3444
Longitude: 148.8993
Distance: 25
Email: michael.oconnor@ecosm.com.au
Date submitted: Tuesday 09 Jan 2024 14:42:19
Date extracted: Tuesday 09 Jan 2024 14:50:02

The number of records retrieved = 842

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Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			22
animals	amphibians	Hylidae	*Cyclorana alboguttata*	greenstripe frog		C		8
animals	amphibians	Hylidae	*Cyclorana brevipes*	superb collared frog		C		4
animals	amphibians	Hylidae	*Cyclorana novaehollandiae*	eastern snapping frog		C		9
animals	amphibians	Hylidae	*Cyclorana verrucosa*	rough collared frog		C		1
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		27
animals	amphibians	Hylidae	*Litoria fallax*	eastern sedgefrog		C		4
animals	amphibians	Hylidae	*Litoria inermis*	bumpy rocketfrog		C		16
animals	amphibians	Hylidae	*Litoria latopalmata*	broad palmed rocketfrog		C		11
animals	amphibians	Hylidae	*Litoria peronii*	emerald spotted treefrog		C		1
animals	amphibians	Hylidae	*Litoria rothii*	eastern laughing treefrog		C		5
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		7
animals	amphibians	Limnodynastidae	*Limnodynastes salmini*	salmon striped frog		C		7
animals	amphibians	Limnodynastidae	*Limnodynastes tasmaniensis*	spotted grassfrog		C		8
animals	amphibians	Limnodynastidae	*Limnodynastes terraereginae*	scarlet sided pobblebonk		C		3
animals	amphibians	Limnodynastidae	*Platyplectrum ornatum*	ornate burrowing frog		C		12
animals	amphibians	Myobatrachidae	*Uperoleia rugosa*	chubby gungan		C		1
animals	amphibians	Myobatrachidae	*Uperoleia sp.*			C		1
animals	birds	Acanthizidae	*Acanthiza apicalis*	inland thornbill		C		1
animals	birds	Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill		C		7
animals	birds	Acanthizidae	*Acanthiza nana*	yellow thornbill		C		2
animals	birds	Acanthizidae	*Acanthiza reguloides*	buff-rumped thornbill		C		2
animals	birds	Acanthizidae	*Acanthiza uropygialis*	chestnut-rumped thornbill		C		1
animals	birds	Acanthizidae	*Gerygone olivacea*	white-throated gerygone		C		15
animals	birds	Acanthizidae	*Pyrrholaemus sagittatus*	speckled warbler		C		3
animals	birds	Acanthizidae	*Sericornis frontalis*	white-browed scrubwren		C		1
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		45
animals	birds	Accipitridae	*Accipiter cirrocephalus*	collared sparrowhawk		C		4
animals	birds	Accipitridae	*Accipiter fasciatus*	brown goshawk		C		5
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		13
animals	birds	Accipitridae	*Aviceda subcristata*	Pacific baza		C		4
animals	birds	Accipitridae	*Circus approximans*	swamp harrier		C		1
animals	birds	Accipitridae	*Circus assimilis*	spotted harrier		C		1
animals	birds	Accipitridae	*Elanus axillaris*	black-shouldered kite		C		5
animals	birds	Accipitridae	*Haliaeetus leucogaster*	white-bellied sea-eagle		C		3
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		25
animals	birds	Accipitridae	*Hieraaetus morphnoides*	little eagle		C		3
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		12
animals	birds	Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler		C		7
animals	birds	Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar		C		11
animals	birds	Alaudidae	*Mirafra javanica*	Horsfield's bushlark		C		7
animals	birds	Alcedinidae	*Dacelo leachii*	blue-winged kookaburra		C		16
animals	birds	Alcedinidae	*Dacelo novaeguineae*	laughing kookaburra		C		45
animals	birds	Alcedinidae	*Todiramphus macleayii*	forest kingfisher		C		4
animals	birds	Alcedinidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		C		3
animals	birds	Alcedinidae	*Todiramphus sanctus*	sacred kingfisher		C		10

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		8
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		20
animals	birds	Anatidae	*Aythya australis*	hardhead		C		7
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		8
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		6
animals	birds	Anatidae	*Dendrocygna arcuata*	wandering whistling-duck		C		4
animals	birds	Anatidae	*Dendrocygna eytoni*	plumed whistling-duck		C		3
animals	birds	Anatidae	*Malacorhynchus membranaceus*	pink-eared duck		C		1
animals	birds	Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose		C		2
animals	birds	Anatidae	*Radjah radjah*	radjah shelduck		C		1
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		8
animals	birds	Ardeidae	*Ardea alba modesta*	eastern great egret		C		12
animals	birds	Ardeidae	*Ardea pacifica*	white-necked heron		C		5
animals	birds	Ardeidae	*Bubulcus ibis*	cattle egret		C		1
animals	birds	Ardeidae	*Egretta garzetta*	little egret		C		2
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		14
animals	birds	Ardeidae	*Egretta picata*	pied heron		C		1
animals	birds	Ardeidae	*Ixobrychus flavicollis*	black bittern		C		1
animals	birds	Ardeidae	*Nycticorax caledonicus*	nankeen night-heron		C		6
animals	birds	Artamidae	*Artamus cinereus*	black-faced woodswallow		C		5
animals	birds	Artamidae	*Artamus cinereus inkermani*	black-faced woodswallow (east-central Queensland)		C		4
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		8
animals	birds	Artamidae	*Artamus personatus*	masked woodswallow		C		9
animals	birds	Artamidae	*Artamus superciliosus*	white-browed woodswallow		C		9
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		46
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		32
animals	birds	Artamidae	*Gymnorhina tibicen*	Australian magpie		C		61
animals	birds	Burhinidae	*Burhinus grallarius*	bush stone-curlew		C		1
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		49
animals	birds	Cacatuidae	*Calyptorhynchus banksii banksii*	red-tailed black-cockatoo (Cape York & Eastern Aust)		C		1
animals	birds	Cacatuidae	*Eolophus roseicapilla*	galah		C		23
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		7
animals	birds	Campephagidae	*Coracina maxima*	ground cuckoo-shrike		C		4
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		37
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		2
animals	birds	Campephagidae	*Edolisoma tenuirostre*	common cicadabird		C		5
animals	birds	Campephagidae	*Lalage tricolor*	white-winged triller		C		22
animals	birds	Casuariidae	*Dromaius novaehollandiae*	emu		C		5
animals	birds	Charadriidae	*Charadrius ruficapillus*	red-capped plover		C		1
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		6
animals	birds	Charadriidae	*Erythrogonys cinctus*	red-kneed dotterel		C		1
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		3
animals	birds	Charadriidae	*Vanellus miles novaehollandiae*	masked lapwing (southern subspecies)		C		5
animals	birds	Charadriidae	*Vanellus tricolor*	banded lapwing		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Ciconiidae	*Ephippiorhynchus asiaticus*	black-necked stork		C		1
animals	birds	Cisticolidae	*Cisticola exilis*	golden-headed cisticola		C		10
animals	birds	Columbidae	*Geopelia cuneata*	diamond dove		C		5
animals	birds	Columbidae	*Geopelia humeralis*	bar-shouldered dove		C		5
animals	birds	Columbidae	*Geopelia placida*	peaceful dove		C		27
animals	birds	Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)		V	V	12
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		28
animals	birds	Columbidae	*Phaps chalcoptera*	common bronzewing		C		3
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		23
animals	birds	Corcoracidae	*Corcorax melanorhamphos*	white-winged chough		C		5
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		31
animals	birds	Corvidae	*Corvus bennetti*	little crow		C		1
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		8
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		70
animals	birds	Cuculidae	*Cacomantis flabelliformis*	fan-tailed cuckoo		C		3
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		19
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		16
animals	birds	Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo		C		9
animals	birds	Cuculidae	*Chalcites minutillus barnardi*	Eastern little bronze-cuckoo		C		5
animals	birds	Cuculidae	*Eudynamys orientalis*	eastern koel		C		2
animals	birds	Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		C		18
animals	birds	Dicaeidae	*Dicaeum hirundinaceum*	mistletoebird		C		38
animals	birds	Dicruridae	*Dicrurus bracteatus*	spangled drongo		C		8
animals	birds	Dicruridae	*Dicrurus bracteatus bracteatus*	spangled drongo (eastern Australia)		C		4
animals	birds	Estrildidae	*Lonchura castaneothorax*	chestnut-breasted mannikin		C		5
animals	birds	Estrildidae	*Neochmia modesta*	plum-headed finch		C		6
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		20
animals	birds	Estrildidae	*Taeniopygia guttata*	zebra finch		C		9
animals	birds	Eurostopodidae	*Eurostopodus mystacalis*	white-throated nightjar		C		2
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		16
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		19
animals	birds	Falconidae	*Falco longipennis*	Australian hobby		C		3
animals	birds	Falconidae	*Falco peregrinus macropus*	Australian peregrine falcon		C		3
animals	birds	Falconidae	*Falco subniger*	black falcon		C		1
animals	birds	Gruidae	*Antigone rubicunda*	brolga		C		9
animals	birds	Haematopodidae	*Haematopus longirostris*	Australian pied oystercatcher		C		1
animals	birds	Hirundinidae	*Hirundo neoxena*	welcome swallow		C		14
animals	birds	Hirundinidae	*Petrochelidon ariel*	fairy martin		C		12
animals	birds	Hirundinidae	*Petrochelidon nigricans*	tree martin		C		9
animals	birds	Jacanidae	*Irediparra gallinacea*	comb-crested jacana		C		1
animals	birds	Laridae	*Hydroprogne caspia*	Caspian tern		SL		4
animals	birds	Locustellidae	*Cincloramphus cruralis*	brown songlark		C		5
animals	birds	Locustellidae	*Cincloramphus mathewsi*	rufous songlark		C		13
animals	birds	Locustellidae	*Cincloramphus timoriensis*	tawny grassbird		C		2
animals	birds	Maluridae	*Malurus assimilis*	purple-backed fairy-wren		C		11
animals	birds	Maluridae	*Malurus cyaneus*	superb fairy-wren		C		2

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animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		33
animals	birds	Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		C		4
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		34
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		31
animals	birds	Meliphagidae	*Grantiella picta*	painted honeyeater		V	V	2
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		21
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		32
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		16
animals	birds	Meliphagidae	*Meliphaga lewinii*	Lewin's honeyeater		C		3
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		23
animals	birds	Meliphagidae	*Melithreptus brevirostris*	brown-headed honeyeater		C		2
animals	birds	Meliphagidae	*Melithreptus gularis gularis*	black-chinned honeyeater (eastern)		C		2
animals	birds	Meliphagidae	*Myzomela sanguinolenta*	scarlet honeyeater		C		1
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		28
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		40
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		29
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		C		9
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		32
animals	birds	Monarchidae	*Monarcha melanopsis*	black-faced monarch		SL		2
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		5
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		16
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		9
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		6
animals	birds	Oriolidae	*Sphecotheres vieilloti*	Australasian figbird		C		6
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		11/1
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		20
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		23
animals	birds	Pandionidae	*Pandion haliaetus cristatus*	eastern osprey		SL		1
animals	birds	Pardalotidae	*Pardalotus punctatus*	spotted pardalote		C		1
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		35
animals	birds	Passeridae	*Passer domesticus*	house sparrow	Y			6
animals	birds	Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		C		7
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		1
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		14
animals	birds	Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant		C		3
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		7
animals	birds	Phalacrocoracidae	*Phalacrocorax varius*	pied cormorant		C		3
animals	birds	Phasianidae	*Synoicus ypsilophorus*	brown quail		C		7
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		9
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		7
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		22
animals	birds	Pomatostomidae	*Pomatostomus temporalis temporalis*	grey-crowned babbler (eastern)		C		10
animals	birds	Psittaculidae	*Aprosmictus erythropterus*	red-winged parrot		C		34
animals	birds	Psittaculidae	*Melopsittacus undulatus*	budgerigar		C		5
animals	birds	Psittaculidae	*Platycercus adscitus*	pale-headed rosella		C		29
animals	birds	Psittaculidae	*Platycercus adscitus adscitus*	pale-headed rosella (northern form)		C		1

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animals	birds	Psittaculidae	*Platycercus adscitus palliceps*	pale-headed rosella (southern form)		C		10
animals	birds	Psittaculidae	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet		C		4
animals	birds	Psittaculidae	*Trichoglossus moluccanus*	rainbow lorikeet		C		15
animals	birds	Ptilonorhynchidae	*Chlamydera maculata*	spotted bowerbird		C		12
animals	birds	Rallidae	*Fulica atra*	Eurasian coot		C		2
animals	birds	Rallidae	*Gallinula tenebrosa*	dusky moorhen		C		6
animals	birds	Rallidae	*Porphyrio melanotus*	purple swamphen		C		4
animals	birds	Rallidae	*Tribonyx ventralis*	black-tailed native-hen		C		3
animals	birds	Recurvirostridae	*Himantopus leucocephalus*	pied stilt		C		6
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		14
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		21
animals	birds	Rhipiduridae	*Rhipidura leucophrys leucophrys*	willie wagtail (southern)		C		12
animals	birds	Rhipiduridae	*Rhipidura rufifrons*	rufous fantail		SL		5
animals	birds	Scolopacidae	*Calidris acuminata*	sharp-tailed sandpiper		SL	V	2
animals	birds	Scolopacidae	*Gallinago hardwickii*	Latham's snipe		SL	V	1
animals	birds	Scolopacidae	*Tringa stagnatilis*	marsh sandpiper		SL		1
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		12
animals	birds	Sulidae	*Morus serrator*	Australasian gannet		C		1
animals	birds	Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		C		3
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		7
animals	birds	Threskiornithidae	*Plegadis falcinellus*	glossy ibis		SL		1
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		3
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		5
animals	birds	Turnicidae	*Turnix varius*	painted button-quail		C		2
animals	birds	Turnicidae	*Turnix velox*	little button-quail		C		2
animals	birds	Tytonidae	*Tyto javanica*	eastern barn owl		C		7
animals	birds	Zosteropidae	*Zosterops lateralis*	silvereye		C		1
animals	birds	Zosteropidae	*Zosterops lateralis cornwalli*	silvereye (eastern)		C		1
animals	insects	Nymphalidae	*Acraea andromacha andromacha*	glasswing				1
animals	insects	Nymphalidae	*Charaxes sempronius sempronius*	tailed emperor				1
animals	insects	Nymphalidae	*Danaus petilia*	lesser wanderer				1
animals	insects	Nymphalidae	*Euploea corinna*	common crow				1
animals	insects	Nymphalidae	*Hypolimnas bolina nerina*	varied eggfly				2
animals	insects	Nymphalidae	*Junonia orithya albicincta*	blue argus				2
animals	insects	Nymphalidae	*Junonia villida villida*	meadow argus				2
animals	insects	Nymphalidae	*Tirumala hamata hamata*	blue tiger				1
animals	insects	Papilionidae	*Cressida cressida cressida*	clearwing swallowtail				1
animals	insects	Papilionidae	*Papilio aegeus aegeus*	orchard swallowtail (Australian subspecies)				1
animals	insects	Pieridae	*Belenois java teutonia*	caper white				1
animals	insects	Pieridae	*Catopsilia pomona*	lemon migrant				1
animals	insects	Pieridae	*Cepora perimale scyllara*	caper gull (Australian subspecies)				2
animals	insects	Pieridae	*Eurema smilax*	small grass-yellow				1
animals	mammals	Bovidae	*Bos taurus*	European cattle	Y			19
animals	mammals	Canidae	*Canis familiaris*	dog	Y			4
animals	mammals	Canidae	*Canis familiaris (dingo)*	dingo				2

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animals	mammals	Dasyuridae	*Planigale ingrami*	long-tailed planigale		C		1
animals	mammals	Dasyuridae	*Sminthopsis macroura*	stripe-faced dunnart		C		2
animals	mammals	Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail bat		C		6
animals	mammals	Equidae	*Equus caballus*	horse	Y			1
animals	mammals	Felidae	*Felis catus*	cat	Y			2
animals	mammals	Leporidae	*Lepus europaeus*	European brown hare	Y			3
animals	mammals	Leporidae	*Oryctolagus cuniculus*	rabbit	Y			17
animals	mammals	Macropodidae	*Macropus giganteus*	eastern grey kangaroo		C		23
animals	mammals	Macropodidae	*Notamacropus dorsalis*	black-striped wallaby		C		1
animals	mammals	Macropodidae	*Onychogalea frenata*	bridled nailtail wallaby		E	E	3
animals	mammals	Macropodidae	*Osphranter robustus*	common wallaroo		C		3
animals	mammals	Macropodidae	*Wallabia bicolor*	swamp wallaby		C		5
animals	mammals	Molossidae	*Mormopterus lumsdenae*	northern free-tailed bat		C		1
animals	mammals	Muridae	*Hydromys chrysogaster*	water rat		C		2
animals	mammals	Muridae	*Leggadina forresti*	Forrest's mouse		C		4
animals	mammals	Muridae	*Mus musculus*	house mouse	Y			20
animals	mammals	Muridae	*Pseudomys delicatulus*	delicate mouse		C		12
animals	mammals	Muridae	*Rattus sordidus*	canefield rat		C		2
animals	mammals	Petauridae	*Petaurus notatus*	Krefft's glider		C		3
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		12
animals	mammals	Potoroidae	*Aepyprymnus rufescens*	rufous bettong		C		5
animals	mammals	Potoroidae	*Bettongia gaimardi gaimardi*	eastern bettong		EX	EX	4
animals	mammals	Pteropodidae	*Pteropus scapulatus*	little red flying-fox		C		2
animals	mammals	Suidae	*Sus scrofa*	pig	Y			3
animals	mammals	Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna		SL		4
animals	mammals	Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat		C		2
animals	mammals	Vespertilionidae	*Chalinolobus morio*	chocolate wattled bat		C		3
animals	mammals	Vespertilionidae	*Chalinolobus nigrogriseus*	hoary wattled bat		C		2
animals	mammals	Vespertilionidae	*Chalinolobus picatus*	little pied bat		C		2
animals	mammals	Vespertilionidae	*Nyctophilus geoffroyi*	lesser long-eared bat		C		2
animals	mammals	Vespertilionidae	*Nyctophilus gouldi*	Gould's long-eared bat		C		4
animals	mammals	Vespertilionidae	*Scotorepens balstoni*	inland broad-nosed bat		C		1
animals	mammals	Vespertilionidae	*Scotorepens greyii*	little broad-nosed bat		C		1
animals	mammals	Vespertilionidae	*Vespadelus baverstocki*	inland forest bat		C		1
animals	ray-finned fishes	Ambassidae	*Ambassis agassizii*	Agassiz's glassfish				3
animals	ray-finned fishes	Anguillidae	*Anguilla reinhardtii*	longfin eel				4
animals	ray-finned fishes	Apogonidae	*Glossamia aprion*	mouth almighty				5
animals	ray-finned fishes	Ariidae	*Neoarius graeffei*	blue catfish				4
animals	ray-finned fishes	Atherinidae	*Craterocephalus stercusmuscarum*	flyspecked hardyhead				2
animals	ray-finned fishes	Belonidae	*Strongylura krefftii*	freshwater longtom				3
animals	ray-finned fishes	Clupeidae	*Nematalosa erebi*	bony bream				5
animals	ray-finned fishes	Eleotridae	*Hypseleotris klunzingeri*	western carp gudgeon				3
animals	ray-finned fishes	Eleotridae	*Hypseleotris species 1*	Midgley's carp gudgeon				1
animals	ray-finned fishes	Eleotridae	*Mogurnda adspersa*	southern purplespotted gudgeon				1
animals	ray-finned fishes	Eleotridae	*Oxyeleotris lineolata*	sleepy cod				5
animals	ray-finned fishes	Eleotridae	*Philypnodon grandiceps*	flathead gudgeon				1

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animals	ray-finned fishes	Melanotaeniidae	*Melanotaenia splendida splendida*	eastern rainbowfish				2
animals	ray-finned fishes	Osteoglossidae	*Scleropages leichardti*	southern saratoga				4
animals	ray-finned fishes	Percichthyidae	*Macquaria ambigua*	golden perch				7
animals	ray-finned fishes	Plotosidae	*Neosilurus hyrtlii*	Hyrtl's catfish				5
animals	ray-finned fishes	Plotosidae	*Tandanus tandanus*	freshwater catfish				3
animals	ray-finned fishes	Pseudomugilidae	*Pseudomugil signifer*	Pacific blue eye				1
animals	ray-finned fishes	Terapontidae	*Amniataba percoides*	barred grunter				4
animals	ray-finned fishes	Terapontidae	*Leiopotherapon unicolor*	spangled perch				4
animals	ray-finned fishes	Terapontidae	*Scortum hillii*	leathery grunter				4
animals	reptiles	Agamidae	*Chlamydosaurus kingii*	frilled lizard		C		1
animals	reptiles	Agamidae	*Diporiphora sp.*			C		1
animals	reptiles	Agamidae	*Intellagama lesueurii*	eastern water dragon		C		1
animals	reptiles	Agamidae	*Pogona barbata*	bearded dragon		C		4
animals	reptiles	Boidae	*Antaresia maculosa*	spotted python		C		3
animals	reptiles	Boidae	*Aspidites melanocephalus*	black-headed python		C		3
animals	reptiles	Boidae	*Morelia spilota*	carpet python		C		1
animals	reptiles	Carphodactylidae	*Nephrurus asper*	spiny knob-tailed gecko		C		5
animals	reptiles	Chelidae	*Chelodina longicollis*	eastern snake-necked turtle		C		1
animals	reptiles	Chelidae	*Elseya albagula*	white-throated snapping turtle		CR	CE	1
animals	reptiles	Chelidae	*Emydura macquarii krefftii*	Krefft's river turtle		C		7
animals	reptiles	Chelidae	*Rheodytes leukops*	Fitzroy River turtle		E	V	1
animals	reptiles	Colubridae	*Boiga irregularis*	brown tree snake		C		3
animals	reptiles	Colubridae	*Dendrelaphis punctulatus*	green tree snake		C		2
animals	reptiles	Colubridae	*Tropidonophis mairii*	freshwater snake		C		6
animals	reptiles	Diplodactylidae	*Amalosia queenslandia*	Queensland zigzag gecko		C		1
animals	reptiles	Diplodactylidae	*Diplodactylus platyurus*	eastern fat-tailed gecko		C		2
animals	reptiles	Diplodactylidae	*Lucasium steindachneri*	Steindachner's gecko		C		3
animals	reptiles	Diplodactylidae	*Oedura monilis sensu lato*	ocellated velvet gecko		C		7
animals	reptiles	Diplodactylidae	*Oedura sp.*			C		1
animals	reptiles	Diplodactylidae	*Strophurus williamsi*	soft-spined gecko		C		3
animals	reptiles	Elapidae	*Brachyurophis australis*	coral snake		C		1
animals	reptiles	Elapidae	*Demansia psammophis*	yellow-faced whipsnake		C		7
animals	reptiles	Elapidae	*Denisonia maculata*	ornamental snake		V	V	1
animals	reptiles	Elapidae	*Furina diadema*	red-naped snake		C		1
animals	reptiles	Elapidae	*Furina ornata*	orange-naped snake		C		1
animals	reptiles	Elapidae	*Pseudechis australis*	king brown snake		C		1
animals	reptiles	Elapidae	*Pseudonaja textilis*	eastern brown snake		C		2
animals	reptiles	Elapidae	*Suta suta*	myall snake		C		5
animals	reptiles	Elapidae	*Vermicella annulata*	bandy-bandy		C		3
animals	reptiles	Gekkonidae	*Gehyra catenata*	chain-backed dtella		C		27
animals	reptiles	Gekkonidae	*Gehyra dubia*	dubious dtella		C		12
animals	reptiles	Gekkonidae	*Gehyra sp.*			C		1
animals	reptiles	Gekkonidae	*Gehyra versicolor*			C		2
animals	reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		C		48
animals	reptiles	Pygopodidae	*Lialis burtonis*	Burton's legless lizard		C		3
animals	reptiles	Pygopodidae	*Paradelma orientalis*	brigalow scaly-foot		C		4

