Progressive Rehabilitation and Closure Plan

Curragh Mine

Version 3.0

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1 Introduction

Under the Environmental Protection Act 1994 (EP Act), all mining operations undertaken under a site-specific environmental authority (EA) are required to prepare and submit a Progressive Rehabilitation and Closure Plan (PRCP) to the Department of Environment, Tourism, Science and Innovation (DESTI). The PRCP forms a central component of Queensland's rehabilitation framework and ensures that mining activities are planned, designed and undertaken in a manner that maximises progressive rehabilitation throughout the life of the operation. The framework also establishes the final condition to which all land disturbed by mining must be rehabilitated before surrender of the EA can be considered.

This PRCP has been prepared in accordance with the transition notice issued to Coronado Curragh Pty Ltd (CCPL) under section 754 of the EP Act. The plan satisfies the statutory requirements of sections 126C and 126D and has been developed in alignment with the Progressive Rehabilitation and Closure Plans Guideline (ESR/2019/4964).

The PRCP comprises two core components:

- The rehabilitation planning part, which is not a legislated document but outlines, at a conceptual level, how rehabilitation will be planned, sequenced and managed over the life of the mine. The rehabilitation planning part provides strategic guidance only; operational details are expected to evolve in response to mine planning, environmental conditions and emerging technical information.
- The approved PRCP schedule, which is the binding, enforceable component of the PRCP. The schedule establishes the specific rehabilitation outcomes, milestone criteria and timeframes that CCPL must achieve to demonstrate progressive rehabilitation and ultimately meet the requirements for EA surrender. The EP Act provides statutory mechanisms for amending the PRCP schedule where necessary to reflect operational changes or improved technical understanding.

Together, these components articulate the complete rehabilitation framework for the Curragh Complex, including the optimisation of the final landform to meet PRCP requirements, the post-mining land use strategy, the integration of rehabilitation with operational sequencing, and the milestone criteria that demonstrate achievement of a long-term safe and stable condition.

The PRCP applies to all mining-related disturbance within the approved EA footprint and has been developed to complement—not duplicate—the operational compliance requirements of EA EPML00643713. Whereas the EA regulates how mining activities must be undertaken to ensure environmental compliance during operations, the PRCP defines the closure outcomes that must be achieved before the EA can be surrendered. The PRCP also supports transparency and accuracy in rehabilitation liability consistent with the Financial Provisioning Scheme (FPS) introduced under the MERFP Act.

The PRCP has been informed by site-specific geotechnical, hydrological, ecological and operational data to ensure that the proposed final landform and post-mining land uses are technically achievable, environmentally appropriate and reflective of contemporary rehabilitation expectations for the Curragh Complex.

1.1 Relevant Legislation and Policies

1.1.1 Mined Land Rehabilitation Policy

The Mined Land Rehabilitation Policy is a whole-of-government policy jointly prepared by DESTI, the former Department of Natural Resources and Mines (DNRM), and Queensland Treasury. It establishes the Queensland Government's position on mined land rehabilitation and provided the foundation for the reforms introduced through the Mineral and Energy Resources (Financial Provisioning) Act 2018 (MERFP Act), which commenced on 1 April 2019. The subsequent introduction of the PRCP framework and associated EP Act obligations on 1 November 2019 strengthened the regulatory focus on progressive and outcome-based rehabilitation.

The Policy sets out the principle that land disturbed by mining is considered rehabilitated when it can be demonstrated to be safe, stable, non-polluting, and capable of sustaining the approved Post-Mining Land Use (PMLU)—a condition referred to as stable condition. The Policy also recognises that, in specific circumstances, certain areas may not feasibly or safely support a PMLU. In these cases, an area may be designated as a Non-Use Management Area (NUMA) where best-practice management is demonstrated and where rehabilitating the land would either pose a greater environmental risk, or the environmental risks are localised and the rehabilitation cost would be so disproportionate that it would not be in the public interest.

The Policy further establishes a targeted prohibition on final voids located wholly or partly within a floodplain, reflecting the Government's position that voids in these locations pose unacceptable long-term risks to public safety, downstream landholders and environmental values. This prohibition is embedded in the PRCP framework through the 2019 EP Act amendments.

1.1.2 Environmental Protection Act 1994

Amendments to the Environmental Protection Act 1994 commencing on 1 November 2019 introduced the requirement for all site-specific mining operations to prepare a PRCP. The Act prescribes the mandatory content requirements for the rehabilitation planning part and PRCP schedule, and outlines the statutory process for the assessment and approval of a proposed PRCP.

The EP Act also contains transitional provisions for existing mining operations. These provisions enable DESTI to issue transition notices requiring the submission of a proposed PRCP by a specified date and allow existing approvals to be translated into a proposed PRCP without additional assessment or public notification. This ensures a clear and efficient transition to the PRCP framework.

Final voids that were previously approved under a Land Outcome Document (LoD) retain their approval status and are expressly exempt from both the prohibition on final voids located in a floodplain and the requirement to undertake a public interest evaluation for a NUMA.

1.1.3 Environmental Protection Regulation 2019

The Environmental Protection Regulation 2019 (EP Regulation) provides the supporting detail necessary to implement the PRCP framework. Schedule 8A sets out the objectives and performance outcomes that must be considered by the administering authority when deciding a proposed PRCP. These include criteria relating to the achievement of stable condition, suitability of the proposed PMLUs, and environmental risk management.

The EP Regulation also prescribes the method for identifying the extent of a floodplain for the purpose of applying the final void prohibition, defining a 0.1% Annual Exceedance Probability (AEP) flood event as the benchmark for determining floodplain boundaries.

1.1.4 PRCP Guideline

The Environmental Protection Regulation 2019 (EP Regulation) provides the supporting detail necessary to implement the PRCP framework. Schedule 8A sets out the objectives and performance outcomes that must be considered by the administering authority when deciding a proposed PRCP. These include criteria relating to the achievement of stable condition, suitability of the proposed PMLUs, and environmental risk management.

The EP Regulation also prescribes the method for identifying the extent of a floodplain for the purpose of applying the final void prohibition, defining a 0.1% Annual Exceedance Probability (AEP) flood event as the benchmark for determining floodplain boundaries.

Collectively, these legislative instruments form the statutory framework for the Curragh PRCP. This PRCP has been developed to fully comply with these requirements and to clearly demonstrate how CCPL will achieve progressive rehabilitation, stable condition, and the closure outcomes required for EA surrender.

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2 A: Rehabilitation Planning

3 Project Planning

3.1 Project Description

Mining commenced at the Curragh Complex in 1983, initially supplying thermal coal to domestic power stations. The export of hard coking coal to international steelmakers commenced in 1984 following the construction and commissioning of the CHPP.
Ownership and management of the site has transitioned over time:

- 1983–2000: Operated by ARCO and Mitsui.
- 2000–2018: Managed by Wesfarmers Curragh Pty Ltd.
- 2018–present: Acquired by Coronado Global Resources Inc., with Curragh Coal Pty Ltd (CCPL)—a wholly owned subsidiary of Coronado—holding ownership and operational responsibility.

CCPL is the current holder of Environmental Authority EPML00643713 and all associated Mining Leases.

3.1.1 Geographic Location

The Curragh Complex is an established metallurgical and thermal coal mining operation located within the Central Highlands Regional Council area of Central Queensland. The site is situated approximately 6 kilometres north of the township of Blackwater and about 200 kilometres west of Rockhampton by road (Figure 1).

The Complex covers approximately 19,650 hectares and comprises multiple granted Mining Leases. It is operated as an integrated mining complex incorporating open-cut and underground mining operations, coal handling and preparation facilities (CHPP), and extensive supporting infrastructure. The operation supplies both domestic and export coal markets, with metallurgical coal representing the primary product stream.

Mining at the Curragh Complex commenced in 1983 and the site is recognised as one of the long-life coal assets of the Bowen Basin. The operation benefits from direct access to rail infrastructure, linking the site to the Port of Gladstone and other export terminals, ensuring reliable supply to key international customers.
Progressive rehabilitation and closure planning for the Complex has been prepared in accordance with the requirements of the Environmental Protection Act 1994 (Qld), the Progressive Rehabilitation and Closure Plan (PRCP) Guideline (ESR/2019/4964), and Environmental Authority EPML00643713. The PRCP provides the framework for achieving safe, stable, and sustainable final landforms that are consistent with approved Post-Mining Land Use (PMLU)s (PMLUs).

The Complex includes a combination of active and decommissioned mining areas, tailings storage facilities, water management infrastructure, and non-use management areas (NUMAs). The PRCP identifies the proposed final land use outcomes for each domain and outlines milestone criteria to guide rehabilitation and closure activities across the life of mine.

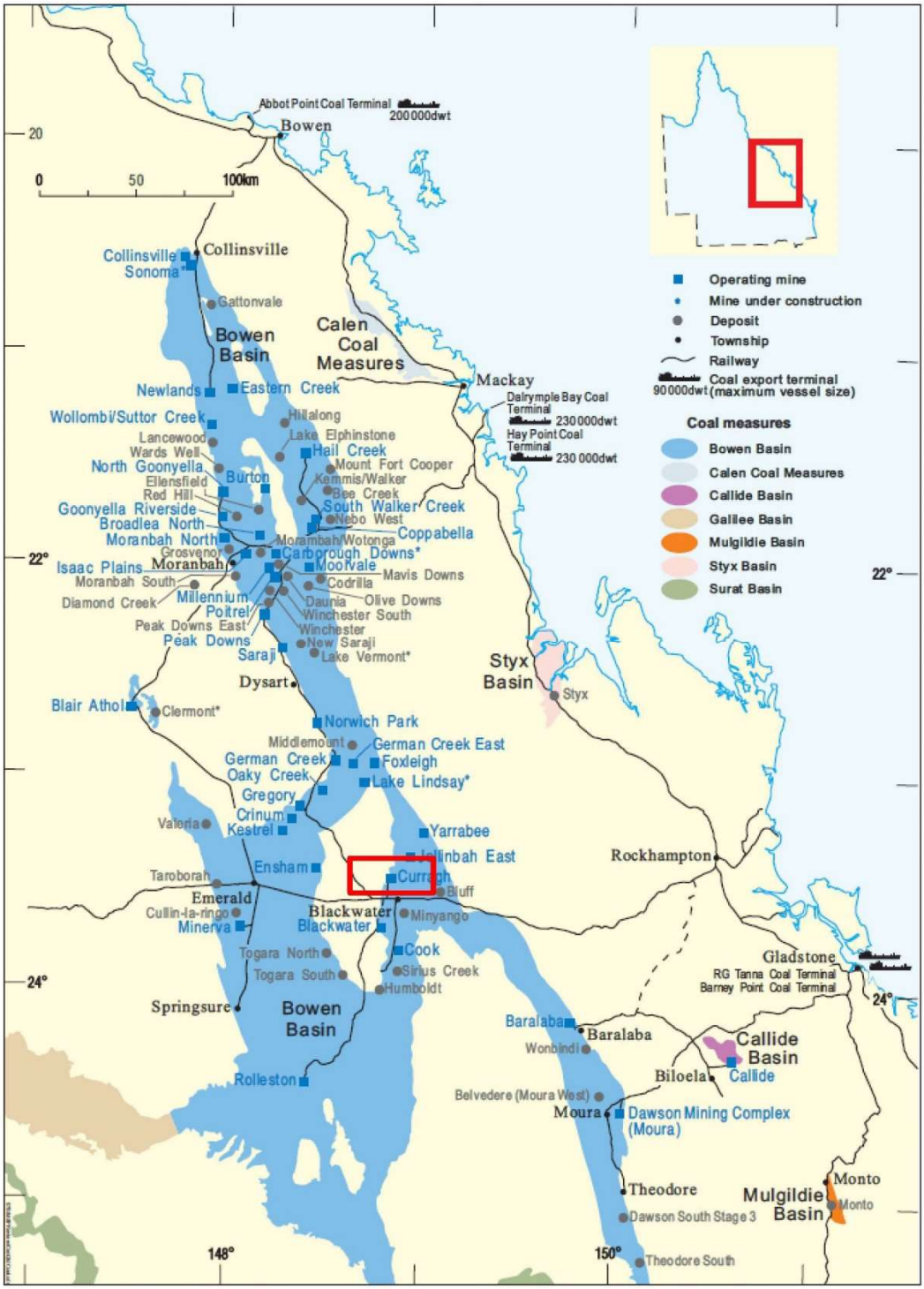

Figure 1: Curragh Complex Regional Locality

3.1.2 Mining Tenements

The Curragh Complex comprises multiple Mining Leases (MLs) across distinct project areas. These are summarised in Table 1 and illustrated in Figure 2 Together, the leases cover the operational mining footprint and associated infrastructure, supporting both open-cut and underground mining activities.
The Mining Leases are grouped as follows:

- Curragh Main – ML1878, ML1990, ML80010, ML80011, ML80012, ML80112
- Curragh East – ML80086
- Curragh North – ML80110, ML80123
- Curragh West – ML80171
- Curragh South – ML700006
- Curragh Expansion Project (CEP) – ML700007, ML700008, ML700009
- Mammoth Underground Mine – ML80110, ML700007 (operations commenced 2024)

These tenures also encompass the site's key processing, transport, and support infrastructure, including the CHPP, overland conveyor systems, haul roads, workshops, laydown yards, accommodation facilities, and water management infrastructure.

Tenures	Project Area	Tenure Area (ha)	Date Granted	Prescribed Purpose
ML1878	Curragh Main	4,456	27/05/1982	Loading facilities, railway, temporary accommodation
ML1990	Curragh Main	173	30/07/1992	Not Applicable
ML80010	Curragh Main – Ext. No. 1	25	30/07/1992	Environmental dam, pipeline (water only)
ML80011	Curragh Main – Ext. No. 2	6.14	30/07/1992	Environmental dam, pipeline (water only)
ML80012	Curragh Main – Ext. No. 3	43	30/07/1992	Pipeline (water/slurry), tailings/settling dam
ML80086	Curragh East	3,033	19/10/2000	Not Applicable
ML80110	Curragh North	4,860	22/07/2004	Environmental buffer, environmental dam, road/access/right-of-way, stockpile ore/overburden, transport/conveyor/vehicular, water management, workshop/machinery/storage
ML80112	Curragh Main – TL218070	111	09/09/2004	Conveyor belt, transport (vehicular/haul road), treatment plant/mill site
ML80123	Curragh North	4,901.6	26/07/2007	Environmental buffer, environmental dam, stockpile ore/overburden, water supply
ML80171	Curragh West	954	15/07/2015	Not Applicable
ML700006	Curragh South	1,432	27/06/2016	Not Applicable

Table 1: Curragh Complex Mining Tenements

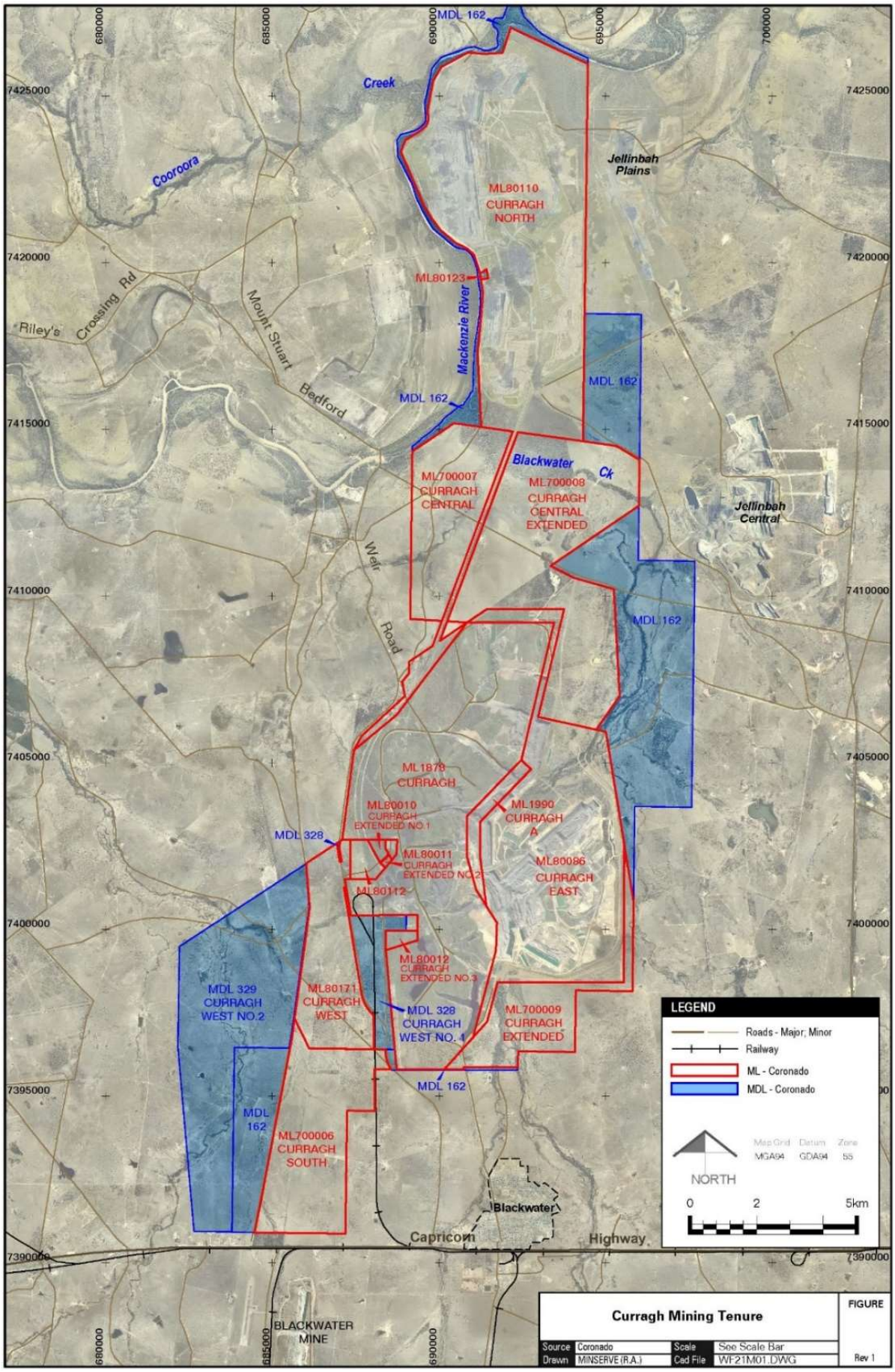

Figure 2: Curragh Complex Mining Tenure

3.1.3 Primary Mine Features and Infrastructure

The Curragh Complex is a large-scale open-cut coal mining operation that has developed progressively across several distinct mining areas over more than four decades. The site comprises a combination of active extraction areas, completed extraction voids, in-pit backfilling zones and engineered out-of-pit spoil dumps, together forming the operational and rehabilitation footprint of the mine. These features are organised into defined mine domains, which support mine planning, landform design and the implementation of the PRCP. Table 2 summarises the primary mine features that occur within each domain.

Mining at Curragh is undertaken through multiple open-cut pits that have been advanced sequentially across the complex. As coal extraction is completed in each area, voids are progressively backfilled where practicable or shaped into stable final landforms designed to achieve long-term geotechnical stability, erosion resistance and appropriate drainage performance. Out-of-pit spoil dumps located throughout the site provide additional overburden placement capacity and are similarly shaped to conform with the PRCP final landform requirements and the approved post-mining land uses.

A dedicated flood protection levee forms a key component of the site's flood management system, providing engineered protection for critical mining infrastructure from external catchment flows. This structure integrates with the broader surface water management network and is maintained in accordance with design specifications and regulatory requirements.

Coal processing and materials handling activities are centralised at the Coal Handling and Preparation Plant (CHPP), located within the main operational hub of the complex. The CHPP receives run-of-mine coal via a network of haul roads and conveyors, and includes coal washing circuits, raw and product coal stockpiles and a rail load-out facility connected to the Blackwater Rail System. Supporting this infrastructure is an extensive system of conveyors, transfer stations, stackers, reclaimers, surge bins and tunnels that enable efficient movement of coal between the extraction areas, the CHPP and the rail load-out.

A wide range of general mine infrastructure supports safe and efficient operation of the site. This includes the administration complex, heavy-vehicle and light-vehicle workshops, mechanical and electrical maintenance facilities, fuel and chemical storage areas, washdown bays, accommodation facilities, and key utilities infrastructure such as powerlines, substations, communications towers and water supply pipelines (including the Braeside pipelines). These facilities underpin the operational, logistical and workforce requirements of the mine.

The Curragh Complex also contains a network of stockpile areas used to support both operational needs and progressive rehabilitation. These include run-of-mine and product coal stockpiles, as well as topsoil and rock stockpiles managed to preserve material quality and ensure suitability for use in future rehabilitation works.

Tailings generated through coal processing are managed within a suite of engineered structures. B-Pit is the only operational Tailings Storage Facility (TSF) currently receiving fine coal tailings from the CHPP. The Old Tailings Dam and A-Pit TSF are inactive facilities that no longer receive tailings but continue to be monitored and maintained to ensure long-term structural integrity and environmental

performance. These facilities form part of the PRCP closure pathway and are designed to transition to safe, stable and non-polluting landforms.

The water management system at Curragh includes numerous mine-affected water dams, raw water storages, sediment dams, drainage channels, diversion banks, pipelines and pumping systems that collectively manage stormwater, sediment and mine-affected water. These systems support operational water supply, environmental compliance and site-wide water-balance management.

The mine includes several creek diversions that have been constructed or approved to facilitate safe access to coal resources while maintaining natural drainage function. The existing Blackwater Creek Diversion has established rehabilitation, while additional diversions approved for future mining areas remain unconstructed at this stage.

General disturbance areas across the complex include haul roads, access tracks, laydown areas, drains and temporary workspaces that support operational activities. These areas are progressively reshaped and rehabilitated in accordance with PRCP sequencing as mining advances. Areas within the EA boundary that have not been disturbed by mining activities remain in their natural condition and continue to provide ecological connectivity and hydrological function.

Table 2: Primary Mine Features and Infrastructure at Curragh Complex.

Mine domain	Mine feature
Flood Protection	Levee
Pits: voids and spoil dumps	Curragh South – Pit Z Curragh Central Extended – Pit X (East, South and West), Pit D Curragh Extended – Pit J Curragh South – Pit Z Curragh West – Pit Y Curragh East – Pits A–C, E–I, K–L Curragh North – Pits S, T, U
General Infrastructure	Administration Camp Accommodation Workshop Fuel, oil, and chemical storage Fuel and wash bays Pipes and pumps (including Braeside pipelines) Power lines Switchyard and substations Communications towers Fences
Stockpiles	Run-of-mine (ROM) coal stockpiles Product coal stockpiles Topsoil stockpiles Rock stockpiles
Tailings storage facilities (TSFs)	Old Tailings Dam (out of pit) A-PIT TSF B-Pit TSF
Dams	Mine water dams Raw water dams Sediment dams
Creek diversions	Blackwater Creek Diversion (existing rehabilitation) Minne Creek Diversion (Approved, unconstructed) Bonny Doon Creek Diversion (Approved, unconstructed)
Processing infrastructure	Coal handling and preparation plant (CHPP) Conveyors and transfer stations Stackers and reclaimers Surge bins and hoppers Tunnels
General Disturbance	Laydown areas Access roads haul roads Drains Topsoil stockpiles
Undisturbed Area	Land that has not been impacted by mining operations

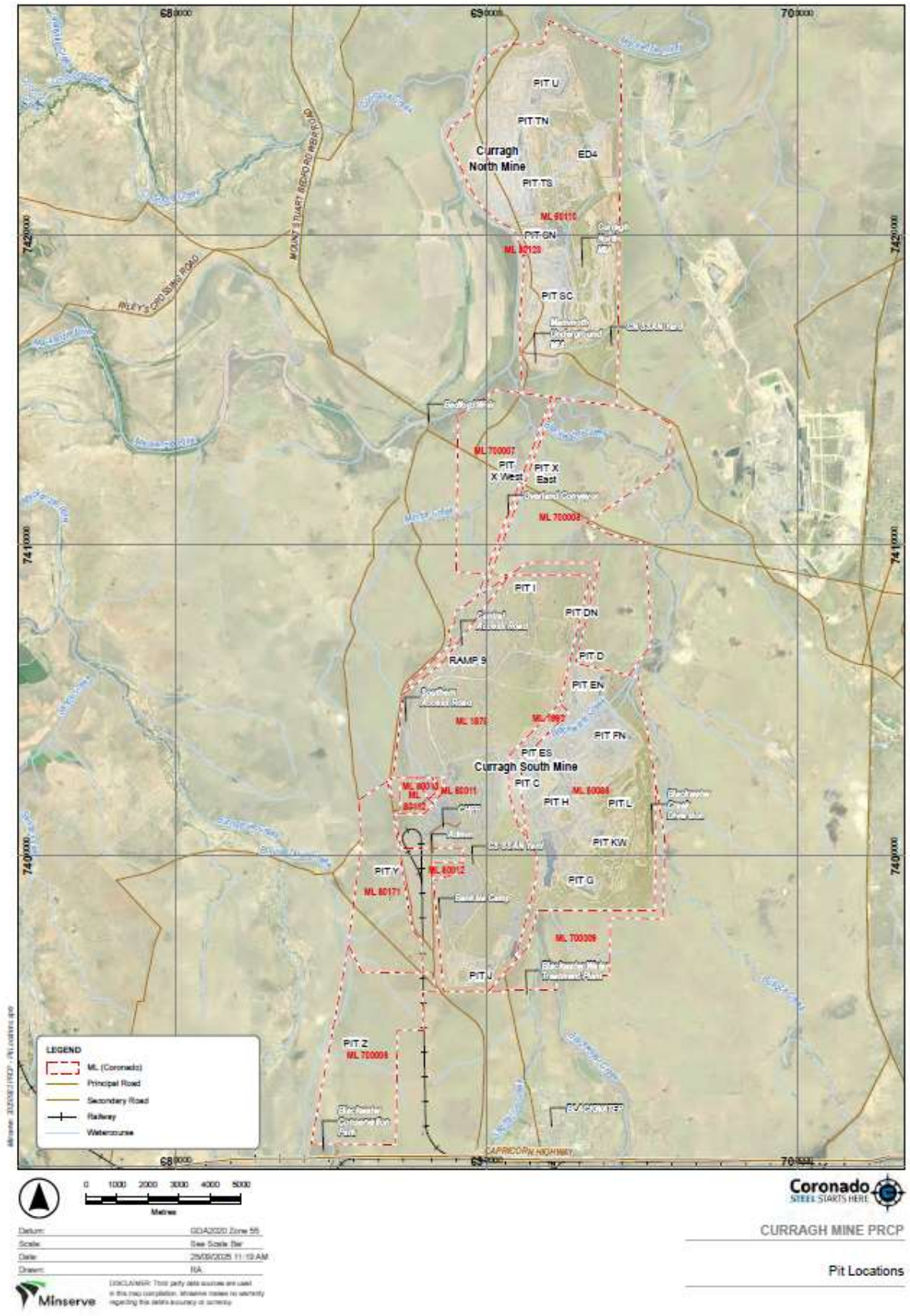

Figure 3: Curragh Complex Mine Layout

3.1.4 Type of Mining Operation

Mining at the Curragh Complex is undertaken using a combination of extraction methods selected to match local geological conditions, seam geometry and operational objectives. The predominant method across the site is open-cut mining, supplemented in targeted areas by highwall mining, and more recently by underground Bord-and-Pillar extraction at the Mammoth Underground Mine.

Open-cut mining has been the primary method at Curragh since operations commenced in 1983. Extraction is carried out using large draglines and truck-and-shovel fleets, enabling the efficient removal of overburden and coal across the multiple mining areas that make up the complex. This approach has been progressively refined to optimise overburden handling, support in-pit backfilling, and integrate rehabilitation sequencing in accordance with the PRCP.

Highwall mining has been employed selectively at Curragh to recover residual coal resources adjacent to established open-cut operations. This method provides a safe and efficient means of extracting coal from zones that are uneconomic or impractical to mine using traditional open-cut methods, while minimising additional surface disturbance. The use of highwall mining maximises resource recovery within the existing operational footprint and complements the site's broader land-use and rehabilitation strategy.

Underground mining commenced in 2024 with the development of the Mammoth Underground Mine. The operation uses the Bord-and-Pillar mining method, chosen for its inherently low-subsidence characteristics and ability to maintain overlying landform integrity. This approach significantly reduces surface disturbance and supports long-term geotechnical and hydrological stability, allowing underground extraction to integrate effectively with the existing open-cut operations and the approved PRCP final landform.

3.1.4.1 Proposed Duration

The Curragh Complex holds approval for a maximum Run-of-Mine (ROM) coal production rate of 18 million tonnes per annum (Mtpa), in accordance with Environmental Authority EPML00643713. Product coal is transported via the Central Queensland Rail Network (Blackwater Line) to the Port of Gladstone, providing direct access to export markets and supporting domestic supply contracts. The currently approved Life of Mine extends to 2046.

In accordance with the relevant legislation, this PRCP application covers all current and approved disturbance areas authorised under the Environmental Authority. Increases in the extent of disturbance beyond the approved footprint are not included in this PRCP and will be subject to the required regulatory approval processes, including but not limited to amendments to the Environmental Authority (EA) and this PRCP.

3.2 Baseline Information

The environmental baseline of the Curragh Complex provides the essential foundation for mine planning, progressive rehabilitation and long-term closure outcomes. Baseline information has been compiled from historical site investigations, specialist technical studies and results from ongoing monitoring programs undertaken in accordance with Environmental Authority (EA) conditions and the *PRCP Guideline* (ESR/2019/4964).

This information characterises the physical, hydrological, ecological and geotechnical setting of the Curragh Complex and informs the development of final landform designs, water management strategies and the selection and justification of approved Post-Mining Land Uses (PMLUs). Understanding the baseline environmental conditions ensures that proposed rehabilitation outcomes are technically achievable, environmentally appropriate and aligned with long-term landscape function and regulatory expectations.

3.2.1 Site topography

The Curragh Complex is located in Central Queensland within the Bowen Basin, one of Australia's most significant coal-producing provinces. The regional landscape comprises broad, low-relief terrain with gently undulating plains typical of the central Bowen Basin geomorphology. Across the Curragh operational footprint, elevations range from approximately 180 to 260 metres Australian Height Datum (AHD), with natural surface gradients predominantly falling to the east and north. These gradients direct overland flow towards the Mackenzie River system and its associated tributaries, which form the primary hydrological controls at the catchment scale.