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animals	reptiles	Pygopodidae	*Pygopus schraderi*	eastern hooded scaly-foot		C		1
animals	reptiles	Scincidae	*Carlia munda*	shaded-litter rainbow-skink		C		1
animals	reptiles	Scincidae	*Carlia pectoralis*	open-litter rainbow skink		C		11
animals	reptiles	Scincidae	*Carlia pectoralis sensu lato*			C		5
animals	reptiles	Scincidae	*Carlia schmeltzii*	robust rainbow-skink		C		7
animals	reptiles	Scincidae	*Cryptoblepharus metallicus*	metallic snake-eyed skink		C		1
animals	reptiles	Scincidae	*Cryptoblepharus pannosus*	ragged snake-eyed skink		C		23
animals	reptiles	Scincidae	*Cryptoblepharus pulcher pulcher*	elegant snake-eyed skink		C		14
animals	reptiles	Scincidae	*Cryptoblepharus sp.*			C		2
animals	reptiles	Scincidae	*Cryptoblepharus virgatus sensu lato*			C		3
animals	reptiles	Scincidae	*Ctenotus ingrami*	unspotted yellow-sided ctenotus		C		1
animals	reptiles	Scincidae	*Ctenotus sp.*			C		1
animals	reptiles	Scincidae	*Ctenotus spaldingi*	straight-browed ctenotus		C		6
animals	reptiles	Scincidae	*Ctenotus taeniolatus*	copper-tailed skink		C		4
animals	reptiles	Scincidae	*Lerista fragilis*	eastern mulch slider		C		12
animals	reptiles	Scincidae	*Lerista punctatovittata*	eastern robust slider		C		5
animals	reptiles	Scincidae	*Lerista sp.*			C		1
animals	reptiles	Scincidae	*Lygisaurus foliorum*	tree-base litter-skink		C		4
animals	reptiles	Scincidae	*Menetia greyii*	common dwarf skink		C		2
animals	reptiles	Scincidae	*Menetia sp.*			C		1
animals	reptiles	Scincidae	*Morethia boulengeri*	south-eastern morethia skink		C		22
animals	reptiles	Scincidae	*Morethia taeniopleura*	fire-tailed skink		C		2
animals	reptiles	Scincidae	*Tiliqua scincoides scincoides*	eastern bluetongue		C		1/1
animals	reptiles	Typhlopidae	*Anilios affinis*	small-headed blind snake		C		1
animals	reptiles	Typhlopidae	*Anilios ligatus*	robust blind snake		C		1
animals	reptiles	Varanidae	*Varanus tristis*	black-tailed monitor		C		5
animals	uncertain	Indeterminate	*Indeterminate*	Unknown or Code Pending				1
plants	Ulvophyceae	Ulotrichaceae	*Ulothrix cylindricum*			C		1/1
plants	land plants	Acanthaceae	*Acanthaceae*					1/1
plants	land plants	Acanthaceae	*Dipteracanthus australasicus*			C		1
plants	land plants	Acanthaceae	*Pseuderanthemum variabile*	pastel flower		C		3
plants	land plants	Acanthaceae	*Rostellularia adscendens*			C		1
plants	land plants	Acanthaceae	*Rostellularia adscendens var. adscendens*			C		1
plants	land plants	Aizoaceae	*Trianthema portulacastrum*	black pigweed	Y			3
plants	land plants	Aizoaceae	*Trianthema triquetra*	red spinach		C		8
plants	land plants	Aizoaceae	*Zaleya galericulata subsp. galericulata*			C		1
plants	land plants	Alismataceae	*Caldesia oligococca*			SL		1
plants	land plants	Amaranthaceae	*Achyranthes aspera*			C		3
plants	land plants	Amaranthaceae	*Alternanthera denticulata*	lesser joyweed		C		2
plants	land plants	Amaranthaceae	*Alternanthera nana*	hairy joyweed		C		1
plants	land plants	Amaranthaceae	*Alternanthera nodiflora*	joyweed		C		2
plants	land plants	Amaranthaceae	*Amaranthus macrocarpus*	dwarf amaranth		C		1
plants	land plants	Amaranthaceae	*Deeringia amaranthoides*	redberry		C		1
plants	land plants	Amaranthaceae	*Gomphrena celosioides*	gomphrena weed	Y			1
plants	land plants	Amaranthaceae	*Nyssanthes diffusa*	barbed-wire weed		C		1
plants	land plants	Amaranthaceae	*Nyssanthes erecta*			C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Amaranthaceae	*Ptilotus semilanatus*			C		1/1
plants	land plants	Amaryllidaceae	*Crinum flaccidum*	Murray lily		SL		1
plants	land plants	Anacardiaceae	*Euroschinus falcatus*			C		1
plants	land plants	Anacardiaceae	*Pleiogynium timorense*	Burdekin plum		C		1
plants	land plants	Annonaceae	*Melodorum leichhardtii*			C		1
plants	land plants	Apocynaceae	*Alstonia constricta*	bitterbark		C		5
plants	land plants	Apocynaceae	*Alyxia magnifolia*			C		1
plants	land plants	Apocynaceae	*Alyxia ruscifolia*			C		1
plants	land plants	Apocynaceae	*Carissa ovata*	currantbush		C		15
plants	land plants	Apocynaceae	*Cryptostegia grandiflora*	rubber vine	Y			2
plants	land plants	Apocynaceae	*Cynanchum viminale*			C		3
plants	land plants	Apocynaceae	*Cynanchum viminale subsp. australe*			C		1
plants	land plants	Apocynaceae	*Gymnema pleiadenium*			C		1
plants	land plants	Apocynaceae	*Leichhardtia micradenia*			C		1
plants	land plants	Apocynaceae	*Leichhardtia viridiflora*			C		1
plants	land plants	Apocynaceae	*Leichhardtia viridiflora subsp. viridiflora*			C		3
plants	land plants	Apocynaceae	*Parsonsia eucalyptophylla*	gargaloo		C		1
plants	land plants	Apocynaceae	*Parsonsia lanceolata*	northern silkpod		C		5
plants	land plants	Apocynaceae	*Parsonsia plaesiophylla*			C		1
plants	land plants	Apocynaceae	*Secamone elliptica*			C		1
plants	land plants	Apocynaceae	*Vincetoxicum ovatum*			C		1
plants	land plants	Araliaceae	*Polyscias elegans*	celery wood		C		1
plants	land plants	Arecaceae	*Livistona*					1
plants	land plants	Asteraceae	*Acmella grandiflora var. brachyglossa*			C		1
plants	land plants	Asteraceae	*Bidens pilosa*		Y			1
plants	land plants	Asteraceae	*Brachyscome*					1
plants	land plants	Asteraceae	*Brachyscome dalbyensis*			C		1
plants	land plants	Asteraceae	*Calotis*					1
plants	land plants	Asteraceae	*Calotis cuneata*			C		1
plants	land plants	Asteraceae	*Eclipta prostrata*	white eclipta	Y			2/1
plants	land plants	Asteraceae	*Erigeron bonariensis*		Y			2/1
plants	land plants	Asteraceae	*Euchiton sphaericus*			C		1
plants	land plants	Asteraceae	*Flaveria trinervia*		Y			1/1
plants	land plants	Asteraceae	*Minuria integerrima*	smooth minuria		C		2
plants	land plants	Asteraceae	*Olearia canescens*			C		1
plants	land plants	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			4/2
plants	land plants	Asteraceae	*Peripleura hispidula*			C		1
plants	land plants	Asteraceae	*Pterocaulon redolens*			C		1
plants	land plants	Asteraceae	*Rhodanthe polyphylla*			C		2/2
plants	land plants	Asteraceae	*Senecio*					1
plants	land plants	Asteraceae	*Senecio brigalowensis*			C		1/1
plants	land plants	Asteraceae	*Sonchus asper*	rough sowthistle	Y			1
plants	land plants	Asteraceae	*Sonchus oleraceus*	common sowthistle	Y			2/1
plants	land plants	Asteraceae	*Sphaeromorphaea subintegra*			C		1
plants	land plants	Asteraceae	*Vittadinia sulcata*	native daisy		C		1
plants	land plants	Asteraceae	*Xanthium occidentale*		Y			1

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plants	land plants	Bignoniaceae	*Pandorea pandorana*	wonga vine		C		1
plants	land plants	Boraginaceae	*Ehretia membranifolia*	weeping koda		C		4
plants	land plants	Boraginaceae	*Heliotropium indicum*		Y			1/1
plants	land plants	Boraginaceae	*Heliotropium ovalifolium*			C		1/1
plants	land plants	Byttneriaceae	*Melochia pyramidata*		Y			1
plants	land plants	Cactaceae	*Harrisia martinii*		Y			10/1
plants	land plants	Cactaceae	*Opuntia*					1
plants	land plants	Cactaceae	*Opuntia stricta*		Y			4
plants	land plants	Cactaceae	*Opuntia tomentosa*	velvety tree pear	Y			5/1
plants	land plants	Campanulaceae	*Lobelia concolor*			SL		1
plants	land plants	Campanulaceae	*Wahlenbergia*					1
plants	land plants	Campanulaceae	*Wahlenbergia gracilis*	sprawling bluebell		SL		1
plants	land plants	Capparaceae	*Capparis anomala*			C		1
plants	land plants	Capparaceae	*Capparis arborea*	brush caper berry		C		1
plants	land plants	Capparaceae	*Capparis lasiantha*	nipan		C		4
plants	land plants	Capparaceae	*Capparis loranthifolia*			C		1
plants	land plants	Capparaceae	*Capparis loranthifolia var. loranthifolia*			C		2/2
plants	land plants	Capparaceae	*Capparis mitchellii*			C		3
plants	land plants	Capparaceae	*Capparis ornans*			C		1
plants	land plants	Caryophyllaceae	*Cerastium glomeratum*	mouse ear chickweed	Y			1
plants	land plants	Casuarinaceae	*Casuarina cristata*	belah		C		2/1
plants	land plants	Casuarinaceae	*Casuarina cunninghamiana*			C		1
plants	land plants	Celastraceae	*Denhamia bilocularis*			C		1
plants	land plants	Celastraceae	*Denhamia cunninghamii*			C		3
plants	land plants	Celastraceae	*Denhamia disperma*			C		1
plants	land plants	Celastraceae	*Denhamia oleaster*			C		2
plants	land plants	Celastraceae	*Elaeodendron australe*			C		1
plants	land plants	Celastraceae	*Siphonodon australis*	ivorywood		C		1
plants	land plants	Chenopodiaceae	*Atriplex elachophylla*			C		1
plants	land plants	Chenopodiaceae	*Atriplex muelleri*	lagoon saltbush		C		6
plants	land plants	Chenopodiaceae	*Chenopodium desertorum subsp. anidiophyllum*			C		1
plants	land plants	Chenopodiaceae	*Dysphania melanocarpa forma melanocarpa*			C		1/1
plants	land plants	Chenopodiaceae	*Einadia nutans*			C		2
plants	land plants	Chenopodiaceae	*Einadia nutans subsp. linifolia*			C		1/1
plants	land plants	Chenopodiaceae	*Einadia polygonoides*	knotweed goosefoot		C		1
plants	land plants	Chenopodiaceae	*Enchylaena tomentosa*			C		13
plants	land plants	Chenopodiaceae	*Enchylaena tomentosa var. tomentosa*			C		1
plants	land plants	Chenopodiaceae	*Maireana*					1
plants	land plants	Chenopodiaceae	*Maireana microphylla*			C		1
plants	land plants	Chenopodiaceae	*Rhagodia spinescens*	thorny saltbush		C		1
plants	land plants	Chenopodiaceae	*Salsola australis*			C		10
plants	land plants	Chenopodiaceae	*Sclerolaena anisacanthoides*	yellow burr		C		4
plants	land plants	Chenopodiaceae	*Sclerolaena birchii*	galvanised burr		C		1
plants	land plants	Chenopodiaceae	*Sclerolaena calcarata*	red burr		C		3
plants	land plants	Chenopodiaceae	*Sclerolaena muricata*			C		4
plants	land plants	Combretaceae	*Macropteranthes fitzalanii*			C		1

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plants	land plants	Combretaceae	*Terminalia oblongata*			C		2
plants	land plants	Combretaceae	*Terminalia oblongata subsp. oblongata*			C		9
plants	land plants	Combretaceae	*Terminalia porphyrocarpa*			C		1
plants	land plants	Commelinaceae	*Commelina ensifolia*	scurvy grass		C		2
plants	land plants	Convolvulaceae	*Convolvulus arvensis*		Y			1
plants	land plants	Convolvulaceae	*Convolvulus graminetinus*			C		1/1
plants	land plants	Convolvulaceae	*Evolvulus alsinoides*			C		2
plants	land plants	Convolvulaceae	*Ipomoea calobra*			C		1/1
plants	land plants	Convolvulaceae	*Polymeria pusilla*			C		1
plants	land plants	Crassulaceae	*Bryophyllum delagoense*		Y			5/1
plants	land plants	Cucurbitaceae	*Cucumis melo*			C		1
plants	land plants	Cucurbitaceae	*Cucumis myriocarpus subsp. myriocarpus*	prickly pademelon	Y			1
plants	land plants	Cucurbitaceae	*Neoalsomitra capricornica*			C		1
plants	land plants	Cucurbitaceae	*Zehneria cunninghamii*	slender cucumber		C		1
plants	land plants	Cyperaceae	*Cyperus bifax*	western nutgrass		C		1/1
plants	land plants	Cyperaceae	*Cyperus concinnus*			C		1
plants	land plants	Cyperaceae	*Cyperus difformis*	rice sedge		C		1
plants	land plants	Cyperaceae	*Cyperus exaltatus*	tall flatsedge		C		2
plants	land plants	Cyperaceae	*Cyperus fulvus*			C		1
plants	land plants	Cyperaceae	*Cyperus gracilis*			C		4
plants	land plants	Cyperaceae	*Cyperus gymnocaulos*	spiny flatsedge		C		1
plants	land plants	Cyperaceae	*Cyperus haspan*			C		1
plants	land plants	Cyperaceae	*Cyperus iria*			C		1/1
plants	land plants	Cyperaceae	*Cyperus rigidellus*			C		2
plants	land plants	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		1
plants	land plants	Cyperaceae	*Scleria sphacelata*			C		1
plants	land plants	Dioscoreaceae	*Dioscorea transversa*	native yam		C		3
plants	land plants	Ebenaceae	*Diospyros geminata*	scaly ebony		C		1
plants	land plants	Ebenaceae	*Diospyros humilis*	small-leaved ebony		C		2
plants	land plants	Elatinaceae	*Elatine gratioloides*	waterwort		C		1
plants	land plants	Erythroxylaceae	*Erythroxylum australe*	cocaine tree		C		9/2
plants	land plants	Euphorbiaceae	*Acalypha eremorum*	soft acalypha		C		2
plants	land plants	Euphorbiaceae	*Alchornea ilicifolia*	native holly		C		1
plants	land plants	Euphorbiaceae	*Claoxylon tenerifolium*	Queensland brittlewood		C		1
plants	land plants	Euphorbiaceae	*Croton acronychioides*	thick-leaved croton		C		1
plants	land plants	Euphorbiaceae	*Croton insularis*	Queensland cascarilla		C		1
plants	land plants	Euphorbiaceae	*Croton phebalioides*	narrow-leaved croton		C		4/1
plants	land plants	Euphorbiaceae	*Euphorbia*					1
plants	land plants	Euphorbiaceae	*Euphorbia dallachyana*			C		1
plants	land plants	Euphorbiaceae	*Euphorbia drummondii*			C		2
plants	land plants	Euphorbiaceae	*Euphorbia tannensis*			C		1
plants	land plants	Euphorbiaceae	*Euphorbia tannensis subsp. tannensis*			C		2
plants	land plants	Euphorbiaceae	*Excoecaria dallachyana*	scrub poison tree		C		1
plants	land plants	Euphorbiaceae	*Mallotus claoxyloides*	green kamala		C		1
plants	land plants	Euphorbiaceae	*Mallotus philippensis*	red kamala		C		1
plants	land plants	Euphorbiaceae	*Ricinocarpos ledifolius*	scrub wedding bush		C		1

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plants	land plants	Euphorbiaceae	*Ricinus communis*	castor oil bush	Y			1/1
plants	land plants	Euphorbiaceae	*Tragia novae-hollandiae*	stinging-vine		C		1
plants	land plants	Goodeniaceae	*Brunonia australis*	blue pincushion		SL		1
plants	land plants	Haloragaceae	*Haloragis stricta*			C		1
plants	land plants	Haloragaceae	*Myriophyllum verrucosum*	water milfoil		C		1/1
plants	land plants	Hemerocallidaceae	*Dianella longifolia*			C		1
plants	land plants	Hemerocallidaceae	*Dianella longifolia var. stupata*			C		1/1
plants	land plants	Hemerocallidaceae	*Geitonoplesium cymosum*	scrambling lily		C		1
plants	land plants	Hernandiaceae	*Gyrocarpus americanus*			C		1
plants	land plants	Hydrocharitaceae	*Ottelia ovalifolia*	swamp lily		SL		2
plants	land plants	Juncaceae	*Juncus*					1
plants	land plants	Juncaceae	*Juncus usitatus*			C		1
plants	land plants	Lamiaceae	*Basilicum polystachyon*			C		1
plants	land plants	Lamiaceae	*Coleus australis*			C		1
plants	land plants	Lamiaceae	*Glossocarya hemiderma*			C		1
plants	land plants	Lamiaceae	*Ocimum*					1
plants	land plants	Lamiaceae	*Teucrium junceum*			C		1
plants	land plants	Laxmanniaceae	*Lomandra longifolia*			C		2
plants	land plants	Leguminosae	*Acacia angusta*			C		1/1
plants	land plants	Leguminosae	*Acacia aulacocarpa*			C		1
plants	land plants	Leguminosae	*Acacia bancroftiorum*			C		1/1
plants	land plants	Leguminosae	*Acacia catenulata*	bendee		C		5
plants	land plants	Leguminosae	*Acacia cretata*			C		1/1
plants	land plants	Leguminosae	*Acacia decora*	pretty wattle		C		1
plants	land plants	Leguminosae	*Acacia excelsa*			C		2
plants	land plants	Leguminosae	*Acacia fasciculifera*	scaly bark		C		1
plants	land plants	Leguminosae	*Acacia harpophylla*	brigalow		C		13
plants	land plants	Leguminosae	*Acacia leiocalyx*			C		1
plants	land plants	Leguminosae	*Acacia leiocalyx subsp. leiocalyx*			C		1
plants	land plants	Leguminosae	*Acacia oswaldii*	miljee		C		2
plants	land plants	Leguminosae	*Acacia rhodoxylon*	ringy rosewood		C		9
plants	land plants	Leguminosae	*Acacia salicina*	doolan		C		2
plants	land plants	Leguminosae	*Acacia shirleyi*	lancewood		C		9/1
plants	land plants	Leguminosae	*Acacia stenophylla*	belalie		C		1/1
plants	land plants	Leguminosae	*Acacia victoriae subsp. victoriae*			C		3/3
plants	land plants	Leguminosae	*Aeschynomene indica*	budda pea		C		1
plants	land plants	Leguminosae	*Austrosteenisia blackii*	bloodvine		C		1
plants	land plants	Leguminosae	*Cassia brewsteri*			C		7/3
plants	land plants	Leguminosae	*Cassia brewsteri var. sylvestris*			C		2
plants	land plants	Leguminosae	*Cassia tomentella*			C		1
plants	land plants	Leguminosae	*Crotalaria dissitiflora subsp. dissitiflora*			C		1
plants	land plants	Leguminosae	*Crotalaria medicaginea*	trefoil rattlepod		C		1
plants	land plants	Leguminosae	*Cullen cinereum*			C		1/1
plants	land plants	Leguminosae	*Cullen tenax*	emu-foot		C		3
plants	land plants	Leguminosae	*Desmodium campylocaulon*			C		1
plants	land plants	Leguminosae	*Desmodium varians*	slender tick trefoil		C		1

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plants	land plants	Leguminosae	*Erythrina vespertilio*			C		1
plants	land plants	Leguminosae	*Glycine clandestina var. clandestina*			C		1
plants	land plants	Leguminosae	*Glycine falcata*			C		1
plants	land plants	Leguminosae	*Heliodendron basalticum*			C		2
plants	land plants	Leguminosae	*Heliodendron thozetianum*			C		1
plants	land plants	Leguminosae	*Hovea longipes*	brush hovea		C		1
plants	land plants	Leguminosae	*Indigofera brevidens*			C		1
plants	land plants	Leguminosae	*Indigofera linifolia*			C		1
plants	land plants	Leguminosae	*Indigofera pratensis*			C		1
plants	land plants	Leguminosae	*Lotus australis*	Australian trefoil		C		1
plants	land plants	Leguminosae	*Lysiphyllum*					1
plants	land plants	Leguminosae	*Lysiphyllum carronii*	ebony tree		C		5
plants	land plants	Leguminosae	*Lysiphyllum hookeri*	Queensland ebony		C		8
plants	land plants	Leguminosae	*Macroptilium atropurpureum*	siratro	Y			1
plants	land plants	Leguminosae	*Macroptilium lathyroides*		Y			2/2
plants	land plants	Leguminosae	*Macroptilium lathyroides var. semierectum*		Y			1
plants	land plants	Leguminosae	*Neptunia gracilis forma gracilis*			C		1
plants	land plants	Leguminosae	*Parkinsonia aculeata*	parkinsonia	Y			6/4
plants	land plants	Leguminosae	*Rhynchosia minima*			C		2
plants	land plants	Leguminosae	*Rhynchosia minima var. minima*			C		1
plants	land plants	Leguminosae	*Senna artemisioides*			C		1
plants	land plants	Leguminosae	*Senna artemisioides subsp. coriacea*			C		1
plants	land plants	Leguminosae	*Senna artemisioides subsp. oligophylla*			C		1/1
plants	land plants	Leguminosae	*Senna artemisioides subsp. quadrifolia*			C		1/1
plants	land plants	Leguminosae	*Senna circinnata*			C		1
plants	land plants	Leguminosae	*Senna coronilloides*			C		1
plants	land plants	Leguminosae	*Senna gaudichaudii*			C		1
plants	land plants	Leguminosae	*Sesbania cannabina var. cannabina*			C		3
plants	land plants	Leguminosae	*Stylosanthes scabra*		Y			5
plants	land plants	Leguminosae	*Tephrosia brachyodon*			C		1
plants	land plants	Leguminosae	*Vachellia farnesiana*		Y			2
plants	land plants	Loganiaceae	*Strychnos psilosperma*	strychnine tree		C		1
plants	land plants	Loranthaceae	*Amyema quandang var. quandang*			C		1
plants	land plants	Loranthaceae	*Lysiana subfalcata*			C		1
plants	land plants	Lythraceae	*Ammannia multiflora*	jerry-jerry		C		1/1
plants	land plants	Lythraceae	*Lythrum paradoxum*			C		1
plants	land plants	Lythraceae	*Rotala mexicana*			C		1/1
plants	land plants	Malvaceae	*Abutilon auritum*	Chinese lantern		C		1
plants	land plants	Malvaceae	*Abutilon fraseri subsp. fraseri*			C		2/1
plants	land plants	Malvaceae	*Abutilon guineense*		Y			1/1
plants	land plants	Malvaceae	*Abutilon leucopetalum*			C		2/1
plants	land plants	Malvaceae	*Abutilon nobile*			C		1/1
plants	land plants	Malvaceae	*Abutilon otocarpum*			C		3
plants	land plants	Malvaceae	*Abutilon oxycarpum*			C		1
plants	land plants	Malvaceae	*Abutilon oxycarpum var. incanum*			C		1/1
plants	land plants	Malvaceae	*Abutilon oxycarpum var. oxycarpum*			C		1

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plants	land plants	Malvaceae	*Hibiscus brachysiphonius*			C		3
plants	land plants	Malvaceae	*Hibiscus sp. (Emerald S.L.Everist 2124)*			C		1/1
plants	land plants	Malvaceae	*Hibiscus sturtii*			C		1
plants	land plants	Malvaceae	*Malvaceae*					2/1
plants	land plants	Malvaceae	*Malvastrum americanum*		Y			1
plants	land plants	Malvaceae	*Malvastrum americanum var. americanum*		Y			1
plants	land plants	Malvaceae	*Sida cunninghamii*			C		2
plants	land plants	Malvaceae	*Sida fibulifera*			C		2
plants	land plants	Malvaceae	*Sida hackettiana*			C		5
plants	land plants	Malvaceae	*Sida rohlenae subsp. rohlenae*			C		2
plants	land plants	Malvaceae	*Sida spinosa*	spiny sida	Y			1
plants	land plants	Malvaceae	*Sida trichopoda*			C		3/1
plants	land plants	Marsileaceae	*Marsilea drummondii*	common nardoo		C		1
plants	land plants	Meliaceae	*Melia azedarach*	white cedar		C		1
plants	land plants	Meliaceae	*Owenia acidula*	emu apple		C		3
plants	land plants	Meliaceae	*Owenia venosa*	crow's apple		C		1
plants	land plants	Meliaceae	*Turraea pubescens*	native honeysuckle		C		1
plants	land plants	Menispermaceae	*Tinospora smilacina*	snakevine		C		1
plants	land plants	Menyanthaceae	*Nymphoides crenata*	wavy marshwort		SL		1
plants	land plants	Menyanthaceae	*Nymphoides indica*	water snowflake		SL		1
plants	land plants	Molluginaceae	*Glinus lotoides*	hairy carpet weed		C		1/1
plants	land plants	Moraceae	*Ficus opposita*			C		1
plants	land plants	Myrsinaceae	*Myrsine variabilis*			C		1
plants	land plants	Myrtaceae	*Backhousia kingii*			C		1
plants	land plants	Myrtaceae	*Corymbia citriodora*	spotted gum		C		1
plants	land plants	Myrtaceae	*Corymbia clarksoniana*			C		2
plants	land plants	Myrtaceae	*Corymbia dallachiana*			C		1
plants	land plants	Myrtaceae	*Corymbia erythrophloia*	variable-barked bloodwood		C		1
plants	land plants	Myrtaceae	*Corymbia tessellaris*	Moreton Bay ash		C		3
plants	land plants	Myrtaceae	*Eucalyptus cambageana*	Dawson gum		C		13/1
plants	land plants	Myrtaceae	*Eucalyptus coolabah*	coolabah		C		2
plants	land plants	Myrtaceae	*Eucalyptus crebra*	narrow-leaved red ironbark		C		7
plants	land plants	Myrtaceae	*Eucalyptus exserta*	Queensland peppermint		C		4
plants	land plants	Myrtaceae	*Eucalyptus melanophloia*			C		3
plants	land plants	Myrtaceae	*Eucalyptus populnea*	poplar box		C		9
plants	land plants	Myrtaceae	*Eucalyptus raveretiana*	black ironbox		C	V	1
plants	land plants	Myrtaceae	*Eucalyptus tereticornis*			C		1
plants	land plants	Myrtaceae	*Eucalyptus tereticornis subsp. tereticornis*			C		1
plants	land plants	Myrtaceae	*Eucalyptus thozetiana*			C		9/1
plants	land plants	Myrtaceae	*Gossia bidwillii*			C		1
plants	land plants	Myrtaceae	*Lophostemon suaveolens*	swamp box		C		1
plants	land plants	Myrtaceae	*Melaleuca bracteata*			C		2
plants	land plants	Myrtaceae	*Melaleuca leucadendra*	broad-leaved tea-tree		C		1
plants	land plants	Myrtaceae	*Melaleuca pallescens*			C		1/1
plants	land plants	Myrtaceae	*Melaleuca trichostachya*			C		1/1
plants	land plants	Nyctaginaceae	*Boerhavia*					1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Nyctaginaceae	*Boerhavia dominii*			C		2/1
plants	land plants	Oleaceae	*Jasminum didymum*			C		5
plants	land plants	Oleaceae	*Jasminum didymum subsp. racemosum*			C		1
plants	land plants	Oleaceae	*Jasminum simplicifolium*			C		1
plants	land plants	Oleaceae	*Notelaea microcarpa*			C		2
plants	land plants	Onagraceae	*Ludwigia octovalvis*	willow primrose		C		2
plants	land plants	Onagraceae	*Ludwigia peploides subsp. montevidensis*			C		1
plants	land plants	Orchidaceae	*Cymbidium canaliculatum*			SL		4
plants	land plants	Orchidaceae	*Dockrillia bowmanii*	scrub pencil orchid		SL		1
plants	land plants	Orchidaceae	*Microtis parviflora*	slender onion orchid		SL		1
plants	land plants	Oxalidaceae	*Oxalis corniculata*		Y			1
plants	land plants	Papaveraceae	*Argemone ochroleuca subsp. ochroleuca*	Mexican poppy	Y			2/1
plants	land plants	Passifloraceae	*Passiflora aurantia*			C		1
plants	land plants	Passifloraceae	*Passiflora foetida*		Y			1/1
plants	land plants	Pentapetaceae	*Melhania ovata*			C		1
plants	land plants	Phrymaceae	*Mimulus gracilis*	slender monkey flower		C		1
plants	land plants	Phyllanthaceae	*Breynia oblongifolia*			C		2
plants	land plants	Phyllanthaceae	*Bridelia leichhardtii*			C		1
plants	land plants	Phyllanthaceae	*Flueggea leucopyrus*			C		2
plants	land plants	Phyllanthaceae	*Phyllanthus gunnii*			C		1
plants	land plants	Phyllanthaceae	*Phyllanthus maderaspatensis var. maderaspatensis*			C		3
plants	land plants	Phyllanthaceae	*Phyllanthus virgatus*			C		3
plants	land plants	Picrodendraceae	*Petalostigma pubescens*	quinine tree		C		2
plants	land plants	Pittosporaceae	*Auranticarpa rhombifolia*			C		1
plants	land plants	Pittosporaceae	*Bursaria incana*			C		1
plants	land plants	Pittosporaceae	*Pittosporum angustifolium*			C		1
plants	land plants	Pittosporaceae	*Pittosporum spinescens*			C		1
plants	land plants	Plantaginaceae	*Plantago cunninghamii*	sago weed		C		1
plants	land plants	Plumbaginaceae	*Plumbago zeylanica*	native plumbago		C		3/1
plants	land plants	Poaceae	*Alloteropsis semialata*	cockatoo grass		C		1
plants	land plants	Poaceae	*Ancistrachne uncinulata*	hooky grass		C		2
plants	land plants	Poaceae	*Aristida calycina*			C		3
plants	land plants	Poaceae	*Aristida caput-medusae*			C		3
plants	land plants	Poaceae	*Aristida holathera var. holathera*			C		1
plants	land plants	Poaceae	*Aristida jerichoensis*			C		1
plants	land plants	Poaceae	*Aristida leptopoda*	white speargrass		C		1
plants	land plants	Poaceae	*Aristida queenslandica*			C		3
plants	land plants	Poaceae	*Aristida ramosa*	purple wiregrass		C		1
plants	land plants	Poaceae	*Astrebla lappacea*	curly mitchell grass		C		1
plants	land plants	Poaceae	*Astrebla squarrosa*	bull mitchell grass		C		1
plants	land plants	Poaceae	*Austrostipa verticillata*	slender bamboo grass		C		1
plants	land plants	Poaceae	*Bothriochloa bladhii subsp. bladhii*			C		1
plants	land plants	Poaceae	*Bothriochloa decipiens*			C		1
plants	land plants	Poaceae	*Bothriochloa ewartiana*	desert bluegrass		C		1
plants	land plants	Poaceae	*Bothriochloa insculpta*		Y			1
plants	land plants	Poaceae	*Brachyachne convergens*	common native couch		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Poaceae	*Calyptochloa gracillima subsp. gracillima*			C		1
plants	land plants	Poaceae	*Cenchrus ciliaris*		Y			21/1
plants	land plants	Poaceae	*Chionachne cyathopoda*	river grass		C		1/1
plants	land plants	Poaceae	*Chloris divaricata*			C		1
plants	land plants	Poaceae	*Chloris inflata*	purpletop chloris	Y			9/1
plants	land plants	Poaceae	*Chloris pectinata*	comb chloris		C		1
plants	land plants	Poaceae	*Chloris virgata*	feathertop rhodes grass	Y			4
plants	land plants	Poaceae	*Chrysopogon fallax*			C		2
plants	land plants	Poaceae	*Cymbopogon refractus*	barbed-wire grass		C		1
plants	land plants	Poaceae	*Cynodon dactylon var. dactylon*		Y			2
plants	land plants	Poaceae	*Dactyloctenium radulans*	button grass		C		3/1
plants	land plants	Poaceae	*Dichanthium*					1
plants	land plants	Poaceae	*Dichanthium sericeum*			C		1
plants	land plants	Poaceae	*Dichanthium sericeum subsp. sericeum*			C		1
plants	land plants	Poaceae	*Digitaria bicornis*			C		2/1
plants	land plants	Poaceae	*Digitaria didactyla*	Queensland blue couch	Y			1
plants	land plants	Poaceae	*Diplachne fusca var. fusca*			C		1/1
plants	land plants	Poaceae	*Echinochloa colona*	awnless barnyard grass	Y			2
plants	land plants	Poaceae	*Echinochloa esculenta*	Japanese millet	Y			1
plants	land plants	Poaceae	*Enneapogon gracilis*	slender nineawn		C		2/1
plants	land plants	Poaceae	*Enneapogon lindleyanus*			C		1
plants	land plants	Poaceae	*Enneapogon nigricans*	niggerheads		C		3
plants	land plants	Poaceae	*Enneapogon polyphyllus*	leafy nineawn		C		1
plants	land plants	Poaceae	*Enteropogon acicularis*	curly windmill grass		C		2
plants	land plants	Poaceae	*Enteropogon ramosus*			C		3
plants	land plants	Poaceae	*Eragrostis brownii var. pubescens*			C		1
plants	land plants	Poaceae	*Eragrostis lacunaria*	purple lovegrass		C		1/1
plants	land plants	Poaceae	*Eragrostis microcarpa*			C		1
plants	land plants	Poaceae	*Eragrostis minor*	smaller stinkgrass	Y			1
plants	land plants	Poaceae	*Eragrostis sororia*			C		1
plants	land plants	Poaceae	*Eragrostis tenellula*	delicate lovegrass		C		1
plants	land plants	Poaceae	*Eriachne*					2
plants	land plants	Poaceae	*Eriachne obtusa*			C		2/1
plants	land plants	Poaceae	*Eriochloa crebra*	spring grass		C		2
plants	land plants	Poaceae	*Eulalia aurea*	silky browntop		C		1
plants	land plants	Poaceae	*Heteropogon contortus*	black speargrass		C		2
plants	land plants	Poaceae	*Iseilema vaginiflorum*	red flinders grass		C		1
plants	land plants	Poaceae	*Leptochloa digitata*			C		4
plants	land plants	Poaceae	*Megathyrsus maximus*		Y			1
plants	land plants	Poaceae	*Megathyrsus maximus var. maximus*		Y			1
plants	land plants	Poaceae	*Melinis repens*	red natal grass	Y			5
plants	land plants	Poaceae	*Panicum coloratum*		Y			1
plants	land plants	Poaceae	*Panicum decompositum*			C		4
plants	land plants	Poaceae	*Panicum larcomianum*			C		1/1
plants	land plants	Poaceae	*Paspalidium caespitosum*	brigalow grass		C		3
plants	land plants	Poaceae	*Paspalidium constrictum*			C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Poaceae	*Paspalidium jubiflorum*	warrego grass		C		1
plants	land plants	Poaceae	*Paspalum distichum*	water couch	Y			1
plants	land plants	Poaceae	*Paspalum longifolium*			C		1
plants	land plants	Poaceae	*Setaria paspalidioides*			C		1/1
plants	land plants	Poaceae	*Sporobolus actinocladus*	katoora grass		C		7
plants	land plants	Poaceae	*Sporobolus australasicus*			C		2
plants	land plants	Poaceae	*Sporobolus caroli*	fairy grass		C		4
plants	land plants	Poaceae	*Sporobolus creber*			C		2
plants	land plants	Poaceae	*Sporobolus disjunctus*			C		2/2
plants	land plants	Poaceae	*Sporobolus elongatus*			C		1
plants	land plants	Poaceae	*Sporobolus laxus*			C		1
plants	land plants	Poaceae	*Sporobolus scabridus*			C		1
plants	land plants	Poaceae	*Themeda triandra*	kangaroo grass		C		3
plants	land plants	Poaceae	*Tragus australianus*	small burr grass		C		3
plants	land plants	Poaceae	*Tripogon loliiformis*	five minute grass		C		1
plants	land plants	Poaceae	*Urochloa mosambicensis*	sabi grass	Y			6
plants	land plants	Polygonaceae	*Duma florulenta*			C		1
plants	land plants	Polygonaceae	*Emex*			C		1
plants	land plants	Polygonaceae	*Persicaria attenuata*			C		1
plants	land plants	Polygonaceae	*Persicaria orientalis*	princes feathers		C		2/1
plants	land plants	Polygonaceae	*Polygonum plebeium*	small knotweed		C		1/1
plants	land plants	Pontederiaceae	*Monochoria cyanea*			C		2
plants	land plants	Portulacaceae	*Calandrinia pickeringii*			C		1
plants	land plants	Portulacaceae	*Portulaca filifolia*			C		2
plants	land plants	Portulacaceae	*Portulaca oleracea*	pigweed	Y			8
plants	land plants	Portulacaceae	*Portulaca pilosa*		Y			1
plants	land plants	Potamogetonaceae	*Potamogeton tricarinatus*	floating pondweed		SL		1
plants	land plants	Proteaceae	*Grevillea helmsiae*			C		1
plants	land plants	Proteaceae	*Grevillea striata*	beefwood		C		2
plants	land plants	Proteaceae	*Hakea*					3/2
plants	land plants	Proteaceae	*Hakea lorea subsp. lorea*			C		1
plants	land plants	Proteaceae	*Xylomelum*			C		1
plants	land plants	Pteridaceae	*Cheilanthes distans*	bristly cloak fern		C		1
plants	land plants	Pteridaceae	*Cheilanthes sieberi subsp. sieberi*			C		2
plants	land plants	Putranjivaceae	*Drypetes deplanchei*	grey boxwood		C		1
plants	land plants	Rhamnaceae	*Alphitonia excelsa*	soap tree		C		5
plants	land plants	Rhamnaceae	*Ventilago viminalis*	supplejack		C		5/1
plants	land plants	Rubiaceae	*Antirhea putaminosa*			C		1
plants	land plants	Rubiaceae	*Coelospermum reticulatum*			C		1
plants	land plants	Rubiaceae	*Dentella repens*	dentella		C		1/1
plants	land plants	Rubiaceae	*Everistia vacciniifolia*			C		1
plants	land plants	Rubiaceae	*Pavetta australiensis*			C		1
plants	land plants	Rubiaceae	*Psychotria daphnoides*			C		1
plants	land plants	Rubiaceae	*Psydrax attenuata forma megalantha*			C		1
plants	land plants	Rubiaceae	*Psydrax johnsonii*			C		1/1
plants	land plants	Rubiaceae	*Psydrax odorata*			C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Rubiaceae	*Psydrax oleifolia*			C		2
plants	land plants	Rutaceae	*Acronychia pauciflora*	soft acronychia		C		1
plants	land plants	Rutaceae	*Citrus glauca*			C		3
plants	land plants	Rutaceae	*Coatesia paniculata*			C		1
plants	land plants	Rutaceae	*Dinosperma erythrococcum*			C		1
plants	land plants	Rutaceae	*Flindersia dissosperma*			C		4/1
plants	land plants	Rutaceae	*Flindersia maculosa*	leopardwood		C		1
plants	land plants	Rutaceae	*Geijera parviflora*	wilga		C		5
plants	land plants	Rutaceae	*Geijera salicifolia*	brush wilga		C		1
plants	land plants	Rutaceae	*Murraya paniculata 'Exotica'*		Y			1
plants	land plants	Santalaceae	*Exocarpos latifolius*			C		1
plants	land plants	Santalaceae	*Santalum lanceolatum*			SL		2
plants	land plants	Santalaceae	*Santalum lanceolatum var. venosum*			C		3
plants	land plants	Santalaceae	*Viscum articulatum*	flat mistletoe		C		1
plants	land plants	Sapindaceae	*Alectryon connatus*	grey birds-eye		C		1
plants	land plants	Sapindaceae	*Alectryon diversifolius*	scrub boonaree		C		5/1
plants	land plants	Sapindaceae	*Alectryon subdentatus*			C		1
plants	land plants	Sapindaceae	*Atalaya hemiglauca*			C		5
plants	land plants	Sapindaceae	*Cardiospermum halicacabum var. halicacabum*		Y			1/1
plants	land plants	Sapindaceae	*Dodonaea viscosa*			C		1
plants	land plants	Sapindaceae	*Dodonaea viscosa subsp. viscosa*			C		1
plants	land plants	Sapindaceae	*Elattostachys xylocarpa*	white tamarind		C		1
plants	land plants	Sapotaceae	*Planchonella cotinifolia var. pubescens*			C		1
plants	land plants	Scrophulariaceae	*Eremophila*					1
plants	land plants	Scrophulariaceae	*Eremophila deserti*			C		2
plants	land plants	Scrophulariaceae	*Eremophila latrobei*			C		1
plants	land plants	Scrophulariaceae	*Eremophila longifolia*	berrigan		C		1
plants	land plants	Scrophulariaceae	*Eremophila mitchellii*			C		9/1
plants	land plants	Scrophulariaceae	*Myoporum acuminatum*	coastal boobialla		C		2
plants	land plants	Simaroubaceae	*Ailanthus triphysa*	white siris		C		1
plants	land plants	Solanaceae	*Physalis*					1
plants	land plants	Solanaceae	*Physalis lanceifolia*		Y			1
plants	land plants	Solanaceae	*Solanum adenophorum*			E		5/4
plants	land plants	Solanaceae	*Solanum cocosoides*			C		1/1
plants	land plants	Solanaceae	*Solanum densevestitum*			C		1
plants	land plants	Solanaceae	*Solanum dissectum*			E	E	1/1
plants	land plants	Solanaceae	*Solanum elachophyllum*			E		7/6
plants	land plants	Solanaceae	*Solanum esuriale*	quena		C		3/1
plants	land plants	Solanaceae	*Solanum ferocissimum*			C		1/1
plants	land plants	Solanaceae	*Solanum stelligerum*	devil's needles		C		1
plants	land plants	Sparrmanniaceae	*Corchorus trilocularis*			C		2
plants	land plants	Sparrmanniaceae	*Grewia latifolia*	dysentery plant		C		1
plants	land plants	Sparrmanniaceae	*Grewia savannicola*			C		1
plants	land plants	Sparrmanniaceae	*Grewia scabrella*			C		3/3
plants	land plants	Sterculiaceae	*Brachychiton australis*	broad-leaved bottle tree		SL		1
plants	land plants	Sterculiaceae	*Brachychiton bidwillii*	little kurrajong		SL		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Sterculiaceae	*Brachychiton rupestris*			SL		8
plants	land plants	Sterculiaceae	*Sterculia quadrifida*	peanut tree		C		1
plants	land plants	Surianaceae	*Cadellia pentastylis*	ooline		V	V	1
plants	land plants	Tamaricaceae	*Tamarix aphylla*	athel pine	Y			1/1
plants	land plants	Thymelaeaceae	*Pimelea haematostachya*			C		1/1
plants	land plants	Typhaceae	*Typha orientalis*	broad-leaved cumbungi		C		1
plants	land plants	Urticaceae	*Dendrocnide photiniphylla*	shiny-leaved stinging tree		C		1
plants	land plants	Verbenaceae	*Lippia alba var. alba*		Y			4/4
plants	land plants	Violaceae	*Pigea enneasperma*			C		1
plants	land plants	Vitaceae	*Apocissus oblonga*			C		1
plants	land plants	Vitaceae	*Causonis clematidea*			C		1
plants	land plants	Vitaceae	*Cayratia acris*	hairy grape		C		1
plants	land plants	Vitaceae	*Cissus reniformis*			C		1
plants	land plants	Vitaceae	*Cissus repens*			C		1
plants	land plants	Vitaceae	*Clematicissus opaca*			C		3
plants	land plants	Xanthorrhoeaceae	*Xanthorrhoea johnsonii*			SL		1
plants	land plants	Zygophyllaceae	*Tribulus terrestris*	caltrop		C		1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.*
The codes are Extinct (EX), Extinct in the Wild (PE), Critically Endangered (CR), Endangered (E), Vulnerable (V), Near Threatened (NT), Special Least Concern (SL) and Least Concern (C).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.*
The values of EPBC are Extinct (EX), Extinct in the Wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) and Conservation Dependent (CD).

Records - The first number indicates the total number of records of the taxon (wildlife records and species listings for selected areas).
This number is output as 99999 if it equals or exceeds this value. A second number located after a / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix C

Detailed Desktop Assessment

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C1 Overview of environmental values

This appendix presents in detail the results of the desktop review completed as part of the ecological assessment.

C1.1 Queensland Government Mapped Geology

As shown in Table C1, the Queensland Government mapped surface geology of the study area comprises:

- predominantly quaternary floodplain alluvium
- Duaringa Formation within the central portions of the study area
- Late tertiary – quaternary alluvium.

Equivalent Land Zones (as defined under the VM Act and in Wilson and Taylor 2012) are also listed in Table C1, as these are relevant to assigning field-validated vegetation communities to REs within the study area.

Table C1: Surface geology mapping within the study area

Map symbol	Geological unit	Lithology	Dominant rock type	Equivalent land zone
Qa	Qa-QLD	Clay, silt, sand and gravel; flood-plain alluvium	Sedimentary	3
Tu	Duaringa Formation	Mudstone, sandstone, conglomerate, siltstone, oil shale, lignite, basalt	Sedimentary	4
TQa	TQa-Qld	Locally red-brown mottled, poorly consolidated sand, silt, clay, minor gravel; high-level alluvial deposits (generally related to present stream valleys but commonly dissected)	Sedimentary	3

C1.2 Soils

The Australia Soils Atlas identifies two primary soil types within the study area, as follows in order of dominance:

- CC23: Level alluvial flood-plains associated with major streams
- Va31: texture contrast soils and cracking clays on weathered clay plains

C1.3 Surface water

The study area is located in the Fitzroy River catchment in the Mackenzie River drainage sub-basin. The Mackenzie River (stream order 8 watercourse) is located directly adjacent to the north-western boundary of the of the study area. Blackwater Creek (stream order 5) dissects the southern portion of the study area and there are a number of minor watercourses that contribute to Blackwater Creek through the study area in a north to south direction. In the northern portion of the study area two 1st order streams dissect the study area which flow in a north easterly direction to the Mackenzie River north of the study area.