Prior to mining, the local landform consisted of alluvial flats and floodplains associated with the Mackenzie River and Blackwater Creek, interspersed with residual ridges and gently undulating plains underlain by Permian geological formations. Shallow ephemeral drainage lines and minor tributaries contributed to the broader Fitzroy River catchment, with localised depressions influencing surface water retention, flow connectivity and wet-season inundation patterns.

Outside the township of Blackwater and nearby resource developments, the predominant regional land use has historically been extensive cattle grazing supported by the broad alluvial flats and open grasslands. Limited dryland cropping and small areas of irrigated agriculture occur along more fertile sections of the Mackenzie River, but pastoral activity remains the dominant land use surrounding the Curragh Complex.

3.2.2 Climate

The Curragh Complex lies within a subtropical climate zone characterised by pronounced wet and dry seasonal variability. Long-term climatic records (1900 to 2021) indicate an average annual rainfall of approximately 565 millimetres and an average annual potential evaporation of about 2,054 millimetres. This substantial imbalance results in a persistent climatic water deficit across most of the year, which has direct implications for mine water management, surface hydrology, rehabilitation performance and long-term landform stability.

Rainfall is highly variable between years and is strongly concentrated in the summer wet season. Most rainfall typically occurs between December and March, while evaporation rates peak during late spring and summer under high temperatures and low humidity. Average maximum daily temperatures range from about 22 degrees Celsius in winter to about 34 degrees Celsius in summer, while minimum temperatures range from about 8 degrees Celsius to about 22 degrees Celsius, reflecting the broader Central Queensland climatic regime. The long-term distribution of rainfall, evaporation and temperature is summarised in Table 3 and presented graphically in Figure 4.

Analysis of rainfall patterns over the mining period (1983 to 2021) indicates that site conditions have generally been drier than the long-term historical record. Wetter periods occurred in the late 1980s, and several isolated high rainfall years were recorded, such as 1998 to 1999 and 2010 to 2011. Recent monitoring data (2017 to 2021) show consistently below average rainfall. Long-term variability and rainfall trends relevant to operational and closure planning are illustrated in Figure 5.

The combination of low annual rainfall, high evaporation and substantial year-to-year variability influences hydrological and rehabilitation outcomes at Curragh. These climatic characteristics shape the site's water balance modelling, inform the design of mine water storages and surface drainage systems, and define seasonal windows for effective revegetation. Consideration of weather extremes, including flood events, prolonged dry periods and heatwaves, is incorporated into the PRCP final landform design criteria, risk assessments and rehabilitation scheduling to ensure resilient long-term post mining outcomes.

Average Total Monthly (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall	93	88	58	30	29	29	24	16	21	42	56	80	565
Evaporation	229	184	190	151	118	94	103	132	173	214	226	240	2,054

Table 3: Long-term average monthly rainfall and evaporation (January 1900 – August 2021)

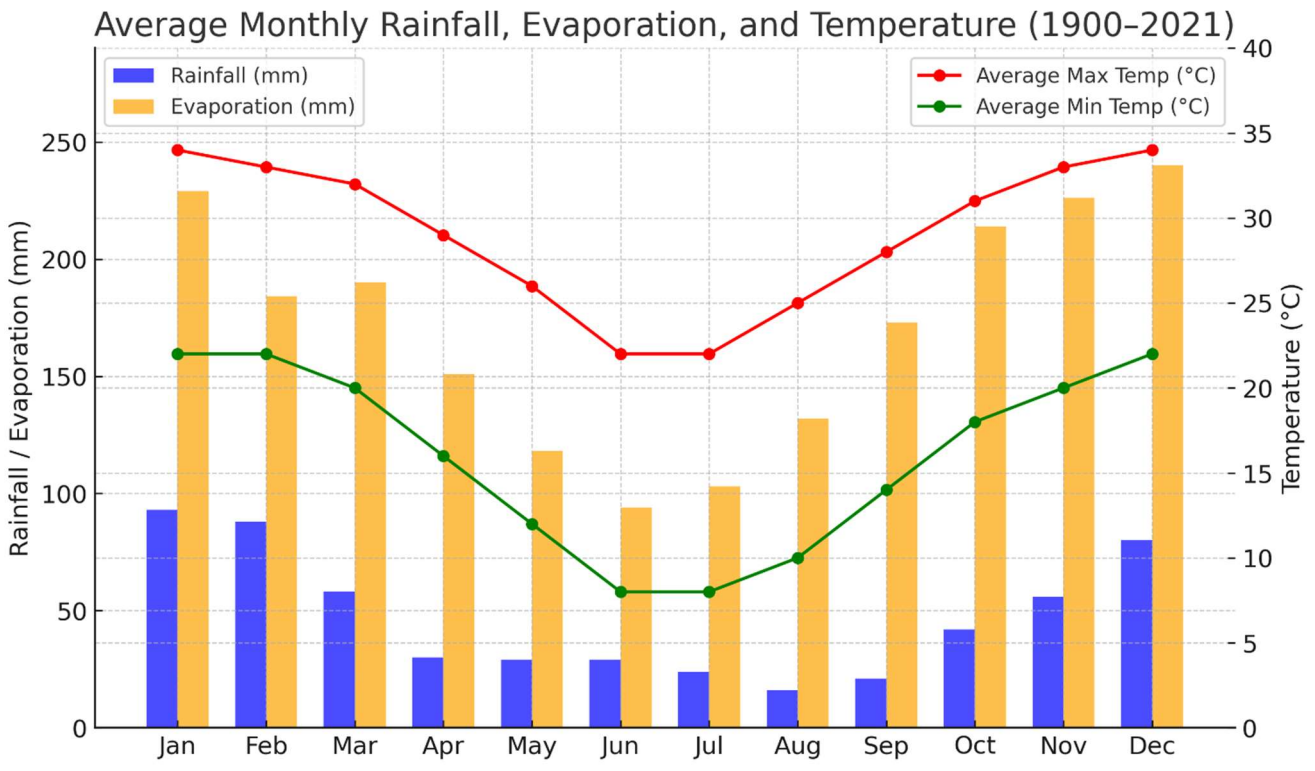

Figure 4: Average Monthly Evaporation, Rainfall and Temperature (January 1900 to August 2021)

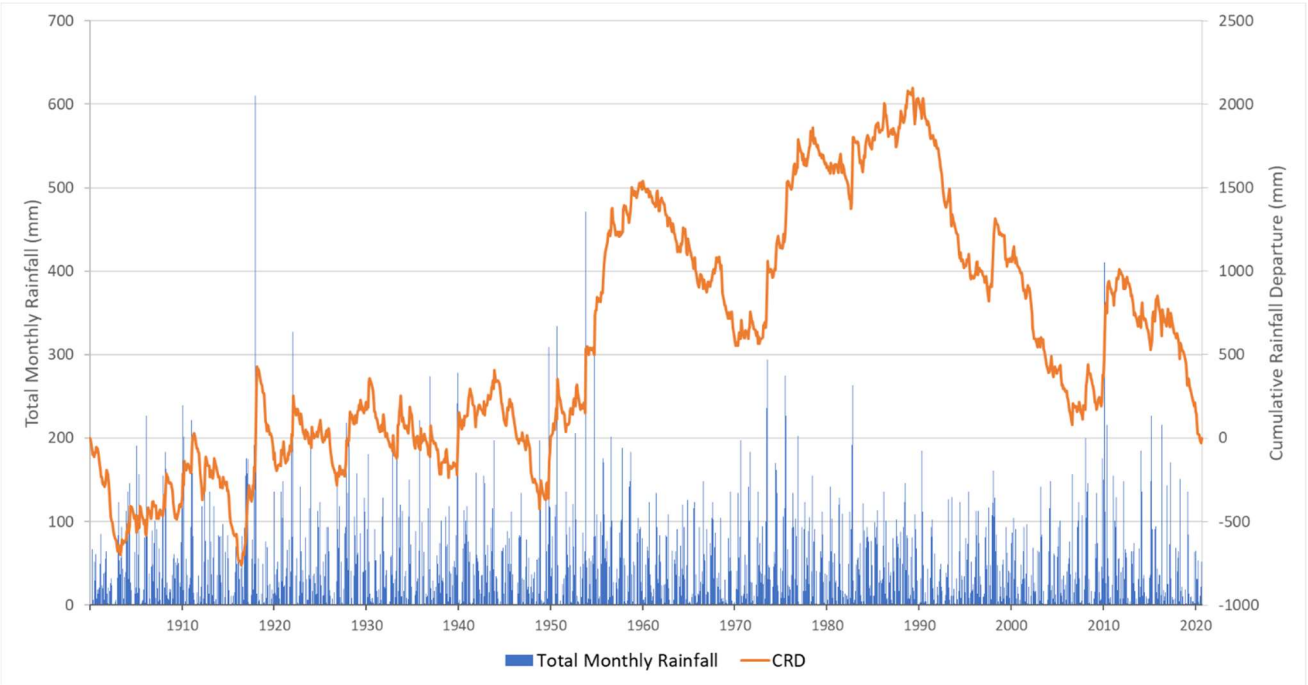

Figure 5: Cumulative Rainfall Departure and Total Monthly Rainfall (1900-2021)

Long-term Climate Projections

To ensure the Curragh Complex is well positioned to respond to future climate variability, the PRC Plan and its supporting technical studies have proactively incorporated nationally recognised climate projection datasets relevant to the Bowen Basin. These inputs draw on long-term modelling from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Bureau of Meteorology (BoM), the Queensland Department of Environment and Science and other published scientific sources. All datasets are aligned with the Consistent Climate Scenarios Projection Data and High-Resolution Projection Data frameworks, ensuring that projections used for planning are regionally relevant, scientifically robust and consistent with established national guidance.

Climate projections for Central Queensland indicate a gradual increase in average temperatures, with modelling suggesting an uplift in maximum temperatures of approximately 1.8 degrees Celsius by 2050. While long-term rainfall trends remain variable, projections indicate a higher likelihood of short-duration, high-intensity rainfall events interspersed with extended dry periods. Potential increases in evaporation of around 0.88 millimetres per day and a slight reduction in relative humidity of approximately 1.2 per cent are also anticipated. Extreme weather trends suggest that although tropical cyclones may occur less frequently overall, those that do form may be of greater intensity, and the region may experience a continuation of the trend toward more frequent dangerous fire weather days.

These projections do not represent specific predictions but instead outline a reasonable envelope of future climatic conditions. Incorporating them into the PRC Plan ensures closure designs, hydrologic modelling and water management systems are developed with flexibility and resilience. This approach supports robust long-term landscape function, enhances the durability of rehabilitation outcomes and ensures that the final landform remains stable and sustainable under a wide range of plausible future climate scenarios.

3.2.3 Geological Setting

The Curragh Complex is situated within the Permian coal measures of the Bowen Basin, one of Australia's most significant metallurgical coal provinces. The site is underlain by a sequence of interbedded coal seams, sandstones, siltstones, mudstones and tuffaceous units that form part of the Rangal Coal Measures and associated formations. These units represent fluvial to deltaic depositional environments typical of the Permian coal-bearing strata of Central Queensland.

The coal seams within the Curragh Complex are laterally continuous across much of the mining lease area, although thickness, quality and structural characteristics vary depending on local stratigraphy and depositional setting. Overlying and interburden lithologies exhibit differing geotechnical and hydrological properties, which influence pit slope design, spoil behaviour, groundwater movement and final landform stability. Localised structural features, including gentle folding, minor faulting and seam splitting, have been identified through mining and exploration activities and are incorporated into mine planning and geotechnical modelling.

A summary of the stratigraphic sequence relevant to Curragh is provided in Table 4, while Figure 6 and Figure 7 present the local and regional geological context. The geological setting provides a critical foundation for final landform development, rehabilitation design, materials management and groundwater modelling undertaken as part of this PRCP.

Age	Group	Stratigraphic Unit	Description
Quaternary		Alluvium	Soils, unconsolidated silts, sands, gravels, and clays,
Cenozoic (Tertiary)		Duaringa Formation/ Emerald Formation	Claystone, siltstone, sandstone, conglomerate (often poorly consolidated), lignite, basalt
Triassic	Mimosa	Rewan Formation	Mudstone, interbeds of lithic sandstone.
Upper Permian	Blackwater Group	Rangal Coal Measures	Coal seams calcareous sandstone, calcareous shale, mudstone, calcareous tuff in places. Main coal seams include Aries, Castor, Pollux, Orion, Pisces.
		Burngrove Formation	Siltstone, carbonaceous shales and mudstone, fine lithic sandstone, calcareous lithic and feldspathic sandstone, tuffaceous shales, and thin coal seams.
		Fair Hill Formation	Lithic and feldspathic labile sandstone, quartzose sublabile sandstone, siltstone, mudstone, calcareous and tuffaceous sandstone, volcanic conglomerate, carbonaceous mudstone, coal
Permian	Back Creek Group	Macmillan Formation	Interbedded mudstone and sandstone, prominent dark grey basal unit.

Table 4: Regional Stratigraphy

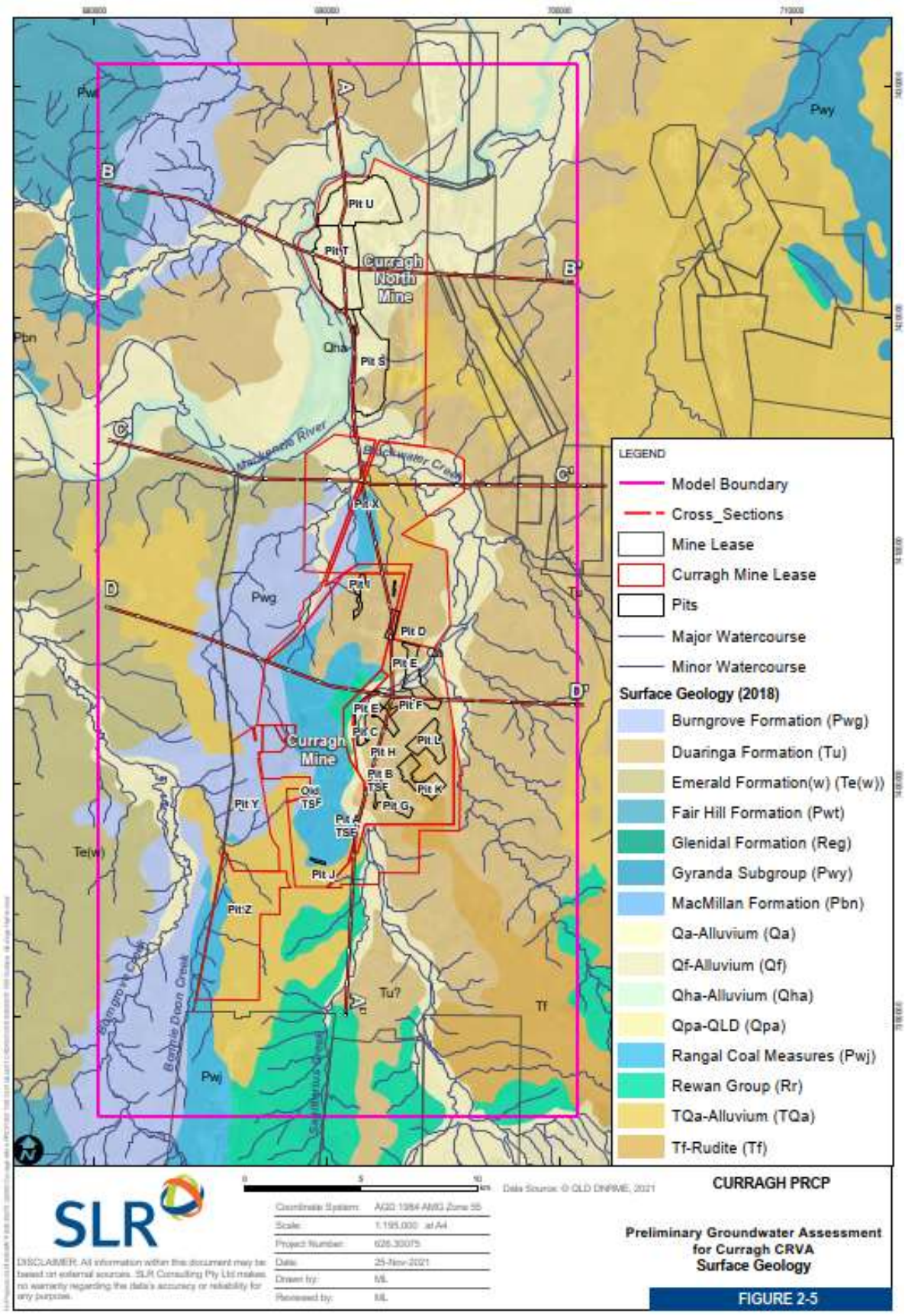

Figure 6: Surface Geology

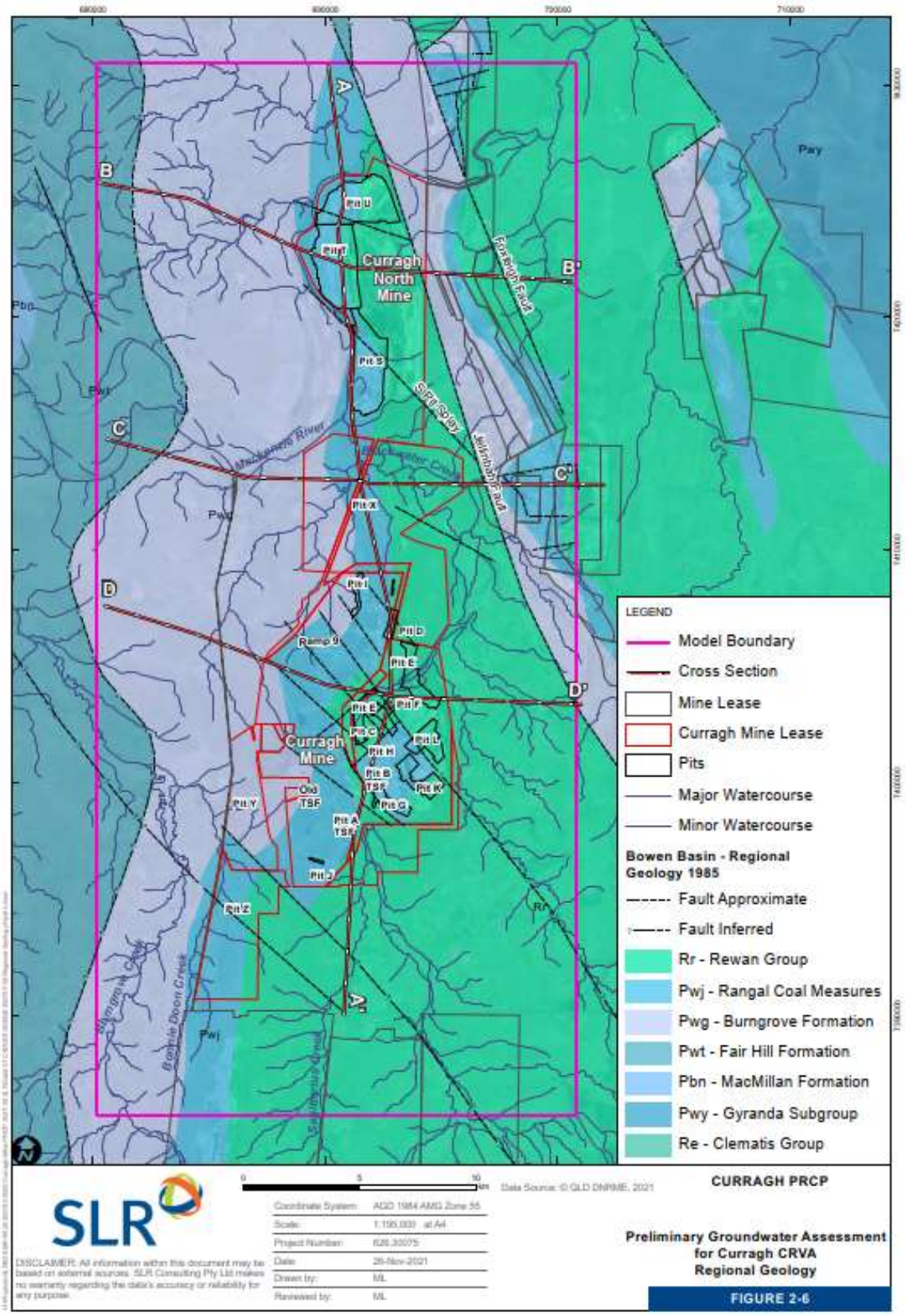

Figure 7: Regional Geology

At surface, Quaternary and Tertiary alluvium is associated with the Mackenzie River, Blackwater Creek, and their tributaries. This alluvium extends extensively across the Curragh North leases and southern extension areas, and is of particular hydrogeological significance due to its interaction with surface water systems. Exploration drilling indicates thicknesses up to 35 m near the Mackenzie River, with typical thicknesses in proposed mine areas ranging from <2 m to 12 m, comprising clay, silt, and occasional sand/gravel channel lenses.
Beneath the alluvium, the stratigraphic sequence comprises:

- Emerald and Duaringa Formations (Cenozoic): claystone, siltstone, sandstone, conglomerate, often poorly consolidated.
- Rewan Formation (Triassic): mudstones and interbedded lithic sandstones.
- Blackwater Group (Upper Permian):
- Rangal Coal Measures – the principal coal-bearing unit exploited at Curragh, including the Aries, Castor, Pollux, Orion, and Pisces seams, interbedded with carbonaceous shales and calcareous sandstones.
- Burngrove Formation – siltstone, carbonaceous mudstone, lithic sandstone, and thin coal seams.
- Fair Hill Formation – labile sandstones, siltstones, mudstones, volcaniclastic conglomerates, and carbonaceous mudstones.
- Macmillan Formation (Back Creek Group, Permian): interbedded mudstone and sandstone, with a prominent basal dark grey mudstone.

Structural influences include regional scale folding and faulting, with several mapped lineaments traversing the leases (Figure 6). These structures locally affect seam continuity and dip, influencing mine design and long-term void stability. Geotechnical investigations confirm that spoil materials are generally competent but include reactive clays and dispersive horizons. These materials pose erosion and stability risks if not managed appropriately, requiring targeted spoil handling, selective placement, and engineered shaping strategies.
The geological setting has direct implications for rehabilitation and closure planning, including:

- Coal seam geometry – controlling pit design, extraction limits, and residual void development.
- Alluvial aquifers – interacting with mine water systems and informing hydrogeological modelling.
- Spoil characteristics – dictating selective handling, placement, and erosion management measures.
- Geotechnical conditions – guiding slope design, highwall treatments, and final landform stability assessments.

3.2.4 Hydrology

The Curragh Complex lies within the Mackenzie River catchment, a major sub-catchment of the Fitzroy Basin in Central Queensland. The Mackenzie River originates at the confluence of the Nogoa and Comet Rivers and flows eastward to join the Dawson River, forming the broader Fitzroy system that ultimately discharges into the Great Barrier Reef lagoon near Rockhampton. The upstream drainage area contributing to Bingegang Weir, located downstream of the mine, is approximately 50,960 square kilometres, with the Nogoa and Comet Rivers providing the majority of inflow.

Surface water behaviour across the Curragh Complex is strongly influenced by the Mackenzie River trunk system and its network of ephemeral tributaries, particularly Blackwater Creek, which flows northward through the mining lease before entering the Mackenzie River roughly 3.3 kilometres downstream of Bedford Weir. The creek has been diverted several times since mining commenced, with the most recent diversion completed in 2009. Downstream of the site, Blackwater Creek transitions into a multi-channel ephemeral system typical of dryland hydrology in Central Queensland.

Several ephemeral tributaries contribute flows to Blackwater Creek, including Taurus, Sagittarius, Minnie, Bullock, Bonnie Doon and Burngrove Creeks. These systems flow only during significant rainfall events and exhibit little to no baseflow. Minnie Creek, which intersects a planned future mining area, will require a diversion to allow operational progression consistent with the PRCP and EA requirements.

Streamflow gauging data highlight the hydrological contrast between the perennial Mackenzie River and the highly ephemeral Blackwater Creek system. As shown in Table 5, the Mackenzie River at Coolmaringa (station 130005A) drains about 16,000 square kilometres and records a mean annual discharge of approximately 1,200,000 megalitres, with median monthly flows peaking at around 25,000 megalitres in January and February. The river experiences no-flow conditions in less than five per cent of the long-term record due to regulated releases from Bedford Weir, which maintain flows for irrigation, industrial supply and environmental water requirements.

In contrast, Blackwater Creek at Glenalmond (station 130305B) drains a much smaller catchment of roughly 1,100 square kilometres and records a mean annual flow of approximately 35,000 megalitres. Median monthly flows are typically around 1,200 megalitres during January to March, yet more than 60 per cent of the gauging record comprises zero-flow conditions, confirming the creek's characteristically flashy runoff response and minimal baseflow between wet season rainfall events.

The spatial arrangement of the Mackenzie River and its tributaries across the Curragh Complex is illustrated in Figure 8, which presents major and minor watercourses, catchment boundaries and the relationship between site activities and surrounding hydrological regimes. These catchment characteristics underpin the site's surface water management strategy, diversion design requirements and final landform drainage planning under this PRCP.

Gauging Station	Catchment Area (km²)	Mean Annual Flow (ML/yr)	Median Monthly Flow (ML)	No-Flow Frequency (% record)	Hydrological Notes
Mackenzie River at Coolmaringa	~16,000	~1,200,000	25,000 (Jan–Feb)	<5%	Major trunk stream; regulated by Bedford Weir releases, perennial flows maintained by environmental and irrigation supply releases.
Blackwater Creek at Glenalmond	~1,100	~35,000	1,200 (Jan–Mar)	>60%	Highly ephemeral tributary; flashy runoff response to wet-season rainfall, negligible baseflow contribution during dry season.

Table 5: Flow Characteristics – Mackenzie River (Coolmaringa) and Blackwater Creek (Glenalmond).

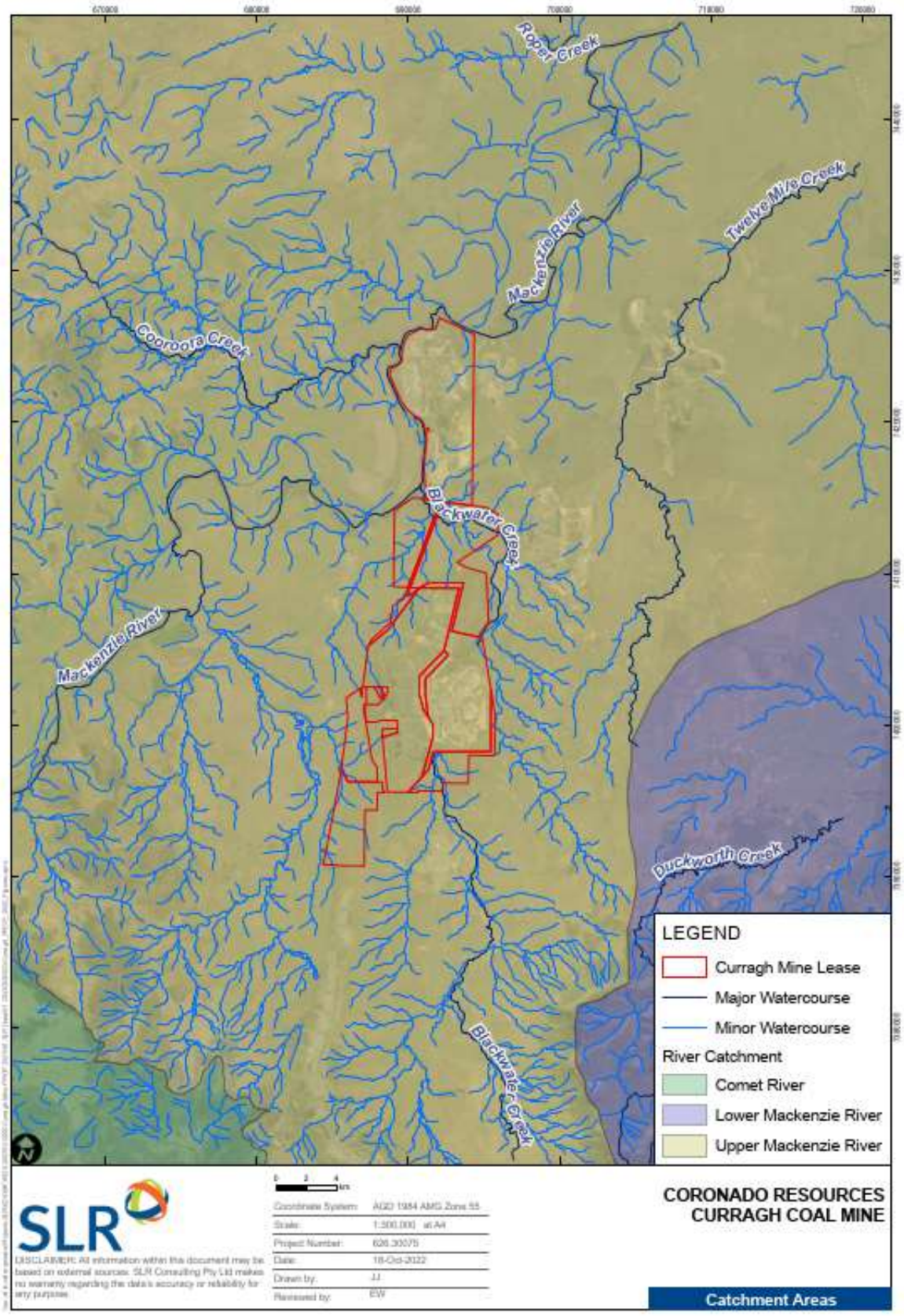

Figure 8: Curragh Complex Catchment

Fluvial Processes and Floodplain Context

Runoff and streamflow within the Curragh Complex are strongly seasonal and are predominantly generated during the summer wet season from December to March. High-intensity convective rainfall produces rapid overland flow and short-duration flood peaks that shape the hydrologic and geomorphic behaviour of both the Mackenzie River and its tributary systems. The Mackenzie River floodplain is characterised by an intricate network of distributary channels, backwater depressions and intermittent wetlands that activate during moderate to high rainfall events. These features provide valuable temporary flood storage, attenuate peak flows, promote sediment deposition and support short-lived aquatic habitats that function episodically during wet season conditions.

In contrast, Blackwater Creek and its tributaries exhibit a markedly different hydrological character. These channels respond rapidly to storm rainfall, producing sharp rises and falls in discharge followed by extended no-flow periods throughout most of the year. Sediment transport in these systems is highly episodic, alternating between phases of bed scouring during high-energy runoff events and localised deposition during receding flows. Flood frequency assessments indicate that the Mackenzie River floodplain is extensively inundated during the 1 per cent Annual Exceedance Probability (AEP) flood, with backwater effects propagating into Blackwater Creek and Lagoon Creek. Understanding these floodplain interactions is fundamental to the design of watercourse diversions, flood protection structures and surface water management elements proposed under this PRCP. These processes also inform final landform drainage design and stability criteria, ensuring mine-affected areas integrate appropriately with the broader catchment behaviour.

Water Quality and Environmental Values

Surface water quality across the Mackenzie River sub-catchment is generally characterised as poor to moderate, consistent with historical assessments undertaken by Parsons Brinckerhoff (2015), SLR (2021a) and ongoing regional monitoring programs. Exceedances of the Fitzroy Basin Water Quality Objectives (WQOs), established under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld), commonly relate to turbidity, salinity, dissolved oxygen and nutrient concentrations. Turbidity levels are frequently elevated during high-flow events due to natural erosion processes and mobilisation of suspended sediments across the catchment. Electrical conductivity routinely exceeds guideline values, reflecting the influence of saline groundwater inputs and the inherent geochemistry of the Bowen Basin.

Dissolved oxygen concentrations can be variable and often fall below WQOs, particularly during low-flow conditions when water residence times increase. Nutrient concentrations, particularly nitrogen and phosphorus, are also regularly above guideline thresholds. Trace metal concentrations, including aluminium, copper, chromium, iron, lead, silver, zinc and uranium, occasionally exceed aquatic ecosystem values. These exceedances reflect a combination of natural catchment processes, regional geology, and cumulative land-use influences, including grazing, cropping and upstream mining activities.

The environmental values (EVs) identified for the Mackenzie River and Blackwater Creek include protection of aquatic ecosystems, stock watering, irrigation supply, primary and secondary recreation, and cultural and spiritual values. These waterways also play an important role in supporting downstream water quality objectives relevant to the Fitzroy Basin and the Great Barrier Reef.

A summary of environmental values, relevant water quality indicators, baseline observations, fluvial context and the corresponding PRCP rehabilitation measures is provided in Table 6. The PRCP incorporates targeted sediment and erosion controls, flood-compatible landforms, long-term drainage designs and water quality protection measures to ensure that rehabilitated areas support, and do not compromise, the established EVs for receiving waters.

Table 6: Mackenzie River Sub-Catchment Environmental Values

Environmental Value (EV)	Relevant Indicators	Baseline Observations	Fluvial Context	PRCP Relevance
Aquatic ecosystem health	Turbidity, DO, nutrients, metals, EC	Exceedances of turbidity, EC, nutrients, and metals; DO often below guideline values	Mackenzie River: perennial fluvial trunk (~1.2M ML/yr); Blackwater Creek: ephemeral, >60% no-flow, flashy sediment transport	Diversions replicate fluvial stability; stable landforms and erosion control minimise sediment/nutrient export.
Stock watering	EC, metals, turbidity	EC frequently elevated; some bores saline; metals occasionally exceed stock thresholds	Mackenzie perennial flows provide reliability; tributaries unreliable	Rehabilitation ensures land is suitable for stock watering, consistent with ANZECC & EPP WQOs.
Irrigation	EC, turbidity, nutrients	Elevated EC constrains irrigation; turbidity high in wet season	Irrigation supported by regulated Mackenzie flows	Rehabilitation minimises saline and sediment inputs to irrigation users.
Primary recreation (swimming)	Turbidity, DO, microbiological (E. coli), pH	High turbidity and low DO reduce suitability; limited microbial data	Mackenzie perennial flows sustain recreational use	Closure ensures water quality meets WQOs for primary recreation.
Secondary recreation (boating, fishing)	Turbidity, nutrients, metals	Elevated turbidity and nutrients reduce amenity and fish habitat	Mackenzie baseflows support ongoing recreation	Rehabilitation outcomes maintain water quality and amenity values.
Cultural and spiritual values	All indicators	Exceedances may affect cultural water values	Mackenzie perennial fluvial system sustains cultural connections; tributaries ephemeral	Closure outcomes must demonstrate EV compliance to protect cultural values.
Downstream protection (GBR)	Sediment, nutrients, metals	Wet-season fluvial events transport sediment/nutrient loads downstream	Mackenzie and Fitzroy rivers discharge to GBR lagoon	Stable landforms, vegetation cover, and compliant discharges reduce sediment/nutrient export.

Taken together, the hydrology, fluvial processes and water quality characteristics of the Curragh Complex establish the baseline conditions that inform diversion design, drainage planning and rehabilitation outcomes under this PRCP. The hydrology and fluvial setting of the site is defined by perennial, regulated flows in the Mackenzie River; the ephemeral, storm-driven behaviour of Blackwater Creek and its tributaries; and floodplain processes that redistribute and store water during major rainfall events. Surface water quality reflects both natural processes and cumulative anthropogenic pressures, with periodic exceedances against the Fitzroy Basin WQOs.

By embedding fluvial stability, erosion control and water quality protection into PRCP milestone criteria, and aligning them with the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld), the PRCP ensures that final landforms are safe, stable, non-polluting, reflective of natural catchment processes where appropriate, and protective of environmental values, consistent with the requirements for achieving stable condition under the EP Act.

3.2.5 Hydrogeology

This section provides an overview of the hydrogeological setting of the Curragh Complex and the environmental values relevant to groundwater under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld) (EPP Water). The EPP Water establishes the environmental values (EVs) and water quality objectives (WQOs) necessary to protect Queensland's waters, including rivers, wetlands, aquifers and associated ecological processes. It specifically identifies the uses and ecological functions that must be maintained for groundwater systems—such as suitability for stock watering and irrigation, the protection of groundwater-dependent ecosystems, and the maintenance of aquatic ecosystem health within connected surface-water environments.

Within this regulatory framework, the Curragh Complex is underlain by a hydrogeological system comprising shallow Quaternary alluvial aquifers associated with the Mackenzie River, the deeper Permian coal measures of the Bowen Basin, and the regional Triassic Rewan Formation aquitard. These units govern groundwater occurrence, recharge and hydraulic connectivity with surface-water systems. Hydrogeological investigations and long-term monitoring (CBPMP EAR Main Report, Section 5.4; Appendices Part 1–2) demonstrate that the EVs identified under the EPP Water are predominantly supported by surface-water flows, floodplain processes and rainfall-driven recharge, rather than by groundwater discharge. This low degree of hydraulic connectivity provides an important basis for assessing project interactions with groundwater and ensuring the protection of these prescribed environmental values.

Mackenzie River Alluvium

Quaternary alluvium is developed extensively along the Mackenzie River and forms the principal shallow aquifer system relevant to the Curragh Complex. These deposits are up to 35–40 m thick near the Mackenzie River, though more commonly 2–12 m in thickness across mine areas. The alluvium consists of clays, silts, and sandy/gravel channel lenses with hydraulic conductivities of 0.1–5 m/day. Recharge occurs episodically during major rainfall and floodplain inundation events. Groundwater quality in the Mackenzie River alluvium ranges from fresh to moderately brackish (500–2,000 mg/L TDS), suitable for stock watering and, locally, irrigation.

Blackwater Creek Channel Deposits

Unlike the Mackenzie River, Blackwater Creek does not host a laterally continuous Quaternary alluvial aquifer. Targeted drilling and ground-truthing confirm that the creek is incised into fresh Permian bedrock. Only thin, discontinuous deposits of weathered Tertiary sediments and isolated exposures of sandstone, siltstone, and mudstone occur along the creek margins. These materials lack hydraulic continuity and do not function as an aquifer system. As such, Blackwater Creek surface flows are dominated by rainfall-runoff with negligible groundwater contribution.

Permian Coal Measures

The Rangal Coal Measures and Burngrove Formation host the principal mineable seams (Aries, Castor, Pollux, Orion, Pisces). These interbedded coal, carbonaceous mudstones, siltstones, and sandstones have low permeability (1×10^{-6} – 1×10^{-4} m/s), with groundwater stored mainly in fractures. Water quality is typically brackish to saline (>2,000 mg/L TDS), unsuitable for irrigation or potable use, and of limited ecological significance.

Rewan Formation Aquitard

The Triassic Rewan Formation underlies the coal measures and comprises thick mudstones and lithic sandstones with permeability $<1\times10^{-8}$ m/s. It acts as a regionally extensive aquitard, restricting vertical flow and separating coal measures from deeper groundwater systems. No beneficial use is associated with this unit due to very low transmissivity and poor quality.

3.2.5.1 Groundwater Levels and Monitoring

Groundwater levels across the Curragh Complex vary by aquifer system:

- Alluvium: Water tables typically 5–15 m BGL near the Mackenzie River, increasing to >20 m BGL further inland.
- Coal measures: >30 m BGL, generally confined or semi-confined conditions.
- Rewan Formation: >60 m BGL, hydraulically isolated.

Table 7: Hydrogeology Summary – Curragh Complex

Unit	Thickness/Lithology	Hydrologic Conductivity	Groundwater Quality	Relevance to EVs
Mackenzie River Alluvium	2–40 m; clays, silts, sands, gravels	0.1–5 m/day	Fresh–brackish (500–2,000 mg/L TDS)	Stock watering; limited irrigation
Blackwater Creek Deposits	Thin, discontinuous sediments	Negligible	N/A	Not an aquifer
Permian Coal Measures	Coal, mudstone, sandstone	1×10^{-6} – 1×10^{-4} m/s	Brackish saline (>2,000 mg/L TDS)	Limited hydrogeological/ecological significance
Rewan Formation Aquitard	Thick mudstone, lithic sandstone	$<1\times10^{-8}$ m/s	Highly saline	Regional aquitard; no beneficial use

3.2.5.2 Groundwater Quality

Groundwater chemistry across the Curragh Complex shows a clear decline in quality with depth:

- Alluvium: fresh to moderately brackish (500–2,000 mg/L TDS), Ca–Mg–HCO_3 facies. This water is locally suitable for stock watering and limited irrigation, representing the only aquifer with beneficial use aligned to Environmental Values (EVs) identified under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld).
- Coal Measures (Rangal and Burngrove Formations): brackish to saline (>2,000 mg/L TDS), Na–Cl dominant. Water quality is unsuitable for irrigation or stock watering, and these units have no recognised beneficial use under the EPP (Water).
- Rewan Formation: highly saline, with negligible beneficial use due to very low transmissivity and poor quality.
- Groundwater quality data is generally available from late 2015 onward, with limited earlier records from 1997 to 2012. Monitoring frequency increased after 2015, with samples analysed for electrical conductivity (EC), pH, major ions, nutrients, dissolved metals, and hydrocarbons.
- These data confirm that:
- Only the shallow alluvium has limited beneficial use relevant to EVs.
- Deeper aquifers are of low quality and are not relied upon for EV protection; and
- Environmental values associated with aquatic ecosystems, stock watering, and irrigation in the Curragh region are sustained by surface water flows and rainfall, rather than groundwater discharge.

Table 8: Groundwater Quality Monitoring Data – Curragh Complex

Screened Formation	Bore ID	Data availability	
		From	To
Alluvium	1309MB	28-10-2015	01-04-2020
Alluvium	1312MB	03-10-2019	03-10-2019
Alluvium	1426MB	30-10-2015	10-11-2020
Alluvium	1531MB	28-10-2015	13-05-2020
Alluvium	1410MB	03-03-2016	29-06-2018
Alluvium	1411MB	28-04-2016	11-06-2019
Tertiary (weathered)	1301aMB	30-01-2020	06-01-2021
Tertiary (weathered)	1302MB	03-10-2019	07-01-2021
Tertiary (weathered)	1303MB	03-10-2019	07-01-2021
Tertiary (weathered)	1304aMB	18-09-2013	13-06-2016
Tertiary (weathered Duaringa Fm.)	1419MB	06-08-2015	28-06-2018
Tertiary (weathered Duaringa Fm.)	1420MB	30-12-2016	20-06-2017
RCM	BH1	26-06-2000	09-11-2020
RCM	BH2	09-02-2000	16-11-2020
RCM	BH3	09-02-2000	11-11-2020
RCM (weathered)	1301bMB	03-10-2019	06-01-2021
RCM (weathered)	1304bMB	04-09-2013	06-01-2021
RCM	1529MB	06-08-2015	10-11-2020
RCM	1534MB	06-08-2015	09-12-2020
RCM	1536MB	16-04-2018	14-05-2020
RCM	1538MB	19-08-2015	11-11-2020
RCM	1539MB	29-10-2015	20-08-2018
Burngrove Fm.	BH4	09-02-2000	09-12-2020
Burngrove Fm. (weathered)	1323MB	07-01-2014	09-11-2020
Burngrove Fm. (weathered)	1417MB	05-08-2015	09-11-2020
Burngrove Fm. (weathered)	1418MB	22-06-2015	11-11-2020
Burngrove Fm. (coal seam)	1537MB	30-10-2015	10-11-2020

Table 9: Groundwater Quality Summary – Curragh Complex

Aquifer	TDS Range (mg/L)	Dominant Facies	Beneficial Use
Mackenzie River Alluvium	500–2,000	Ca–Mg–HCO_3	Stock watering, limited irrigation
Permian Coal Measures	>2,000	Na–Cl	Not suitable
Rewan Formation	>>2,000	Na–Cl	No beneficial use

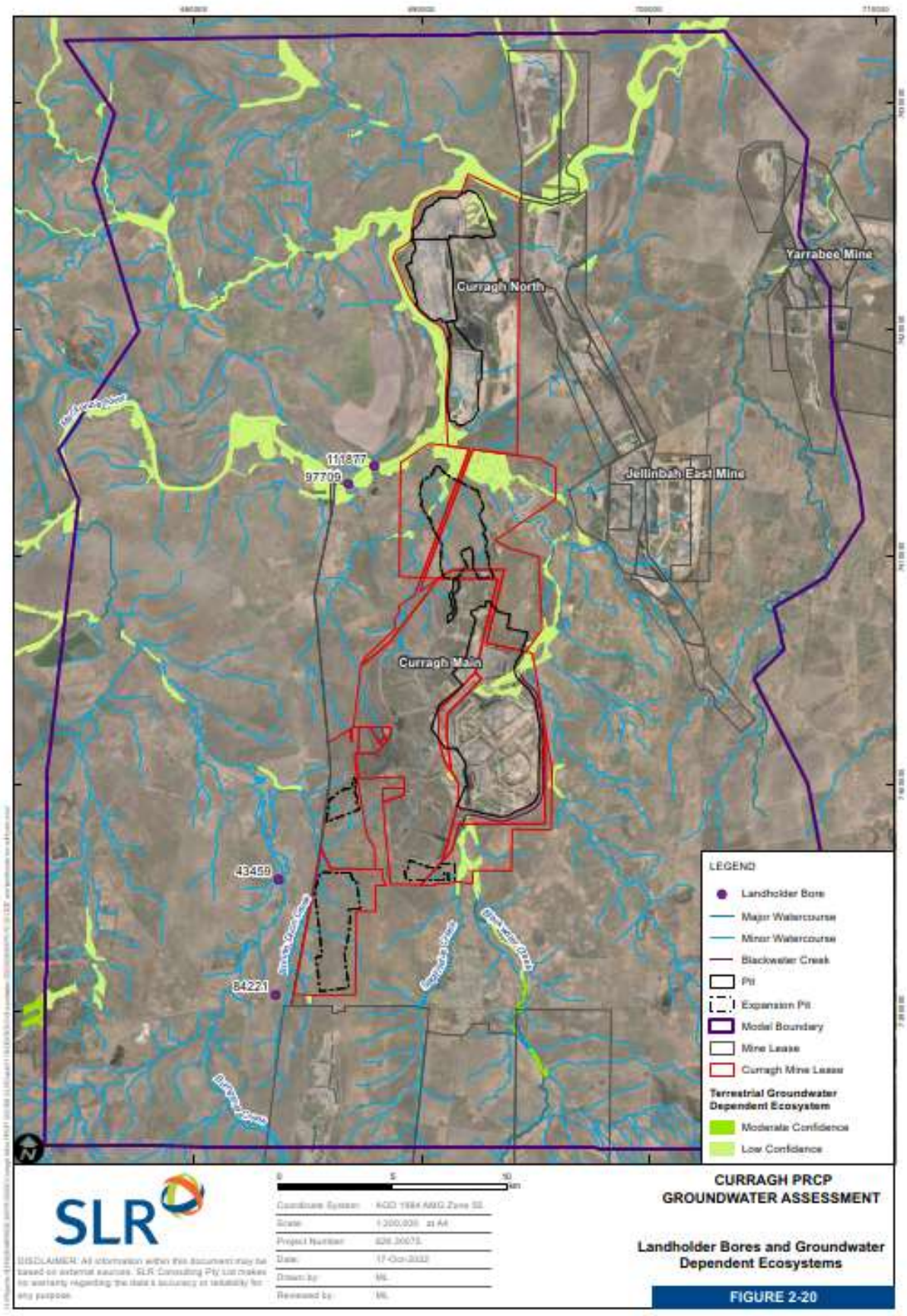

Figure 9: Groundwater monitoring network and state mapped potential GDEs

There are four registered bores within 3 km of the Curragh mining operations (existing or proposed). Their details are provided in Table 10. These bores include shallow alluvium and deeper bedrock aquifers; however, beneficial use is limited to the Mackenzie River alluvium bore (RN111877), which supplies small-scale irrigation.

RN	Aquifer	Depth (m)	SWL (mbgl)	Water quality	Yield (L/s)	Installed
43459	-	-	-	-	-	-
84221	Burngrove Formation	31	30	salty	0.12	1988
97709	-	57	13	Fresh	3.2	1998
111877	Mackenzie River Alluvium	23	15			2002

Table 10: Registered bores within 3km of Curragh mining operations

It is noted that RN111877 is owned by Central Highlands Regional Council and located at the campground approximately 150 m south of Bedford Weir on the Mackenzie River. The Council have indicated the bore is used to irrigate grass near and in the toilet block at the campground and that the groundwater is relatively saline. The bore is used to fill a 45,000 L tank 2 to 3 times each week (PB, 2016).

Groundwater-Dependent Ecosystems (GDEs)

Groundwater Dependent Ecosystems (GDEs) are ecological communities that rely on the availability of groundwater to maintain their structure and function. The Bureau of Meteorology *Groundwater Atlas* (BoM, 2021) identifies areas of low potential terrestrial GDEs and inflow dependent ecosystems (IDEs) in the Mackenzie River catchment, primarily associated with the riparian corridor of the Mackenzie River and, to a lesser extent, Blackwater Creek Figure 9.

At the time of the Parsons Brinckerhoff (2016) assessment, understanding of groundwater–ecosystem interactions were based largely on conceptual mapping. Potential GDEs were assumed to be restricted to areas of saturated alluvium, with groundwater dependence inferred from the relationship between water table depth and vegetation rooting depth. Under this framework, zones with water tables <10 m below ground level were classified as “high potential,” 10–20 m as “possible,” and >20 m as “unlikely.” Applying this methodology led to the mapping of potential subsurface GDEs along the Mackenzie River, Cooroora Creek, and sections of northern Blackwater Creek.

Recent investigations undertaken as part of the Curragh North Baseline Project Environmental Assessment Report (CNBPMP EAR, 2024) expanded the assessment across to include ground truthing assessments. These studies utilised refined geological and hydrogeological datasets, updated numerical groundwater modelling, and targeted ecological field surveys. The key findings confirmed that:

- Alluvium across much of the Curragh footprint is unsaturated and of limited thickness.
- Regolith and bedrock aquifers (Rangal Coal Measures, Burngrove Formation) are highly faulted and occur at depths (>30–60 m BGL) that are beyond the rooting capacity of terrestrial vegetation.
- Riparian and floodplain ecosystems are maintained by episodic surface flows and floodplain inundation, not by groundwater.
- No phreatophytic species or other evidence of groundwater dependence were identified during ecological field verification.

This shift from mapping-based precaution to evidence-based assessment is summarised in Table 11: Evolution of GDE Understanding – Curragh Complex**.**

Aspect	Parsons Brinckerhoff (2016) – Assumptions & Mapping	CNBPMP EAR (2024) – Updated Evidence	Current Status for Curragh Complex*
Methodology	Conceptual assessment based on groundwater modelling and Queensland Herbarium mapping; dependence inferred from depth-to-water vs rooting depth.	Numerical groundwater modelling, refined geological datasets, and ecological field verification.	Updated assessment with high confidence, applicable across Curragh Complex.
Aquifer Setting	Focused on saturated alluvium near Mackenzie River and northern Blackwater Creek.	Alluvium generally unsaturated; low transmissivity regolith and bedrock aquifers.	Groundwater availability insufficient to sustain ecosystems.
Classification	<10 m = high potential; 10–20 m = possible; >20 m = unlikely.	Framework validated, but no GDEs verified.	Mapping thresholds no longer identify GDEs at Curragh.
Riparian Vegetation	Assumed possible groundwater access in riparian corridors.	Confirmed reliant on surface water and floodplain processes.	No GDEs present.
Ecosystem Verification	No site-specific evidence collected.	Field surveys confirmed absence of groundwater dependence.	GDEs not present within mine footprint.

*CNBPMP EAR, 2024

Table 11: Evolution of GDE Understanding – Curragh Complex

The eco-hydrogeological relationships between rooting depths, aquifer depths, and groundwater availability across the Curragh Complex are summarised in Table 12. These data confirm that groundwater depths far exceed vegetation rooting capacities, precluding ecological access.

Table 12: Ecological Access to Groundwater – Curragh Complex

Attribute	Rooting Depths	Groundwater Depths	Implication
Riparian eucalypt woodland	5–10 m	>30 m BGL	No groundwater access
Open woodland	<5 m	>30 m BGL (coal measures >60 m)	Reliant on rainfall and episodic surface flows
Floodplain grasses/shrubs	<3 m	>20 m BGL	No ecological access
Aquatic ecosystems	Surface-flow driven	No baseflow contribution	Supported by rainfall and Bedford Weir releases

Groundwater systems in the project area are defined by transmissive but episodic alluvium, low-yield coal measures, and the regionally extensive Rewan Formation aquitard. Water quality declines with depth, with shallow alluvial groundwater ranging from fresh to moderately brackish and deeper coal measures yielding more saline water. Monitoring and modelling demonstrate the absence of functional GDEs, with EVs supported exclusively by rainfall-driven runoff, episodic floodplain inundation, and surface water systems. Predicted mining drawdown remains confined to the deeper coal measures and does not extend to the Mackenzie River or Blackwater Creek alluvium, ensuring protection of identified environmental values under the *EPP (Water and Wetland Biodiversity)*.

3.2.6 Soil Types, Properties and Productivity

The Curragh Complex has been subject to more than three decades of soil and waste characterisation, commencing in 1990 and most recently updated through validation programs in 2020 and 2022. This extensive dataset provides the baseline understanding of soil resources that underpins selective stripping, stockpile management, erosion control, and rehabilitation milestone criteria under this PRCP.

Soils across the Complex are consistent with regional Bowen Basin conditions, dominated by Vertosols and Sodosols, with Dermosols present in the Extension leases. These soil types are well understood in agricultural and mining contexts, with predictable performance under rehabilitation when managed appropriately.

Key characteristics include:

- **Topsoil (A horizons):** The primary source of growth media, typically 0.15–0.30 m in depth, extending locally to ~0.60 m in favourable Vertosol profiles. These horizons are structurally stable, contain higher organic matter, and represent the most valuable resource for rehabilitation.
- **Subsoil (B horizons):** Frequently constrained by sodicity, dispersion, and elevated salinity, with limited fertility. These materials are unsuitable for direct use and are excluded from salvage.
- **Regional limitations:** Fertility is constrained by deficiencies in nitrogen, phosphorus, calcium, magnesium, and zinc. These constraints are consistent with Bowen Basin soils and are managed through fertiliser and amendment programs.

The baseline dataset has been progressively developed through investigations undertaken between 1990 and 2015 (Table 13). These studies confirmed the dominance of Vertosols and Sodosols, shallow effective topsoil depths (10–30 cm), and consistent subsoil limitations including sodicity, dispersion, and salinity.

Year	Consultant / Source	Mining Lease (ML) coverage	Soil Units / Classification	Key Findings & Limitations
1990	Land Resource Survey (LRS)	Curragh Main (ML 700005, ML 70142)	Seven soil mapping units; Vertosols and Sodosols dominant	Seven soil mapping units; Vertosols and Sodosols dominant. Only upper 10–20 cm suitable; subsoils dispersive and saline; fertility limitations
1998	Environmental Health & Safety Systems (EHSS)	Curragh East (ML 700002)	Duplex soils, Vertosols, Sodosols	Duplex soils, Vertosols, Sodosols. Low fertility (N, K, Ca, Mg deficiencies). Sodicity low at surface, increases with depth.
2003	Australasian Resource Consultants (ARC)	Curragh North (ML 80110, ML 80123)	Six soil types grouped into AMUs: Dee, Callide, Maculata, Oombabeer	Six soil types grouped into AMUs. Dee/Callide favourable. Oombabeer constrained by sodicity and texture contrast.
2011	Parsons Brinckerhoff (PB)	Curragh West (ML 700005 extension areas)	Grey duplex soils, Grey-brown clays, Red-brown clays	Grey duplex, grey-brown clays, red-brown clays. Topsoils suitable; subsoils sodic, dispersive
2015	SLR Consulting	Curragh Extension (ML 70415, ML 70458)	Brown and Black Vertosols; Brown Dermosols	Brown/Black Vertosols, Brown Dermosols. Surface soils suitable; subsoils sodic/saline at depth.

Table 13: Historic Soil Investigations – Curragh Complex (1990–2015)

Topsoil Resource and Quality and Quantity (2020-2022)
The 2020–2022 validation programs confirmed that more than 12.9 million m³ of topsoil and growth media are stockpiled across the Curragh Complex, exceeding the ~10.8 million m³ forecast demand under the PRCP.

Topsoil Resource – Quality
Laboratory characterisation (2020–2022) confirmed that stockpiled growth media is chemically and physically suitable for direct use, subject to targeted amendments.
Key findings:

- pH and salinity: Neutral to mildly alkaline, non-saline; elevated pH (>9.0) in some stockpiles reduces zinc availability.
- CEC: Moderate to high, supporting nutrient retention.
- Sodicity: Generally low, though isolated sodic stockpiles (>15% ESP) require gypsum treatment.
- Organic matter: Moderate to high; some stockpiles <1% require compost/organic amendment.
- Nutrients: Nitrogen and phosphorus consistently low; zinc deficiency risk under high pH.