C2 Queensland Government mapping

C2.1 Regional ecosystems

The Queensland Government has mapped the majority of the study area as supporting non-remnant vegetation. The remnant vegetation communities that have been identified are primarily associated with Blackwater Creek and minor waterways. Small, isolated patches of remnant vegetation have also been mapped in the central and northern portions of the study area.

A total of seven REs have been mapped by the Queensland Government as occurring within the study area. This includes two endangered REs and five of concern REs as defined under the VM Act. The status and short descriptions for each of these REs is provided below in Table C2.

Table C2: Queensland Government mapped REs within the study area

RE Code	Short Description[1]	Conservation Status		Other
		VM Act Status	Biodiversity Status	
11.3.1	Brigalow (*Acacia harpophylla) and/or* Balah (*Casuarina cristata)* open forest on alluvial plains.	Endangered	Endangered	-
11.3.3	Coolabah (*Eucalyptus coolabah*) woodland on alluvial plains.	Of concern	Of concern	-
11.3.3c	Coolabah (*Eucalyptus coolabah*) woodland to open woodland (to scattered trees) with a sedge or grass understorey in back swamps and old channels.	Of concern	Of concern	-
11.3.6	Silver-leaved Ironbark *(Eucalyptus melanophloia)* woodland on alluvial plains	Least concern	Of concern	-
11.3.25	Queensland Blue Gum *(Eucalyptus tereticornis) or* Forest Red Gum *(Eucalyptus camaldulensis)* woodland fringing drainage lines.	Least concern	Of concern	Riverine
11.4.1	Semi-evergreen vine thicket +/- *Casuarina cristata* on Cainozoic clay plains	Endangered	Endangered	-
11.4.2	Eucalyptus species and/or Corymbia species grassy or shrubby woodland on Cainozoic clay plains	Of concern	Of concern	-
11.4.9a	*Acacia harpophylla, Lysiphyllum carronii* +/- *Casuarina cristata* open forest to woodland on level to gently undulating Cainozoic plains	Endangered	Endangered	Contains Palustrine

[1] VM Act and Biodiversity status defined under the Regional Ecosystem Description Database (REDD) (DESI 2004).

C2.2 Vegetation management watercourses

Many of the Queensland Government mapped watercourses within the study area are identified as vegetation management watercourses (Figure 6) most of which intersect with remnant vegetation at various locations within the study area. In accordance with the EO Act, remnant REs that occur within certain distances of watercourses are classified as MSES. Appendix 3 of the Queensland Environmental Offsets Policy (QEOP), lists the following defined distances for measuring regulated vegetation near watercourses in non-coastal bioregions, in which the study area is located:

- stream order 1 or 2 = 25 m from the defining bank
- stream order 3 or 4 = 50 m from the defining bank
- stream order 5 or greater = 100 m from the defining bank (DESI 2024).

Using these distances, a total of 135.7 ha of remnant vegetation occurs within 25 m of the first order drainage feature in the north-west of the study area.

C2.3 Vegetation management wetlands

Vegetation management wetlands have been identified by the Queensland Government as occurring within the study area. Under the VM Act, Category A, B, C or R vegetation that is within 100 m of the defining bank of a wetland identified on the vegetation management map is considered MSES.

These wetlands are predominately in the alluvial areas associated with Blackwater Creek with another wetland mapped in association with a 1st order water course in the northern portion of the study area (137.5 ha within the study area).

The Queensland Herbarium identifies two REs as having wetland values in their REDD descriptions (Refer Table C2). REs 11.3.25 and 11.4.9 are described as having the potential to contain palustrine (vegetated non-channel environments of less than 8 ha, e.g. billabongs, swamps, bogs, springs) or riverine (open, non-vegetated channels) wetlands.

C2.4 Referable wetlands

A search of the referable wetlands map shows there are no Wetland Protection Areas, High Ecological Significance or High Ecological Value or wetlands within or adjacent to the study area.

C2.5 Protected plants high risk areas

The Queensland Government has not identified high risk areas (HRA) mapped on the Protected Plants Flora Survey Trigger Map within the study area. Several HRAs have been identified immediately to the south of the study area and while the associated species is not detailed, there are records of *Solanum elachophyllum* (no common name) (endangered) and *Solanum adenophorum* (no common name) (endangered) in the vicinity of the mapped HRAs.

C2.6 Essential habitat

With reference to Figure 3, essential habitat has been mapped in the southern portion of study area for Ornamental Snake. A total of 465.40 ha of essential habitat has been mapped within the study area and is primarily associated with Blackwater Creek and its tributaries.

C2.7 Koala habitat areas

The Queensland Government has produced mapping of Koala Districts, priority areas and habitat areas as required under Division 3, Section 8 of the Nature Conservation (Koala) Conservation Plan 2017. The Koala Conservation Plan maps focus efforts for habitat protection, restoration and threat mitigation towards areas with the highest likelihood of achieving the best conservation outcomes for koalas.

The assessment area is located within Koala District C on the Koala Conservation Plan mapping. However, there are no Koala habitat areas mapped within or adjacent to the assessment area. It is noted that at present, Koala habitat areas have only been identified by the Queensland Government within Koala District A.

C3 Matters of state environmental significance

C3.1 Regulated vegetation

With reference the Queensland Government mapping presented in Figure 6, the study area supports regulated vegetation in the form of:

- remnant and high value regrowth Endangered vegetation (RE 11.3.1)
- remnant and high value regrowth Endangered vegetation (RE 11.4.9a)
- remnant and high value regrowth Of Concern vegetation (RE 11.3.3)
- remnant and high value regrowth Of Concern vegetation (RE 11.3.3c)
- remnant and high value regrowth Of Concern vegetation (RE 11.3.6)
- remnant and high value regrowth Of Concern vegetation (RE 11.3.25)
- remnant and high value regrowth Of Concern vegetation (RE 11.4.2)Watercourse vegetation (REs 11.3.1. 11.3.2, 11.3.3c, 11.3.6, 11.3.25, 11.4.2, 11.4.9a)

C3.2 NC Act listed flora

Database searches identified four endangered, two vulnerable and two near threatened flora species listed under the NC Act as potentially occurring within the study area, as follows:

- Queensland White Gum (*Eucalyptus argophloia*) – critically endangered
- *Solanum adenophorum* (no common name) – endangered
- *Solanum dissectum* (no common name) - endangered
- *Solanum elachophyllum* (no common name) - endangered.
- *Daviesia discolor* (no common name) – vulnerable

- *Daviesia quoquoversus* (no common name) - vulnerable
- Ooline (*Cadellia pentastylis*) – vulnerable
- Blackdown Fan Palm (*Livistonia fulva)* - vulnerable
- King Bluegrass (*Dichanthium queenslandicum*) - vulnerable
- Quassia (*Samadera bidwillii*) - vulnerable
- Native Frangipanni (*Cerbera dumicolor*) – near threatened

These species, along with a description of their preferred habitat, and likelihood of occurrence within the study area are outlined in Appendix D. Conservation significant flora listed under the NC Act that were recorded or are considered likely to occur in the study area are discussed in Section 5.3.2.

C3.3 NC Act listed fauna

C3.3.1 Threatened fauna

Database searches and essential habitat mapping identified a total of nine threatened birds, six threatened mammals and six threatened reptiles listed under the NC Act as follows:

Birds

- Curlew Sandpiper (*Calidris ferruginea*) – critically endangered
- Australian Painted Snipe (*Rostratula australis*) – endangered
- Black-throated Finch (Southern) (*Poephila cincta cincta*) - endangered
- Red Goshawk (*Erythrotriorchis radiatus*) – endangered
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*) – endangered
- Diamond Firetail (*Stagonopleura guttata*) - vulnerable
- Grey Falcon (*Falco hypoleucos*) – vulnerable
- Painted Honeyeater (*Grantiella picta*) – vulnerable
- Squatter Pigeon (Southern) (*Geophaps scripta scripta*) – vulnerable

Mammals

- Bridled Nail-tail Wallaby (*Onychogalea fraenata*) - endangered
- Greater Glider (central & southern) (*Petauroides volans and armillatus*) – endangered
- Ghost Bat (*Macroderma gigas*) – endangered
- Koala (*Phascolarctos cinereus*) – endangered
- Corben's Long-eared Bat (*Nyctophilus corbeni*) – vulnerable
- Yellow-bellied Glider (*Petaurus australis australis*) - vulnerable

Reptiles

- Allan's Lerista (*Lerista allanae*) – endangered
- Grey Snake (*Hemiaspis damelii*) – endangered

- Dunmall's Snake (*Furina dunmalli*) – vulnerable
- Collared Delma (Delma torquate) - vulnerable
- Ornamental Snake (*Denisonia maculata*) – vulnerable
- Yakka Skink (*Egernia rugosa*) – vulnerable

A description of the preferred habitat of these species and an assessment of the likelihood of occurrence within the study area is outlined in Appendix D. NC Act listed fauna that were recorded or are considered likely to occur in the study area are discussed in Section 6.2.1.

C3.3.3 Special least concern fauna

One special least concern species, the Short-beaked Echidna (*Tachyglossus aculeatus*), was identified from the database searches (Appendix B) as occurring in the search area. It is discussed further in Section 6.3.4 and Appendix D.

Several special least concern migratory birds were also identified in database search results as occurring or potentially occurring in the search area (Appendix B). These species are discussed further in Appendix D.

C3.4 Critical habitat

The study area is not within an area identified as Critical Habitat under the NC Act.

C4 Biodiversity Planning Assessment Mapping

DESI has prepared a Biodiversity Planning Assessment (BPA) for the region. The BPA mapping identifies numerous areas within the study areas as representing state, regional and local significance (Figure 7). These areas are primarily associated with Blackwater Creek and its tributaries in the south and smaller areas just to its north, as well as some additional areas in the far northern portions of the study area.

The larger area in the south portion of the study area correlates with vegetation that has been mapped as remnant endangered (RE 11.3.1) and of concern vegetation (REs 11.3.3) while the area in the northern portion of the study area correlates with vegetation mapped as both remnant and high value regrowth REs 11.3.3/11.3.6 (Figure 7).

C5 Previous studies in the region

A number of studies have been undertaken in the region many of which have formed components of Environmental Impact Statements for proposed coal projects. It should be noted that most of the publicly available studies were completed prior to the listing of the Koala, Greater Glider and Yellow-bellied Glider.

C5.1 Curragh North Coal Project

The curragh North Project is located immediately adjacent the study area. Flora and Fauna surveys for the Curragh North project were undertaken as part of the EIS Assessment Report which was completed in 2004. This project identified endangered (RE 11.3.1) and of concern (RE 11.3.3 and 11.4.2) regional

ecosystems within the project area in addition to habitat the Ornamental Snake and the Squatter Pigeon.

C5.2 Proposed Minyango Coal Project

The proposed Minyango Coal Project is located approximately 25 km south of the study area. Flora and fauna surveys for the Minyango Coal Project were undertaken as part of the EIS report which was completed in 2014. This project identified of concern (RE 11.3.3 and 11.9.7) regional ecosystems within the project area in addition to habitat for the Squatter Pigeon. No threatened flora was identified within the project area. However, *Solanum elachophyllum* was assessed as having the potential to occur.

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Appendix D

Likelihood for Significant Flora and Fauna to occur in the Study Area

Table D1: Likelihood of conservation significant flora species to occur within the study area

Species name/ Common name	NC Act Status[2]	Record source[3]	Habitat preferences	Likelihood to occur in the study area
Cadellia pentastylis Ooline	V	PMST, AVH, Wildlife Online	*Distribution:* This species occurs on the western edge of the New South Wales north-west slopes, from Mt Black Jack near Gunnedah to west of Tenterfield, and extends into Queensland to Carnarvon Range and Callide Valley, south-west of Rockhampton (TSSC 2008a). *Habitat preferences:* This species occurs in dry rainforest, semi-evergreen vine thicket, sclerophyll forest, Brigalow-Belah, Poplar Box and Bendee communities on moderately fertile soils and a normally associated with upper and mid-slopes in the landscapes (TSSC 2008a). *Notable features:* This is a tree growing to between 10 m and 25 m with hard scaly bark. It is often locally dominant or is present as an emergent (TSSC 2008b). *Dispersal mode:* Gravity and/or bird dispersed. *Nearest record:* The nearest published record for this species is approximately 14 km west of the study area (CSIRO 2024).	Low: The study area does not contain suitable habitat for this species, in the form of SEVT communities or dry rainforest. Brigalow present within the study area occurs on alluvial plains low in the landscape which is not typical habitat for Ooline. This is a vegetatively distinctive, emergent tree species that was not recorded within the study area during the field survey.
Livistonia fulva Blackdown Fan Palm	V	AVH	*Distribution:* This species has a restricted distribution with all published records occurring within the Backdown Tablelands and surrounds (CSIRO 2024; DES 2024a). *Habitat preferences:* mainly along sandstone cliff-lines, on rocky foot-slopes below cliffs, in shallow rocky gullies and in deep sandstone gorges below major waterfalls around the edge of the plateau (DES 2024a). *Notable features:* This is a palm with a solitary trunk growing to 13 m tall and to 20 to 25 m in diameter (DES 2024a). This species is distinct	Low: Sandstone cliff lines or rocky terrain does not occur within the study area. This is a vegetatively distinctive species that was not recorded within the study area during the field survey.

Species name/ Common name	NC Act Status[2]	Record source[3]	Habitat preferences	Likelihood to occur in the study area
			from all other Australian species and shows no obvious relationships *Dispersal mode:* Gravity and/or bird dispersed. *Nearest record:* The nearest published record for this species is approximately 14 km west of the study area (CSIRO 2024).	
Dichanthium queenslandicum King Bluegrass	V	PMST	*Distribution:* This species is known from three disjunct populations: 1) Hughenden district, 2) Nebo to Monto and west to Clermont and Rolleston, and 3) Dalby district. *Habitat preferences:* This grass is confined to natural tussock grassland areas on heavy black cracking clay soils. It mainly occurs in association with other species of blue grasses (i.e. *Dichanthium* spp. And *Bothriochloa* spp.). It is strongly associated with the natural bluegrass grasslands of central and southern Queensland, including the EPBC Act listed natural grassland ecological communities (TSSC 2013). Recorded only from well-managed and conservatively grazed properties (Fletcher 2001; Sharp and Simon 2002). *Notable features:* A grass growing to 80 cm in height. *Dispersal mode:* Wind and mammal dispersed – awned seeds assist with wind movement and attachment to mammals. *Nearest record:* The nearest published record of this species is approximately 40 km to the west of the study area (CSIRO 2024).	Low: The study area does not support suitable habitat in the form of natural grassland communities and the species has not been recorded within 25 km of the study area
Daviesia discolor No common name	V	AVH	*Distribution:* This species is known from three widely disjunct localities in Queensland, near Blackwater on the Blackdown Tableland, in the Mount Walsh area near Biggenden and north of	Low: Small areas of broadly suitable habitat for this species are present in patches of Coolabah woodland on alluvial plains

Species name/ Common name	NC Act Status[2]	Record source[3]	Habitat preferences	Likelihood to occur in the study area
			Mount Playfair within Carnarvon National Park (DEWHA 2008a). *Habitat preferences:* This species has been recorded on sandy soils, loam and hill crests in open eucalypt forest and *Angophora* species open forests (DEWHA 2008a). *Notable features:* multi-stemmed shrub to 2 m tall with hairless, angular branchlets. Phyllodes are spirally arranged, more or less sickle-shaped, tapered to both ends, 4−16 cm long, 4−11 mm wide, thin and green (DEWHA 2008a). *Nearest record:* The nearest published record of this species is approximately 23 km north-east of the study area (CSIRO 2024).	(RE11.3.3) associated with Blackwater Creek. However, this is a vegetatively distinct species that was not identified during the field survey.
Solanum adenophorum No common name	E	AVH, WO	*Distribution:* This species is known from the Dingo-Nebo-Clermont area in Queensland (DES 2024b). *Habitat preferences:* It occurs in deep cracking clay soils in Brigalow (*Acacia harpophylla*) and Gidgee (*Acacia cambageana*) communities (DES 2024b). *Notable features:* It flowers in October and fruits in May, September and October (DES 2024b). *Dispersal mode:* Vertebrate dispersed, particularly birds − multi-seeded fleshy fruit. *Nearest record:* The nearest published record of this species is approximately 2.3 km south of the study area (CSIRO 2024).	Potentially: Areas of deep cracking clay soils are present within the study area. These areas have been extensively cleared and do not support remnant or regrowth vegetation. However, given the soil type and location of the nearest records, there is potential for this species to persist within the study area.
Solanum dissectum No common name	E	AVH PMST WO	*Distribution:* This species is known from the Leichardt and Port Curtis pastoral districts in the Biloela-Banana-Baralaba area (TSSC 2016a). *Habitat preferences:* It grows in Brigalow/Belah open forest on clay soils, semi-	Low: Broadly suitable habitat for this species occurs within the study area in the form of Brigalow open forest (Re 11.3.1). However, these

Species name/ Common name	NC Act Status[2]	Record source[3]	Habitat preferences	Likelihood to occur in the study area
			evergreen vine thicket or *Eucalyptus thozetiana* woodland on solodic clay soils (TSSC 2016a). *Notable features:* Small sub-shrub to 0.8 m high with prickles on the branchlets and occasionally on the upper and lower mid-veins of the deeply lobed leaves (Bean 2013a). *Dispersal mode:* Vertebrate dispersed, particularly birds – multi-seeded fleshy fruit. *Nearest record:* The nearest published record of this species is approximately 13 km to the west of the study area (CSIRO 2024).	vegetation communities occur on mostly sandy, alluvial soils rather than the clay soils typically associated with this species (i.e. landzone 3 rather than landzone 4). Areas of clay soils within the study area have been extensively cleared and support little to no remnant or regrowth vegetation. Land clearing has been identified as a primary threat to this species with the possible demise of the species reported in areas of recently cleared Brigalow scrub (TSSC 2016b).
Solanum elachophyllum (no common name)	E		*Distribution:* This species has a broad range throughout central Queensland and includes records from near Nebo in the north, Emerald in the west, Rockhampton in the east, Rolleston in the south-west and Theodore in the south (CSIRO 2024). *Habitat preferences:* Occurs on fertile, cracking clay soils and has been associated with Napunyah (*Eucalyptus thozetiana*), Brigalow, Belah, and *Macropteranthes* dominated vine thickets or Dawson River Gum (*Eucalyptus cambageana*), Narrow-leaved Red Ironbark (*Eucalyptus crebra*) and *Eucalyptus tenuipes* (no common name) woodlands (Bean 2005; CSIRO 2024). *Notable features:* Prostrate or sprawling sub-shrub to 30 cm in height with numerous prickles on branchlets (Bean 2013).	Potentially: Areas of deep cracking clay soils are present within the study area. These areas have been extensively cleared and do not support remnant or regrowth vegetation. However, given the soil type and location of the nearest records, there is potential for this species to persist within the study area.

Species name/ Common name	NC Act Status[2]	Record source[3]	Habitat preferences	Likelihood to occur in the study area
			Dispersal mode: Vertebrate dispersed, particularly birds – multi-seeded fleshy fruit. *Nearest record:* The nearest published record of this species is approximately 2.3 km south of the study area (CSIRO 2024).	
Capparis thozetiana No common name	V	AVH	*Distribution:* This species is endemic to central Queensland in the Marlborough–Rockhampton region where it is confined to serpentinite hills and adjacent undulating colluvial aprons (DEWHA 2008b). *Habitat preferences:* The species grows on mostly shallow skeletal serpentinitic soils in woodland communities dominated by *Eucalyptus fibrosa* and *Corymbia xanthope* (DEWHA 2008b). *Notable features:* Spiny shrub to 0.5 m tall with simple appressed hairs on the branchlets and leaves (DEWHA 2008b). *Nearest record:* The nearest published record of this species is approximately 13 km south of the study area (CSIRO 2024).	Low: Undulating hills and the associated Eucalypt and Corymbia woodlands that are known to support this species do not occur within the study area. The nearest published record for this species is potentially erroneous. The record is dated from 1878 and there are no other published records of this species within 80 km of the study area.
Daviesia quoquoversus	V	AVH	*Distribution:* This species is endemic to Blackdown Tableland (Pearson et al. 1989). *Habitat preferences:* The species occurs in open forest on sandy soil derived from sandstone. Associated species that have been recorded include *Corymbia peltata*, *C. polycarpa*, *Eucalyptus baileyana* and sclerophyllous shrubs and grasses (*Banksia*, *Ricinocarpos* and spinifex grasses) (DES 2012). *Dispersal mode:* Explosive release; Invertebrate dispersed, particularly ants – hard-coated seed with aril.	Low: Sandstone derived soils known to support this species do not occur within the study area.

Species name/ Common name	NC Act Status[2]	Record source[3]	Habitat preferences	Likelihood to occur in the study area
			Nearest record: The nearest published record of this species is approximately 24 km north-west of the study area (CSIRO 2024).	
Eucalyptus argophloia Queensland White Gum	CR	AVH	*Distribution:* This species is known only from a small area north-east of Chinchilla, Queensland (DEWHA 2008c). *Habitat preferences:* This species prefers deep, dark, heavy clay soils, often with strong gilgai (melon hole) development. It has been recorded growing in Brigalow woodland and forest communities associated with Belah (*Casuarina cristata*), Poplar Box (*Eucalyptus populnea*) and Inland Grey Box (*Eucalyptus microcarpa*) (DES 2009). *Dispersal mode:* Gravity/bird *Nearest record:* The nearest record of this species is located approximately 23 km south of the study area in the town of Blackwater.	Low: The areas of heavy clay soils that occur within the study area have largely been cleared of mature or regrowth vegetation. Remnant Brigalow woodland communities within the study area primarily occur on alluvial sandy soils (RE 11.3.1) that are not known to support this species. This species was not identified within the study area during the flora field survey.

[1]EPBC Act Status: E, Endangered; V, Vulnerable.

[2]NC Act Status: E = Endangered; V = Vulnerable; NT = Near threatened, LC = Least concern

[3]Source:

- AVH - − Australasian Virtual Herbarium (Table A1 of Appendix A)
- PMST − Protected Matters Search Tool (PMST database results contained in Appendix A)
- WO − Wildlife Online database (Wildlife Online database search results contained in Appendix A).

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Table D2. Likelihood of conservation significant fauna to occur within the study area

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
Birds				
Australian Painted Snipe *Rostratula australis*	E	PMST	*Distribution:* The Australian Painted Snipe has been recorded at wetlands in all states of Australia. It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, New South Wales, Victoria and south-eastern South Australia. This population is considered to occur as a single, contiguous breeding population (DCCEEW 2024a). The Fitzroy Basin of Central Queensland is considered an important area for the species (TSSC 2013). *General habitat preferences:* This secretive, cryptic, crepuscular (active at dawn, dusk and during the night) species occurs in terrestrial shallow wetlands, both ephemeral and permanent, usually freshwater but occasionally brackish. They also use inundated grasslands, salt-marsh, dams, rice crops, sewage farms and bore drains with rank emergent tussocks of grass, sedges, rushes or reeds or samphire, and often with scattered clumps of Lignum (*Muehlenbeckia florulenta*), canegrass or sometimes tea trees. It has been known to use areas lined with trees, or that have some scattered fallen or washed-up timber (DCCEEW 2024a). *Foraging habitat:* The species feeds on vegetation, seeds, and invertebrates including crustaceans and molluscs as well as insects, worms and other invertebrates (DotE 2016; Marchant and Higgins 1994). The species generally remain in dense cover when feeding but may also forage over nearby mudflats, ploughed land or grassland (TSSC 2013). *Breeding habitat:* Requirements are specific and include shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Almost all records of nests occur on or near small islands in freshwater wetlands characterised by a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover. Although this species uses modified habitat, it doesn't necessarily breed in these habitats. It most likely	Potentially: The study area does provide potentially suitable seasonal foraging habitat in the form of ephemeral wetlands drainage lines, watercourses and gilgai. While there are no published records of this species in proximity to the study area, this species is highly mobile and is known to utilise a variety of aquatic and wetland habitats across large grographical areas. Within the study area, the habitat for this species is likely to only be suitable following extended periods of high rainfall. The wetland and watercourse habitat is within the study area is not considered likely to provide suitable breeding habitat for this species..