Parameter	Range / Average	Constraint / Risk	Management Implication
pH	7.3–9.2 (avg ~8.2)	High pH limits Zn	Apply Zn fertiliser if >9.0
EC	<0.75 dS/m	No constraint	Direct use
ESP	2–8% (mostly non-sodic)	Isolated >15%	Gypsum amendment
Organic C	0.8–2.5%	<1% in some stockpiles	Organic inputs as required
Total N	<0.1%	Deficient	N fertiliser
Colwell P	4–12 mg/kg	Deficient	Apply MAP/DAP
Vegetation cover	~89%	Stable	Maintain cover

Table 14: Stockpile Chemistry Summary (2020–2022 Investigations)

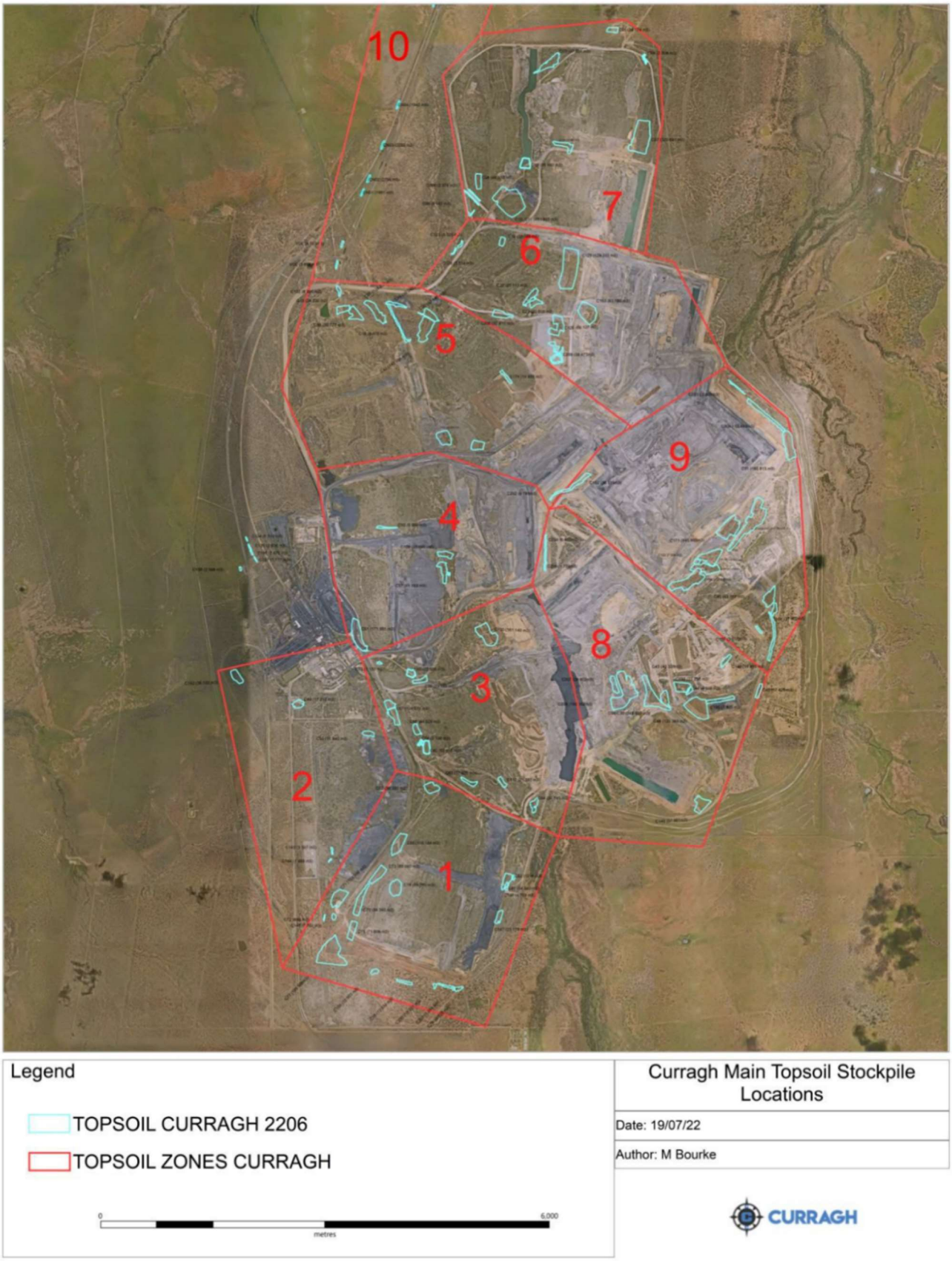

Figure 10: Curragh South Topsoil Stockpile Locations by Zone

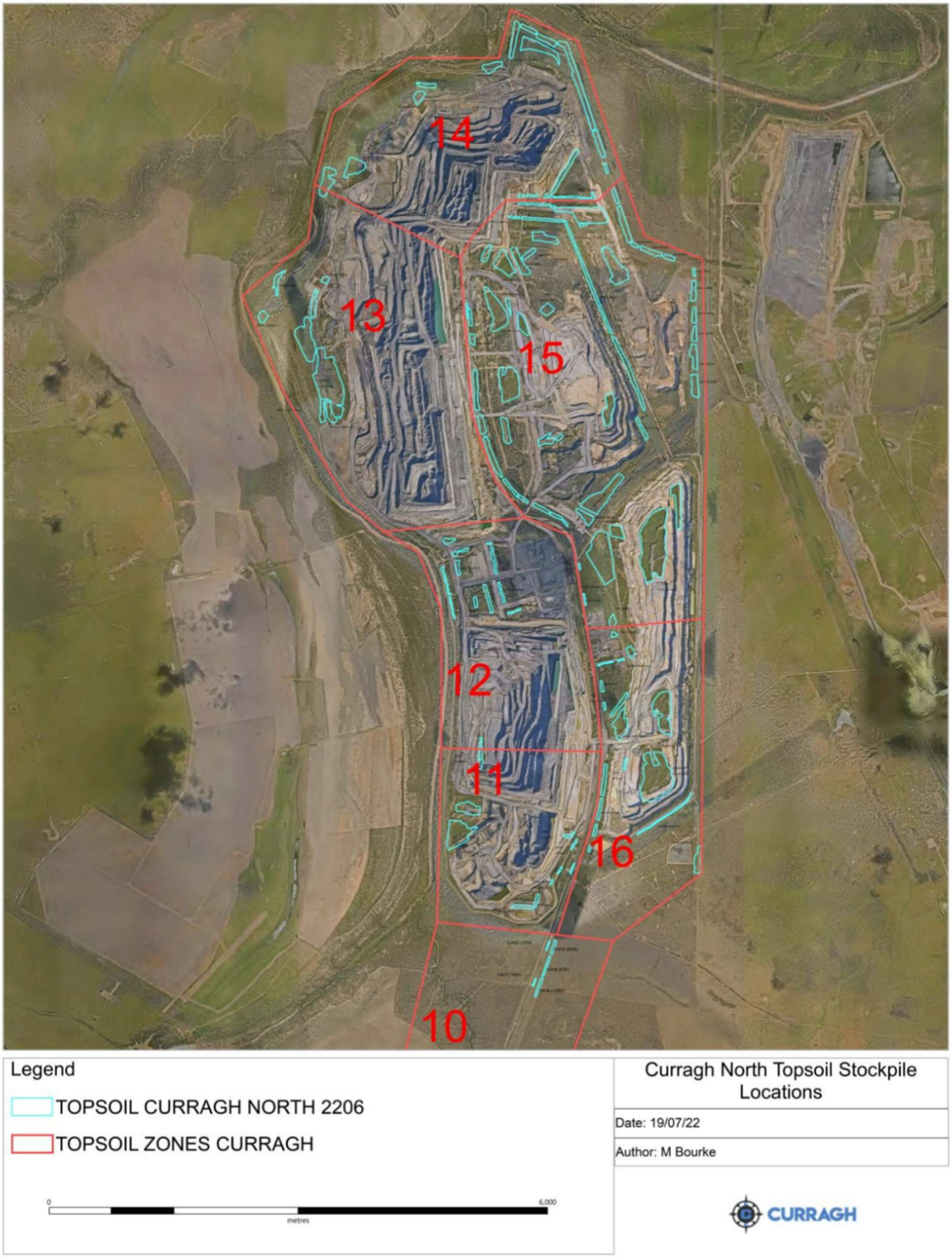

Figure 11: Curragh North Topsoil Stockpile Locations by Zone.

Topsoil Quality Classification Framework

The 2020–2022 assessments divided topsoil into Category A (high quality) and Category B (moderate but suitable) (Appendix H, Table 4). Category A soils meet thresholds for high-quality growth media: neutral pH, non-saline, non-sodic, moderate–high fertility (CEC >12), organic carbon >1.5%, stable in field tests, and >85% cover Table 16). These are direct-use soils that support rapid vegetation establishment and long-term stability. Category B soils exhibit manageable constraints: alkaline pH >8.5, slight salinity (EC 0.75–1.5 dS/m), sodicity (ESP 6–15%), lower organic carbon (0.8–1.5%), and some dispersive behaviour. These remain suitable with amelioration (gypsum, fertiliser, compost, rapid revegetation).

Parameter	Category A (High Quality)	Category B (Moderate Quality)	Reference Benchmarks	Management Implications
pH	7.0–8.5	8.5–9.2	Optimal 6.5–8.5	A: direct use; B: micronutrient amendments (e.g., Zn)
Electrical Conductivity (EC 1:5)	< 0.75 dS/m	0.75 – 1.5 dS/m	Non-saline <0.75; slight salinity 0.75–2.0	A: none; B: species selection & drainage
Exchangeable Sodium Percentage (ESP)	< 6% (non-sodic)	6–15% (sodic); >15% strongly sodic	Sodic >6%; dispersive risk >15%	A: none; B: gypsum addition
Cation Exchange Capacity (CEC)	> 12 meq/100 g	6 – 12 meq/100 g	Brigalow Belt soils low fertility <12	A: supports growth directly; B: fertiliser programs
Organic Carbon (%)	> 1.5%	0.8 – 1.5%	>1.5% indicates fertility and stability	A: direct use; B: compost or organic amendments

Table 15 Topsoil Quality Classification Framework

Soils by Project Area

Detailed investigations at Curragh Main, East, North, West, and Extension confirm consistent patterns:

- Curragh Main: Seven soil mapping units identified (LRS, 1990). Grey-brown clays over calcareous material provide the most favourable growth media (~0–60 cm). Melonhole clays and grey-brown cracking clays unsuitable due to dispersivity and chloride content.
- Curragh East: (EHSS, 1998). Duplex soils and Vertosols provide limited recoverable horizons (0.15–0.25 m). Sodosols unsuitable due to strong dispersivity.
- Curragh North: (ARC, 2003). Dee and Callide AMUs favourable; Oombabeer strongly sodic and unsuitable. Consistency with Australian Soil Classification and AMUs (Table 21).
- Curragh West: (PB, 2011). Grey duplex and red-brown clays provide shallow recoverable horizons; dispersivity restricts deeper subsoils.
- Curragh Extension: (SLR, 2015). Brown/Black Vertosols and Brown Dermosols provide usable horizons (0.20–0.30 m); subsoils limited by salinity and sodicity.

Land Suitability and Capability

Land suitability and capability assessments have been undertaken across the Curragh Complex to evaluate the potential of soils to sustain agricultural and grazing uses both pre-mining and post-mining. These assessments were first established for the Curragh North EIS (Australasian Resource Consultants, 2003) and were subsequently updated by Coronado (2021) to reflect progressive knowledge and expanded mine footprint coverage. Together, these assessments confirm that soils within the Curragh Complex are consistent with broader Bowen Basin conditions and demonstrate predictable performance under rehabilitation management.

Pre-Mining Land Suitability

Prior to mining, the soils of the Curragh Complex were predominantly assessed as Class 3, being suitable for cropping with moderate limitations, and Class 2–3, supporting grazing under moderate constraints. Smaller pockets were mapped as Class 2, indicating moderate potential for cropping, while more marginal land units were assigned to Class 4, which is primarily suited to grazing. The principal limitations constraining land use capability included shallow effective topsoil depths, typically ranging between 0.15 and 0.30 metres, together with subsoil conditions characterised by sodicity, salinity and dispersivity. In addition, nutrient deficiencies were consistently observed, particularly with respect to nitrogen, phosphorus, calcium, magnesium and zinc.

A representative assessment of the Curragh North area illustrates this distribution (Table 16), with approximately 3.0 per cent of land classified as Class 2 for cropping (Class 1 for grazing), 68.6 per cent as Class 3 for cropping (Class 2 for grazing), and 28.4 per cent as Class 4 for cropping (Class 3 for grazing). This distribution is consistent with the broader Curragh Complex and reflects the moderate to high constraints present in the pre-mining landscape.

Suitability for Cropping	Suitability for Grazing	Percentage of Project Area
2	**1**	**3.0**
3	2	68.6
4	3	28.4

Table 16: Pre-Mining Land Suitability Classes – Curragh North Mine

Following mining disturbance, the land capability transitions predominantly to pastoral outcomes rather than cropping. This shift reflects both the inherent limitations of the pre-mining soils and the effects of disturbance, which include restricted depths of recoverable topsoil, altered spoil chemistry and subsoil sodicity and salinity. Notwithstanding these limitations, the volume and quality of salvaged growth media are sufficient to support the re-establishment of sustainable Light Grazing and Open Woodland Habitat post-mining land uses (PMLUs) across the Curragh Complex.

The updated land capability assessment (Coronado, 2021) confirmed that post-mining capability is dominated by Class VII, with only limited areas of Class IV and isolated pockets of Class VIII (Table 17). Specifically, 89 hectares were assessed as Class IV, which is land primarily suitable for pastoral use but occasionally capable of supporting cropping; 1,823 hectares were classified as Class VII, suitable only for limited pastoral use; and 10,789 hectares were assessed as Class VIII, being unsuitable for agriculture or grazing. This outcome is consistent with regional expectations for mined land within the Bowen Basin.

Class	Description	Hectares
IV	Land primarily suitable for pastoral use but may be cropped occasionally	89
VII	Land not suitable for cropping; only limited pastoral use possible	1,823
VIII	Land unsuitable for agriculture or grazing	10,789

Table 17: Post-Mining Land Capability Classes – Curragh Complex (Coronado Curragh, 2021)

3.2.7 Ecological Values

Ecological values within the Curragh Complex comprise the terrestrial flora, fauna and habitat features shaped by the Brigalow Belt landscape, historic land use, and the distribution of remnant vegetation. This section draws on historical ecological assessments undertaken by AARC (1998, 2001, 2003), supported by verified Regional Ecosystem mapping and site observations.

3.2.7.1 Flora

The Curragh Complex occurs within the Brigalow Belt Bioregion, a landscape characterised by Brigalow (*Acacia harpophylla*) woodlands, Poplar Box (*Eucalyptus populnea*) communities and extensive historically cleared grasslands. Historical flora surveys undertaken by AARC identified six distinct vegetation communities, which correspond to the Regional Ecosystems listed in Table 18 and mapped spatially in Figure 12.
Recorded vegetation communities included:

- Fringing River Red Gum (*Eucalyptus camaldulensis*) tall woodland, occurring on alluvial plains along riparian corridors.
- Open Coolabah (*Eucalyptus coolabah*) woodland with a grassy understorey.
- Brigalow (*Acacia harpophylla*) woodland with Yellowwood (*Terminalia oblongata*), including patches consistent with the Brigalow Threatened Ecological Community (TEC) listed under the EPBC Act.
- Poplar Box (*Eucalyptus populnea*) and Dallachy's Gum (*Corymbia dallachiana*) open woodland.
- Lemon-scented Gum (*Corymbia citriodora*) woodland with Rosewood (*Acacia rhodoxylon*).
- Open grassland with scattered trees, predominantly occurring in historically cleared and grazing-modified areas.

Riparian vegetation along the Mackenzie River and Blackwater Creek provides important ecological connectivity and contributes to landscape-scale biodiversity. River Red Gum and Coolabah woodlands support a mix of structural habitat niches, complementing adjacent woodland and grassland communities.
These riparian areas form integral components of future rehabilitation planning and will continue to support ecological values under the PRCP through stabilised landforms, improved groundcover, and progressive weed management.

RE Code	VM Act Status	Biodiversity status	REDD Short Description
RE 11.3.1	Endangered	Endangered	Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains
RE11.4.8	Endangered	Endangered	Eucalyptus cambageana woodland to open forest with Acacia harpophylla or A. argyrodendron on Cainozoic clay plains
RE11.4.9	Endangered	Endangered	Acacia harpophylla shrubby woodland with Terminalia oblongata on Cainozoic clay plains
RE 11.4.7 (field mapped)	Endangered	Endangered	Eucalyptus populnea with Acacia harpophylla and/or Casuarina cristata open forest to woodland on Cainozoic clay plains
RE 11.3.3	Of Concern	Of Concern	Eucalyptus coolabah woodland on alluvial plains
RE 11.3.25	Least Concern	Of Concern	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines
RE 11.7.1 (field mapped)	Least Concern	Of Concern	Acacia harpophylla and/or Casuarina cristata and Eucalyptus thozetiana or E. microcarpa woodland on lower scarp slopes on Cainozoic lateritic duricrust

Table 18: Regional Ecosystem Classes present at Curragh Mine

The vegetation communities present offer a strong ecological benchmark that guides rehabilitation design, supporting the establishment of stable landforms, appropriate soil profiles and native vegetation consistent with the broader Brigalow Belt landscape.

3.2.7.2 Fauna

AARC surveys recorded 198 fauna species across the Curragh Complex, reflecting the diversity and adaptability of Brigalow Belt ecosystems. The recorded fauna includes:

- 14 butterflies
- 15 amphibians
- 22 reptiles
- 120 birds
- 27 mammals

This species richness demonstrates the ecological connectivity of woodland, riparian and grassland habitats present within the mine footprint and surrounding landscape.

3.2.7.3 Species of Conservation Significance

- Several species of conservation significance either occur within, or have suitable habitat across, the Curragh Complex. These include:
- Squatter Pigeon (*Geophaps scripta scripta*) – Vulnerable
  Supported by open woodland and grassland habitats with accessible groundcover and nearby water sources.
- Ornamental Snake (*Denisonia maculata*) – Vulnerable
  Found within cracking clays and gilgai microhabitats, particularly where Brigalow and grassland ecosystems intersect.
- Yakka Skink (*Egernia rugosa*) – Vulnerable
  Associated with deep-soil woodlands and Brigalow habitats. While not recorded during earlier surveys, high-quality potential habitat exists within mapped Brigalow REs (Figure 3.14).
  Rehabilitation design will enhance opportunities for this species by incorporating coarse woody debris, log piles, and groundcover mosaics.
- Brigalow Scaly-Foot (*Paradelma orientalis*) – historically listed, closely associated with Brigalow ecosystems.
- Little Pied Bat (*Chalinolobus picatus*) – historically recorded, indicative of the region's woodland fauna.

3.2.7.4 Habitat Values

- The Curragh Complex contains a range of habitat types that collectively support ecological connectivity and biodiversity. Key habitat values include:
- Riparian corridors along the Mackenzie River and Blackwater Creek that provide movement pathways, moisture gradients and seasonal resources for fauna.
- Brigalow remnants, including areas corresponding to the EPBC-listed TEC, which form valuable habitat refuges and support potential occupancy for threatened reptile species.
- Woodland and grassland ecosystems, which contribute to habitat heterogeneity and support species such as the Squatter Pigeon.
- Cracking clay and gilgai systems, important microhabitats for the Ornamental Snake and providing suitable conditions for the Yakka Skink.
- These habitat values provide clear ecological reference points for PRCP rehabilitation strategies, guiding species selection, groundcover establishment, and structural habitat design.

3.2.7.5 Declared Weeds

Declared weeds have been recorded throughout the Curragh Complex, reflecting typical Brigalow Belt land use patterns. Although present, their distribution is manageable and contributes to a clear baseline for ongoing improvement under the PRCP. Field surveys identified six declared pest species listed under the *Land Protection (Pest and Stock Route Management) Act 2002*.

- Targeted weed management during rehabilitation will support:
- stronger native groundcover establishment,
- improved soil stability,
- increased success of woodland and grassland PMLUs, and
- long-term ecosystem resilience.

3.2.7.6 Environmental Management Areas

Curragh has five environmental management areas (Figure 13) that are requirements of conditions of approval under the two separate referrals under the Commonwealth *EPBC Act 1999*. These environmental management areas and the relevant referrals involve:

- Curragh North Coal Mine (EPBC 2003/1096).
    - Brigalow Management Area (55ha) – Condition 2,
    - Brigalow Rehabilitation Area (37ha) – Condition 2, and
    - Transport Corridor Management Area (17ha) – Condition 1.
- Blackwater Creek Diversion and Coal Mine (EPBC2007/3925).
    - Northern Brigalow Area (44.9ha) – Condition 1, and
    - Northern Brigalow Revegetation Area (21.4ha) – Condition 1.

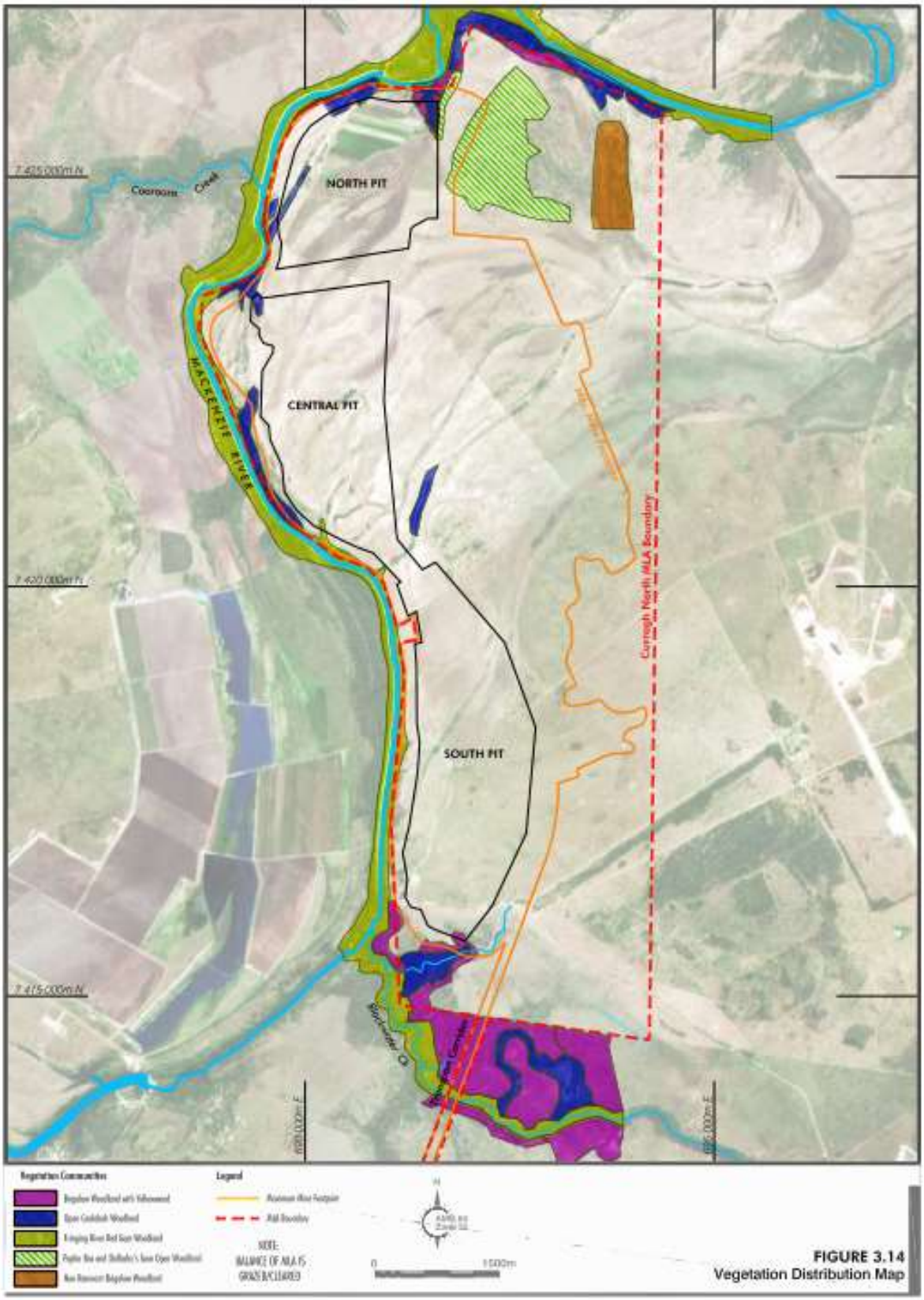

Figure 12: Vegetation Communities mapped for Curragh North

Figure 13: Environmental Management Areas at Curragh Mine

3.2.8 Pre-Mining Land Use

The Curragh Complex is situated within the Central Highlands Regional Council Local Government Area (LGA), approximately 30 km north of Blackwater in Central Queensland. Prior to mining, land use across the area reflected the broader regional landscape, which is characterised by a mix of low-intensity cattle grazing, irrigated cultivation, and dispersed domestic, industrial and pastoral activities (Coronado Global Resources, 2019).

The predominant land use across the Curragh mining leases was beef cattle grazing, supported by extensive open grasslands and cleared clay-plain landscapes. A smaller area at the north-eastern extent of the site had been historically developed for irrigated cultivation, reflecting access to suitable soils and proximity to existing water infrastructure.

Across the broader Curragh Complex, pre-mining land use comprised:

- 85% beef cattle grazing
- 11% conservation or minimally disturbed vegetation (primarily along ridgelines and riparian corridors)
- 4% disturbed areas, including tracks, fencelines and rural infrastructure
  (Coronado Curragh, 2019)

Extensive clearing associated with pastoral development resulted in a landscape where intact remnant vegetation was largely retained along major creek lines, higher ridgelines and isolated woodland refuges, with more open plains exhibiting highly fragmented native vegetation. These pre-mining land uses and landscape patterns provide the contextual baseline for the PRCP, informing the selection of post-mining land uses, rehabilitation objectives and land capability assessments.

3.2.9 Underlying Landholders

Within Curragh North, portions of land are held in freehold ownership by *Peter Dunn*, while in Curragh East, certain parcels are owned by the *State of Queensland* (Figure 14). This tenure arrangement reflects the predominance of CCPL freehold ownership across the Curragh Complex, supplemented by limited areas of private and State-owned land within the lease boundaries. Overlapping Tenure. Overlapping petroleum tenure exists over the southern extents of the CCPL tenements. Under MERCPA 2014 legislation this entails annual information exchange and the provision and maintenance of Joint Information Management Plans with the overlapping tenement holder.

Sensitive Receptors

There are 13 sensitive receptors surrounding the Curragh Complex, these are shown in Figure 15.

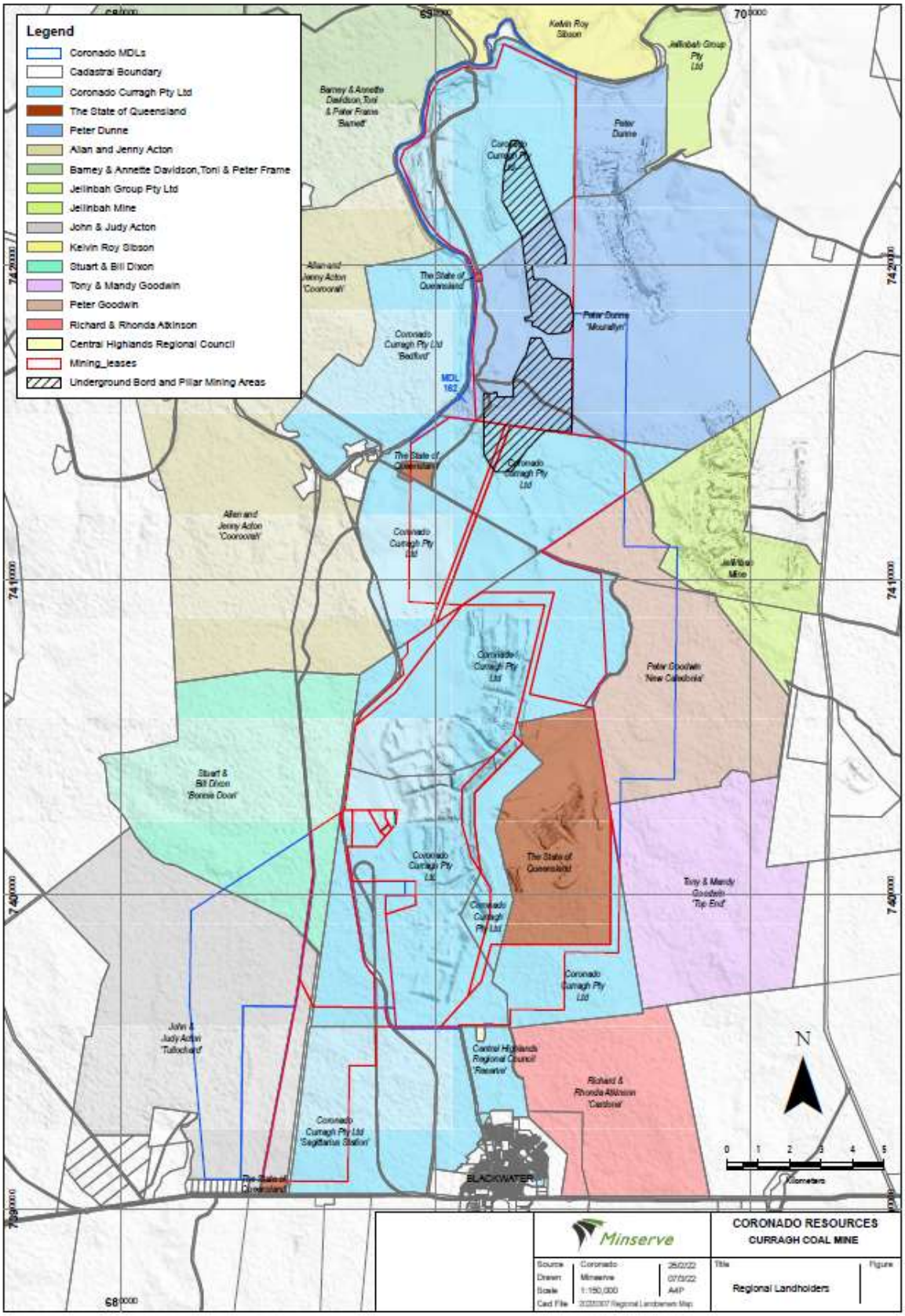

Figure 14:Underlying land holders

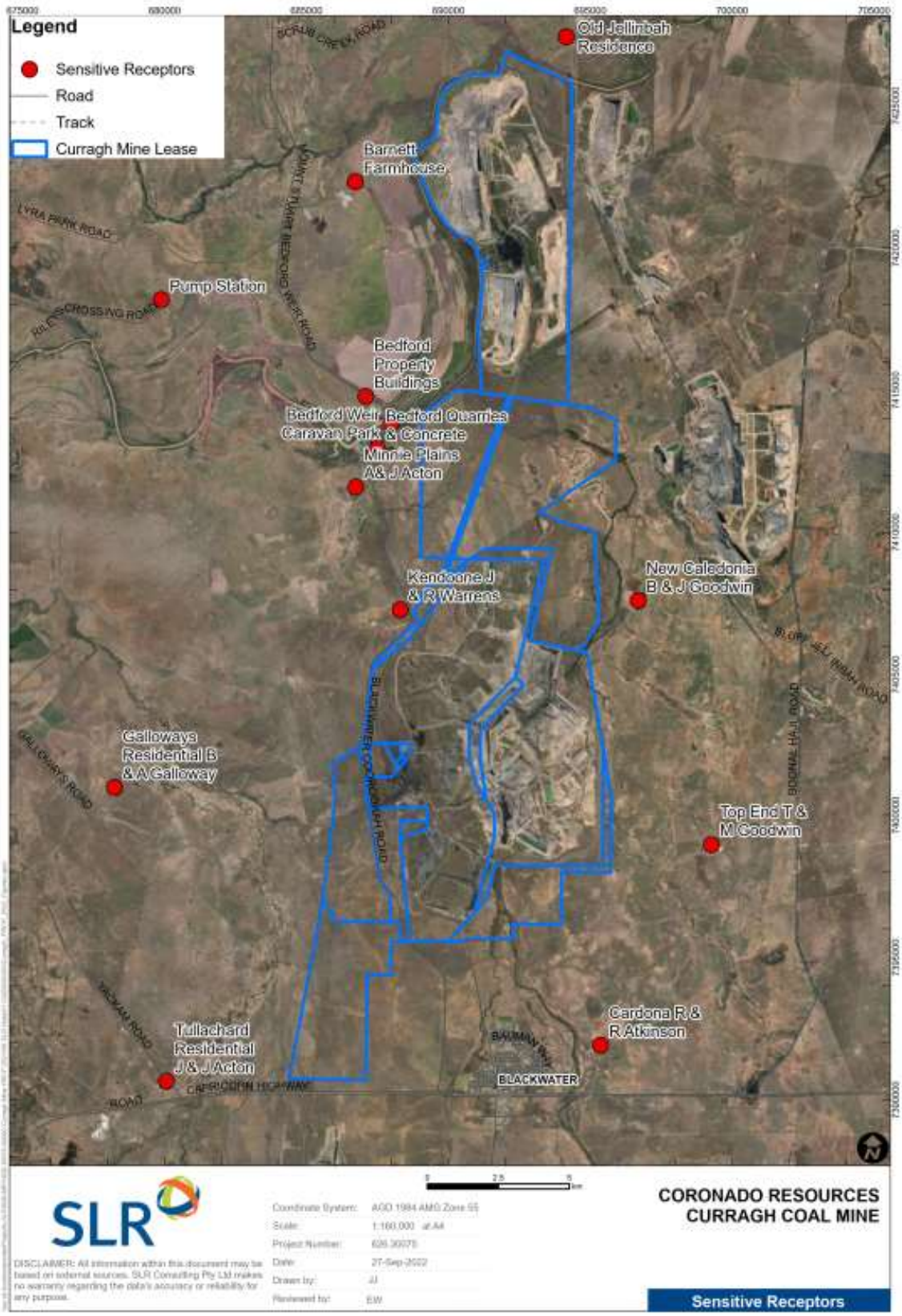

Figure 15: Sensitive Receptors

3.3 Design for Closure

The Curragh Complex PRC Plan has been prepared under the transitional PRC Plan arrangements of the *Environmental Protection Act 1994 (Qld)*. Under the standard PRCP framework, proponents must demonstrate full integration of closure considerations across all aspects of mine planning, with explicit linkages between site design, progressive rehabilitation and final landform outcomes. In contrast, transitional PRC Plans are not required to retrospectively demonstrate design-for-closure for existing or previously approved disturbance areas (PRCP Guideline, Section 3.1).

Despite operating under these transitional provisions, the Curragh PRC Plan has been intentionally developed to align with the intent and guiding principles of the PRCP framework. Progressive rehabilitation has been systematically incorporated into operational planning, with milestone criteria designed to be realistic, measurable and achievable. The plan emphasises:

- minimising long-term management requirements
- reducing closure liabilities and whole-of-life costs
- delivering stable, sustainable and fit-for-purpose post-mining landscapes
- ensuring rehabilitation outcomes remain consistent with the environmental protection and sustainability objectives of the *Environmental Protection Act 1994 (Qld)*.

A design-for-closure philosophy underpins the structure and implementation of this PRC Plan. Key elements of this approach include:

- Stakeholder engagement to identify appropriate Post-Mining Land Uses (PMLUs) and non-use management areas (NUMAs).
- Risk-informed rehabilitation planning, with practices targeted to the physical, environmental and operational risks that may influence the achievement of milestone criteria.
- Clear rehabilitation trajectories, demonstrating how landforms will transition from active operations to stable, self-sustaining post-mining landscapes.
- Integration with broader mine planning, ensuring rehabilitation actions are coordinated with sequence planning, resource extraction and progressive landform development.

Although subject to transitional arrangements, this PRC Plan reflects a forward-looking, transparent and accountable approach to closure. It ensures that Curragh's rehabilitation and closure outcomes are strategically aligned with long-term regulatory requirements, contemporary expectations for mine closure, and the principles of ecologically sustainable development.

3.4 Rehabilitation Planning

3.4.1 Relevant activities requiring rehabilitation

The relevant activities at Curragh Mine that will require rehabilitation, their predicted operational duration, and the availability for progressive rehabilitation are summarised in Table 19. Infrastructure that is beneficial to the agreed PMLU may be retained and, where retained, will not be available for rehabilitation.

Relevant Activity	Operational Duration	Progressive Rehabilitation Availability
Spoil dumps	Active spoil placement and reshaping will continue until the end of mining (currently 2046).	Rehabilitation becomes available as final dump faces are reached and reshaping/contouring is completed. Progressive rehabilitation is staged in alignment with milestone criteria and mine sequencing.
CHPP and associated infrastructure and coal stockpiles	Required until cessation of coal processing.	Rehabilitation is available once coal processing ceases and associated infrastructure is decommissioned.
Workshops, buildings and other operational infrastructure	Varies; final components remain in use until cessation of mining.	Rehabilitation timing depends on the designated PMLU. Infrastructure no longer required will be progressively decommissioned, with opportunities for beneficial re-use where consistent with the PRCP.
Mine dams	Required throughout mining for operational and water-management functions.	Rehabilitation or retention depends on long-term hydrological function. Dams may be retained, decommissioned, reshaped or revegetated based on final landform and water-management needs.
Train load-out (TLO) and rail infrastructure (Aurizon-owned)	Utilised until the end of coal transport activities.	Land becomes available for rehabilitation once coal loading is complete and infrastructure is removed by the third-party owner.
Roads, laydown areas and general disturbance areas	Varies; some areas remain in use until cessation of mining.	Rehabilitation depends on location and PMLU. Roads and disturbed areas no longer required may be repurposed for beneficial use or rehabilitated in accordance with milestone criteria.
Exploration disturbance	Varies across mining leases according to exploration programs.	Exploration pads, drill sites and tracks are progressively rehabilitated as exploration activities are completed.
Creek diversions and crossings	Varies according to mining sequence and operational requirements.	Rehabilitation is available once diversions are no longer required. Final works include reshaping, stabilisation and integration with the final landform and catchment design.
Tailings storage facilities (TSFs)	Varies depending on deposition schedules and design capacity.	Progressive rehabilitation occurs as TSF cells reach capacity. Final rehabilitation includes capping, shaping, drainage controls and revegetation.
Residual voids	Utilised until the end of mining operations.	Residual voids will form NUMAs. Rehabilitation of surrounding low-wall spoil will occur progressively, with NUMA improvement works available once adjacent rehabilitation is complete. Long-term management focuses on safety, bunding, geochemical performance and landform stability.

Table 19: Predicted Duration of Activities

All areas are included in the PRCP schedule for rehabilitation as soon as practicable after land becomes available. For infrastructure and general disturbance areas, rehabilitation is scheduled in the year following land availability to allow for final planning. Spoil dump areas are scheduled within two years of becoming available, to allow for final settlement, detailed planning, and the allocation of resources (consistent with EA condition E4). Management milestones for residual voids are scheduled to commence once each void becomes available for improvement, following completion of final mining and backfilling activities.

3.4.2 Rehabilitation Areas and Milestones

Rehabilitation Areas (RAs) and Rehabilitation Milestones (RMs) for the Curragh Complex have been defined in accordance with the PRCP Guideline (DES, 2019) and the transitional provisions of the EP Act. This framework provides the statutory basis for:

- allocating authorised disturbance areas to a nominated Post-Mining Land Use (PMLU)
- identifying areas where rehabilitation obligations apply
- establishing measurable Rehabilitation Milestones (RMs)
- demonstrating progressive rehabilitation across the life of mine.

An RA represents an area of authorised disturbance that must be rehabilitated to the nominated PMLU. A RM represents a measurable and significant step toward establishing a safe, stable, non-polluting and sustainable post-mining condition consistent with section 110 of the EP Act.

Consistent with the PRCP Guideline, RAs are only mapped over authorised disturbance areas. Undisturbed or naturally retained areas are not assigned an RA, as they are expected to remain in their existing state. Should future mine planning identify additional disturbance, these areas would be incorporated through the EA amendment and PRCP amendment processes, ensuring rehabilitation commitments remain aligned with current approvals.

To support ongoing operations, certain ancillary and exploration activities may occur outside mapped RAs without requiring a formal PRCP amendment. These include:

- access tracks, minor roads and culverts
- services, telecommunications, power and pipelines
- monitoring pads, environmental infrastructure and bores
- exploration drill pads, lines and associated tracks

These activities are undertaken in accordance with the Eligibility Criteria and Standard Conditions for Exploration and Mineral Development Projects (DEHP, 2016 or successor) and must be rehabilitated to a stable condition compatible with the surrounding PMLU.
The full set of Rehabilitation Areas, associated domains, and nominated PMLUs is provided in Table 21, with spatial representation in Figure 16. These areas form the foundation of all rehabilitation scheduling, milestone tracking and closure performance assessment.
Across the Curragh Complex, the mapped rehabilitation areas comprise:

- Rehabilitation Areas (RAs): 14,965 ha
- Improvement Areas (IAs): 1,691.8 ha

Improvement Areas include residual voids, geotechnical setback zones, permanent safety bunds and associated exclusion areas. These features do not support revegetation-based rehabilitation but require long-term management to ensure safety and environmental stability.

The combined area subject to closure management under the PRCP therefore totals 16,657.5 ha (Table 20).

Rehabilitation Area (RA)	Area (ha)	PMLU	Domain
RA1	5,341.1	Open Woodland	Overburden Dumps and Ramps (<15%)
RA2	2,538.0	Light Grazing	Overburden Dumps and Ramps (>15%)
RA3	2,273.6	Light Grazing	Process and Mine Infrastructure Areas
RA4	1,693.7	Light Grazing	Infrastructure and Miscellaneous Activities
RA5	96.8	Light Grazing	Water Infrastructure
RA6	73.5	Open Woodland (Watercourse)	Watercourse Diversion (Approved, Not Constructed)
RA7	176.5	Flood Protection	Flood Protection Landform
RA8	264.7	Grassland and Shrubs	In-Pit TSF
RA9	185.0	Grassland and Shrubs	Out-of-Pit TSF
RA10	263.7	Light Grazing	Bord and Pillar Underground
RA11	1,873.8	Light Grazing and Open Woodland	Existing Rehabilitation
RA12	185.4	Open Woodland (Watercourse)	Blackwater Creek Diversion – Existing Rehabilitation
IA1	1691.8	N/A	Residual voids, geotechnical setbacks, safety bunds and fencing
RA Total	**1495 ha**		
RA an IA Total	**16,657.5 ha**		

Table 20 Rehabilitation and Improvement Areas by Domain

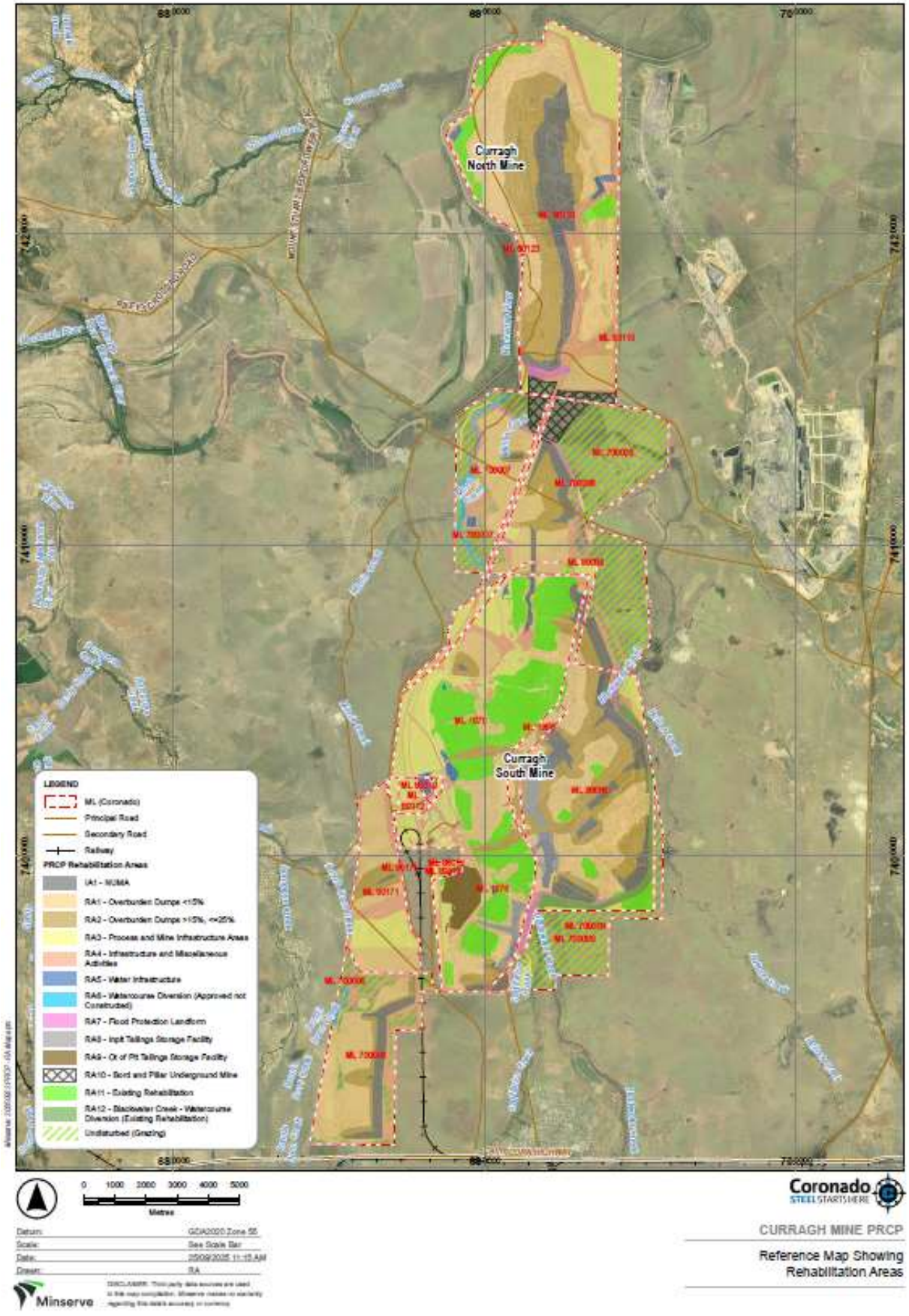

Figure 16: Curragh Complex Rehabilitation Areas

3.4.3 Improvement Areas and Management Milestones

The Improvement Areas (IAs) and Management Milestones (MMs) included in the PRCP Schedule for Curragh Mine are referenced throughout this PRC Plan and form an essential component of long-term closure management for areas that cannot achieve a rehabilitated PMLU.

An IA is defined in the PRCP Guideline as:
"an area of land in the Non-Use Management Area (NUMA) to which a management milestone for the NUMA relates."
A Management Milestone (MM) is defined as:
"each significant event or step necessary to achieve best-practice management of the area and to minimise risks to the environment, consistent with section 112 of the EP Act."

For transitional PRCPs such as the Curragh PRCP, IAs and MMs apply only to approved disturbance areas. Undisturbed land is not allocated as an IA and may be incorporated into closure planning only through the EA amendment and PRCP amendment pathways, should mine planning identify additional disturbance requiring formal assessment.

At the Curragh Complex, residual voids constitute the designated NUMAs, including the associated geotechnical setback zones, perimeter bunding and long-term fencing required to ensure safety, stability and controlled access. These areas are not required to achieve a rehabilitated PMLU but must be managed to ensure long-term geotechnical stability, geochemical stability and environmental protection through the implementation of defined MM requirements. Key management considerations include:

- maintaining long-term geotechnical stability, including low-wall and high-wall behaviour
- ensuring geochemical stability, including water quality management and material performance
- minimising environmental risks, such as erosion, sediment mobilisation and surface water interaction
- applying long-term safety controls, including bunding, fencing, signage and restricted access
- implementing ongoing monitoring and performance verification consistent with MM requirements

The Improvement Areas and associated management activities are summarised in Table 21 and spatially represented in Figure 17. Descriptions of the Management Milestones applicable to each IA are provided in Table 22, which outline the significant steps required to achieve best-practice management in accordance with the EP Act.

Table 21: Improvement Area Milestones for Curragh Complex

Improvement Area (IA)	NUMA	Domain	Area Iha)
IA1	NUMA	Residual voids, geotechnical setbacks, safety bunds and fencing	1691.8

Table 22 Management Milestone for Curragh Complex

Management Milestone	Description
MM1	Achievement of structural stability
MM2	Achievement of surface requirements
MM3	Achievement of sufficient improvement

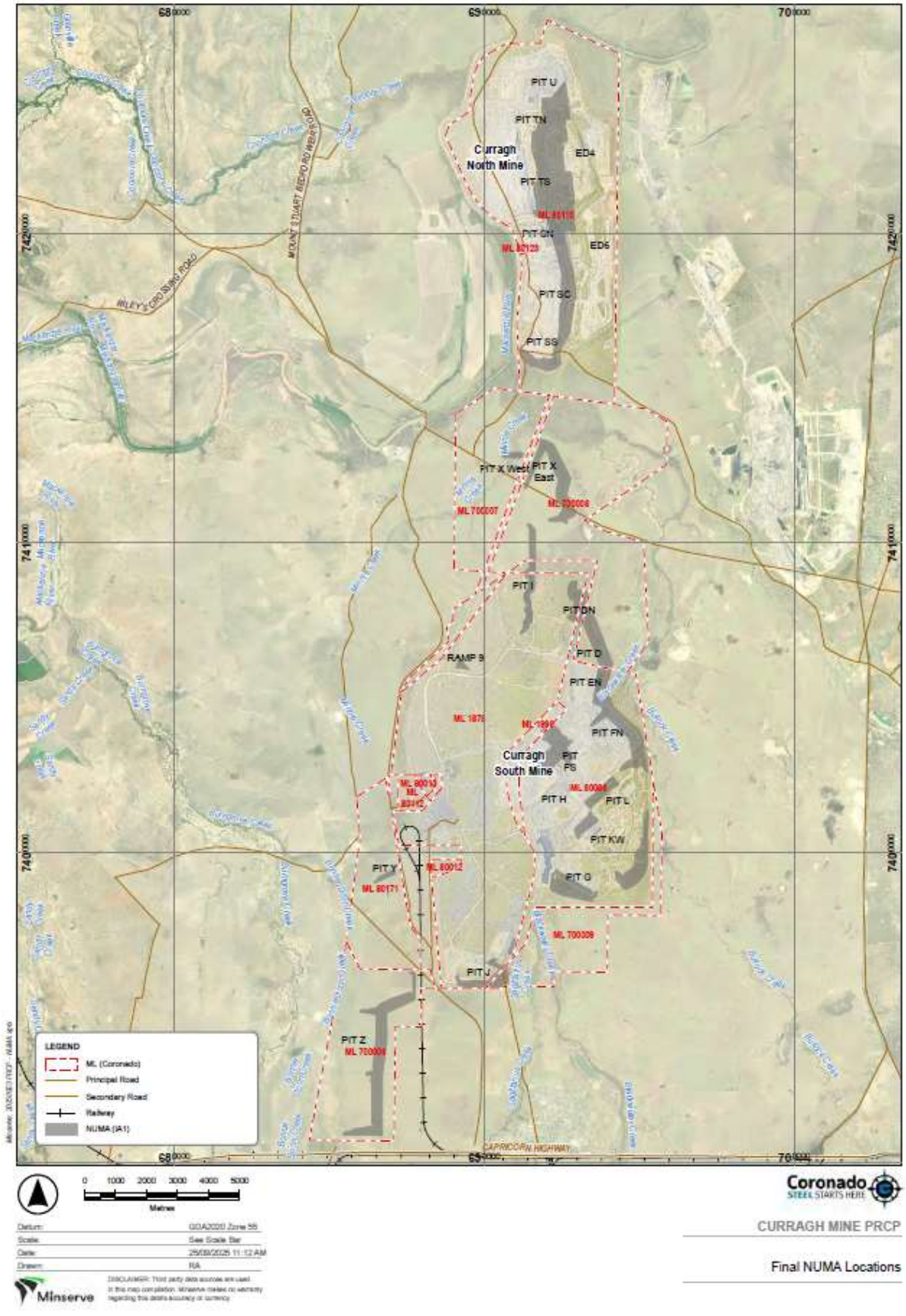

Figure 17: Curragh Complex Improvement Areas

3.4.4 Existing Rehabilitation

Progressive rehabilitation has been undertaken at the Curragh Complex since 1988, with rehabilitation practices evolving over time to align with contemporary standards for landform stability, vegetation establishment and post-mining land use outcomes. Formal monitoring of rehabilitation performance commenced under the University of Queensland's Centre for Mined Land Rehabilitation (CMLR) between 2002 and 2016, followed by ongoing monitoring conducted by WSP since 2019.

As defined in the PRCP Schedule, the Curragh Complex currently contains a total of 2,059 ha of existing rehabilitation, comprising:

- 1,874 ha of established overburden rehabilitation mapped as RA11 – Existing Rehabilitation, and
- 185.4 ha of completed rehabilitation associated with the Blackwater Creek Diversion, mapped as RA12 – Existing Rehabilitation (Blackwater Creek Diversion).

These areas are spatially illustrated in Figure 20 – Existing Rehabilitation Areas, which depicts the distribution of legacy rehabilitation across Curragh North and Curragh South within the authorised mining leases.

Historical Assessment of Certification Potential

To support future progressive certification opportunities, WSP undertook a detailed assessment in 2019 to identify legacy rehabilitation areas with potential to meet the criteria for certification under the EP Act. The assessment focused on six rehabilitation areas previously nominated by CCPL:

- Ramp 4 North (2005)
- Ramp 2 North (2002)
- Ramp 2 North SW (2000)
- Ramp 7 North (1992)
- Ramp 9 North (1999)
- Ramp 13 West (2008)

Using a combination of GIS and remote sensing analysis validated through field-based monitoring, WSP concluded that approximately 75.4 ha of these areas demonstrated sufficient maturity to progress toward certification, subject to targeted improvement actions and ongoing monitoring.

Recent Rehabilitation Monitoring Outcomes

WSP monitoring completed in 2020, 2021 and 2024 confirms that existing rehabilitation is progressing toward the required Rehabilitation Milestones (RMs) defined in the PRCP Schedule. While these areas do not yet meet all completion criteria, performance trends indicate a positive trajectory toward long-term stability and ecological function. Recommendations to further improve rehabilitation outcomes include:

- Retaining and refining the topsoil/spoil strip rehabilitation method, which continues to perform well in achieving native tree and shrub establishment and maintaining landform stability aligned with Open Woodland and Light Grazing PMLUs.
- Establishing additional reference sites representative of Light Grazing and Open Woodland PMLUs to support comparative performance assessments.
- Applying 100% topsoil to areas targeting a grassland-dominant grazing outcome.
- Investigating and remediating recalcitrant bare areas (>0.1 ha) through soil testing, targeted amendments and reseeding.
- Avoiding the inclusion of buffel grass in seed mixes due to its potential to suppress native woody species recruitment and alter the intended vegetation trajectory.

Alignment with PRCP Requirements

Existing rehabilitation areas (RA11 and RA12) are subject to defined Rehabilitation Milestones in the PRCP Schedule, including:

- achieving safe and stable landforms with a Factor of Safety (FoS) > 1.5,
- establishing ≥80% groundcover,
- achieving minimum native species richness thresholds (grasses and shade trees),
- demonstrating erosion performance no greater than “moderate”, and
- meeting relevant BioCondition score thresholds consistent with the nominated Light Grazing and Open Woodland PMLUs.

The monitoring results to date indicate that existing rehabilitation is on a credible pathway to achieving these outcomes, providing an evidence-based foundation for future applications for progressive certification and supporting the long-term objectives of the PRCP.

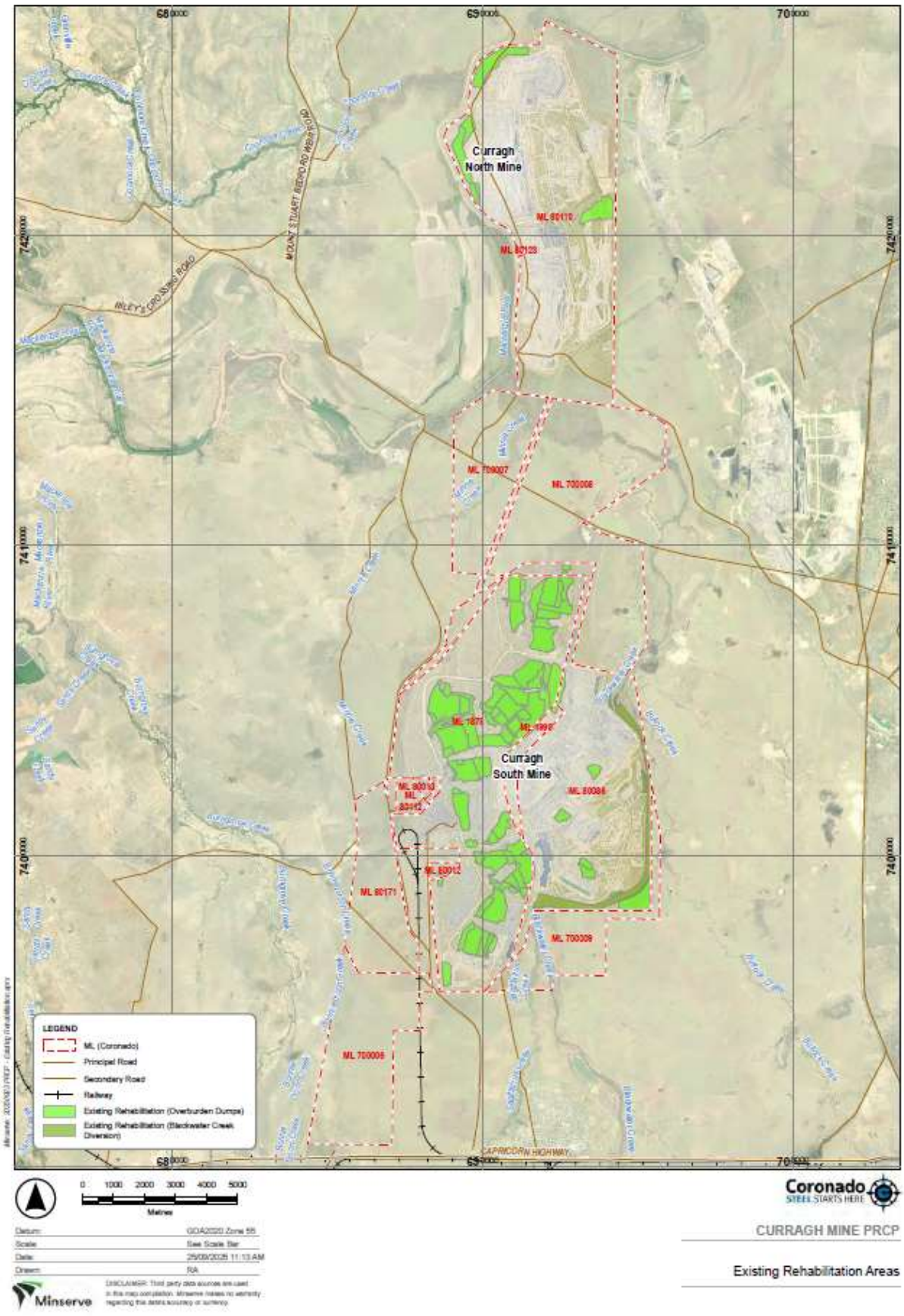

Figure 18: Existing Rehabilitation at Curragh Complex

3.4.5 Availability for Progressive Rehabilitation

Spoil dumps are the primary areas progressively available for rehabilitation during mining at Curragh Mine. As mining advances down-dip and pits deepen, spoil dumps increase in height to accommodate larger volumes of spoil material. This maximises in-pit capacity and reduces the need for out-of-pit dumping. However, given the scale of the spoil dumps, only a small proportion of the operational dump surface is available for rehabilitation at any one time. Rehabilitation availability is therefore inherently staged, reflecting the sequencing of spoil placement and final landform development.

The availability of land for rehabilitation is influenced by a combination of operational and geotechnical factors:

- Multiple dump faces and access ramps: Spoil placement occurs across several dump benches, each requiring access ramps for haulage. As mining advances, ramp locations shift, constraining the footprint available for progressive rehabilitation until the ramps are no longer required. Ramp voids are typically backfilled at the end of mining, making these areas available only at that stage.
- Geotechnical stability: Lower dump benches must achieve sufficient stand-off distance and consolidation before final cover systems can be safely placed. Early in the mine life, this limits the extent of progressive rehabilitation, but as dump construction advances, larger contiguous surfaces become available for treatment.
- Advancing low-wall dumps: Low-wall dumps advance with mining and increase in height as spoil is placed. Rehabilitation of low-wall areas cannot occur until adjacent mining ceases and final void backfilling is complete.

As a result, spoil dumps do not become available for rehabilitation in a uniform or linear manner. Instead, availability is variable and staged. In the early years of mining, opportunities are limited to outer slopes of dumps. As mining progresses, progressively larger surfaces become available once final profiles are achieved. Low-wall areas of each pit become available only once mining and final backfilling are complete.

Other operational areas of the mine, including haulage networks, infrastructure corridors, and facilities, will remain in use until mining ceases and therefore have only limited availability for rehabilitation until closure. Similarly, pit voids and associated NUMA components (IA1) will only become available for rehabilitation once mining and backfilling are complete.

4 Community Consultation

SLR has prepared a Community Consultation Plan (**Appendix A**) which includes the required information in the EP Act and PRCP Guideline, including, but not limited to:

- Objectives for community consultation.
- How the community will be engaged.
- Proposed consultation frequency.
- What information will be released for community consultation.
- How feedback/comments will be considered; and
- Community Consultation Register.

The Community Consultation Register (contained within the Community Consultation Plan) only captures engagement activities undertaken by CCPL where closure of the Curragh complex was discussed.

4.1 Consultation to Date

As part of the PRCP process CCPL has engaged three key stakeholders – DES, Traditional Owners Group and Peter Dunn (underlying landholder).

4.1.1 DES Meeting

CCPL and SLR had a PRCP pre-lodgement meeting with the Department of Environment and Science (DES) on 1 June 2021. The primary purpose of the meeting was to confirm what land outcomes are approved in Land Outcome Documents and to agree to a PRCP submission date. The outcomes of the meeting include:

- The Curragh Complex has pre-approved residual voids as Non-Use Management Areas.
- CCPL will update the Residual Void study to provide clarification on previously identified voids and to include any voids within the new MLs; and
- A proposed combined PMLU of grazing and native habitat was agreed upon.

The other key outcome of the meeting was that the PRCP for Curragh would be due to DES on 21st October 2022.

4.1.2 Traditional Owners

CCPL has a quarterly meeting with the local indigenous group, Gaangalu Nation People, to discuss a number of matters as they arise. At the meeting in May 2022, SLR provided a presentation on the PRCP process and how this relates to the Curragh Complex. The key discussion items included:

- Explanation of the PRCP process and purpose and presentation of a PowerPoint which includes a description of the consultation process.
- Where the rehabilitation seeds come from and potential for supply by local Indigenous supplier.
- An overview of the nature of PRCP being progressive and reiterative as the mine life continues.
- Possibility of Curragh looking to complete fauna surveys as evidence of return of totemic species and to further support the suitability of rehabilitation.
- Curragh requested a list of target species that can be targeted in fauna surveys; and
- Potential for returning artefacts to the land, however, will need to be a conversation with the native title applicants and consider what the post mining use will be.