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			breeds in response to wetland conditions rather than during a particular season (DCCEEW 2024a). *Nearest record:* The nearest published record of this species is approximately 60 km east of the study area.	
Black-throated Finch (southern) *Poephila cincta cincta*	E	PMST	Distribution: The Black-throated Finch (southern) occurs at two general locations: in the Townsville region, where it is considered to be locally common at a few sites around Townsville; and Charters Towers (Garnett and Crowley 2000). It has also been recorded at scattered sites in central-eastern Queensland (between Aramac and Great Basalt Wall National Park). DCCEEW considers birds recorded since 1998, at the following locations to be part of the southern subspecies: ▪ Townsville and its surrounds (Giru, Serpentine Lagoon, Toonpan, and near Ross River Dam) ▪ Ingham, and sites nearby (near Mutarnee [at Ollera Creek], and near Mount Fox) ▪ scattered sites in central-eastern Queensland (Great Basalt Wall, Yarrowmere Station, Moonoomoo Station, Doongmabulla Station, Fortuna Station and Aramac) (DCCEEW 2024b). General habitat preferences: This species is known from dry, open grassy woodlands and forests and grasslands of the sub-tropics and tropics with seeding grasses and ready access to water (Higgins et al. 2006). Also thought to probably require a mosaic of different habitat in the wet season to find seed (Garnett et al. 2011). Black-throated Finch mainly inhabit dry open to very open eucalypt woodlands with dense grassy ground cover and typically dominated by Eucalyptus, Corymbia and Melaleuca, and often along watercourses or in the vicinity of water (Marchant et al. 2006). Almost all recent records of this species, south of the tropics, have been from riparian habitat. It is thought that permanent sources of water and surrounding habitat provides refuge for this species during the dry season and particularly during drought conditions. This species has been recorded in degraded habitats such as heavily grazed paddocks (DCCEEW 2024b). This species has undergone a significant range contraction from the	Low: This species has not been recorded in the broader region for a significant period and its distribution has contracted to central and northern Queensland. Available species records and habitat modelling indicate that the study area is outside the current known range of this species (CSIRO 2023). Suitable open grassy woodland habitat in proximity to water is not present in the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			southern parts of its former distribution. It has not been recorded in south-east Queensland since the early 80s and is now thought to be extinct in NSW. It is noted as being mostly absent from the coastal plain but occasionally recorded from the area around Townsville and Ingham (Higgins et al. 2006). Foraging habitat: This subspecies is thought to require a mosaic of different habitats in which it can find seed during the wet season (DCCEEW 2024b). Breeding habitat: Nests are often built in a hollow branch of a tree, or in a fork of a tree, shrub or sapling. It is not uncommon for nests to be placed in other sites, such as in tall grass, amongst mistletoe, beneath active raptor nests, or in an old nest of a Babbler (*Pomatostomus spp*.) or Diamond Firetail (*Stagonopleura guttata*). Nest sites tend to be located in close proximity to water, i.e. approximately 400 m (DCCEEW 2024b). Nearest Record: There are no published records for this species within 25 km of the study area.	
Curlew Sandpiper *Calidris ferruginea*	CR	PMST	*Distribution:* This species occurs along the coasts but is also widespread inland. In Queensland there are scattered records in the Gulf of Carpentaria, widespread records along the coast, south of Cairns, and sparsely scattered records inland (DoEE 2017). *General habitat preferences:* Near the coast it inhabits intertidal mudflats in sheltered areas, such as estuaries, bays inlets and lagoons and non-tidal swamps, lakes, lagoons, ponds in saltworks and sewage farms (DoEE 2017). Inland they are occasionally recorded around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. The will use fresh and brackish habitats and floodwaters (DoEE 2017). *Foraging habitat:* This species usually wade and forage in waters 15-30 mm deep, but up to 60 mm deep at the edge of saltmarsh, emergent vegetation and inundated saltflats. It feeds on invertebrates, including worms, molluscs, crustaceans, and insects as well as seeds (DoEE 2017).	Low: This species was not recorded during the field survey and is not known from the region. Substantial and permanent wetland habitats are not present in or within proximity to the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			Roosting habitat: The species usually roosts on bare dry shingle, shell or sand beaches, sandspits and islets and sometimes in dunes (DoEE 2017). *Notable features:* This species does not breed in Australia (DoEE 2017). *Nearest record:* There are no published records of this species within the search area.	
Diamond Firetail (*Stagonopleura guttata*)	V	PMST	*Distribution:* Diamond Firetails occur on the south-east mainland of Australia from south-east Queensland to Eyre Peninsula, South Australia, and about 300 km inland from the sea. Their range once extended to north Queensland inland from Cardwell, but they now occur only in the very south of the state (DCCEEW 2023). *General habitat preferences:* Diamond Firetails occur in eucalypt, acacia or casuarina woodlands, open forests and other lightly timbered habitats, including farmland and grassland with scattered trees (Higgins et al. 2007). They prefer areas with relatively low tree density, few large logs, and little litter cover but high grass (DCCEEW 2023). *Foraging habitat:* This species feeds predominantly at ground level, on the seeds and leaves of grasses and herbs, as well as insects (especially during the breeding season) (DCCEEW 2023). *Breeding habitat:* Nests are constructed from fine grass leaves or stems and are often built into the base of larger birds of prey including Whistling Kite (*Haliastur sphenurus*), White-bellied Sea- eagle (*Haliaeetus leucogaster*), Wedge-tailed Eagle (*Aquila audax*), Brown Falcon (*Falco berigora*), Nankeen Kestrel (*Falco cenchroides*) or a Square-tailed Kite (*Lophoictinia isura*). Nests are also constructed within prickly shrubs such as Hakea spp., Rosea spp. and Lycium spp. (DCCEEW 2023). *Nearest Record:* There are no published records of this species within 25 km of the project area (CSIRO 2024).	Low: Broadly suitable habitat for this species is present in the form of eucalypt or acacia woodlands and open forests. However, the range for this species has contracted significantly and is now only known to occur in the very south of Queensland. This species was not recorded during the field surveys.
Grey Falcon *Falco hypoleucos*	V	PMST	*Distribution:* This species occurs in low densities across arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and Western Australia	Low: This species is typically associated with more arid areas of Queensland. The species is a rare vagrant closer to the coast when wet years

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			(Marchant S. and Higgins 1993; TSSC 2019). The species is mainly found where annual rainfall is less than 500 mm, except when wet years are followed by drought, when the species might become marginally more widespread, although it is essentially confined to the arid and semi-arid zones at all times. In Queensland, the species is generally absent from the Cape York Peninsula and areas east of the Great Dividing Range (TSSC 2019). *General habitat preferences:* The Grey Falcon is typically associated with timbered lowland plains, particularly *Acacia* shrublands that are crossed by tree-lined water courses. The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter (TSSC 2019). *Breeding habitat:* This species breed in old nests of other birds, particularly those of other raptors or corvids. The nests chosen are usually in the tallest trees along watercourses, particularly River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. coolabah*), but falcons also nest in telecommunication towers (TSSC 2019). *Nearest record:* No published records were returned for the search area (CSIRO 2024).	in arid and semi-arid areas are followed by drought. Furthermore, this species has not been recorded within 40 km of the study area despite the numerous surveys that have been conducted on Curragh and other projects in the area.
Painted Honeyeater	V	ALA PMST	*Distribution:* This species is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory. Greatest concentrations, including all breeding records, come from south of 26º, on inland slopes of the Great Dividing Range between the Grampians in Victoria and Roma in Queensland (TSSC 2015a). After breeding, many birds move to semi-arid regions such as north-eastern South Australia, central and western Queensland and central Northern Territory. This species is considered to have a single population (TSSC 2015b). *General habitat preferences:* This species occurs in mistletoes in eucalypt forests, woodlands, riparian woodlands of black box and river red gum, box-ironbark-yellow gum woodlands, *Acacia*-dominated woodlands, paperbarks, casuarinas, *Callitris*, and trees on farmland or gardens. Prefers woodlands with a higher number of mature trees, as	Low: Mistletoe species were recorded in some of the vegetation communities present in the study area. This is a highly mobile species that is known to disperse large distances in response to mistletoe flowering and fruiting and as such, it is possible that this species could use remnant vegetation within the study area as foraging habitat during migration. However, there are no published records of this species within 25 km of the study area and only one published record within 50 km of the study area in the last 20 years and given the small area of remnant vegetation that the study area supports it is considered unlikely that the study area provides frequent or important habitat for this species.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			these generally support more mistletoes. More common in larger remnant tracts, rather than narrow remnant strips (TSSC 2015b). *Breeding habitat:* The greatest concentrations and almost all records of breeding come from south of 26ºS, on inland slopes of the Great Dividing Range between the Grampians, Victoria and Roma, Queensland . Breeding season is closely aligned with fruiting of mistletoe, therefore north-south movements have been observed. It has been known to breed in narrow roadside strips if ample mistletoe fruit is present. The species appears to prefer mistletoe as a nest substrate and is likely to be attracted to habitats where mistletoe is prevalent and parasitism rates are high (TSSC 2015b). *Nearest record:* The nearest published record returned for the search area is approximately 29 km to the south-west of the study area (CSIRO 2024).	
Red Goshawk *Erythrotriorchis radiatus*	E	ALA PMST	*Distribution:* This species occurs in a patchy, widespread distribution across coastal and sub-coastal Australia. Historically it occurred from the north-east tip of New South Wales, across Queensland and the Northern Territory, to the north of Western Australia (TSSC 2015c). *General habitat preferences:* This species inhabits tall open forests and woodlands, tropical savannas traversed by wooded or forested rivers, and the edges of rainforests, usually on fertile soils. In partly cleared parts of eastern Queensland it is associated with gorge and escarpment country (TSSC 2015c). The species avoids both very dense and very open habitats. They are solitary and secretive birds and hunt mainly from ambush. Their prey is mostly birds, but also mammals, reptiles and insects (Marchant and Higgins 1994). *Breeding habitat:* Nests are restricted to trees taller than 20 m and within 1 km of a watercourse or wetland. It is thought to rarely breed in areas with fragmented native vegetation (Garnett et al. 2011). Home ranges of 120 km^2 and 200 km^2 for females and males, respectively have been recorded (Marchant and Higgins 1994).	Low: The study area does not support preferred habitat for this species in the form of riverine forests or a mosaic of vegetation associated with permanent water. This species has not been recorded despite extensive surveys having been undertaken in the area over the last 20 years.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			Nearest record: The nearest published records returned for the search area are over 40 km to the south-west of the study area (CSIRO 2024).	
Squatter Pigeon (southern) *Geophaps scripta scripta*	V	ALA PMST WO	*Distribution:* The southern sub-species for the Squatter Pigeon (southern subspecies) is described as occurring south of the Burdekin River-Lynd divide in the southern region of Cape York Peninsula to the Border Rivers region of northern New South Wales, and from the east coast to Hughenden, Longreach and Charleville (Higgins and Davies 1996). The known distribution of the southern sub-species overlaps with the known distribution of the northern subspecies (DCCEEW 2024c). *General habitat preferences:* This species is known from tropical dry, open sclerophyll woodlands and sometimes savannah with *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species in the overstorey. The groundcover layer is patchy consisting of native, perennial tussock grasses or a mix of grasses and low shrubs or forbs. However, the groundcover layer rarely exceeds 33% of the ground area. It appears to favour sandy soil dissected with low gravely ridges and is less common on heavier soils with dense grass cover. It is nearly always found in close association i.e. within 3 km, with permanent water. While the species is unlikely to move far from woodland trees, where scattered trees still occur and the distance of cleared land between remnant trees or patches of habitat does not exceed 100 m, individuals may be found foraging in, or moving across modified or degraded environments (DCCEEW 2024c). *Foraging habitat:* This occurs in any remnant or regrowth open-forest to sparse, open woodland or scrub dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species, on sandy or gravelly soils. It feeds primarily on seeds of grasses, herbs and shrubs (DCCEEW 2024c). *Breeding habitat:* This occurs on well-draining, stony rises occurring on sandy or gravelly soils or on low 'jump-ups' and escarpments (i.e. land zones 5 and 7), within 1 km of a suitable, permanent waterbody (DCCEEW 2024c).	Present: This species was recorded at one location in non-remnant vegetation in the central portion of the study area. A total of XX hectares (Figure X) of Squatter Pigeon habitat has been mapped within the study area

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			Dispersal habitat: This can be any forest or woodland occurring between patches of foraging or breeding habitat, and suitable waterbodies and may include denser patches of vegetation not suitable for foraging or breeding (DCCEEW 2024c). *Nearest record:* This species was recorded within the study area during the fauna field survey.	
Star Finch (eastern) *Neochmia ruficauda ruficauda*	E	PMST	*Distribution:* The distribution of the Star Finch is poorly known. It is thought to occur between Bowen in the north, Winton in the west and Wowan in the south (DCCEEW 2024d). However, this species' range has largely contracted to southern Cape York. There have not been any confirmed records from the Cairns to Townsville region for some time and none were recorded during the Birds Australia Atlas project. Recent records around Rockhampton are thought likely to be aviary escapees (Higgins et al. 2006). *General habitat preferences:* This species usually inhabits low dense damp grasslands bordering wetlands and waterways and also open savannah woodlands near water or subject to inundation but is absent from expanses of open country and uplands, usually occurring in valleys (Higgins et. al. 2006). It also occurs in cleared or suburban areas. Woodland communities in which it occurs include *Eucalyptus coolabah*, *E. tereticornis*, *E. tessellaris*, *Melaleuca leucadendra*, *E. camaldulensis* and *Casuarina cunninghamii* and typically where permanent water is present or areas that are regularly inundated (DCCEEW 2024d). *Foraging habitat:* It feeds on grass and shrub seeds, most likely from *Arundinella*, *Brachyachne*, Chloris, *Chrysopogon*, *Digitaria*, *Echinochloa*, *Heterachne*, *Iseilema*, *Oryza*, *Panicum*, *Setaria*, *Sorghum*, *Themeda*, *Urochloa*, *Casuarina*, *Fimbristylis* and *Tridax* species. It also feeds on insects. It has been recorded foraging, in the shade of eucalypt species, on the ground (DCCEEW 2024d). *Breeding habitat:* Nests are thought to be 'bottle-shaped' and placed in trees, amongst grass, sedges or reeds, at	Low: None of the study area support suitable wetland, grassland and savannah woodland habitat for this species. There are no published records for this species in the region.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			heights of approximately 3-9 m above the ground (DCCEEW 2024d). *Nearest record:* There are no published records for this species within 25 km of the study area (CSIRO 2024).	
Mammals				
Bridled Nail-tail Wallaby *Onychogalea fraenata*	E	WO	*Distribution:* In Queensland, this species is believed to be confined to Taunton National Park (Scientific) (an area of 11 000 ha) near the town of Dingo with some sightings within 10 km of the park. Reintroduced populations have persisted in the Avocet Nature Refuge and the Idalia National Park (DCCEEW 2024e). *General habitat preferences:* In Taunton NP Bridle Nailtail Wallabies use woodland, particularly in Brigalow (*Acacia harpophylla*) scrub, preferring areas with the most fertile soil. During the day (when they are resting), Bridled Nailtail Wallabies prefer habitat that consists of young Brigalow regrowth or contains fallen logs. They generally choose shelter sites with the densest cover of foliage and stems at Bridled Nail-tail Wallaby height (25—50 cm), and this type of shelter is concentrated at the edges of wooded areas such as Brigalow regrowth (TSSC 2016a). *Foraging habitat:* Bridled Nailtail Wallabies forage at night and prefer the ecotone habitat containing both pasture and young Brigalow regrowth. When feeding in open pasture, they prefer to stay close to the edge of shelter habitat (DCCEEW 2024e). *Breeding habitat:* Bridled Nailtail Wallabies require areas of low, dense ground cover that is close to pasture to breed successfully (DCCEEW 2024e). After young leave the pouch permanently at around 17 weeks old, juvenile Bridled Nail-tail Wallabies do not follow their mothers, instead they spend the day concealed in dense cover, generally at the edge of a feeding area, no more than 200 m away from their mothers' daytime shelter (DCCEEW 2024e). *Notable features:* Bridled Nailtail Wallabies have a distinctive 'bridle' of white around the shoulder blades, which begins as a white stripe bordered by black at the	Low: The study area does support broadly suitable habitat for this species in the form of Brigalow woodland (RE 11.3.1) with fallen logs. However, the study area is separated from Taunton national park by over 25 km of highly fragmented landscape. The Queensland Herbarium regional ecosystem map (version xx) has mapped very little remnant or regrowth vegetation of any kind that may provide habitat connectivity between the study area and known populations of this species.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			back of the neck. The end of the tail is black and has a small crest of hair covering the claw-like nail. The tail is held stiff in an inverted 'U' shape with the tip pointing up while hopping. This species hops with its head held low and its arms held outwards and juveniles often freeze and lie flat on the ground when approached, and are then very difficult to see (DCCEEW 2024e). The droppings of the Bridled Nail-tail Wallaby are more cylindrical than those of the Black-striped Wallaby (*Macropus dorsalis*), which is common in the same habitat within Taunton NP (DCCEEW 2024e) *Nearest record:* The nearest published record of this species is record from 1975 located approximately 24 km south-west of the study area(CSIRO 2024).	
Corben's Long-eared Bat *Nyctophilus corbeni*	V	PMST	*Distribution:* In Queensland, this species is mainly recorded in the Brigalow Belt South Bioregion, inland from the Great Dividing Range; as far north as the Expedition Range and Dawson River areas, extending eastwards to the Bunya Mountains National Park and further south-east to Warwick, and west into the Mulga Lands Bioregion and west of Bollon. The distribution extends south into New South Wales (TSSC 2015d). *General habitat preferences:* Corben's Long-eared Bat occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands as well as Buloke woodland, Brigalow woodland, Belah woodland, Smooth-barked Apple (*Angophora leiocarpa*) woodland, River Red Gum (*Eucalyptus camaldulensis*) woodland and dry sclerophyll forest. It is known from habitat dominated by various eucalypt and bloodwood species and various types of tree mallee, being most abundant in vegetation with a distinct canopy and a dense cluttered shrub layer (TSSC 2015d). *Foraging habitat:* This insectivorous bat feeds in flight, by gleaning vegetation and during ground foraging. It feeds on beetles, bugs, moths, grasshoppers, crickets, ants, spiders	Low: There is limited suitable habitat with a distinct canopy and dense cluttered shrub layer within the study area and there are no published records for this species within 50 km of the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			and mosquitoes. Foraging tends to be concentrated around patches of trees (TSSC 2015d). *Roosting habitat:* Occurs solitarily under exfoliated bark and in the crevices on trees (TSSC 2015d). *Breeding habitat:* Maternity roosts are likely to occur in colonies in larger tree cavities. Breeding is thought to occur around November, although there is little information about this (TSSC 2015d). *Nearest record:* No published records were returned for the search area.	
Ghost Bat *Macroderma gigas*	E	PMST	*Distribution:* It is predicted, based on analysis of historic climatic data, fossils, and modelling that the Ghost Bat is a geographically relictual species in southern, arid landscapes, present only because caves provide suitable roost microclimates (TSSC 2016b). Although this species is thought to once occupy much of Australia, its current range is discontinuous across northern Australia, with colonies known in the Pilbara, Kimberly, Northern Territory, the Gulf of Carpentaria, coastal and near coastal eastern Queensland from Cape York to near Rockhampton and the Riversleigh and Camooweal districts in western Queensland and occupying both arid and lush rainforest habitats (TSSC 2016b; van Dyck and Strahan 2008). *General habitat preferences:* Habitat is comprised of thicket, open woodland, and spinifex and black soil grasslands (van Dyck et al. 2013; van Dyck and Strahan 2008). Monsoon forests, open savannah woodland, tall open forest, deciduous vine forest and tropical rainforest is also used (Churchill 2009). Cave habitat is important for roosting and breeding (van Dyck and Strahan 2008). Ghost bats usually require a number caves to move between seasonally (TSSC 2016b). *Foraging habitat:* This species feeds on frogs, lizards, birds, small mammals and sometimes other bats (TSSC 2016b; van Dyck and Strahan 2008). It captures prey on the ground and then returns to an established feeding site, e.g. rock overhang or small cave, to feed (van Dyck and Strahan 2008). It is known to forage up to 2 km from the roost cave	Low: Suitable habitat in the form of rocky escarpments, overhangs and small caves are not present within or adjacent to the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			and will use the same foraging area each night. Foraging areas are approximately 60 ha in size (Churchill 2009; TSSC 2016b). This species is a high order carnivore that does not enter torpor. Therefore, this species requires environmental conditions capable of providing an adequate supply of prey. *Breeding habitat:* Breeding is likely to occur in July or August with young being born between September and November. Nursery colonies are formed separately to males (van Dyck and Strahan 2008). Only 14 breeding sites are currently known (TSSC 2016b). Young are fully weaned by about March each year but may be left in nurseries or forage with the mother up until this age (Churchill 2009). There is a tendency for breeding caves to have multiple entrances (TSSC 2016b). *Roosting habitat:* Caves provide suitable roost microclimates and it is known to rest during the day in large sandstone or limestone caves, boulder piles, shallow escarpments or deep rock fissures and mines (Churchill 2009; TSSC 2016b; van Dyck and Strahan 2008). This species appears to require caves with specific temperature and humidity ranges (TSSC 2016b). Groups of greater than 100 individuals is unusual (van Dyck and Strahan 2008). During the non-breading season most of the colony will disperse (up to 150 km) from permanent roosts and utilise a large number of caves, overhangs, rock shelters, vertical cracks and mines as day roosts. Dispersed groups are small, usually a single pair (Troop 1985). *Nearest record:* No published records were returned for the search area.	
Greater Glider (southern and central) *Petauroides volans* (armillatus)	E	ALA PMST WO	*Distribution:* This species is restricted to eastern Australia, between Proserpine in north Queensland and Wombat State Forest in central Victoria. It occurs from sea level up to 1,200 m above sea level (DCCEEW 2024f). *General habitat preferences:* The Greater Glider (central) occurs in a range of eucalypt-dominated habitats, including low open forests on the coast to tall forests in the ranges and low woodland westwards of the Dividing Range. It does not use rainforest habitats (van Dyck et al. 2013; van Dyck and	Moderate: The study area supports potentially suitable habitat for this species in the form of tall eucalypt forest with tree hollows (particularly, REs 11.3.3 and 11.3.25), additionally the species has been recorded approximately 15 km to the south of the study area. Approximately XX ha of habitat has been mapped for this species within the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			Strahan 2008). This species typically occurs in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows and a diversity of eucalypt species (DCCEEW 2024f). *Foraging habitat:* The Greater Glider has an almost exclusive diet of eucalypt leaves and occasionally flowers or buds (DCCEEW 2023k; van Dyck and Strahan 2008). Although the species is known to feed on a range of eucalypt species, in any particular area it is likely to only forage on one or two species (van Dyck and Strahan 2008). *Breeding habitat:* This species is an obligate hollow breeder and (Eyre TJ et al. 2022) found that trees greater than 50 cm DBH appear to be important for use by Greater Glider as den trees. Breeding occurs between March and June and a single young is born each year (DCCEEW 2024f; van Dyck and Strahan 2008). The young stays with the mother or is left in the nest and becomes independent at about 9 months (Menkhorst and Knight 2011). *Notable features:* This species appears to have low dispersal ability and typically small home ranges of 1-4 ha. It may glide over distances of up to 100 m (DCCEEW 2024f; van Dyck and Strahan 2008). *Nearest record:* The nearest published record returned for the search area is approximately 15 km to the south of the study area (CSIRO 2024).	
Grey-headed Flying-fox *Pteropus poliocephalus*	LC	ALA PMST	*Distribution:* This species is endemic to Australia and occurs in the coastal belt between Rockhampton in central Queensland and Melbourne in Victoria. It infrequently occurs west of the Great Dividing Range. It moves throughout its range in response to availability of foraging resources (DCCEEW 2024g). *General habitat preferences:* This species is a canopy-feeding frugivore and nectarivore, usually feeding on rainforest, open forest, closed and open woodland communities as well as *Melaleuca* swamps and *Banksia* woodlands. It will also feed on fruit crops and other introduced tree species. Its primary food source is *Eucalyptus* (and related genera) blossom (DCCEEW 2024g).	Low: Vegetation communities within the study area provide broadly suitable foraging resources for this species. However, there are very few published records of this species in the region and there are no active or historic records of Grey-headed Flying-fox camps in close proximity to the study area (National Flying-fox Monitoring Program and CSIRO 2021).

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			Camps: Camps are generally in rainforest patches, stands of *Melaleuca*, mangroves and riparian vegetation located near water, such as lakes, rivers or the coast (DCCEEW 2024g). *Breeding:* Mating occurs in early autumn. Young are usually born in October (DCCEEW 2024g). *Nearest record:* The nearest published record of this species is approximately 22 km south of the study area (CSIRO 2024).	
Koala *Phascolarctos cinereus*	E	ALA PMST WO	*Distribution:* This species is widespread in sclerophyll forest and woodlands on foothills and plains on both sides of the Great Dividing Range from about Chillagoe, Queensland to Mt Lofty Ranges in South Australia (Menkhorst and Knight 2011). In Queensland the species is thought to occur in eight bioregions; Einasleigh Uplands, Wet Tropics, Desert Uplands, Central Mackay Coast, Mitchell Grass Downs, Mulga Lands, Brigalow Belt North and Brigalow Belt South. In many locations Koalas are of low density, widespread and fragmented (DAWE 2022). *General habitat preferences:* Koalas in Queensland use a range of habitats (typically dominated by *Eucalyptus* species), including moist coastal forests, southern and central western sub-humid woodlands and a number of eucalypt woodlands adjacent to waterbodies in the semi-arid western parts of the state (DAWE 2022). These habitats may include forests or woodlands, road-side and rail vegetation and paddock trees, safe intervening ground matrix for travelling between trees and patches (DAWE 2022). In north-west of Queensland, studies have found that Koalas are patchily distributed, associated with creek-lines, areas of higher tree species richness and with higher abundance correlating with leaf-moisture content (DAWE 2022). *Foraging habitat:* The diet of the Koala is highly specialised and relies on species of the Eucalyptus, Corymbia and Angophora genera. While the Koala may use more than 400 species of tree for their food and habitat requirements, preferred tree species will vary by habitat type and location across their range, with primary food species varying in	Possible: The study area supports suitable habitat for this species in the form of remnant and regrowth eucalypt dominated woodlands (Figure X). Approximately XX ha of potential habitat for the Koala has been mapped within the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			different habits and potentially comprising as few as two species in any given location (DAWE 2022). *Refuge habitat:* Areas where microclimates provide refuge from heat, and perennial water results in leaf-water content remaining high, e.g. deep gullies, caves, cliffs or dense vegetation. Climate refugia for this species includes drainage lines, riparian zones and patches that are resilient to drying conditions due to favourable hydrological systems (DAWE 2022). *Nearest record:* The nearest published record returned for the search area is approximately 7 km to the south of the study area (CSIRO 2024).	
Yellow-bellied Glider (*Petaurus australis australis*)	V	PMST	*Distribution:* The yellow-bellied glider (south-eastern) occurs at altitudes ranging from sea level to 1400 m above sea level and has a widespread but patchy distribution from south-eastern Queensland (Qld) to far south-eastern SA, near the SA-Vic border. It is primarily associated with forests along the east coast but also extends inland to the western slopes of the Great Dividing Range in NSW and QLD. Isolated subpopulations are also found inland in the Blackdown and Canarvon Ranges of central Qld (TSSC 2022a). *General habitat preferences:* The yellow-bellied glider (south-eastern) occurs in eucalypt-dominated woodlands and forests, including both wet and dry sclerophyll forests. Abundance is highly dependent on habitat suitability, which is in turn determined by forest age and floristics. The subspecies shows a preference for large patches of mature old growth forest that provide suitable trees for foraging and shelter (TSSC 2022a). Forests with winter flowering, smooth barked eucalypts are heavily favoured by the Yellow-bellied Glider. They are unlikely to persist in forests dominated by only one or two species of eucalypt (TSSC 2022a). Hollow bearing trees are a critical habitat feature for this species with den trees primarily being living smooth-barked eucalypts more than 1 m in trunk diameter (TSSC 2022a).	Possible: Potentially suitable habitat for this species is present within the study area in the form of remnant eucalypt forest that supports tree hollows. However, the abundance of this habitat is limited and largely restricted to vegetation communities associated with Blackwater Creek (RE 11.3.25, RE 11.3.1 and RE 11.3.3). Approximately XX ha of habitat has been mapped for this species in the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			The Yellow-bellied Glider lives in small family groups with an exclusive home range of 50 to 65 ha. Large home ranges are thought to be required as the trees used for foraging are dispersed and vary spatially and temporally. Large tracts of forests of 180 to 350 km^2 are considered necessary to maintain long term population viability with a minimum of 150 to 200 glider groups required (TSSC 2022a). The species has low dispersal capabilities over gaps larger than its gliding distance that is a maximum of 120 to 140 m but on average is just over 25 m in low canopy forest (TSSC 2022a). *Nearest Record:* There are no published records of this species within the search area. Eco Solutions and Management identified this species along Blackwater Creek approximately 8 km south of the study area during fauna spotter catcher work on the Curragh North Mine in 2018.	
Reptiles				
Collared Delma *Delma torquata*	V	ALA PMST WO	*Distribution*: The species has been recorded within the Bunya Mountains, Blackdown Tablelands National Park, Expedition National Park (Central Queensland), Western Creek, near Millmerran and the Toowoomba Range. A large concentration of records are from the western suburbs of Brisbane (DCCEEW 2024h). *General habitat preferences:* This species is predominantly associated with open rocky terrain although it has also been found in eucalypt woodlands and brigalow with little surface rock (Wilson 2005). It is most likely to inhabit eucalypt-dominated woodland and open forests on landzones 3, 9 and 10. The presence of rocks, logs, bark and other coarse woody debris, and mats of leaf litter typically 30-100 mm thick) appear to be essential characteristics of Collared Delma microhabitat, which may be a limiting factor for recolonising recently burnt areas (DCCEEW 2024h). This species has been found in only a hand full of small, isolated	Low: There are no published records of this species within 50 km of the search area and the species has not been recorded despite the numerous field surveys that have been undertaken at or adjacent to the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			populations in South-east Queensland and the Brigalow Belt bioregions (DCCEEW 2024h). *Nearest record*: The nearest published record returned for the search area is over 50 km to the south of the study area in the Blackdown Tablelands National Park (CSIRO 2024).	
Dunmall's Snake *Furina dunmalli*	V	PMST	*Distribution:* This snake occurs in the Brigalow Belt South and Nandewar bioregions from near the Queensland border south to Ashford in New South Wales. *General habitat preferences:* Dunmall's Snake has been found in a broad range of habitats including forests and woodlands on clay or clay loam soils dominated by Brigalow (*Acacia harpophylla*), other wattles such as *A. burrowii*, *A. deanii*, *A. leiocalyx*, native Cypress (*Callitris spp.*) or Bull Oak and various Spotted Gum (*Corymbia citriodora ssp. variegata*), Ironbark (*Eucalyptus crebra* and *E. melanophloia*), White Cypress Pine (*Callitris glaucophylla*) and Bull Oak open forest and woodland associations on sandstone derived soils. It has rarely been found on the edge of dry vine scrub and in hard ironstone country. It shelters under fallen timber and ground litter and may use cracks in alluvial clay soils. The Dunmall's Snake feeds on small skinks and geckos (DCCEEW 2024h). *Notable features:* This is a very secretive snake with few known records. The high number of mid-body scales (21) and small yellow flecks over the temporal region and lips will generally distinguish this snake from other similar species. *Nearest record:* No published records were returned for the search area.	Low: The study area does support broadly suitable habitat for this species in the form of Brigalow or Eucalypt woodland on clay or alluvial soils (RE 11.3.1, 11.4.9). However, there are no published records of this species within 100 km of the study area despite the numerous fauna surveys that have been undertaken in the area.
Grey Snake *Hemiaspis damelii*	E	PMST	*Distribution:* In Queensland, the grey snake has a broader and more dispersed distribution when compared to it's more disjunct distribution in NSW. Most records occur along the Macintyre and Condamine Rivers and associated floodplains of the southern Brigalow Belt from Goondiwindi and Dalby west to Glenmorgan, on the Darling Downs and western Lockyer Valley, near Rockhampton on the central Queensland coast, and on the Darling Riverine Plains near Currawinya in	Low: Heavy, cracking clay soils are present within the study area. However, there are no published records of this species within 50 km of the study area despite the numerous fauna surveys that have been undertaken in the area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			south-western Queensland (TSSC 2022b). Occurrence records range from 70 m above sea level to 540 m with most records in NSW and QLD occurring below 300 m (TSSC 2022b). *General habitat preferences:* In Queensland, grey snake habitat is Brigalow and Belah woodlands on heavy, dark brown to black cracking clay soils associated with water bodies and floodplain environments, sheltering under logs, rocks and soil cracks (TSSC 2022b). *Nearest record:* No published records were returned for the search area.	
Ornamental Snake *Denisonia maculata*	V	ALA PMST	Distribution: This snake species is known from the Brigalow Belt North and parts of the Brigalow Belt South Bioregions, with the main occurrences in the drainage system of the Fitzroy and Dawson Rivers. General habitat preferences: This snake is found in close association with frogs which form the majority of its prey. It is known to prefer woodlands and open forests associated with moist areas, particularly gilgai (melon-hole) mounds and depressions with clay soils but is also known from lake margins, wetlands and waterways. This species has been recorded mostly in Brigalow (Acacia harpophylla), Gidgee (Acacia cambagei), Blackwood (Acacia argyrodendron) or Coolibah (Eucalyptus coolabah) - dominated vegetation communities or pure grassland associated with gilgais. REs in which it has been recorded include; 11.4.3, 11.4.6, 11.4.8 and 11.4.9 and 11.3.3 and 11.5.16. It shelters in logs, under coarse woody debris and in ground litter. It appears to prefer a diversity of gilgai size and depth and with some fringing groundcover vegetation and ground timber and where soils are of a high clay content with deep-cracking characteristics. Habitat patches greater than 10 ha and connected to larger areas of remnant vegetation are preferred (DCCEEW 2024i). The Draft Referral guidelines for the nationally listed Brigalow Belt reptiles describes gilgai depressions and mounds as being important habitat with habitat connectivity between	Present: The study area does support potentially suitable habitat for this species in the form of Gilgai (predominately in the potential drawdown area) and Brigalow woodland adjacent Blackwater Creek (RE 11.3.1) (Figure XX). While this species was not recorded during the fauna field survey there is a published record from 2003 located on the southern border of the study area.

Common name/ Species name	NC Act status[1]	Record source[2]	Habitat preferences	Likelihood to occur in the study area
			gilgais and other suitable habitats also being important (SEWPaC 2011). Foraging habitat: It prefers habitats where there is an abundance of burrowing frog species (DCCEEW 2024i). Refuge habitat: This species seeks refuge in soil cracks on gilgai mounds within habitat areas. Nearest record: The nearest published record for this species is located on the southern border of the study area (CSIRO 2024).	
Yakka Skink *Egernia rugosa*	V	ALA PMST	*Distribution:* The distribution of this species is highly fragmented. It extends from the coast to the hinterland of sub-humid to semi-arid eastern Queensland. It has been recorded between the Queensland/New South Wales border to Mungkan Kandju National Park on Cape York Peninsula, and from Bundaberg and the region west of Gympie to Mariala National Park west of Charleville (DCCEEW 2024j). *General habitat preferences:* This species occurs in woodland and open forest habitats, wet/dry sclerophyll forest and ecotonal rainforest habitats. This species is commonly found in cavities under and between partly buried rocks, logs or tree stumps, root cavities and abandoned animal burrows. The species often takes refuge in large hollow logs and has been known to excavate deep burrow systems, sometimes under dense ground vegetation (Cogger 2000; Wilson 2005). In cleared habitat, this species can persist where there are shelter sites such as raked log piles, deep gullies, tunnel erosion/sinkholes and rabbit warrens. The species has also been found sheltering under sheds and loading ramps. This species is not generally found in trees or rocky habitats (Chapple 2003). *Feeding habitat:* This species burrows and feeds on soft plant material and fruits as well as a variety of invertebrates that venture into or near the burrow entrance. *Nearest record:* The nearest published record of this species is a spatially generalised record located approximately 2.3 km south of the study area (CSIRO 2024).	Low: There is one spatially generalised record (to 2000 m) of this species approximately 2.3 km south of the study area recorded in the year 2000 which is published only on the Atlas of Living Australia. The study area provides broadly suitable habitat for this species in the form open forest habitats (RE 11.3.25. 11.3.1 and 11.3.3). However, many habitat features such as partly buried rocks and logs and abandoned animal burrows were generally in low abundance throughout the study area. No signs of this species were detected during the fauna field survey. Given the species has a limited capacity to disperse from a colony site and the highly fragmented landscape surrounding the study area it is considered unlikely that the study area provides habitat for this species.

[1]EPBC Act Status: CE, Critically endangered; E, Endangered; V, Vulnerable

[2]NC Act Status: E = Endangered; V = Vulnerable; NT = Near threatened, LC = Least concern

[3]Source:

- ALA − Atlas of Living Australia (Table A2 of Appendix A)
- PMST − Protected Matters Search Tool (PMST database results contained in Appendix A)
- WO − Wildlife Online database (Wildlife Online database search results contained in Appendix A).

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Appendix E

Flora Species Identified in the Study Area

Table E1: Flora species list

Family	Scientific Name	Common Name	Status
Amaranthaceae	*Achyranthes aspera*	Chaff Flower	C
Apocynaceae	*Carissa ovata*	Klunkerberry	C
Apocynaceae	*Marsilea sp.*	ncn	C
Asteraceae	*Bidens bipinnata*	Cobbler's Pegs	*
Boraginaceae	*Ehretia membranifolia*	Peach Bush	C
Cactaceae	*Harrisia martinii*	Harrisia Cactus	*(RI)
Cactaceae	*Opuntia tomentosa*	Velvety Tree Pear	*(RI)
Caesalpiniaceae	*Lysiphyllum hookeri*	Pegunny	C
Caesalpiniaceae	*Parkinsonia aculeata*	Parkinsonia	*(RI)
Caesalpiniaceae	*Cassia brewsteri*	Leichardt Bean	C
Casuarinaceae	*Casuarina cristata*	Belah	C
Celastraceae	*Denhamia oleaster*	Stiff Denhamia	C
Chenopodiaceae	*Sclerolaena muricata*	ncn	C
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush	C
Combretaceae	*Terminalia oblongata subsp. oblongata*	Yellowwood	C
Commelinaceae	*Commelina benghalensis*	ncn	*
Cyperaceae	*Cyperus rotundus*	Nutgrass	*
Cyperaceae	*Cyperus sp.*	ncn	C
Ebenaceae	*Diospyros geminata*	Queensland Ebony	C
Erythroxylaceae	*Erythroxylum australe*	Cocaine Bush	C
Euphorbiaceae	*Euphorbia sp.*	ncn	*
Euphorbiaceae	*Acalypha sp.*	ncn	C
Fabaceae	*Rhynchosia minima*	ncn	C
Fabaceae	*Hovea sp.*	ncn	C
Fabaceae	*Hovea longipes*	ncn	C
Goodeniaceae	*Brunonia australis*	Blue Trumpet	SL
Laxmanniaceae	*Lomandra longifolia*	Spiny-headed Mat Rush	C
Malvaceae	*Abutilon fraseri subsp. fraseri*	Dwarf-lantern Flower	C
Malvaceae	*Sida sp.*	ncn	*
Malvaceae	*Sida cordifolia*	Flannel Weed	*
Malvaceae	*Malvastrum americanum var. americanum*	Spiked Malvastrum	*
Malvaceae	*Abutilon auritum*	ncn	C
Mimosaceae	*Acacia harpophylla*	Brigalow	C
Mimosaceae	*Vachellia farnesiana*	Prickly Acacia	*
Mimosaceae	*Acacia salicina*	Sally Wattle	C
Mimosaceae	*Archidendropsis basaltica*	Dead Finish	C
Myrtaceae	*Eucalyptus cambageana*	Dawson River Gum	C
Myrtaceae	*Eucalyptus coolabah*	Coolabah	C
Myrtaceae	*Eucalyptus tereticornis*	ncn	C
Myrtaceae	*Corymbia tessellaris*	Carbeen	C
Myrtaceae	*Melaleuca bracteata*	Black Tea Tree	C
Myrtaceae	*Eucalyptus populnea*	Poplar Box	C
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Red Ironbark	C
Myrtaceae	*Corymbia clarksoniana*	Long-fruited Bloodwood	C

Myrtaceae	*Corymbia dallachiana*	Dallachy's Gum	C
Nyctaginaceae	*Boerhavia dominii*	Tarvine	C
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	*
Poaceae	*Cenchrus ciliaris*	Buffel Grass	*
Poaceae	*Paspalidium caespitosum*	Brigalow Grass	C
Poaceae	*Sporobolus caroli*	Fairy Grass	C
Poaceae	*Megathyrsus maximus*	ncn	*
Poaceae	*Bothriochloa sp.*	ncn	C
Poaceae	*Dichanthium aristatum*	Angleton Grass	*
Poaceae	*Digitaria sp.*	ncn	C
Poaceae	*Bothriochloa pertusa*	Indian Bluegrass	*
Poaceae	*Sporobolus mitchellii*	Swamp Rat's Tail Grass	C
Poaceae	*Enneapogon sp.*	Nine-awn Grass	C
Poaceae	*Ancistrachne uncinulata*	ncn	C
Poaceae	*Melinis repens*	Red Natal Grass	*
Poaceae	*Panicum sp.*	ncn	C
Poaceae	*Sporobolus sp.*	ncn	C
Poaceae	*Neptunia sp.*	ncn	C
Proteaceae	*Hakea lorea subsp. lorea*	Corkwood	C
Rhamnaceae	*Ventilago viminalis*	Vine Tree	C
Rutaceae	*Geijera parviflora*	Wilga	C
Rutaceae	*Flindersia dissosperma*	Scrub Leopardwood	C
Santalaceae	*Santalum lanceolatum*	Northern Sandalwood	SL
Sapindaceae	*Atalaya hemiglauca*	Whitewood	C
Sapindaceae	*Alectryon diversifolius*	Scrub Boonaree	C
Sapindaceae	*Alectryon oleifolius subsp. elongatus*	Western Rosewood	C
Scrophulariaceae	*Eremophila longifolia*	ncn	C
Scrophulariaceae	*Eremophila mitchellii*	False Sandalwood	C
Solanaceae	*Solanum sp.*	Nightshade	C
Sparrmanniaceae	*Grewia latifolia*	Dysentry Bush	C
Sterculiaceae	*Brachychiton rupestris*	Narrow-leaved Bottle Tree	SL
Verbenaceae	*Verbena africana*	ncn	C
Vitaceae	*Clematicissus opaca*	Forest Grape	C
Zygophyllaceae	*Tribulus terrestris*	Caltrop	C
Zygophyllaceae	*Roepera sp.*	Twin Leaf	C

Appendix F

Fauna Species Identified in the Study Area

Table F1: Fauna species list (sites S1 – S12)

Common Name	*Scientific Name*	Status		Survey site												
		EPBC Act	NC Act	Incidental	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Amphibians																
Broad-palmed Rocket Frog	*Litoria latopalmata*	NL	LC					Sp		Sp						
Bumpy Rocket Frog	*Litoria inermis*	NL	LC							Sp						
Cane Toad	*Rhinella marina*	NL	*													
Desert Tree Frog	*Litoria rubella*	NL	LC		As											
Green Tree Frog	*Litoria caerulea*	NL	LC				As	Sp		Sp	Sp		Sp	Sp		
Ornate Burrowing Frog	*Platyplectrum ornatum*	NL	LC					Sp		Sp						
Striped Rocket Frog	*Litoria nasuta*	NL	LC					Sp								
Birds																
Australian Magpie	*Cracticus tibicen*	NL	LC		x		x	x	x						x	
Black Kite		NL	LC													
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	NL	LC		x		x	x	x						x	
Blue-faced Honeyeater	*Entomyzon cyanotis*	NL	LC				x								x	
Brown Falcon		NL	LC	x												
Brush Cuckoo	*Cacomantis variolosus*	NL	LC	x												
Channel-billed Cuckoo	*Scythrops novaehollandiae*	NL	LC						x							
Cockatiel	*Nymphicus hollandicus*	NL	LC			x										
Crested Pigeon	*Ocyphaps lophotes*	NL	LC					x								
Dollarbird	*Eurystomus orientalis*	NL	LC	x	x											
Eastern Barn Owl	*Tyto javanica*	NL	LC										Cp			
Eastern Koel	*Eudynamys orientalis*	NL	LC				x									

Common Name	*Scientific Name*	Status		Survey site												
		EPBC Act	NC Act	Incidental	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Forest Kingfisher	*Todiramphus macleayii*	NL	LC				x									
Galah	*Eolophus roseicapillus*	NL	LC					x								
Grey Butcherbird	*Cracticus torquatus*	NL	LC			x		x								
Grey-crowned Babbler	*Pomatostomus temporalis*	NL	LC		x	x						x			x	
Grey Shrike-thrush	*Colluricincla harmonica*	NL	LC		x		x					x				
Laughing Kookaburra	*Dacelo novaeguineae*	NL	LC		x		x									
Leaden Flycatcher	*Myiagra rubecula*	NL	LC		x		x									
Little Friarbird	*Philemon citreogularis*	NL	LC		x	x										
Magpie-lark	*Grallina cyanoleuca*	NL	LC									x				
Mistletoebird	*Dicaeum hirundinaceum*	NL	LC			x		x								
Nankeen Kestrel	*Falco cenchroides*	NL	LC									x				
Noisy Friarbird	*Philemon corniculatus*	NL	LC					x								
Olive-backed Oriole	*Oriolus sagittatus*	NL	LC			x										
Pacific Baza	*Aviceda subcristata*	NL	LC				x	x								
Pale-headed Rosella	*Platycercus adscitus*	NL	LC	x			x								x	
Pallid Cuckoo	*Cacomantis pallidus*	NL	LC				x	x								
Pheasant Coucal	*Centropus phasianinus*	NL	LC		x		x		x			x				
Pied Butcherbird	*Cracticus nigrogularis*	NL	LC				x					x			x	
Rainbow Bee-eater	*Merops ornatus*	NL	LC									x				