In September 2023, SLR and Curragh met with the Traditional Owners, the Gaangalu Nation People, to discuss the PRCP process, the current status of the PRCP and Rehabilitation at Curragh. The following key items were discussed:

- An overview of the PRCP
- Curragh Mine Rehabilitation
- Totem Species and seed mixes
- Post Mining Land Uses
- Returning of Artefacts to rehabilitated/relinquished land

4.1.3 Underlying Landholder

On 9th August 2022, CCPL and SLR had a one-on-one meeting with an underlying landholder (property manager of Mourallyn) at Curragh North. The purpose of the meeting was to discuss the PRCP framework and how it relates to Curragh Complex. SLR provided a presentation on the PRCP process, the proposed Post-Mining Land Use (PMLU)s at Curragh and the community consultation process. Key discussion points from the meeting included:

- Conversation with the landholder about how a 'grazing' land use is assessed. The landholder's advice is that this should focus on management requirements and not specific parameters such as stocking rates given that these change with changing conditions (e.g. weather, condition of pasture, etc.).

Some of the key queries regarding the closure of Curragh for the landholder included:

- Responsibility of final voids.
- How the land will be managed for grazing.
- Importance of an ongoing relationship between the landholder and CCPL.
- Erosion of the land.
- Potential for the retainment of infrastructure including areas of bare land.
- Peter was happy for consultation to occur as required and was interested in attending larger community events and site visits; and
- It was reiterated that the land should be rehabilitated with the final land user in mind and that there should be no surprises at the time of surrender.

Peter offered to provide some guidance on grazing management strategies that he would recommend for incorporation into the rehabilitation strategy.

5 Post-Mining Land Uses

Under section 112 of the *Environmental Protection Act 1994 (Qld)* (EP Act), a Post-Mining Land Use (PMLU) is defined as the purpose for which land will be used after all relevant activities under the PRCP have ended. For a PMLU to be approved, the land must be demonstrated to be in a stable condition—that is, it must be safe and structurally stable, must not cause environmental harm from anything on or in the land, and must be capable of sustaining the nominated post-mining use.

5.1 Nominated PMLUs

For the Curragh Complex, Coronado Curragh Pty Ltd (CCPL) has identified five PMLUs that collectively reflect the site's environmental values, pre-mining land uses, and long-term closure objectives. These PMLUs are:

- Light Grazing
- Open Woodland Habitat
- Watercourse
- Flood Protection Landform
- Grassland and Shrubs (applied to Tailings Storage Facility domains)

Together, these land uses provide for productive, low-risk post-mining outcomes; support biodiversity and ecological function; and ensure that final landforms remain safe, stable, and non-polluting with long-term resilience consistent with the EP Act.
The following sections:

- outline the technical implementation requirements for each nominated PMLU across the Curragh Complex
- describe the rehabilitation treatments and landform design parameters that will be applied
- explain how PMLU outcomes align with and give effect to relevant Environmental Authority (EA) conditions, and
- demonstrate how those conditions have been translated into SMART (Specific, Measurable, Achievable, Relevant, Time-bound) milestone criteria under the PRCP framework.

This approach ensures clear continuity between existing EA obligations and the progressive certification pathways required under the transitional PRCP provisions of the EP Act, providing a structured and verifiable basis for achieving the final land use outcomes across the Curragh Complex.

5.1.1 Light Grazing

The Post-Mining Land Use (PMLU) of light cattle grazing is proposed across areas of infrastructure, spoil landforms, and reshaped slopes where long-term stability (≤15% slope) can be achieved. These areas are technically suitable for safe rehabilitation through pasture establishment without requiring structural treatments such as rock mulching. Pasture cover will provide erosion resistance, dust suppression, and ground stability. This PMLU reflects the predominant pre-mining land use of the surrounding region and provides an economically beneficial outcome by supporting sustainable low-intensity grazing. It also facilitates progressive rehabilitation across areas during the life of mine.

The grazing PMLU will be supported by the retention of selected water management structures, which will provide safe and reliable water access for livestock or be retained for other water management purposes. Any unnecessary structures or infrastructure inconsistent with the grazing PMLU will be decommissioned and rehabilitated in accordance with the PRCP Schedule. Infrastructure that provides beneficial re-use and is compatible with the grazing outcome.

Species composition will be guided by the approved lists provided in Section 7.0 (Revegetation). While buffel grass (*Cenchrus ciliaris*) is not included in the seed mix, it is present in topsoil stockpiles and is widespread in the surrounding landscape. Its natural re-establishment is expected and will provide persistent groundcover and erosion control alongside other pasture and native species.

Table 23: EA Conditions vs PRCP Milestone Criteria – Light Grazing

EA Reference	Objective	PRCP Milestone Criteria	Justification on Transition
G9	Rehabilitated land must be a stable landform with a self-sustaining vegetation cover.	Grazing areas shaped to ≤15% slope, stable, and supporting self-sustaining pasture vegetation prior to certification.	EA criteria transitioned; milestone recognises natural buffel grass recruitment from topsoil and landscape.
G10	Progressive rehabilitation must commence within 3 years when areas become available.	Grazing areas rehabilitated within 3 years of becoming available, monitored against progressive milestone targets.	EA condition reframed as milestone scheduling requirement
G13	(a) Soil loss ≤ that of representative unmined areas; (b) No excessive erosion compared to unmined areas.	Grazing areas demonstrate erosion stability equivalent to nearby reference paddocks; gullies/rills ≤5% of RA area.	EA erosion criteria reframed into measurable PRCP milestone.
G14	Declared weeds (Class 1 & 2) not present in densities preventing revegetation success.	Weed monitoring confirms <5% cover by declared weeds prior to certification.	EA requirement retained and reframed as milestone.

The milestone criteria presented in Table 23 have been derived directly from the Environmental Authority (EPML00643713) acceptance criteria for grazing land use. Their inclusion in the PRCP Schedule ensures consistency between the EA and PRCP, while providing a clear, measurable pathway to certification. This approach aligns with the transitional provisions of the Environmental Protection Act 1994 (Qld).

5.1.2 Open Woodland

The Open Woodland Habitat PMLU applies to steeper spoil slopes (>15%), ridgelines, and buffer areas where grazing would not be sustainable in the long term. These domains are designed to provide fauna habitat, ecological connectivity, and slope stability, with vegetation communities aligned to pre-mining regional ecosystems but adapted to anthropogenic landforms characterised by skeletal soils and rocky substrates.

Rehabilitation treatments emphasise the establishment of pasture-dominated groundcover to provide immediate erosion resistance and continuity with adjoining grazing areas. Overstorey tree and shrub species (including *Eucalyptus*, *Corymbia*, *Acacia*, and *Casuarina*) will be strategically established to create structurally diverse habitats, while the pasture layer ensures slope stability and resilience.

Species composition for rehabilitation will be determined in accordance with the approved species list provided in Section 7.0 (Revegetation). Final species selection may be further informed by outcomes from site-specific trials and contemporary industry knowledge, ensuring that revegetation strategies are both compliant with regulatory approvals and responsive to demonstrated performance under local conditions. Buffel grass (*Cenchrus ciliaris*) is not included in prescribed mixes but is expected to naturally re-establish from topsoil and the surrounding catchment. Where present, buffel will provide early groundcover stability and erosion resistance, coexisting with designed woodland communities as they mature.

Rehabilitation Treatments

- Slopes reshaped to ≤25% with contour banks, rock drains, or surface roughening as required.

- Growth media placed to ≥100 mm depth, supported by soil amelioration informed by survey data.
- Pasture species sown to provide ≥70% cover at relinquishment, stabilising slopes and promoting woodland recruitment.
- Overstorey and shrub species planted or direct seeded to achieve ≥400 stems/ha at relinquishment, with ≥50% survival.
- Woodland patches aligned with remnant vegetation and watercourse buffers to enhance ecological connectivity.

Table 24: EA Conditions vs PRCP Milestone Criteria – Woodland Habitat

EA Reference	Objective	PRCP Milestone Criteria	Justification on Transition
G9	Rehabilitated land must be a stable landform with a self-sustaining vegetation cover.	Slopes >15% stabilised and supporting native woodland vegetation, verified as self-sustaining prior to certification.	EA criteria transitioned; milestone notes buffel grass may re-establish naturally from topsoil and coexist with planted woodland species.
G13	(a) Soil loss ≤ that of representative unmined areas; (b) No excessive erosion compared to unmined areas.	Woodland slopes show erosion stability equivalent to unmined reference areas; gullies/rills ≤5% of RA area.	EA erosion criteria reframed as measurable slope stability milestones.
G14	Declared weeds (Class 1 & 2) not present in densities preventing revegetation success.	Weed monitoring confirms <5% cover by declared weeds prior to certification.	EA criteria retained and expressed as measurable PRCP milestone.

The milestone criteria presented in Table 24 have been derived directly from the Environmental Authority (EPML00643713) acceptance criteria for woodland habitat. Their inclusion in the PRCP Schedule ensures consistency between the EA and PRCP, while providing a clear, measurable pathway to certification. This approach aligns with the transitional provisions of the Environmental Protection Act 1994 (Qld).

5.1.3 Watercourse

A watercourse is defined under the Water Act 2000 (Qld) as:
"…a river, creek or other stream, including a stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events, in a natural channel, whether artificially modified or not; or in an artificial channel that has changed the course of the stream."

Similarly, under the Fisheries Act 1994 (Qld), a waterway includes "a river, creek, stream, watercourse, or inlet of the sea," encompassing both permanent and ephemeral systems in freshwater and tidal environments, as well as drainage features.

At the Curragh Complex, PMLU of watercourse (diversion) applies specifically to the creek diversions associated with Blackwater Creek, Bonnie Doon Creek, and Minnie Creek. These areas include engineered creek diversions, diversion outlets, and crossings where natural waterways intersect mining areas.

The objective of this PMLU is to ensure that rehabilitated diversions replicate the form and function of stable, self-sustaining watercourses. This will be achieved by:

- Constructing stable channel profiles capable of conveying design flow events without excessive erosion or sedimentation.
- Establishing riparian vegetation consistent with local Regional Ecosystems (e.g. RE 11.3.25) to stabilise banks and improve ecological connectivity.
- Ensuring flow regimes reinstate catchment-scale hydrological connectivity while maintaining downstream water quality.

- Supporting aquatic and terrestrial habitat values, consistent with the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld).

The current Environmental Authority (EPML00643713) objectives, indicators, and acceptance criteria for watercourse diversions are listed in Table 25. These criteria have been transitioned into the PRC Plan Schedule as milestone criteria, with modifications where necessary to ensure alignment with the SMART principles. The milestone criteria represent the final achievement of a safe, stable, non-polluting, and sustainable watercourse PMLU.

Figure 37 illustrates the locality of approved watercourse diversions across the Curragh Complex, showing the completed Blackwater Creek diversion together with the approved but as-yet unconstructed diversion alignments for Bonnie Doon Creek and Minnie Creek in relation to the final landform design.

The milestone criteria establish measurable indicators for stability, water quality, safety, and riparian vegetation to ensure diversions are safe, stable, non-polluting, and sustainable are shown in Table 25.

Table 25: EA Conditions vs PRCP Milestone Criteria – Watercourse

EA Reference	Objective	PRCP Milestone Criteria	Justification on Transition
H1	Diversion channels must be constructed and maintained to achieve hydraulic and geomorphic stability.	Blackwater, Bonnie Doon, and Minnie Creek diversions demonstrate long-term stability, verified by inspection and monitoring.	EA condition transitioned; milestone specifies creeks by name.
H2	Diversions must not result in unacceptable downstream erosion or flooding impacts.	Post-rehabilitation monitoring confirms downstream erosion and flooding impacts are within acceptable limits.	EA objective reframed into measurable monitoring milestone.
H3	Riparian vegetation must be re-established along diversion channels.	Riparian vegetation established with ≥70% native cover within 5 years; buffel grass anticipated to re-establish naturally from topsoil and surrounding catchment, contributing to groundcover persistence.	EA criteria retained; milestone provides measurable vegetation target.

The milestone criteria in Table 24 have been derived directly from the Environmental Authority (EPML00643713) acceptance criteria for watercourse diversions. Their inclusion in the PRCP Schedule ensures diversions are stable, functional, and ecologically resilient, with groundcover supported by both planted species and naturally recruited buffel grass from topsoil and adjacent catchments.

5.1.4 Flood Protection Landform

The Flood Protection PMLU provides a permanent land use outcome for engineered embankments that manage regional flood risk. Following regulator consultation, alternative PMLUs such as grazing or woodland were deemed unsuitable due to safety and functionality constraints. The flood protection outcome reflects the essential role of embankments in safeguarding the final landscape against extreme flood events, in accordance with the Environmental Authority (EPML00643713) and the Regulated Structures Guideline (ESR/2016/1933). Rehabilitation treatments will incorporate erosion-resistant vegetation, drainage integration, and engineered rock armouring where required to ensure long-term stability and compatibility with surrounding land uses.

While buffel grass (Cenchrus ciliaris) is not included in the prescribed seed mix, it is present in topsoil stockpiles and widespread in the surrounding landscape; its natural recruitment is expected to contribute to persistent groundcover and erosion control alongside the planted native species. The proposed milestone criteria ensure levees are closed to a standard that is safe, stable, non-polluting, and flood-immune to the 0.1% AEP event.

Table 26: EA Conditions vs PRCP Milestone Criteria – Flood Protection PMLU

EA Reference	Objective	PRCP Milestone Criteria	Justification on Transition
Schedule D – Regulated Structures	Flood protection levees must be designed, constructed, and maintained to provide immunity to the 0.1% AEP flood event, in accordance with the Regulated Structures Guideline.	Levees certified by a RPEQ as meeting 0.1% AEP immunity at final relinquishment, with design and certification consistent with the Regulated Structures Guideline.	EA requirement directly transitioned; milestone references state guideline.
G9	Rehabilitated land must be a stable landform with a self-sustaining vegetation cover.	Levee batters stabilised with ≥70% perennial groundcover; buffel grass expected to re-establish naturally alongside native cover species	EA condition reframed as measurable rehabilitation outcome.
G13	Rehabilitated land must not have higher erosion or soil loss than comparable unmined areas.	Levees demonstrate erosion rates ≤ unmined reference areas; no active gullies >0.3 m deep.	EA erosion requirement reframed as milestone criteria.
G14	Declared weeds not present in densities preventing revegetation success.	Declared weed cover <10% on levees prior to certification.	EA requirement retained; milestone ensures measurable weed management.

The milestone criteria in Table 25 have been derived directly from Environmental Authority EPML00643713 conditions for land stability, erosion, water quality, and weed management. Their inclusion in the PRCP Schedule ensures the Flood protection Landform is rehabilitated to a standard that is safe, stable, non-polluting, and self-sustaining. The grassland and shrub vegetation strategy provides long-term erosion resistance, dust suppression, and ecological functionality, with buffel grass expected to re-establish naturally from topsoil and the surrounding landscape to support persistent groundcover alongside seeded species.

5.1.5 Tailings Storage Facility Grassland and Shrubs

The PMLU of grassland and shrubs is proposed for the Tailings Storage Facility (TSF) domains. Following regulator consultation, grazing and woodland outcomes were deemed unsuitable for the primary PMLU due to the potential long term structural constraints, which may limit rooting depth, plant diversity, and safe livestock access. The grassland and shrubs PMLU reflects the primary role of the TSF landforms in providing a safe, stable, non-polluting outcome that is erosion-resistant and ecologically functional without requiring intensive management.

Rehabilitation treatments will incorporate engineered capping and cover systems to isolate tailings from surface exposure, reduce infiltration, and promote revegetation. A mix of native grasses and shrubs will be established to achieve complementary functions:

- Grasses will provide rapid, dense groundcover for erosion resistance, dust suppression, and topsoil stabilisation.
- Shrubs will contribute to mid-storey cover, habitat value, and ecological diversity. Tree establishment will be limited to species tolerant of shallow rooting depth and soil constraints, consistent with the geotechnical design of the TSF capping system.

Species composition will be guided by the approved species lists provided Section 7.0 (Revegetation), which reflect local Bowen Basin conditions. Final species selection may be further informed by outcomes from site-specific trials and contemporary industry knowledge, ensuring that revegetation strategies are both compliant with regulatory approvals and responsive to demonstrated performance under local conditions. While buffel grass (Cenchrus ciliaris) is not included in the seed mix, it is present in topsoil stockpiles and is widespread in the surrounding landscape. Its re-establishment through natural recruitment is anticipated, particularly in early stages of rehabilitation, and will contribute to groundcover persistence and erosion resistance alongside the planted species mix.

Table 27: EA Conditions vs PRCP Milestone Criteria – TSF Grassland–Shrubland

EA Reference	Objective	PRCP Milestone Criteria	Justification on Transition
G9	Rehabilitated land must be a stable landform with a self-sustaining vegetation cover.	TSF capped and shaped to stable slopes; ≥70% perennial groundcover established with a mix of grasses and shrubs, verified as self-sustaining. Buffel grass expected to re-establish naturally from topsoil and surrounding landscape.	EA requirement transitioned; milestone specifies grass–shrub mix and acknowledges natural buffel recruitment.
G13	Rehabilitated land must not have higher erosion or soil loss than comparable unmined areas.	TSF surfaces demonstrate erosion rates ≤ unmined reference areas; no active gullies >0.3 m deep.	EA erosion criteria reframed into measurable PRCP milestone.
G14	Declared weeds not present in densities preventing revegetation success.	Declared weed cover <5% on TSF surfaces prior to certification.	EA requirement retained; milestone ensures measurable weed management.
Schedule C (Water)	Rehabilitated landforms must not release contaminants at levels harmful to the environment (EC, pH, turbidity).	TSF seepage and runoff quality meets EA water quality criteria, verified through ongoing monitoring.	EA water quality requirement reframed into milestone verification.

The milestone criteria in Table 27 have been derived directly from Environmental Authority EPML00643713 conditions for land stability, erosion, water quality, and weed management. Their inclusion in the PRCP Schedule ensures the Tailings Storage Facility is closed to a standard that is safe, stable, non-polluting, and self-sustaining. The grassland–shrubland outcome provides long-term erosion resistance, dust suppression, and ecological functionality, with buffel grass expected to re-establish naturally from topsoil and the surrounding landscape to support persistent groundcover alongside seeded species.

5.1.6 Post Mining Land Use Summary

The Curragh Mine PRCP establishes a suite of Post-Mining Land Uses (PMLUs) tailored to the physical characteristics, safety constraints, and long-term functional requirements of each rehabilitation domain. Collectively, these PMLUs deliver a cohesive post-mining landscape that is safe, stable, non-polluting, self-sustaining, and consistent with the objectives of Environmental Authority EPML00643713 and the EP Act.

Light Grazing is assigned to low-gradient slopes and gently undulating landforms where safe pastoral use can be sustained over the long term. This PMLU reflects the dominant pre-mining and regional land use and provides resilient groundcover capable of supporting erosion resistance, pasture productivity and low-intensity grazing.

Open Woodland Habitat is applied to steeper slopes, upper batters and ridgeline features where grazing would not be safe or sustainable. Woodland vegetation provides root reinforcement, enhances slope stability, and contributes to biodiversity by establishing habitat structure and improving ecological connectivity across the final landform. Together, these two vegetation-based PMLUs deliver a functional mosaic of pastoral and habitat outcomes aligned with regional land use patterns.

Watercourse PMLUs apply to both the constructed Blackwater Creek diversion and the approved but yet-to-be-constructed diversions of Bonnie Doon Creek and Minnie Creek. These channels will be stabilised, contoured and revegetated to maintain hydraulic capacity, support riparian habitat function and preserve hydrological connectivity within the catchment. Stabilisation will follow best-practice fluvial design principles to ensure long-term channel integrity.

Flood Protection Landforms are retained as a distinct PMLU, recognising their role as permanent engineered structures designed to provide immunity to the 0.1% AEP flood event. These landforms will remain part of the operational drainage network in perpetuity and will be integrated into the final landform in accordance with the Regulated Structures Guideline.

Tailings Storage Facility (TSF) domains will be rehabilitated to a Grassland and Shrubs PMLU. This outcome reflects the inherent geotechnical and geochemical characteristics of TSF substrates, while providing a stable vegetated cover that achieves erosion control, dust suppression and ecological function without imposing structural loadings incompatible with tailings consolidation behaviour.

Across all vegetation-based PMLUs, species composition will be guided by the approved revegetation species lists provided in Section 7.0 (Revegetation). While buffel grass (*Cenchrus ciliaris*) is excluded from prescribed seed mixes due to its competitive behaviour, natural recruitment is expected given its presence in salvaged topsoil and the surrounding landscape. Where buffel establishes, it will provide early, persistent groundcover that contributes to erosion resistance while native woodland and grassland species continue to develop.
A summary of the post-mining land uses is provided in Table 29, with the corresponding Curragh Mine final site design shown in Figure 19.

PMLU	Rehabilitation Domains	Key Rationale	Relevant EA Conditions
Light Cattle Grazing	Low-gradient landforms (≤15%), reshaped spoil, infrastructure areas	Reflects predominant regional land use; safe for livestock; provides erosion control and stable pasture cover. Buffel expected to re-establish naturally.	G9; G10; G13; G14
Open Woodland habitat	Steeper slopes (>15%), ridgelines	Not suitable for grazing; supports slope stability, ecological connectivity, and habitat values. Buffel anticipated to occur naturally in groundcover layer.	G9; G13; G14
Watercourse Diversions	Blackwater Creek, Bonnie Doon Creek, Minnie Creek	Maintain hydraulic/geomorphic stability; prevent downstream impacts; re-establish riparian vegetation. Buffel may re-establish in groundcover alongside native species.	H1; H2; H3
Flood Protection Levees	Engineered embankments for flood defence	Permanent structures required for regional flood management; provide immunity to 0.1% AEP flood event. Buffel expected to provide persistent groundcover on levee batters.	Schedule D (Regulated Structures Guideline); G9; G13; G14
TSF Grassland–Shrubland	Tailings Storage Facility surfaces and embankments	Geotechnical/geochemical constraints limit alternative PMLUs; grass–shrub mix ensures erosion resistance, dust suppression, ecological function. Buffel expected to re-establish naturally from topsoil.	G9; G13; G14; Schedule C

Table 28: EA Conditions vs PRCP Milestone Criteria – PMLU Summary

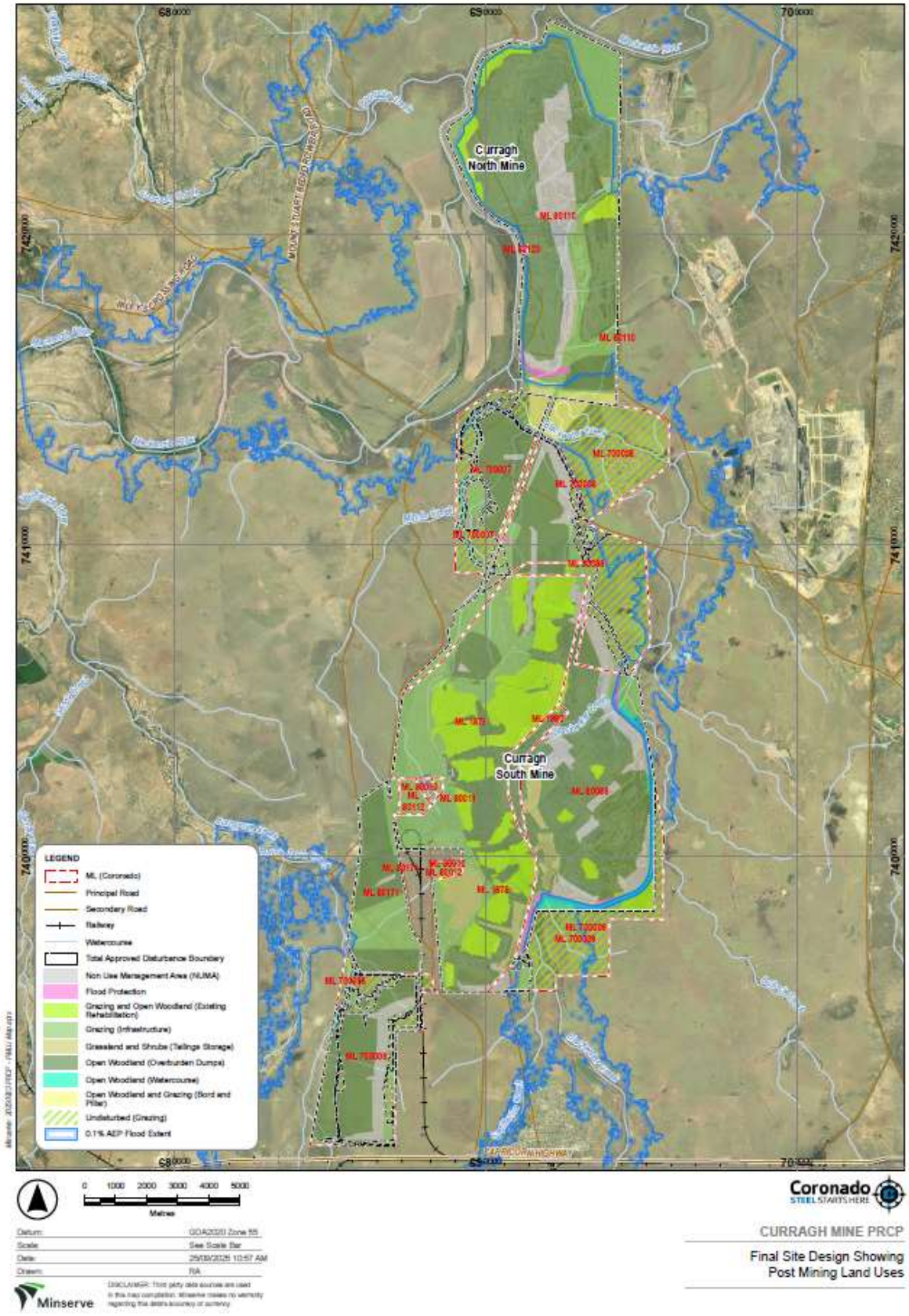

Figure 19: Curragh Comp0lex PMLU's and Final Site Design

5.2 Community Consultation

CCPL has actively engaged with Traditional Owners and an underlying landholder about the proposed PMLUs. Neither party raised any issues with the proposed PMLU and were generally supportive. The underlying landholder was very interested in having the land returned to a landform suitable for light grazing and has provided advice on how to achieve this. Relevant stakeholders will continue to be consulted over the life of the mine to ensure communication of the PMLU and expectations are managed appropriately.

5.3 Regional Planning Integration

Section 126C of the EP Act requires the PRCP to state the extent to which the PMLU is consistent with any strategies or plans for the land of a local government, the State, or the Commonwealth. Relevant plans and strategies have been identified below.

Water Resources (Fitzroy Basin) Plan 2011

The Water Plan (Fitzroy Basin) 2011 remains the current statutory instrument under the Water Act 2000 (Qld) that provides the framework for the sustainable management and allocation of both surface water and groundwater resources within the Fitzroy Basin. The plan establishes the legal basis for water entitlements, sets environmental flow objectives, and specifies strategies to balance consumptive use with the protection of ecological and hydrological values. The plan is particularly relevant to mine closure planning, as it requires that landform design, drainage, and water management systems protect water resources by:

- Maintaining or reinstating flow connectivity (e.g., preventing impoundment of flows, reconnecting baseflows to receiving systems).
- Protecting water quality from sediment, salinity, and acid generation.
- Supporting the long-term recovery of groundwater systems following mining; and
- Ensuring that post-mining landforms do not compromise downstream water users or environmental values.

As of 6 August 2025, the plan's expiry has been extended to 31 March 2028 (Water Plan (Fitzroy Basin) (Extension of Expiry) Amendment Regulation 2025) to allow completion of a comprehensive review process. This review, formally initiated in July 2022, is being undertaken by the Queensland Department of Regional Development, Manufacturing and Water (DRDMW) in consultation with stakeholders. The review objectives include:

- Incorporating updated hydrological modelling that accounts for climate variability and climate change impacts.
- Addressing long-term water security requirements for regional towns, industry, and agriculture.
- Recognising cultural water needs and traditional owner interests.
- Integrating future water infrastructure planning; and
- Ensuring alignment with broader state water policy, including resilience and adaptation strategies.

Until the new plan is finalised, the Water Plan (Fitzroy Basin) 2011 remains in force as the governing statutory framework. Mine closure planning for the Curragh Complex has therefore been developed to remain consistent with its objectives. Specifically:

- Final landform design has considered protection of flow regimes through stable drainage paths, avoidance of impoundment, and maintenance of downstream hydrological connectivity.
- Drainage infrastructure (e.g., diversions and flood protection landforms) has been assessed to ensure compliance with environmental flow objectives and the safe conveyance of design rainfall events.

- Water quality management measures are integrated into rehabilitation to minimise sedimentation, acid generation, or salinity impacts to downstream systems; and
- Groundwater recovery considerations have informed the classification of voids, TSFs, and pit lakes to avoid long-term drawdown or contamination of aquifers.

The PRCP will continue to align with the current plan's objectives while remaining adaptive to the outcomes of the review process. Where the revised Fitzroy Basin Water Plan introduces new requirements, these will be incorporated into future updates of the Curragh PRCP to ensure ongoing compliance with Queensland's statutory water resource management framework.

The Queensland Plan

The Queensland Plan is a 30-year community vision that sets aspirational goals for the State's future development and prosperity. It establishes nine foundation areas, several of which are directly relevant to mine closure planning for the Curragh Complex, including:

- Regions – building thriving communities
- Environment – achieving balance
- Infrastructure – being connected

Mine closure planning must consider these goals to ensure alignment with broader state development objectives. Specifically, closure planning for the Curragh Complex addresses the following themes from *The Queensland Plan*:

- Capitalising on regional opportunities and assets – by designing final landforms and Post-Mining Land Use (PMLU)s (PMLUs) that return land to productive purposes such as grazing and habitat conservation, while supporting regional communities and landholders.
- Environmental protection and natural resource management – through final landforms that are stable, non-polluting, and capable of supporting sustainable ecosystems and land uses, while maintaining hydrological and ecological connectivity.
- Connectivity and accessibility – by retaining selected beneficial infrastructure (e.g., access tracks, water management structures) that supports long-term landholder use and regional land use integration.