Common Name	*Scientific Name*	Status		Survey site												
		EPBC Act	NC Act	Incidental	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Rainbow Lorikeet	*Trichoglossus haematodus*	NL	LC	x											x	
Red-backed Fairy-wren	*Malurus melanocephalus*	NL	LC			x		x	x						x	
Red-winged Parrot	*Aprosmictus erythropterus*	NL	LC				x									
Squatter Pigeon	*Geophaps scripta*	NL	LC	x												
Striated Pardalote	*Pardalotus striatus*	NL	LC			x		x								
Striated Thornbill	*Acanthiza lineata*	NL	LC				x									
Striped Honeyeater	*Plectorhyncha lanceolata*	NL	LC		x	x		x								
Sulphur-crested Cockatoo	*Cacatua galerita*	NL	LC		x		x					x				
Tawny Frogmouth	*Podargus strigoides*	NL	LC								Sp					
Torresian Crow	*Corvus orru*	NL	LC			x	x		x			x			x	
Tree Martin	*Petrochelidon nigricans*	NL	LC									x				
Variegated Fairy-wren	*Malurus lamberti*	NL	LC									x				
Wedge-tailed Eagle	*Aquila audax*	NL	LC		x											
Weebill	*Smicrornis brevirostris*	NL	LC			x			x			x				
White-throated Honeyeater	*Melithreptus albogularis*	NL	LC		x		x									
Whistling Kite	*Haliastur sphenurus*	NL	LC		x	x	x								x	
Willie Wagtail	*Rhipidura leucophrys*	NL	LC									x				
Yellow-throated Miner	*Manorina flavigula*	NL	LC	x			x								x	
Mammals																
Common Brushtail Possum	*Trichosurus vulpecula*	NL	LC		Sp					Sp						

Common Name	*Scientific Name*	Status		Survey site												
		EPBC Act	NC Act	Incidental	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Common Wallaroo	*Macropus robustus*	NL	LC				As									
Dingo, Domestic Dog	*Canis lupus*	NL	*	x												
Eastern Grey Kangaroo	*Macropus giganteus*	NL	LC	x				As						Sp	As	
Pig	*Sus scrofa*	NL	*	x												
Rabbit	*Oryctolagus cuniculus*	NL	*	Sp												
Short-beaked Echidna	*Tachyglossus aculeatus*	NL	LC										Sp		Sc	
Sugar Glider	*Petaurus breviceps*	NL	LC					Sp								
Swamp Wallaby	*Wallabia bicolor*	NL	LC				As					As				
Reptiles																
Black-headed Python	*Aspidites melanocephalus*	NL	LC								Sp					
Brigalow Scaly-foot	*Paradelma orientalis*	NL	LC		Sp			Sp		Sp						
Burton's Legless Lizard Lialis burtonis		NL	LC					Sp								
Bynoe's Gecko	*Heteronotia binoei*	NL	LC		As			Sp, As	As		Sp		Sp			
Carpet Python	*Morelia spilota*	NL	LC				Sp									
Chain-backed Dtella	*Gehyra catenata*	NL	LC		As	As		As	As	Sp		As				
Eastern Brown Snake		NL	LC	x												
Elegant Snake-eyed Skink	*Cryptoblepharus pulcher*	NL	LC		As											
Keelback	*Tropidonophis mairii*	NL	LC										Sp	Sp		Sp
Ocellated Velvet Gecko	*Oedura monilis*	NL	LC		Sp	As										
Orange-flanked Rainbow-skink	*Carlia rubigo*	NL	LC									As				

Common Name	*Scientific Name*	Status		Survey site												
		EPBC Act	NC Act	Incidental	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Red-naped Snake	*Furina diadema*	NL	LC									As				

[1] Status: NC Act: V = Vulnerable, SLC = Special least concern

Biosecurity Act: RI = Restricted invasive

* = exotic
TS = Trap Site; S = Supplementary Site; As = Active Search; Cp = Call Playback; el = Elliot Trap; pf = Pitfall; sc = Scats; Sp = Spotlight; tt = Track, scratch or digging; x = Present

Table F2: Microbats

Common Name	Scientific Name	Status		Anabat Sites	
		NC Act	EPBC Act	AB1	AB2
Chocolate Wattled Bat	*Chalinolobus morio*	LC	NL	◆	◆
Hoary Wattled Bat	*Chalinolobus nigrogriseus*	LC	NL	◆	◆
Little Pied Bat	*Chalinolobus picatus*	LC	NL	◆	◆
Little Broad-nosed Bat	*Scotorepens greyii*	LC	NL	◆	◆
Northern Broad-nosed Bat	*Scotorepens sanborni*	LC	NL	□	□
Inland Forest Bat	*Vespadelus baverstocki*	LC	NL	◆	◆
Troughton's Sheathtail-bat	*Vespadelus troughtoni*	LC	NL	◆	
Eastern Bent-wing Bat	*Miniopterus orianae oceanensis*	LC	NL	◆	◆
Northern Freetail Bat	*Chaerephon jobensis*	LC	NL	◆	◆
Northern Free-tailed Bat	*Ozimops lumsdenae*	LC	NL	◆	◆
Eastern Free-tailed Bat	*Ozimops ridei*	LC	NL	◆	◆
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*	LC	NL	◆	◆

[1] NC Act Status: V = Vulnerable, SLC = Special least concern
♦ = at least one call from the site was attributed unequivocally to the species; □ = calls similar to those of the species were recorded, but could not be reliably identified;

APPENDIX D

Greenhouse Gas Report

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CURRAGH BORD AND PILLAR MINE PROJECT GHG REPORT

Coronado Global Resources

PROJECT NO: A024-1647 **ISSUED**: 24/05/2024

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Disclaimer

The opinions expressed in this report have been based on information provided to Talisman Technical Pty Ltd (Talisman) by the client. The information supplied by the client is, to the best of their knowledge and understanding, complete, accurate, and true. While Talisman has taken all due care in compiling this report, the accuracy of the results and conclusions of this report are dependent on the accuracy and completeness of the supplied data. Talisman does not accept responsibility for any errors or omissions in the provided information and does not accept subsequent liability arising from commercial decisions or actions resulting from any such errors or omissions.

VERSION	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
1.0		Draft report	S Byrom	I Budd	J Joubert

1. Introduction

Talisman Technical Pty. Ltd. was commissioned by Coronado Global Resources Inc (Coronado), to prepare a greenhouse gas (GHG) report as part of the Environmental Assessment Report (EAR) for the Curragh Bord and Pillar Mine Project (the project). The report addresses the GHG information requirements for Environmental Authority (EA) amendment applications specified in the Department of Environment, Science, and Innovation (DESI) *Guideline: Greenhouse gas emissions* (ESR/2024/6819, Version 1, 15 May 2024) (DESI GHG Guideline).

Curragh Mine is a large-scale open cut coal mine located approximately 6 km north of Blackwater township in Central Queensland (Figure 1). The mine has been operating since 1983 and produces export metallurgical and thermal coal. The mine has an approved production rate of up to 18 Mtpa of Run-of-Mine (ROM) coal and utilises dragline and truck and shovel mining methods.



CURRAGH BORD AND PILLAR MINE PROJECT

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Location Plan

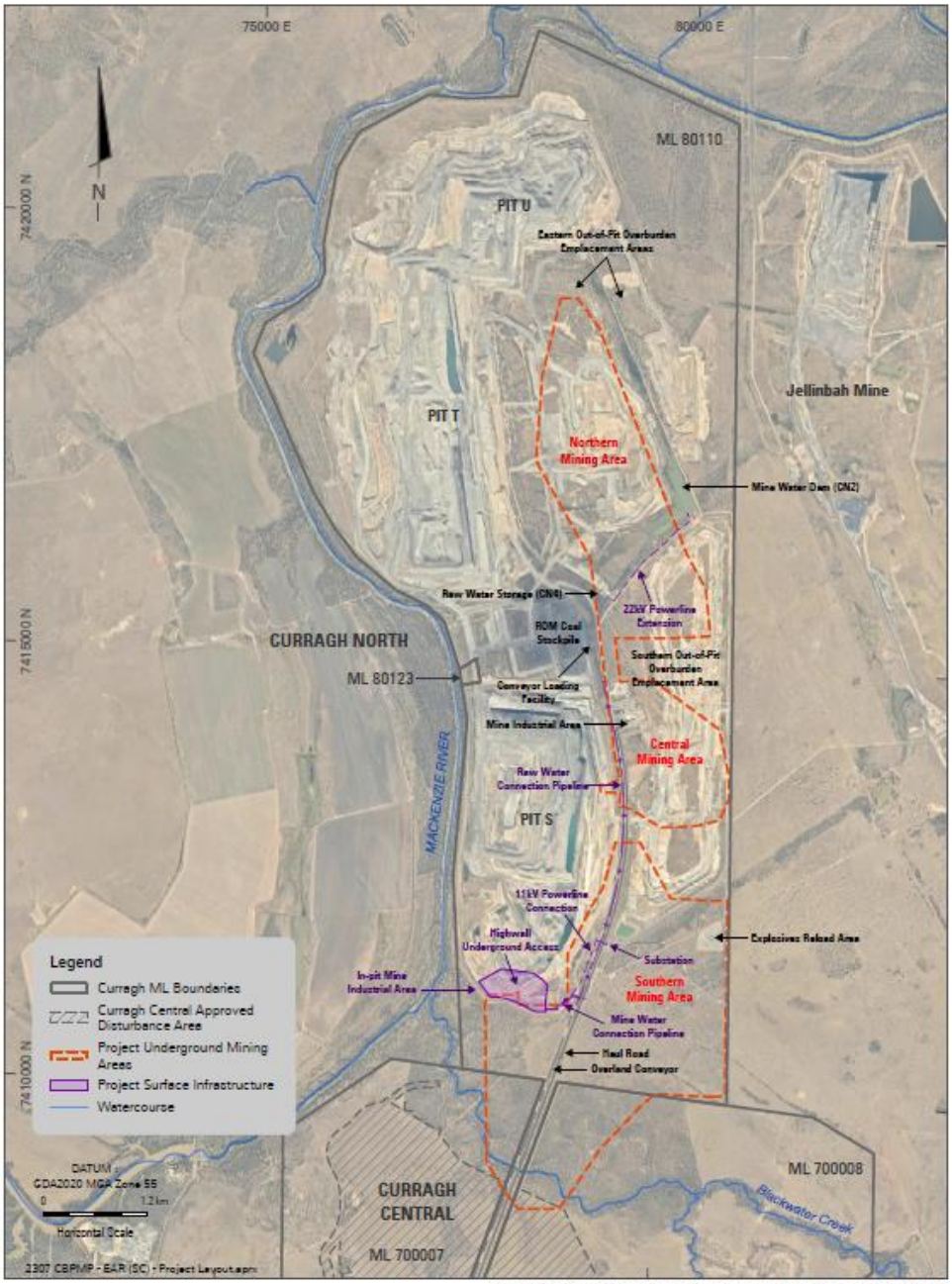
FIGURE 1

Curragh Mine currently has two main operational areas, Curragh South and Curragh North. Curragh South is the original mining area and contains key mine infrastructure including the Coal Handling and Preparation Plant (CHPP), rail loop and train loading facility and Mine Industrial Area (MIA).

Curragh North is located at the northern end of Curragh Mine and commenced operations in 2006. Curragh North includes three open cut pits (Pit S, Pit T and Pit U) and large in-pit and out-of-pit overburden emplacement areas

(Figure 2). There is a transport corridor from Curragh North to Curragh South that includes an overland conveyor and haul road. ROM coal from Curragh North is transported to the CHPP at Curragh South via the overland conveyor. Mine infrastructure at Curragh North includes:

- MIA including a workshop, vehicle servicing facilities, store and administration buildings;
- ROM coal stockpile area and conveyor loading facility; and
- Mine water management infrastructure including raw water supply, mine water dams, flood protection levees, pumps and pipelines.



CURRAGH BORD AND PILLAR MINE PROJECT

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Project Layout

FIGURE 2

The Curragh Central area adjoins the southern end of Curragh North. There are approved open cut mining areas in the Curragh Central area that have not been developed to date. The northern limit of the approved Curragh Central mine disturbance area is shown in Figure 2.

The project involves the development of an underground bord and pillar mine in the Mammoth coal seam accessed from the highwall of Pit S (Figure 2). The proposed underground mining areas are within the existing Curragh North and Curragh Central mining leases. The underground mine will have a mine life of approximately 10 years and a peak production rate of approximately 3.2 Mtpa of ROM coal. The project does not involve an increase in the approved Curragh Mine peak production rate.

The project will utilise existing Curragh Mine infrastructure including:

- Curragh North haul roads and access roads, ROM coal stockpile area, overland conveyor and conveyor loading facility, and power, raw water and mine water supplies.
- Curragh South CHPP, rail loop and train loading facilities, and tailings and rejects storage areas.

New surface infrastructure required for the project will be limited to a MIA located on the pit floor at the southern end of Pit S adjacent to the underground mine portals, and surface connections to existing Curragh North infrastructure for raw water supply, mine water supply and power (Figure 2). The underground mining operations will involve coal seam gas drainage to ensure a safe underground environment. Minor temporary surface gas drainage infrastructure will include gas drainage boreholes and flares.

To address the DESI GHG Guideline requirements for medium to high emitting projects, the report covers the following:

Table 1: DESI GHG Guideline Requirements

GUIDELINE REQUIREMENT	REPORT SECTION
GHG emissions inventory (Scope 1, 2 and 3)	3. Project Emissions
GHG emission mitigation and management practices (including Scope 3 where possible)	4.2. GHG Mitigation and Management
GHG abatement plan	4.3. Project GHG Abatement Plan
A risk assessment that outlines the scale of expected GHG emissions from the activity and how they are expected to contribute to climate change impacts on Queensland's environmental values	5.2. Risk Assessment

2. Regulatory setting

Australia has committed to reducing its greenhouse gas emissions by 43% below 2005 levels by 2030. This target was an update from a previous goal of a 26-28% reduction, aligning more closely with the objectives of the Paris Agreement. Additionally, Australia has set a goal of reaching net-zero emissions by 2050. This long-term target is part of the global effort to limit global warming to well below 2 degrees Celsius, and ideally to 1.5 degrees Celsius, compared to pre-industrial levels. These targets are part of Australia's commitment under international agreements like the Paris Agreement. Queensland has aligned with the target to achieve net zero emissions by 2050, and an interim target of a 30% reduction by 2030.

The National Greenhouse and Energy Reporting Scheme (NGERS) plays a crucial role in Australia's strategy to meet its greenhouse gas emissions reduction targets. Under NGERS, corporations that meet certain thresholds for greenhouse gas emissions, energy production, or energy consumption must report their emissions, energy production, and energy consumption to the Clean Energy Regulator (CER) annually. The thresholds typically include emitting 50kt CO_2-e or more, producing or consuming 200 terajoules or more of energy, or a

combination of both. NGERS provides a framework for the systematic collection, calculation, and reporting of greenhouse gas emissions, energy production, and energy consumption data from Australian corporations. This data is essential for understanding the country's overall emissions profile and tracking progress towards its reduction targets.

The Safeguard Mechanism applies to facilities emitting more than 100,000tCO_2-e greenhouse gases per year. These facilities are required to keep their net emissions within a declining baseline set by the government. If a facility's emissions exceed their baseline, they must take steps to reduce their emissions or offset the excess by purchasing and surrendering eligible emissions units, like Australian carbon credit units (ACCUs). The initial Safeguard period extends to 2030, with a review in 2027 to assess the effectiveness of the structure and set the structure for the proceeding period.

Both these measures are part of Australia's strategy to reduce greenhouse gas emissions and meet its international obligations. The NGERS provides a framework for measuring and reporting emissions, which is critical for understanding the scale of emissions and tracking progress, while the Safeguard Mechanism is designed to ensure that large emitters take responsibility for their emissions and contribute to national emissions reduction efforts. For further information on Curragh Mine's compliance with these two requirements can be found in Section 4.1.

3. Project Emissions

This Project identifies as a medium to high emission category as the GHG emissions are greater than 25,000tCO_2e per year. Potential sources of GHG emissions related to the project have been identified as follows.

Scope 1 Emissions:

- Fossil fuel combustion: Emissions of carbon dioxide (CO_2), nitrous dioxide (N_2O) and methane (CH_4) from the combustion of diesel by stationary and mobile plant and equipment at the mine during construction and operation, and during closure/remediation.
- Fugitive emissions: Emissions from the release of coal bed methane.

Scope 2 Emissions:

- Electricity use: Indirect emissions from the generation of purchased electricity by the mine during construction and operation.

Scope 3 Emissions:

- Coal transport: Transport of product coal to market: consumption of fossil fuels and electricity are required to deliver the product from the mine to the end user.
- Coal combustion: Combustion of coal by end users. The primary intended end users of the product will be based in Asia-Pacific, the Americas and Europe with the coal used for the purposes of steelmaking.
- Production/supply of diesel consumed.
- Electricity transmission losses.

Emission estimation methods and emission factors have been sourced from the following resources:

- **Scope 1 and 2**: from *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (Cth)[1]
- **Scope 3**: the latest National Greenhouse Accounts Factors Workbook[2], applying guidance from the latest Climate Active technical guidance manual to determine which Scope 3 emissions sources must be included on the basis that they are assessed as relevant against the relevance test[3]. Additional methods include the *GHG Protocol Corporate Value Chain.*[4] The accuracy of these estimates is based on material emissions sources associated with the downstream of the coal mining industry. The accuracy of these estimates is based on the following emissions factors. Further assessment is required to provide a more detailed estimation.

The emission factors used in this estimation are as follows:

Table 2: Emissions factors

EMISSION SOURCE	EMISSION FACTOR	UNITS	SOURCE
SCOPE 1			
Diesel combustion – stationary energy	70.20	kg CO_2-e/GJ	National Greenhouse Accounts Factors Workbook 2023
Fugitive gas	-	-	Sourced from gas model
Post mining	0.019	tCO2e/ROMt	NGER Measurement Determination 2008
SCOPE 2			
Consumption of purchased electricity	0.73	kg CO_2-e/kWh	National Greenhouse Accounts Factors Workbook 2023
SCOPE 3			
Production/supply of diesel consumed	17.3	kg CO_2-e/GJ	National Greenhouse Accounts Factors Workbook 2023
Electricity transmission losses	0.15	kg CO_2-e/kWh	National Greenhouse Accounts Factors Workbook 2023
Transport of product coal	-	-	See note ^
Combustion of product (metallurgical)	92.03	kg CO_2-e/GJ	National Greenhouse Accounts Factors Workbook 2023
^ Downstream Scope 3 emissions from the transport of product coal by rail and ship were calculated using the *Mobile Combustion Greenhouse Gas Protocol Transport Calculation Tool*, version 2.6. There are no emission factors available in the NGA Factors for these activities.			

[1] National Greenhouse and Energy Reporting (Measurement) Determination 2008, https://www.legislation.gov.au/Series/F2008L02309

[2] National Greenhouse Accounts Factors (https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-factors

[3] Climate Active, Technical Guidance Manual, https://www.climateactive.org.au/be-climate-active/tools-and-resources/technical-guidance-manual

[4] GHG Protocol, Corporate Value Chain (Scope 3) Standard, https://ghgprotocol.org/standards/scope-3-standard

The LOM emissions estimate for the Project over the underground mine life are as follows:

Table 3: LOM emissions estimate (tCO_2e)

EMISSION SOURCE	LOM EMISSIONS
SCOPE 1	
Diesel combustion – stationary energy	41,042 tCO_2e
Fugitive gas	2,266,924 tCO_2e*
Post mining	400,924 tCO_2e
SCOPE 1 LOM TOTAL	**2,708,890 tCO_2e**
SCOPE 2	
Consumption of purchased electricity	260,236 tCO_2e
SCOPE 2 LOM TOTAL	**260,236 tCO_2e**
SCOPE 1 AND 2 LOM TOTAL	**2,969,126 tCO_2e**
SCOPE 3	
Production/supply of diesel consumed	10,086 tCO_2e
Electricity transmission losses	53,473 tCO_2e
Transport of product coal (rail)	92,177 tCO_2e
Transport of product coal (shipping)	4,445,592 tCO_2e
Combustion of product (metallurgical)	42,997,911 tCO_2e
SCOPE 3 LOM TOTAL	**47,599,238 tCO_2e**
PROJECT LOM TOTAL	**50,568,364 tCO_2e**

* Assumes gas volumes from pre-drainage have been flared. Without flaring, fugitive emissions are approximately 7MtCO_2e across LOM.

Scope 3 emissions represent approximately 94% of total LOM emissions. These emissions are sourced from outside of Australia. The majority of these Scope 3 emissions are:

- Shipping: 8.8%
- Combustion of product (metallurgical): 85%

The average annual emissions across LOM are shown below for the construction phase and the operational phase:

Table 4: Construction phase emissions estimate (tCO_2e)

EMISSION SOURCE	EMISSIONS
CONSTRUCTION	
SCOPE 1	
Diesel combustion – stationary energy	84 tCO_2e
Fugitive gas	295 tCO_2e
Post mining	0 tCO_2e
SCOPE 1 CONSTRUCTION TOTAL	**379 tCO_2e**
SCOPE 2	
Consumption of purchased electricity	808 tCO_2e
SCOPE 2 CONSTRUCTION TOTAL	**808 tCO_2e**
SCOPE 1 AND 2 CONSTRUCTION TOTAL	**1,187 tCO_2e**
SCOPE 3	
Production/supply of diesel consumed	21 tCO_2e
Electricity transmission losses	166 tCO_2e
SCOPE 3 CONSTRUCTION TOTAL	**187 tCO_2e**
CONSTRUCTION TOTAL	**1,374 tCO_2e**

Table 5: Operational annual average emissions estimate (tCO_2e)

EMISSION SOURCE	EMISSIONS
OPERATIONS - ANNUAL AVERAGE	
SCOPE 1	
Diesel combustion – stationary energy	4,551 tCO_2e
Fugitive gas	251,848 tCO_2e
Post mining	44,547 tCO_2e
SCOPE 1 OPERATIONS - ANNUAL AVERAGE TOTAL	**300,946 tCO_2e**
SCOPE 2	
Consumption of purchased electricity	28,825 tCO_2e
SCOPE 2 OPERATIONS - ANNUAL AVERAGE TOTAL	**28,825 tCO_2e**

EMISSION SOURCE	EMISSIONS
SCOPE 1 AND 2 OPERATIONS - ANNUAL AVERAGE TOTAL	**329,771 tCO_2e**
SCOPE 3	
Production/supply of diesel consumed	1,118 tCO_2e
Electricity transmission losses	5,923 tCO_2e
Transport of product coal (rail)	10,242 tCO_2e
Transport of product coal (shipping)	493,955 tCO_2e
Combustion of product (metallurgical)	4,777,546 tCO_2e
SCOPE 3 OPERATIONS - ANNUAL AVERAGE TOTAL	**5,288,783 tCO_2e**
OPERATIONS - ANNUAL AVERAGE TOTAL	**5,618,554 tCO_2e**

4. GHG Management and Reporting

4.1 Reporting

NGERS

Coronado Australia Holdings (CAH) Pty Ltd is the parent entity and has operational control over the Curragh Mine, for the purpose of reporting against the National Greenhouse and Energy Report Scheme (NGERS).

CAH submits a NGERS report each year as the operation is above the facility threshold. Curragh Mine reports their Scope 1 and Scope 2 emissions and energy production and consumption data to the Clean Energy Regulator (CER) under section 19 of the *National Greenhouse and Energy Reporting Act 2007* (NGER Act). CAH reports the emissions and energy for the Curragh Mine through the Emissions and Energy Reporting System (EERS).

Records are maintained by CAH to enable the CER to ascertain whether the corporation has complied with obligations under the NGER Act. This includes information that can be used to verify the relevance, completeness, consistency, transparency, and accuracy of reported data during an external audit.

For the period 1 July 2022 to 30 June 2023, the "Energy and Emissions Report", in compliance with Section 19 of the NGER Act was subject to reasonable assurance through an independent external auditor.

The project will be incorporated into the established Curragh Mine reporting, record keeping and external assurance processes.

Safeguard Mechanism

The Safeguard Mechanism applies to facilities who report through NGERs more than 100,000 tCO_2e each year. CAH is the responsible emitter with operational control over the Curragh Mine facility for the purpose of reporting against the Safeguard Mechanism.

Following the Safeguard Mechanism reform in 2023, new obligations and reporting requirements now apply to Curragh Mine as a Safeguard facility from 1 July 2023.

The Safeguard Mechanism is aimed at reducing greenhouse gas emissions from large industrial facilities through setting limits, or baselines, on the quantity of annual emissions these facilities can produce.

The reformed Safeguard Mechanism means the Curragh Mine Safeguard baseline will adjust with annual production (Run-of-Mine Coal Production Variable) and be subject to a decline rate of 4.9% each year to 2030.

As per the previous Safeguard Mechanism set-up, if a facility is above the baseline, there are several options to manage this, including pre-existing options such as the purchase and surrender of Australian Carbon Credit Units (ACCUs) or entering multi-year monitoring periods. New options also include purchasing and surrendering Safeguard Mechanism Credits (SMCs) or applying to borrow baseline from the previous year. At the close of 2023, Coronado established accounts with several brokers and financial institutions, for purchasing small volumes of ACCUs as part of project readiness.

The modified Safeguard Mechanism has continued to be considered in the Curragh Mine emissions reduction approach.

4.2 GHG Mitigation and Management

For medium to high emission category projects, a GHG Abatement Plan is required. This plan must identify and report against the GHG emission reduction measures that will be implemented to achieve emission reductions required by the Commonwealth Safeguard Mechanism and associated baseline, and be consistent with the Queensland emission reduction targets.

The requirement to develop a GHG Abatement Plan is a relatively new concept which requires the appropriate analysis and study to progress. There are a number of studies currently underway across the broader Curragh Mine facility, including a trial of CNG trucks at the Curragh Open Cut Mine. These studies and trials are anticipated to conclude within approximately 12 – 36 months. As the Curragh Mine is a Safeguard facility which includes both the underground and open cut mines, the studies process that is currently underway is a holistic process to ensure the most cost-effective abatement is achieved across the facility. The detail of the ongoing studies related directly to the underground project can be seen in Table 6 below.

To mitigate and manage the GHG emissions associated with the Project, the following practices have been assessed:

- Gas drainage with power generation
- Gas drainage with compressed natural gas (CNG) conversion for use in retrofit haul trucks
- Gas drainage with liquified natural gas (LNG) conversion for offtake
- Optimised gas drainage with CNG conversion for use in retrofit haul trucks
- Optimised sealing of underground areas

Proposed management practices need to demonstrate that all reasonable and practical measures have been applied to manage GHG emissions through best practice design, process, technology, and management following the GHG abatement hierarchy (Figure 1).

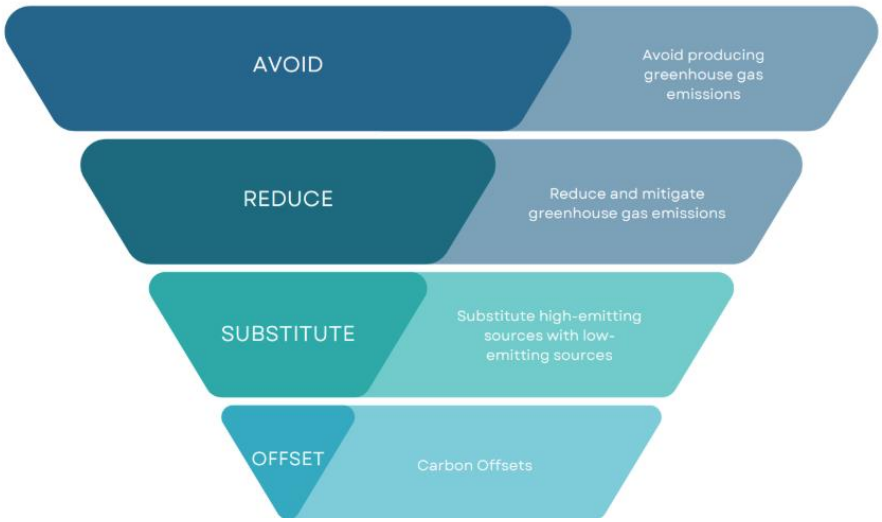


Figure 1: GHG abatement hierarchy

The mitigation and management practices explored for the Project can be categorised as a reduction methodology according to the GHG abatement hierarchy, as well as incorporating the necessary ACCUs (offsets) to meet any potential gap in Safeguard compliance. The majority of scope 1 and 2 emissions for the Project are sourced from fugitive emissions, as coal seams naturally contain methane which is released during or after the mining process. Fugitive emissions are emitted via three sources – pre-drainage, which in this scenario are flared as a base case, from the ventilation stack, and from post mining sources. As fugitive emissions are an inherent part of the coal mining process, it is not reasonable or practical to avoid or substitute these emissions.

To influence the reduction of Scope 3 emissions, CAH is a member of LETA, the industry body for the coal mining sector. Since 2006, Australia's black coal producers have committed $550 million through LETA to identify, research, and develop technologies that can reduce emissions associated with coal-fired power generation and steel production, including carbon capture and storage, and advanced coal-fired power generation technologies. LETA also focus attention on reducing emissions from black coal operations, including ventilation air methane abatement.

4.3 Project GHG Abatement Plan

Emissions from fugitive sources represent approximately 98% of Scope 1 emissions across LOM (Safeguard-covered emissions), and approximately 91% of emissions from Scope 1 and 2 across LOM. As a result, emissions reductions from fugitive sources represent the biggest opportunity to decarbonise the Project.

To develop the GHG abatement plan, scenarios for emission reduction were developed (see Table 6). While there are multiple scenarios assessed for fugitive emissions reduction, it is important to note that they are all utilising the same gas, i.e., only one abatement practice can be progressed. By redirecting the drained gas from flares to another technology, the emissions reductions do not increase. However, by utilising the gas as a resource, there is an offset in emissions from another source, such as electricity.

To address the DESI GHG Guideline requirements for medium to high emitting projects, a project specific GHG abatement plan can be seen in Table 6.

The current process to develop the Curragh Mine abatement plan follows a technical studies pathway. A concept level study has been completed that resulted in marginal abatement cost curves, a prioritisation tool that assesses emission reduction measures based on total abatement achieve on a per tCO_2e basis. This process has been completed for both open cut and underground mines. The next step is to develop a cohesive decarbonisation pathway across the whole facility.

Table 6: Project GHG Abatement Plan

Requirement	Description
a) Project details	Curragh Bord and Pillar Mine Project
b) Emissions projections and commencing abatement measures	See Table 3, Table 4, and Table 5 for emissions projections for the project. This abatement plan is still at the concept level and require further study to determine the pathway forward. Understanding the abatement measures is difficult to quantify until a strategic direction for the fugitive gas utilisation can be determined. During the concept level assessment, the following scenarios were assessed: **Gas drainage + power generation + flare** The power solution modelled in this scenario is the Jenbacher containerised "ready-to-use" power plants. The gas engine has a power output of up to 3,360 kW and electrical efficiency up to 45.9% when utilising coal mine methane. Each engine requires a gas flow rate of 207 l/s. Five Jenbacher engines have been used to model this scenario at a total of 16.8 MW installed capacity. The average power generation from these units 123GWh per year. Electricity consumption accounts for approximately 8% of overall LOM emissions. **Gas drainage + CNG conversion** Compressed natural gas (CNG) is currently being assessed in the Queensland coal mining industry as an option to reduce diesel emissions. The CNG truck conversion technology is currently provided by Mine Energy Solutions, who provide retrofits to all major original equipment manufacturer (OEMs). Haul trucks can be retrofitted with the CNG dual fuel technology and engine technology to enable the dual injection of CNG and diesel. Coronado are currently undertaking a trial of CNG trucks at the Curragh Open Cut Mine. This scenario produces CNG to feed into this truck trial, which could displace diesel emissions for the Curragh Open Cut Mine. **Gas drainage + LNG conversion** The conversion of coal mine methane to LNG via a micro-LNG plant involves several steps. Once methane is captured through pre-drainage, it is then purified. Gas purification removes impurities such as carbon dioxide, nitrogen, and water vapor from the captured methane to meet LNG specifications. In the liquefaction process, purified methane gas is cooled to approximately -162°C to convert it into liquid form (LNG), using cryogenic cooling techniques. The LNG is then stored in cryogenic tanks preparing it for transportation, leveraging the reduced volume for efficient distribution. This scenario is converting the coal mine methane to LNG for offtake.

	Optimised gas drainage + CNG conversion This scenario is built on the assumption that gas drainage can be increased to recover 93.1% across LOM of fugitive gas volumes. This is based on draining the underground workings to $2m^3/t$ – beyond the safety threshold of $4m^3/t$. This allows us to gain 11.5% more gas from the underground, increasing the overall emissions reduction potential of this scenario. **Optimised sealing** Following gas drainage, the remaining emissions from underground coal mines are in the form of ventilation air methane (VAM). These emissions tend to be in low methane concentrations. As mines progress and more areas are sealed, increased proportions and volumes of the gas reporting to the vent stack are sourced from sealed areas. To mitigate this, pressure balancing of seals to reduce the volume of gas that can escape around a seal through the strata is required. Sealed emissions account for approximately 5% of overall LOM emissions.
c) GHG emissions reference point	As this project is captured by the Commonwealth Safeguard Mechanism as part of a larger facility, the reference point is determined by the Safeguard Mechanism.
d) Emission reduction targets	As this project is captured by the Commonwealth Safeguard Mechanism as part of a larger facility, the emission reduction targets are determined by the Safeguard Mechanism. These targets are reported in the Coronado Sustainability Report.
e) GHG emission reduction program	As the project is a part of a larger facility under the Safeguard Mechanism, the emissions reduction program for the underground needs to be incorporated into the overall facility to determine the optimal pathway for reducing emissions across the entire operation. To date, both the open cut operations and underground project have completed an assessment of abatement scenarios and developed marginal abatement cost curves. The next step is to bring together the marginal abatement cost curves for the open cut operation and underground project to determine the facility-level abatement plan. Coronado is currently finalising assessments on the most cost-effective forms of abatement to go forwards to feasibility studies and potential trials.
f) Advancing technologies and opportunities	As part of the Curragh Mine GHG abatement plan that is under development, provisions for regularly reviewing new technologies to identify opportunities to further reduce emissions and energy efficiency will be incorporated.
g) Monitoring and auditing	The program for monitoring GHG emissions and auditing against GHG emission reduction targets will be incorporated into the established Curragh Mine NGERs monitoring and external assurance processes.

h) Reporting	The program for monitoring GHG emissions and auditing against GHG emission reduction targets will be incorporated into the established Curragh Mine NGERs reporting processes.

5. Potential Impacts of GHG Emissions on Environmental Values

The GHG emissions intensity of the Project, assuming that pre-drained gas will be flared at a minimum, results in a LOM emissions intensity of 0.17tCO_2e/ROMt. The industry average emissions intensity as defined in the Safeguard Mechanism by the Clean Energy Regulator is 0.0653tCO_2e/ROMt. However, when analysing publicly available Safeguard facility data, the industry average emissions intensity is 0.116 tCO_2e/ROMt and the industry median is 0.06tCO_2e/ROMt. Underground coal mines typically have higher GHG emissions intensities than open cut mines as the gas content of coal generally increases with depth. The industry average of Safeguard-covered underground coal mine facilities is approximately 0.28tCO_2e/ROMt. While the Project is higher than the industry average for all coal mines, it is lower than the industry average for underground coal mines (see Figure 2). Figure 2 includes both thermal and metallurgical coal mines.

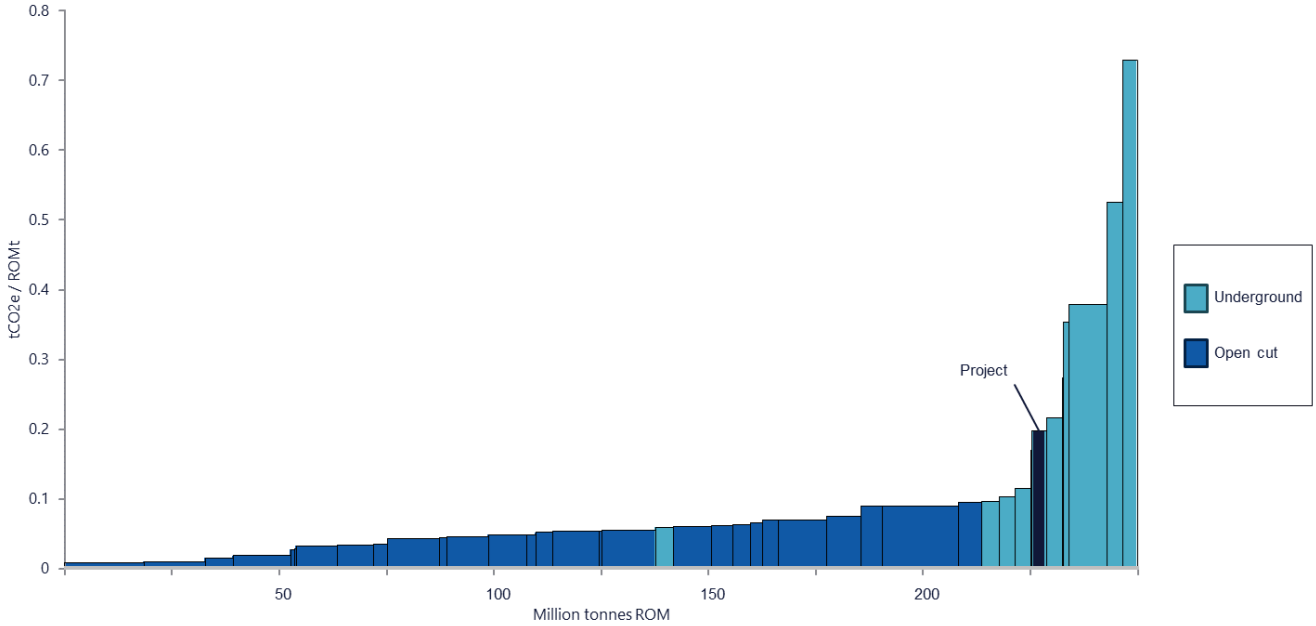


Figure 2: Emissions intensity curve of Safeguard facilities (tCO_2e/ROMt)

The Project will produce metallurgical coal, an essential product in steel production. Global demand for steel has been increasing in recent years due to population and economic growth, and it is expected to continue rising, particularly due to economic expansion in India and other ASEAN countries.[5]

The Queensland Treasury states that metallurgical coal has a "critical role in producing the steel for the renewable technologies we need to decarbonise our state".[6] Wind turbines, solar farms, and hydroelectric dams are all steel-intensive infrastructure that underpin renewable energy generation. It is also 100 percent recyclable, making it a

[5] International Energy Agency, Steel, https://www.iea.org/energy-system/industry/steel

[6] Queensland Treasury, Low Emissions Investment Partnership, https://www.treasury.qld.gov.au/investment/investment-programs-and-support/low-emissions-investment-partnerships/

uniquely sustainable material. CAH produces a variety of high quality low-ash metallurgical coal products which are exported globally to a diverse customer base of leading steelmakers.

CAH exports the majority of its metallurgical coal to steel producers in Japan and India. The export and combustion of metallurgical coal represents the majority of material Scope 3 emissions, and approximately 94% of total LOM emissions. While it is difficult to control, and therefore mitigate, emissions associated with Scope 3, each of the export countries have Nationally Determined Contributions in place under the Paris Agreement. Japan aims to reduce its greenhouse gas emissions by 46% in 2030 from 2013 levels, setting an ambitious target which is aligned with the long-term goal of achieving net-zero by 2050.[7] As India is a developing country, there are different responsibilities under the Paris Agreement that apply. India has committed to an emissions intensity target as opposed to an absolute target, aiming to reduce the emissions intensity of its GDP by 45% by 2030 from 2005 levels, among other sustainability targets.[8]

5.1 Comparison of Estimated Project Emissions

Australia's net GHG emissions estimates for the inventory used to track Australia's progress towards its Paris Agreement targets in 2021-22 totalled 432.6 $MtCO_2e$.[9] The reported 2021 total GHG emissions in Queensland of 124.09 $MtCO_2e$ accounted for 30% of national GHG emissions.

The contributions of the predicted annual Scope 1, 2 and 3 emissions resulting from the Project within Australia are provided in Table 7. This comparison indicates that the annual average emissions are an insignificant proportion of both the Australian and Queensland total emissions, accounting for 0.08% and approximately 0.28% of these, respectively.

Table 7: Project annual average emissions compared with annual emissions for Australia and Queensland (Scope 1, 2 and 3 within Australia)

	Australia	QLD	Project (Within Australia)
2021-22 ($MtCO_2e$)	432.6	124.09	**0.35 $MtCO_2e$**
Project - Annual Average	0.08%	0.28%	

The annual global GHG emissions in 2020 emissions totalled 47,513 $MtCO_2e$ according to the United Nations Environment Programme[10].

The contributions of the predicted annual Scope 1, 2 and 3 emissions resulting from the Project within and outside of Australia are provided in Table 8. This comparison indicates that the Project would account for approximately 0.0097% of the annual global emissions.

[7] Climate Watch, Japan - Summary of Updated First Nationally Determined Contribution, https://www.climatewatchdata.org/ndcs/country/JPN?document=revised_first_ndc

[8] Climate Watch, India - Summary of Updated First Nationally Determined Contribution, https://www.climatewatchdata.org/ndcs/country/IND?document=revised_first_ndc

[9] DCCEEW, National Inventory Report 2022, https://www.dcceew.gov.au/climate-change/publications/national-inventory-report-2022

[10] ENEP, Emissions Gap Report 2023, https://www.unep.org/interactives/emissions-gap-report/2023/#section_0

Table 8: Project annual average emissions compared with annual global emissions (Scope 1, 2 and 3 worldwide)

	World	Project (Global)
2022 ($MtCO_2e$)	57,400	**5.56 $MtCO_2e$**
Project - Annual Average	0.0097%	

5.2 Risk Assessment

The IPCC has identified that human-induced climate change is already affecting weather and climate extremes across the globe and that "continued emission of GHGs will cause further warming and long-lasting changes in all components of the climate system. Increasing the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems".[11] In Queensland, average temperatures across the state are currently 1°C higher than they were 100 years ago. While it is difficult to determine the likelihood and magnitude of impacts to environmental values from an individual project's GHG emissions, it is recognised that any increases in net GHG emissions may also increase the risks, and the larger the relative scale of net GHG emissions, the more significant the contribution may be.

As seen in Table 7, the contribution of emissions from the project when compared with Queensland's emissions profile represents 0.28%. While this is an insignificant proportion of Queensland's total emissions, it is noted that CAH, as a Safeguard covered facility, will reduce emissions in line with the legislation. As per the Queensland Regional Climate Change Impact Studies,[12] the Bowen Basin region is likely to see higher temperatures, hotter and more frequent hot days, more intense downpours, less frequent but more intense tropical cyclones, rising sea level more frequent sea-level extremes, and warmer and more acidic seas.

The project emissions represent 0.28% of Queensland's emissions and 0.08% of Australia's emissions. This increase is statically insignificant. Hence from a risk perspective, the project's GHG emissions will not increase the likelihood and magnitude of impacts to environmental values, nor increase the risk of climate change-related events. As outlined in Section 5 above, on a global perspective, the customers of this metallurgical coal have NDCs in place to decarbonise their own jurisdictions. The need for steel to decarbonise other sectors, such as the renewable energy sector, along with the Safeguard-led decarbonisation of the Curragh Mine, will further contribute to limiting the effect of the project emissions on climate change. The risk rating is therefore D1, insignificant consequence, unlikely likelihood, as per the Coronado Risk Matrix (Figure 3).

[11] ICPP, Climate Change 2014 Synthesis Report Fifth Assessment Report, https://ar5-syr.ipcc.ch/topic_futurechanges.php

[12] Department of Energy and Climate, Climate Change in the Whitsunday, Hinterland and Mackay region 2024, https://www.qld.gov.au/__data/assets/pdf_file/0026/68561/mackay-whitsunday-climate-change-impact-summary.pdf

6. RISK MATRIX - SMS-001A Risk Management Levels & Guidelines

	CONSEQUENCE				
Loss Type	**1 Insignificant**	**2 Minor**	**3 Moderate**	**4 Major**	**5 Catastrophic**
People (STAR, JSA and above)	Low-level short-term subjective inconvenience or symptoms. Includes First Aid Cases.	Objective but reversible impairment. Includes Medical Treatment Cases.	Moderate irreversible disability or impairment to one or one or more persons. Includes Lost Time Injury.	Permanent total disabilities or impairment. Single fatality.	Short- or long-term health effects leading to multiple fatalities, or irreversible human health effects to multiple persons.
Environmental and Cultural Heritage (STAR, JSA and above)	No lasting effect. Rectified by immediate corrective action. Technical non-compliance. Low level social or cultural impacts.	Minor incident, no significant impact. Monitoring result not in compliance, community complaint. Minor medium-term social impacts on social population.	Significant environmental incident, large spill, off-site discharge. Ongoing social issues. Significant damage or infringement to structures or items of cultural significance.	Major impact to surrounding environment. Ongoing serious social issues. Significant damage or infringement to structures or items of cultural significance. Disregard of cultural heritage.	Very serious widespread environmental / social impacts. Irreparable damage to highly valued structures / items or cultural significance. Highly offensive infringement of cultural heritage.
Reputation (WRAC and above)	Public concern restricted to local complaints. Ongoing scrutiny from regulator.	Minor, adverse local public or media attention and complaints. Significant hardship from Regulator.	Attention from media and or heightened concern by local community. Significant difficulties in gaining approvals. Environment credentials moderately affected.	Significant adverse national media or public attention. May lose license to operate or not gain approval.	Serious public or media outcry (international coverage). License to operate threatened. Reputation severely tarnished.
Materials, Assets and Business Operations (WRAC and above)	Slight damage. <$999 No disruption to operation	Minor damage. $1,000 - $24,999. Brief disruption to operation.	Local damage. $25,000 - $99,000. Partial shutdown.	Major damage. $100,000 - $5M Partial loss of operation.	Extreme damage. >$5M. Substantial or total loss of operation.

LIKELIHOOD	**(use only as guide)**	**Risk Rating**				
A - Almost Certain	The event is expected to occur in most circumstances	**Medium**	**High**	**High**	**Very High**	**Very High**
B - Likely	The event will probably occur in most circumstances	**Medium**	**Medium**	**High**	**High**	**Very High**
C - Possible	The event should occur at some time	**Low**	**Medium**	**High**	**High**	**High**
D - Unlikely	The event could occur at some time	**Low**	**Low**	**Medium**	**High**	**High**
E - Rare	The event may occur in exceptional circumstances	**Low**	**Low**	**Medium**	**Medium**	**High**

Risk Level	**Risk Tolerability Criteria and Action Requirements**		
Very High	SSE		The activity must be stopped immediately until action to reduce the level of risk is undertaken or authority to continue is received.
High	Risk must be managed in line with the ALARA Principles	Superintendent or above	The activity must be stopped immediately until action to reduce the level of risk is undertaken or authority to continue is received.
Medium		Supervisor or above	Take action to reduce the level of risk if possible or can authorise tolerations.
Low	Supervisor or above		Tolerable risk unless circumstances change.

Figure 3: Coronado Risk Matrix