In this way, mine closure planning for the Curragh Complex not only ensures compliance with statutory requirements under the Environmental Protection Act 1994 (Qld) and the PRCP framework, but also contributes to the broader aspirational goals of The Queensland Plan, supporting sustainable regions, resilient environments, and connected infrastructure systems across Queensland.

Central Highlands Regional Council Planning Scheme 2016

The Central Highlands Regional Council (CHRC) Planning Scheme 2016, currently operating under Amendment No. 6 (May 2022), is the statutory planning instrument prepared under the Planning Act 2016 (Qld). The scheme establishes the framework for managing regional growth, regulating land uses, and guiding new development to reflect community aspirations and long-term planning objectives.

The land on which the Curragh Complex is situated is zoned Rural under the CHRC Planning Scheme. The Rural zone is intended to:

- Protect the productive value of rural land.
- Facilitate agricultural and grazing activities.
- Maintain ecological and landscape values; and
- Ensure new land uses are compatible with surrounding rural character and regional land use priorities.

The proposed Post-Mining Land Use (PMLU)s (PMLUs) of Light Grazing, Open Woodland, Watercourse (including diversions), and Flood Protection Landform are consistent with the objectives of the Rural zone and regional planning priorities:

- Light Grazing – supports agricultural productivity and returns land to an economically beneficial use consistent with historic and surrounding land uses.
- Open Woodland – reinforces ecological values, strengthens biodiversity corridors, and provides a stable, low-maintenance outcome for steeper slopes.
- Watercourse (including diversions) – reinstates stable drainage systems, protects downstream water quality, and maintains ecological and hydrological connectivity.
- Flood Protection Landform – provides essential flood risk management, ensuring long-term safety and functionality of the rehabilitated landscape, while remaining compatible with surrounding rural land uses.

Through these outcomes, mine closure planning for the Curragh Complex demonstrates alignment with the CHRC Planning Scheme by delivering safe, stable, and regionally appropriate PMLUs that integrate with the Rural zoning framework and community expectations.

6 Non-Use Management Areas

A Non-use Management Area (NUMA) is defined in section 112 of the EP Act as an area of land the subject of a PRCP that cannot be rehabilitated to a stable condition after all relevant activities for the PRCP carried out on the land have ended. A NUMA can only be proposed due to one of the following reasons:

- carrying out rehabilitation of the land would cause greater risk of environmental harm than not carrying out the rehabilitation; or
- both of the following apply:
- The risk of environmental harm as a result of not carrying out rehabilitation of the land is confined to the area of the relevant resource tenure.
- The applicant considers, having regard to each public interest consideration, that it is in the public interest for the land not to be rehabilitated to a stable condition.

6.1 Pre-approved NUMAs

As outlined in Section 4.2, land outcomes may be transitioned from Land Outcome Documents (LODs) in accordance with the transitional provisions of the *Environmental Protection Act 1994 (Qld)*. For the Curragh Complex, the relevant LOD is the Conceptual Residual Void Assessment (CRVA), which formally identifies residual pit areas as Non-Use Management Areas (NUMAs). Under the EP Act, the oldest approved LOD sits higher in the hierarchy when multiple LODs exist.

The original CRVA, prepared by AECOM (2012), occupies the higher position in the LOD hierarchy and identified a total of 1,742 ha of pit area as NUMAs. This assessment predated the CEP Project and its associated pits, which were subsequently authorised through later approval processes.

An updated CRVA was undertaken in 2021 (SLR 2021) which refined the NUMA footprint with the objective of maximising the extent of land capable of supporting a designated Post-Mining Land Use (PMLU), while also accounting for additional mining areas. This refinement identified a reduced total NUMA area of 1,499 ha.

It is noted, however, that the SLR (2021) footprint did not explicitly include geotechnical setback zones, safety bunds, and fencing and was based on preliminary final landform.

6.2 Proposed NUMAs

CCPL proposes to transition the pre-approved residual voids identified in the original Curragh Residual Void Assessment (CRVA, 2012) into NUMAs. The 2012 CRVA committed to approximately 1,742 ha of residual voids. This commitment pre-dated subsequent approvals, including the Curragh Extension Project and Mammoth Underground, and therefore provides a conservative baseline extent.

The more recent CRVA (2021) generated valuable technical information on residual voids but did not fully address PRCP requirements in relation to PMLU and NUMAs. The 2021 CRVA itself acknowledged this limitation, referring to the mapped areas as "preliminary NUMAs" and noting that the locations were "based on the preliminary landform design which is subject to change before the PRCP is submitted." While the study included flood assessments, groundwater investigations, pit lake water balance modelling, and geotechnical stability analysis, its stated intent was to inform preliminary landform design rather than provide PRCP-ready NUMA outcomes.

The 2021 CRVA also attempted to reduce the extent of NUMAs by reviewing parameters for NUMA definition and optimising PMLUs in areas such as the low wall and Tertiary highwall. However, subsequent assessment during the Curragh PRCP (2022) concluded that these treatments would not achieve the stability standards necessary to support an approved PMLU. These areas were therefore correctly reinstated within NUMA extents. As part of the PRCP technical studies, updated pit lake water balance modelling was undertaken to evaluate changes to the approved voids. This work identified two additional pit lakes not assessed in the 2021 CRVA — Main Other and Pit X West 2. The Main Other void, initially assumed in the 2001 CRVA to have potential for beneficial use, is located within an area of existing rehabilitation. Updated modelling confirmed that, consistent with broader Bowen Basin experience, water quality in deep pit lakes trends towards progressive salinisation, reducing their suitability to support a PMLU. Similarly, Pit X West 2 was identified as forming a permanent deep void lake with increasing salinity over time, thereby precluding a beneficial post-mining use. These outcomes highlight the limitations of the 2021 CRVA for PRCP purposes: while it provided a useful technical baseline, it did not address PRCP-specific requirements such as setbacks, bunding, fencing, or the long-term geochemical behaviour of pit lakes, which collectively define NUMA extent.

Importantly, even after accounting for geotechnical setbacks, bunding, fencing, and the inclusion of additional voids approved post-2012, the total NUMA area under this PRCP remains less than the residual void extent originally committed in the 2012 CRVA. As summarised in Table 47, the 2012 CRVA identified approximately 1,742 ha of residual voids, while the 2021 CRVA preliminary NUMA extent reduced this to 1,499 ha (Table 29). Following refinement through the 2025 final landform design, the total PRCP NUMA extent is 1,692 ha — still less than the 2012 commitment.

This progression demonstrates that, while refinements and updates have been incorporated through successive assessments, the overall rehabilitation outcome under the PRCP remains consistent with the commitments of the 2012 CRVA. Importantly, the approach is in line with the transitional provisions of the PRCP framework, which require proponents to demonstrate that final landform and NUMA outcomes are no less protective than those previously approved under earlier closure documentation. The PRCP therefore confirms compliance with transitional requirements while delivering a safe, stable, and legally robust closure outcome.

Table 29: Preliminary NUMA Areas (CRVA 2021)

Domain	2012 CRVA Residual Void Area (ha)	2021 CRVA (Preliminary) NUMA Area (ha)
Curragh Main	1,096	561
Curragh North	646	637
Pit X	-	125
Pit Y	-	48

Domain	2012 CRVA Residual Void Area (ha)	2021 CRVA (Preliminary) NUMA Area (ha)
Pit Z	-	128
Total	1,742	1,499

Table 30 illustrates the final reviewed NUMA extents by pit following incorporation of updated geotechnical setbacks, bunding, fencing, and refined void surface areas. The total NUMA extent of 1,692 ha remains less than the 1,742 ha originally committed under the 2012 CRVA.

Pit	Void Surface area	Total NUMA including setback areas
Pit S, T and U	581.2	635.7
Pit D, E and F	347.5	374.4
Pit G, H and I	128.6	158.8
Pit L	26.8	31.8
Pit K	68.1	81.3
Ramp 9	5.9*	5.9
Pit J	46.7	59.0
Pit X	125.2	132.4
Pit Y	8.0*	8.0
Pit Z	175.9	204.5
Totals	1513.9	1691.8

*Notes: *includes additional areas that make up the NUMA extent – geotechnical setback, safety bund and fencing*

Table 30: 20025 Reviewed Final Landform NUMA areas

6.3 Plans and Strategies

The Central Highlands Regional Council Planning Scheme identified the Curragh Complex lease area as 'rural.' It is acknowledged that mining and exploration activities occur within this planning zone. Therefore, the final land use of residual void / water containment / protection is consistent with the current planning scheme for the area.

6.4 Community Consultation

CCPL has actively engaged with Traditional Owners and an underlying landholder about the proposed NUMAs. Neither stakeholder had any strong objections to the proposed NUMAs. The underlying land holder had questions about the quality of the void water and responsibility of the voids post-surrender.

7 Rehabilitation Management and Methodologies

7.1 General Rehabilitation Practices

Rehabilitation planning at the Curragh Complex takes into account the diverse mining approaches applied across the site, including open-cut dragline, truck-and-shovel operations, and bord-and-pillar underground mining. Each mining method generates distinct disturbance profiles, and rehabilitation practices have been designed to address these variations while working towards a consistent, safe, stable, and non-polluting final landform.
A suite of technical studies has been undertaken to inform and refine the final landform design and to guide the application of general rehabilitation practices. These investigations address key factors such as flood behaviour, residual void closure, geotechnical stability, groundwater interactions, mine waste and soils management, cover system design, and revegetation performance. Collectively, these studies provide the technical foundation for the rehabilitation methodologies described in this section and ensure alignment with Environmental Authority requirements and PRCP outcomes.

The scope and detail of rehabilitation planning will continue to evolve in line with operational progress and the findings of ongoing technical studies. This adaptive approach ensures that rehabilitation remains responsive to site-specific conditions across the Curragh Complex, integrating the outcomes of monitoring, trials, and progressive refinement into practical management strategies that deliver long-term post-mining land use objectives.

7.1.1 Hydrogeology

A comprehensive hydrogeological assessment has been undertaken including a review of existing groundwater, climate, geology, surface water and topography data available for Curragh Complex and developed a Groundwater Technical Report (Appendix G) to support this PRCP. The objectives of the hydrogeological assessment are to understand the post-closure groundwater regime around the mine and specifically to:

- Present an understanding of the hydrogeological setting of the mine including potential groundwater receptors.
- Simulate the post mining groundwater level recovery using the final landform (mine void backfill levels) developed by CCPL to understand whether the final voids act as groundwater sinks or sources; and
- Understand the long-term effect of the proposed post mining landform on local groundwater levels i.e. the residual drawdown, and post-mining groundwater flux.

Section 2 of the Groundwater Technical Report presents information on the hydrogeological setting of the Curragh mine and the Conceptional Hydrogeological Model (CHM) including:

- Topography, climate and hydrology.
- Geology and Hydrostratigraphy.
- Groundwater monitoring data (quality, levels, local Water Quality Objectives); and
- Groundwater values (Groundwater Dependant Ecosystems and local groundwater use).

The surface geology across the study area (based on 1:100,000 published mapping), is presented in Figure 20 and the regional (solid) geology is presented in Cross-sections showing the geology of the study area have been developed using the geological model for the mine together with LiDAR (current and pre mining), and the final landform. The locations of all cross-sections presented in the groundwater technical appendix (Appendix X) are shown on Figure 21, and selected cross sections are reproduced here including the north-south long section (A-A' Figure 20**)**, and east-west sections (C-C' Figure 21, E-E' Figure 22, and G-G' Figure 23.

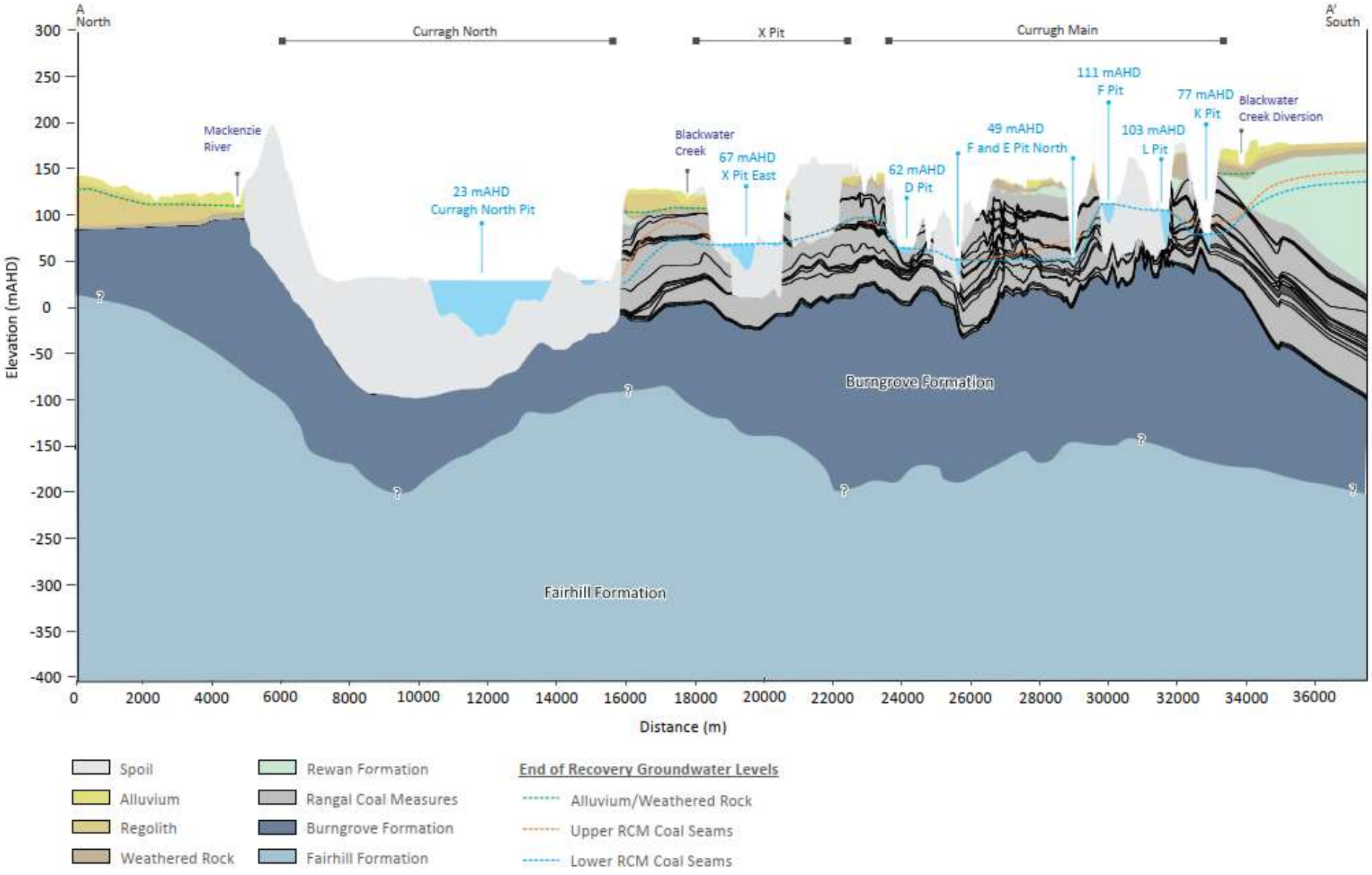

Figure 20:Conceptual geological cross-section A-A' (PB, 2016)

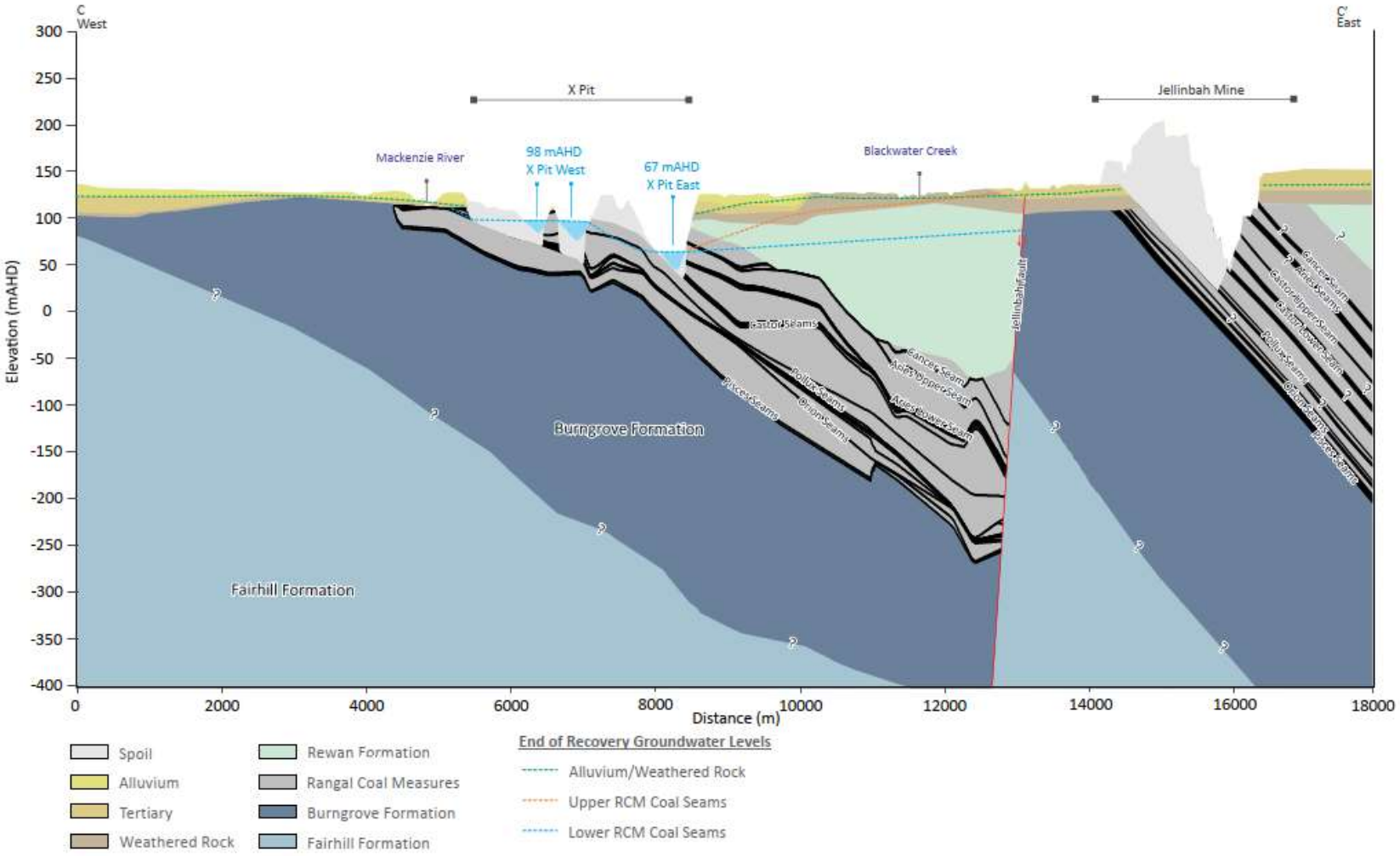

Figure 21: Geological cross-section C-C' of Curragh Complex showing final landforms/voids and groundwater levels

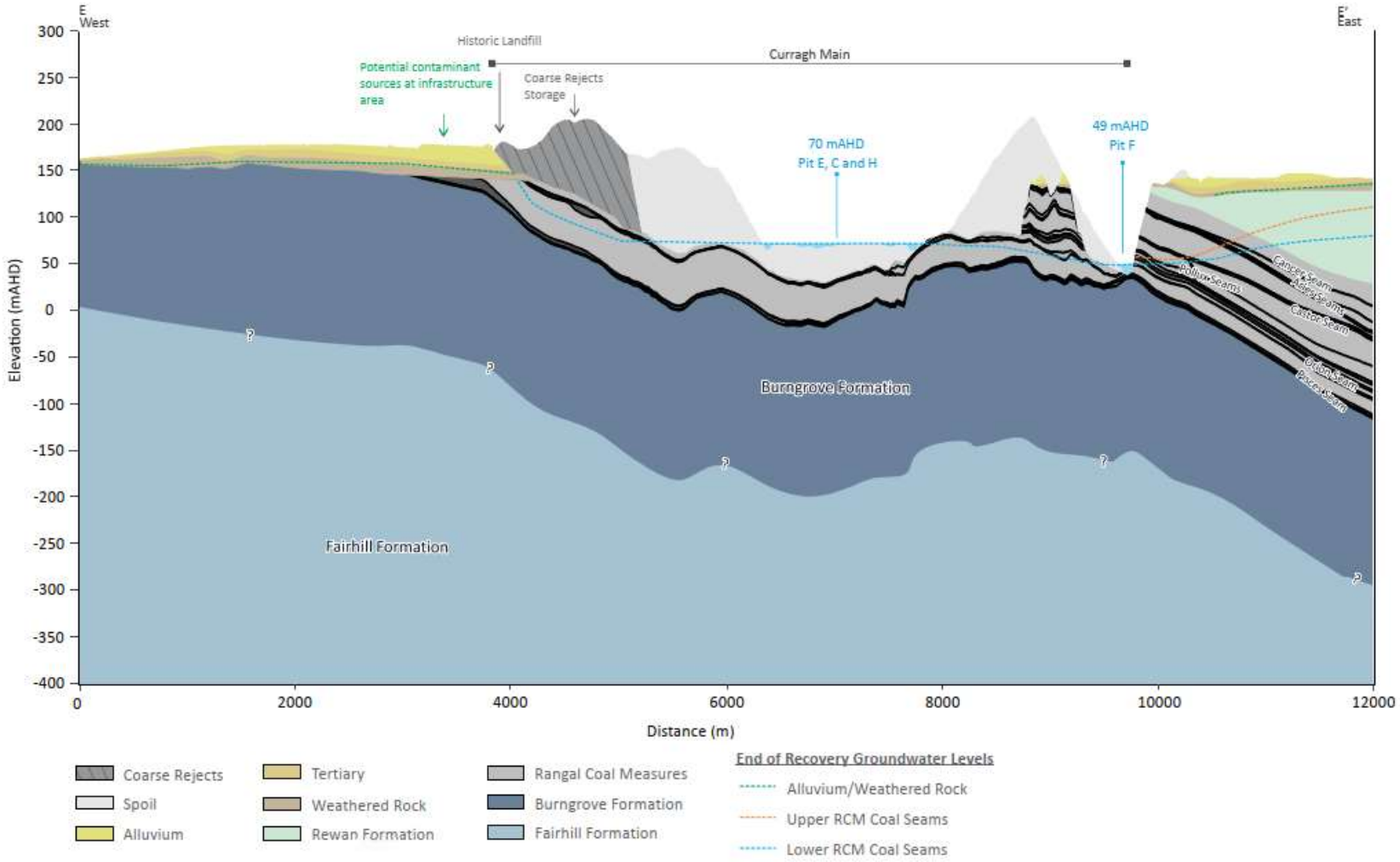

Figure 22: Geological cross-section E-E' of Curragh Complex showing final landforms/voids and groundwater levels

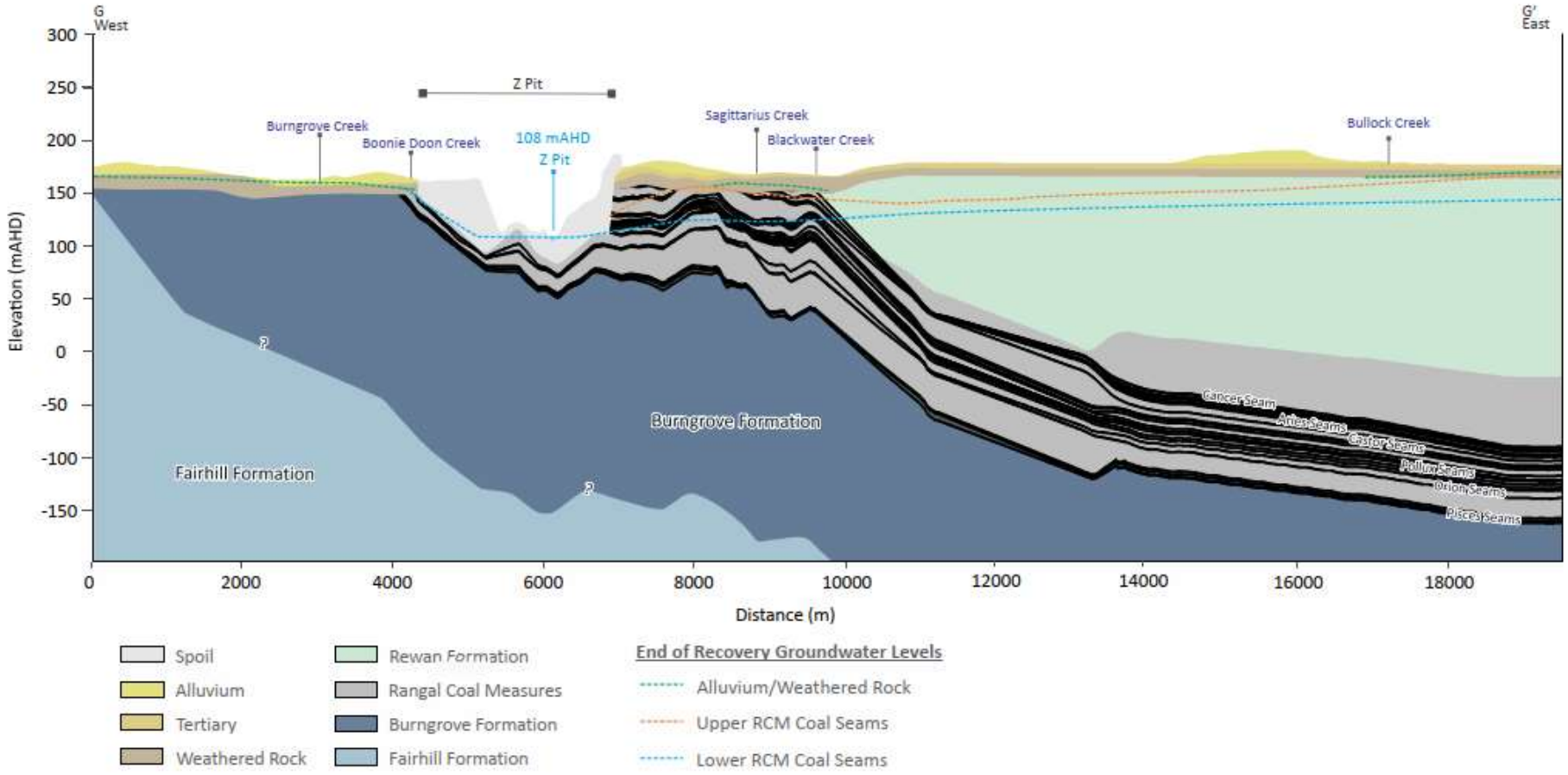

Figure 23: Geological cross-section G-G' of Curragh Complex showing final landforms/voids and groundwater levels

A model was developed by SLR to assess the recovery of the groundwater system after mine closure. The key changes to the model design from that reported for the 2021 CRVA model (SLR, 2021) include:

- Model extent and grid – extended model domain, unstructured Voronoi grid with refinement in key areas.
- Model layers – constructed layers to capture significant displacement faults within Curragh Mine area and incorporate the most recent geological model for the Curragh Mine Complex.
- Boundary conditions – set model boundary conditions with revised grid and regional flows.
- Stresses – model inputs updated with recent and site-specific data.
- Calibration – the new model has been calibrated with an updated calibration data set.

The key modelling objectives were to:

- Develop a calibrated model with mine progression, final voids, tailings storages in line with the current closure landform design developed by Coronado.
- Simulate the post-mining groundwater level recovery to assess whether the final voids will generally act as groundwater sinks or sources; and.
- Understand the long-term effect of the proposed post-mining landform on local groundwater levels by comparing the long-term post closure case to a null case (no mining scenario).

Further information on the numerical model is provided in **Appendix G**.

Post mining impacts were investigated with a recovery model, commencing at the end of active mining. A preliminary transient recovery model was developed initially to assess the relationship between the final voids' lake elevations and groundwater inflow. The relationship between groundwater inflows to the voids and void lake level was extracted from the preliminary recovery model and incorporated into the mine water balance model (WBM). The WBM predicts the equilibrium lake levels for each void and these levels were then used in the final groundwater recovery model.

The final recovery model uses the MODFLOW river package (RIV) to simulate increasing void lake elevations in the final voids over the recovery period, with stage elevations vs time applied according to the WBM predictions for each void, up to the predicted equilibrium lake levels. The WBM predicted water levels in the final voids to reach equilibrium conditions after approximately 50 to 80 years, dependent on void structure and interaction with the regional groundwater system.

The simulated average groundwater takes at the end of recovery (December 2132) for each site area is presented in Figure 24**.** The net groundwater flux has been calculated as a cumulative void flux for each area at the Curragh Complex (Curragh North, X Pit, Curragh Main, Ramp 9, Y Pit and Z Pit (Figure 24 to account for interaction between the adjacent voids within each area. The groundwater fluxes to the final voids are total fluxes, including throughflow from spoil (higher recharge over the spoil and drainage into the final void), and groundwater inflow from the Rangal Coal Measures (RCM).

An equilibrium groundwater flux of 6.14 ML/day was predicted at Curragh North, where the minimum elevation of the final landform is significantly lower than the other voids. The relative depth of the residual void at Curragh North is likely accountable for the higher predicted groundwater flux to the void in this area. Equilibrium total groundwater flux to the voids in X Pit, Curragh Main, Ramp 9, Y Pit and Z Pit are predicted to be 0.57, 1.44, 0.02, 0.08 and 0.64 ML/day respectively, indicating all simulated voids are predicted to be groundwater sinks with net groundwater flow into the voids.

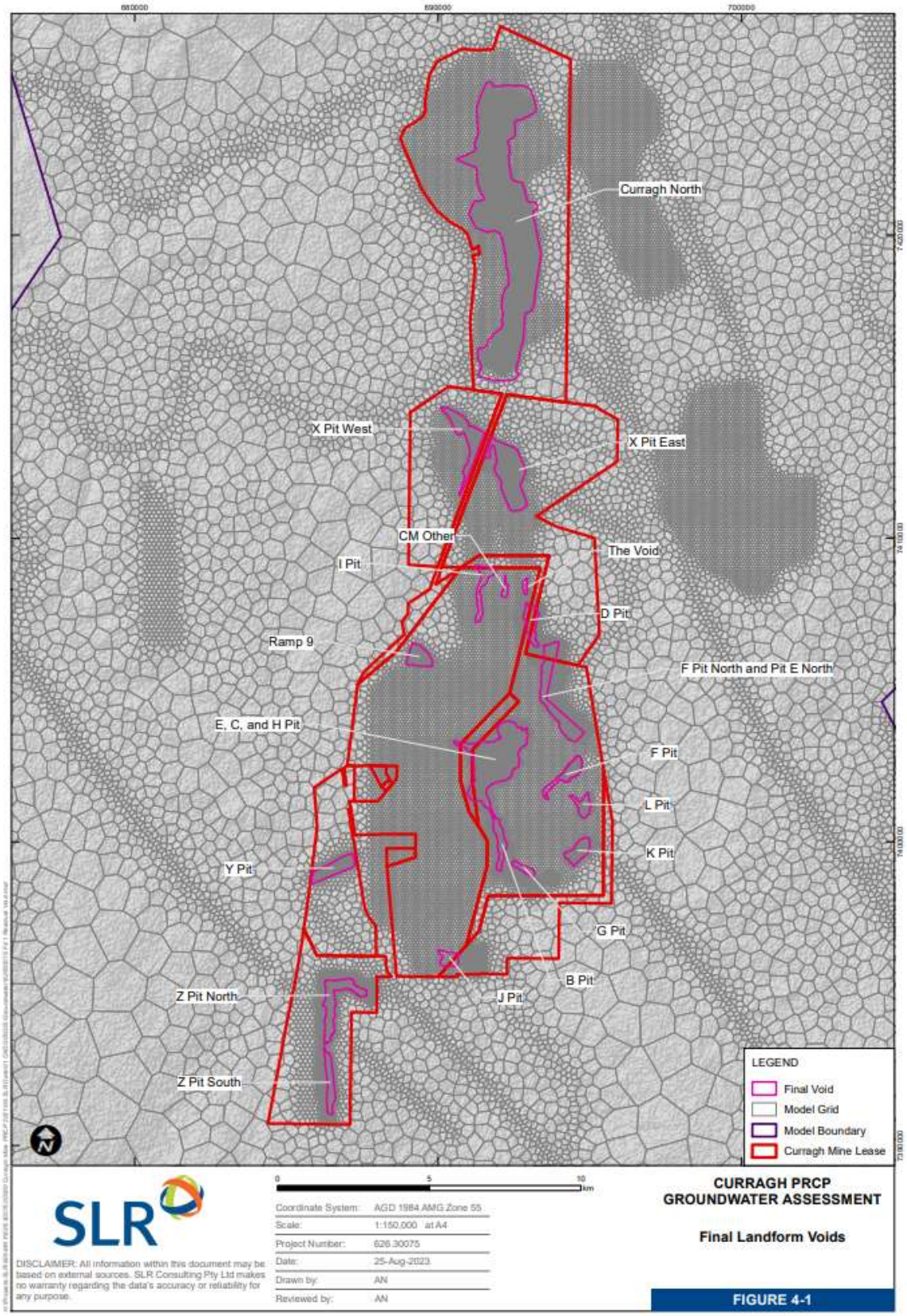

Figure 24: Hydrogeologic Residual Void Groups

The predicted post-mining water table at equilibrium (end of recovery) is shown Figure 26. Hydraulic gradients at equilibrium indicate an overall flow direction toward residual voids at Curragh Main and Curragh North. All residual voids show hydraulic heads decreasing with proximity to the void, indicating all voids are predicted to act as local groundwater sinks.

Predicted drawdown figures (Figure 25 and Figure 26) show where residual drawdown impacts are predicted to exceed 1 m. Figure 27 presents the residual drawdown within the alluvium only, at post-mining equilibrium. Predicted recovered heads in the alluvium west of Curragh North show residual drawdowns of 1 to 2 m extending up to 4 km from mined pits at Curragh North although drawdowns at the very edge of the voids are higher (10-20 m). presents the residual drawdown of the water table at post-mining equilibrium.

To investigate groundwater movement within and around the mine from the end of mining through to post-mining equilibrium particle tracking has been used. Mod-PATH3DU code (S.S. Papadopulos & Associates, Inc., 2021) was used to track the flow paths and destination of groundwater during and after recovery. Particle starting locations were selected within and around the mining areas and particles are released in the uppermost saturated layer at the start of the post-mining simulation (end of mining). The particle starting locations and their movement through the groundwater recovery simulation and in the post mining equilibrium setting are shown in Figure 28 and Figure 29. Particle pathways are colour coded by the geological formation through which they are traveling. Particle tracking runs for 500 years from the end of mining.

The particle flow paths indicate that in all cases groundwater flow is ultimately toward the residual voids i.e., none of the void's act as seepage sources to the wider groundwater system (although some voids may act as sources to adjacent voids with lower final landform elevations or predicted equilibrium water levels). Particle tracking also indicates that indicates that there is no off-site migration of groundwater and that groundwater in the vicinity of the TSFs and sources of potential groundwater contamination (infrastructure area, landfills) will migrate towards the final voids rather than migrate off site.

In some cases, it can be seen that particle traces initially show movement of particles is away from the voids. This occurs during the initial recovery phase where higher recharge over the spoil may result in more rapid recovery within the pit shells than the surrounding geology and some initial outward movement of groundwater from the mined areas. As recovery progresses groundwater levels in the in the surrounding geological formations exceed the recovery levels within the pit shells and final voids and any initial outward hydraulic gradients reverse and groundwater movement is towards the final voids.

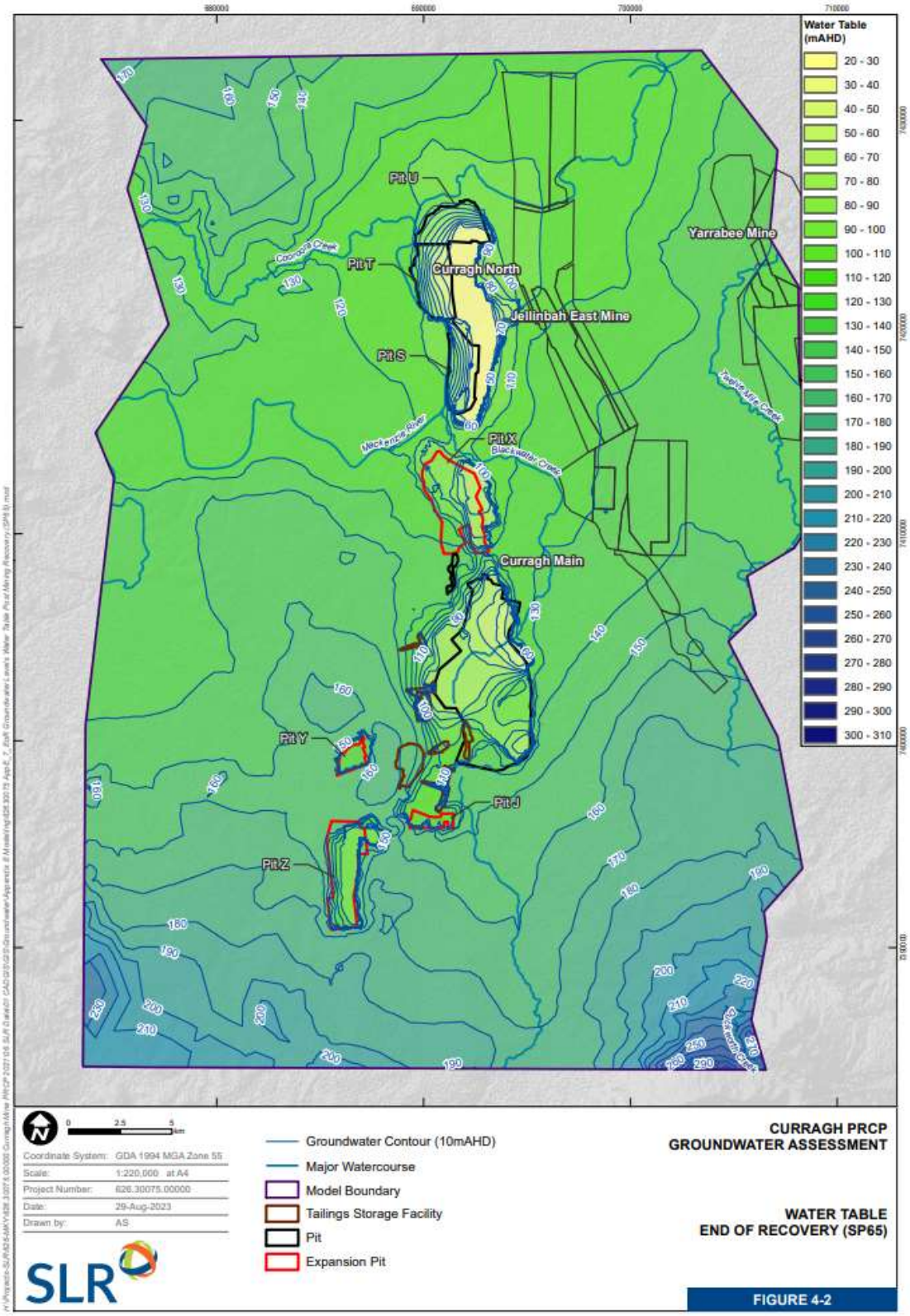

Figure 25: Predicted Water Table at End of Recovery

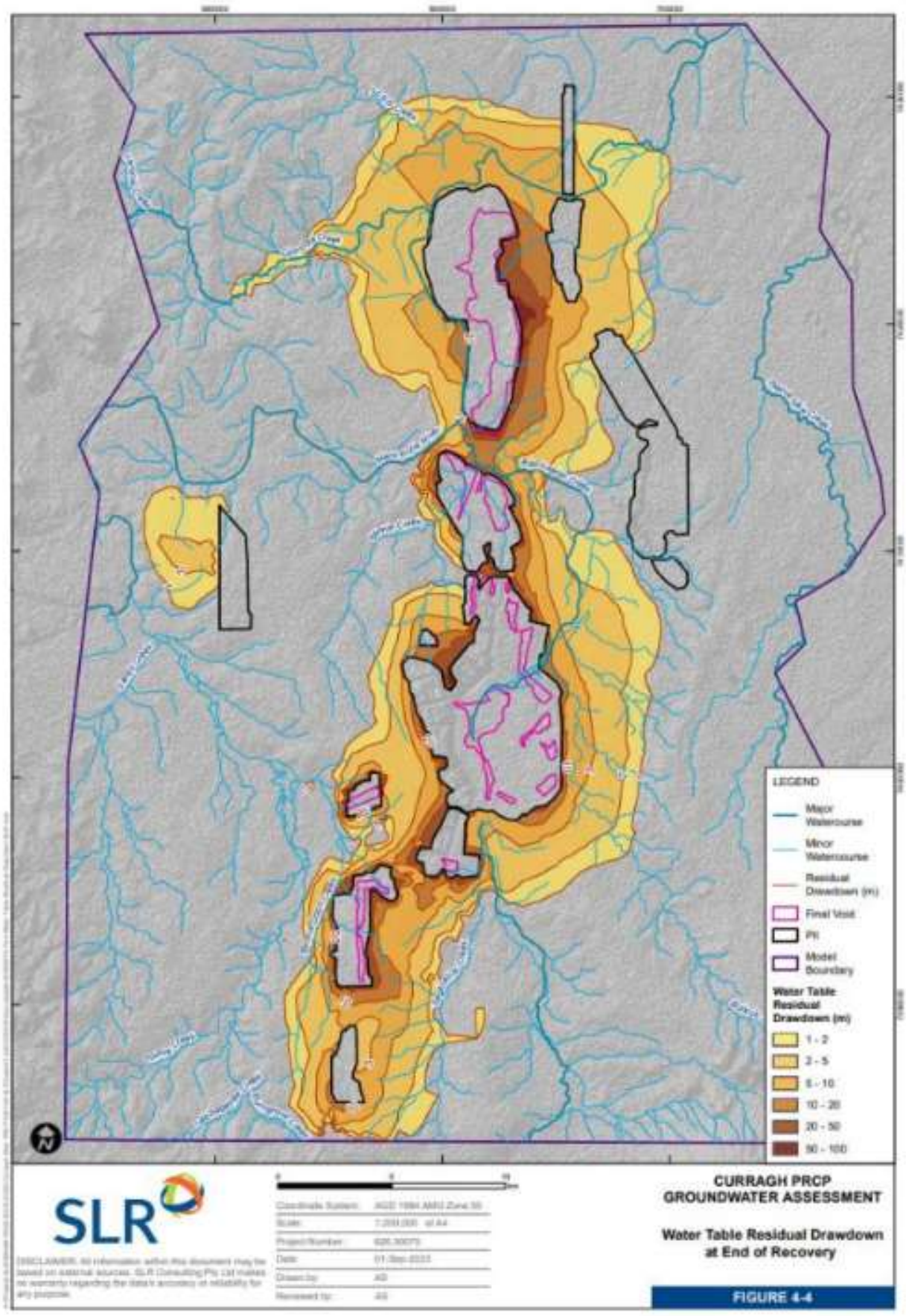

Figure 26: Predicted Water Table at End of Recovery

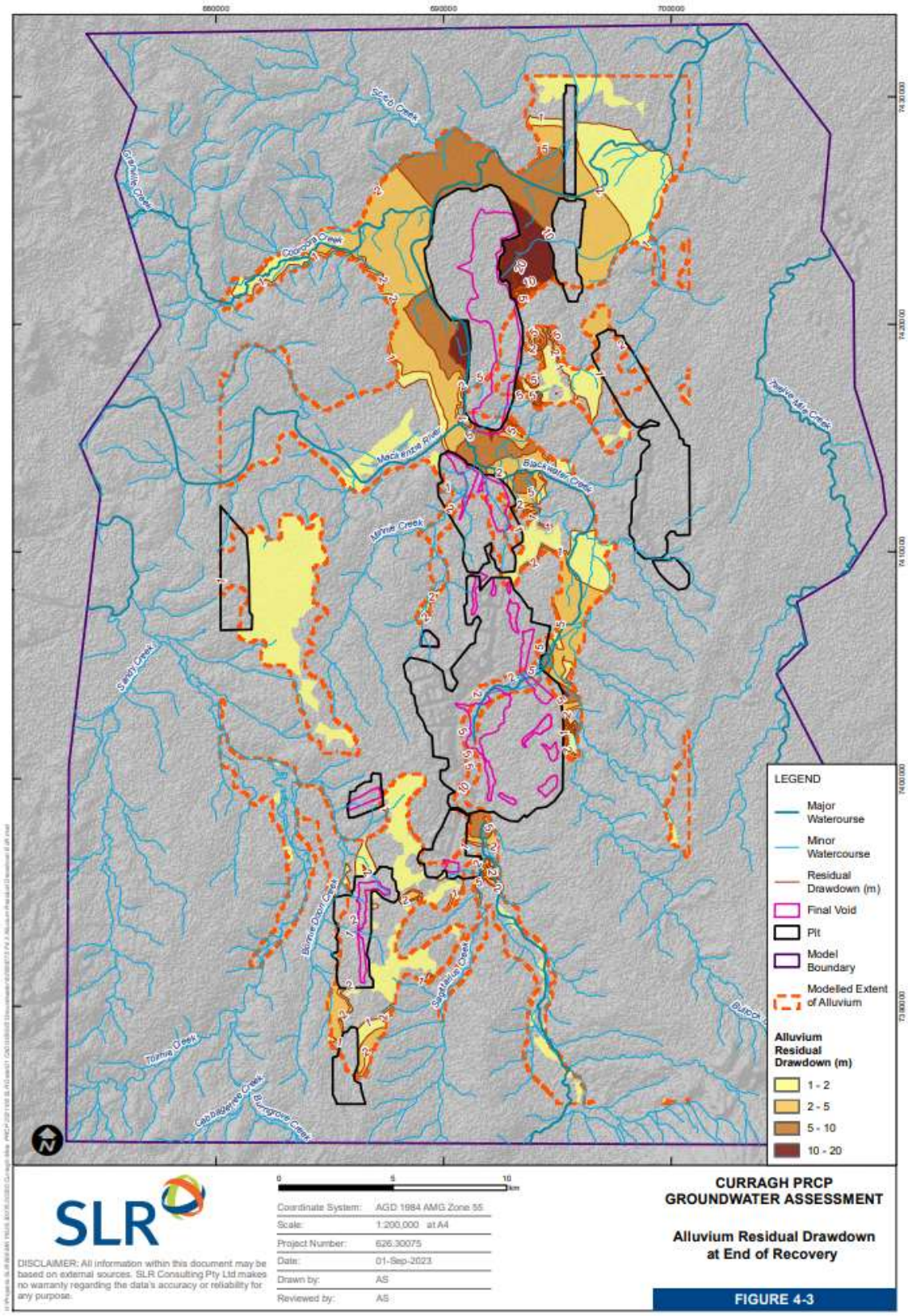

Figure 27: Predicted Residual Drawdown in Alluvium at End of Recovery.

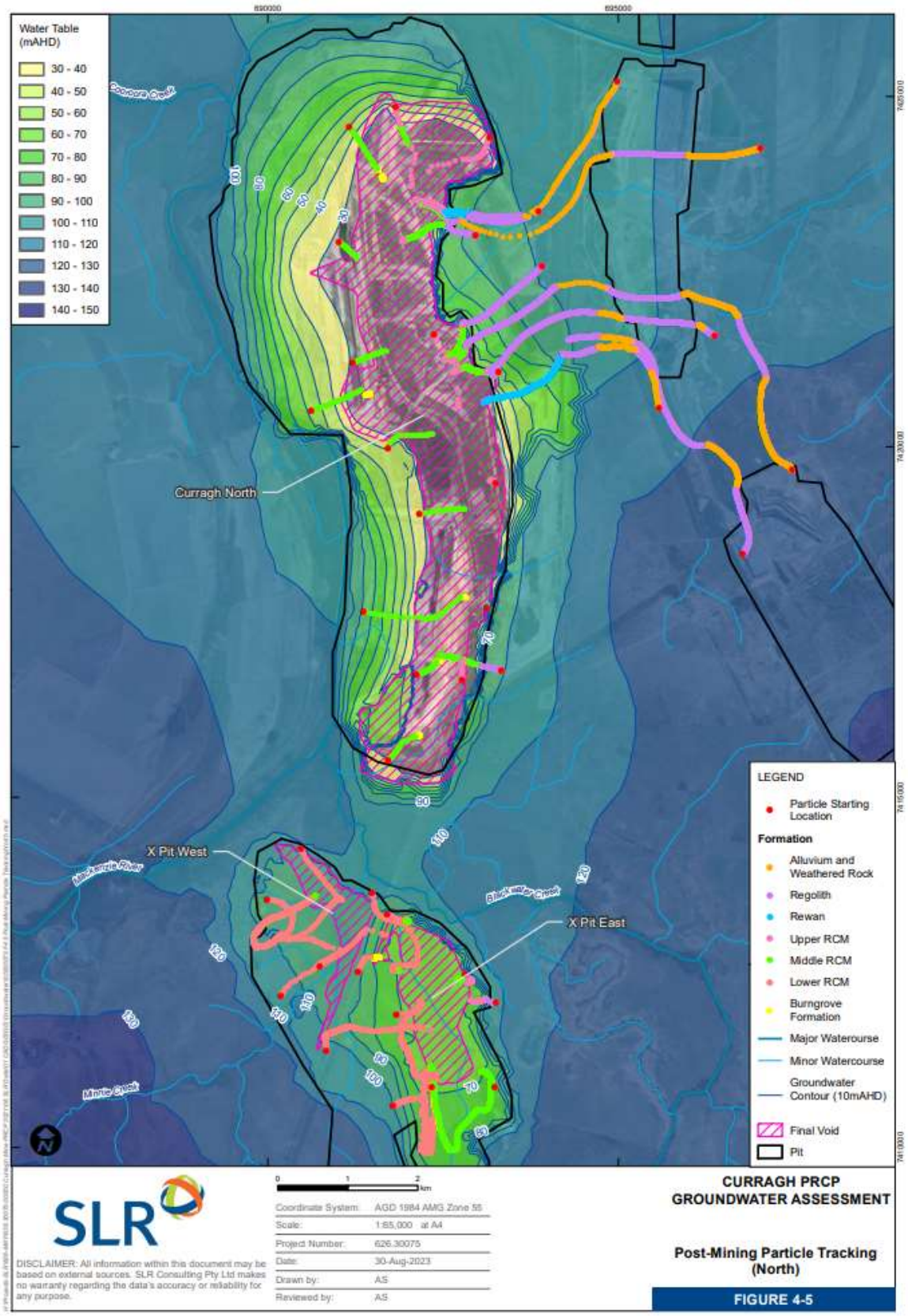

Figure 28: Particle Tracking – Groundwater recovery and Post-Mining Equilibrium (North)

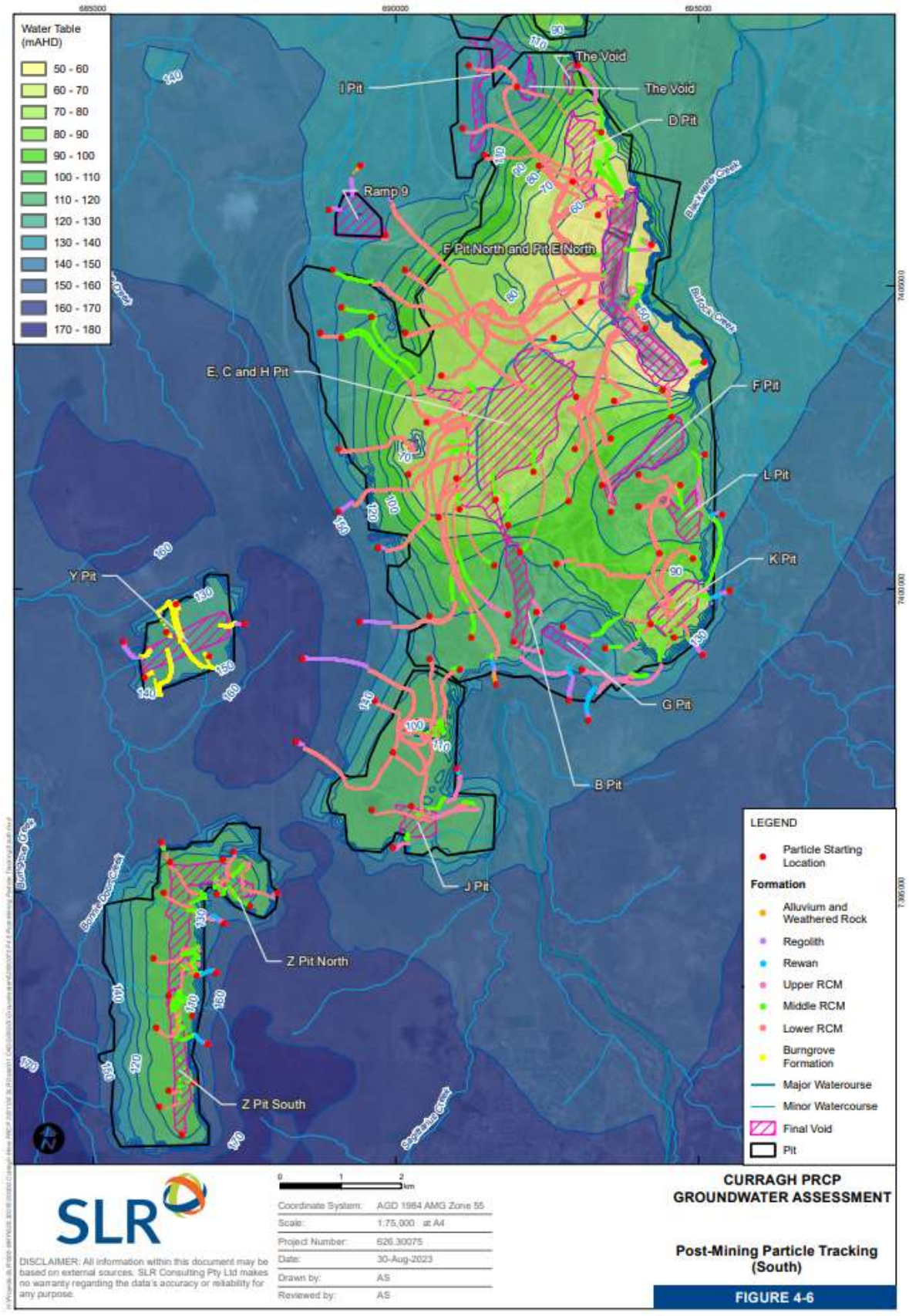

Figure 29: Particle Tracking – Groundwater recovery and Post-Mining Equilibrium (South)

The following key conclusions are drawn from the numerical modelling assessment of the post-mining groundwater environment at the Curragh Mine Complex:

- The modelling indicates that lakes will form within the final voids of the proposed post-mining landform. These lakes will act as groundwater 'sinks' with groundwater within mining disturbed areas (including the TSFs, CRS and shallow groundwater at the location of potential sources of contamination) migrating towards these sinks. This is clearly demonstrated by the particle tracking (Figure 29), post mining (end of recovery) groundwater contours for key formations and the geological cross sections showing post-mining (end of recovery) groundwater levels.
- Post-mining residual drawdown in the Mackenzie River Alluvium to the west of Curragh North will generally be in the order of 1-2m (but up to 20m near the mine voids), noting that the Mackenzie River is regarded as a "losing" watercourse with pre-mining groundwater levels in the alluvium 3-5m below the river stage in the vicinity of the mine. This is consistent with conclusions drawn from the preliminary numerical modelling (SLR, 2021).
- Based on the geological data reviewed for this assessment, it appears that equilibrium void lake levels are generally below the base of the alluvium and the base of weathering (potential preferential pathways for outward seepage of water from the void lakes). Where the minimum base of weathering elevation is potentially exceeded by the predicted equilibrium void lake levels at Ramp 9 and Pit G, particle tracking shows that any seepage from these voids will migrate to adjacent voids with lower void lake levels.
- Post-mining, the total estimated "groundwater" inflow to all voids is approximately 8.89 ML/d although the majority of this is water derived from infiltration to the spoil and drainage into the void lake rather than inflow from the Rangal Coal Measures or Alluvium.

Hydrostratigraphy

The Curragh Complex is underlain by a sequence of alluvial, weathered and Permian units that define local aquifers and aquitards:

- Cenozoic sediments
- Quaternary alluvium — the principal alluvial aquifer occurs within the Mackenzie River floodplain. Within the mine area, these deposits are typically thin to moderate but can reach up to ~40–45 m in thickness near the river, and comprise clays, silts and sandy/gravel channel lenses (Curragh BP EAR Appendices – Part 1 of2.Curragh BP EAR Appendices – Part 2 of 2)
- Tertiary alluvium/weathered profile — generally unsaturated with negligible yield, acting primarily as infiltration pathways and aquitards (Curragh BP EAR Appendices – Part 1 of 2).
- Permian Blackwater Group
- Fort Cooper and Moranbah Coal Measures — interburden units are of low permeability and function as aquitards.
- Moranbah Coal Measures — coal seams display water-bearing properties via primary porosity and secondary fracturing, representing the principal bedrock aquifers relevant to mining and closure (Curragh BP EAR Appendices – Part 1 of 2)
- Permian Back Creek / Burngrove Formation
- A regionally extensive, very low-permeability basal aquitard underlying the coal measures, with minimal water-supply or mine-interaction significance (Curragh BP EAR Appendices – Part 1 of 2).

Conceptual Hydrogeological Model

Groundwater modelling confirms that alluvial aquifers are spatially limited to the Mackenzie River floodplain and are discontinuous elsewhere. The assessed reach of Blackwater Creek lacks alluvium and is incised into Permian bedrock (CBPMP Response to DESI IR 26-07) shallow groundwater there is confined to the weathered profile. Drawdown modelling indicates that the water table will remain 30–40 m below creek beds, and no interaction with surface waters is predicted

Stygofauna have been recorded in the Mackenzie River alluvium and locally within the weathered profile; however, no mapped subterranean groundwater-dependent ecosystems (GDEs) occur within the project area (CBPMP Response to DESI IR 26-07). Ecological values across Curragh are primarily supported by rainfall and surface water systems. Hydrogeological conditions and model outputs confirm that project drawdown is not predicted to affect stygofauna habitats or regional GDEs.

Relevance to Rehabilitation and PMLUs

The hydrogeological assessment provides the basis for ensuring that proposed rehabilitation outcomes are achievable and sustainable, consistent with PRCP requirements:

- PMLU suitability: Conditions confirm that grazing and open woodland PMLUs are rainfall-driven and not groundwater-dependent.
- Watercourse diversions: Diversion design accounts for local alluvial conditions and ensures stable channel geometries without new groundwater connections.
- Flood protection landforms: Constructed above the water table, with negligible risk of seepage or groundwater interaction.
- TSF grassland and shrubs: Engineered capping and drainage systems limit infiltration to aquifers; monitoring bores (EA Table C12) provide verification of groundwater quality and levels in line with Schedule C requirements (CBPMP Response to DESI IR 26-07).
- NUMAs: Groundwater modelling informs placement and design, ensuring long-term geochemical stability and safety.

The alignment of the hydrogeological assessment outcomes with specific PRCP milestone criteria demonstrates that groundwater systems will remain protected throughout operations and closure. This integrated approach ensures that rehabilitation strategies and proposed PMLUs are directly informed by, and compatible with, the hydrogeological setting, in accordance with the PRCP Guideline (DES, 2019) and the requirements of Environmental Authority EPML00643713.

7.1.2 Flooding Assessment

CCPL has undertaken flood modelling of the floodplain surrounding the Curragh Complex to assist in design levels for the concept flood barriers for proposed residual voids. The Flood Model Assessment Report has been provided in **Appendix J**.

The modelling was undertaken to estimate a 0.1% Annual Exceedance Probability (AEP) flood event for the relevant watercourses that impact the Curragh Complex. The intent of the assessment is to understand the locations and dimensions of the flood barrier (long-term stable embankment) required to protect the nominated residual voids from flood influx. For planning purposes, the model has adopted a high level of conservatism by using the most conservative (i.e. largest) flow estimate derived from the flood frequency analysis (FFA).

Modelling highlighted that all residual voids within the Curragh Complex are not subject to flood inundation (0.1% AEP event) due to the diversion of Blackwater Creek and the stable embankments defined as part of the proposed final landform (Figure 30). The modelled results show that a residual void landform can effectively use spoil dumps and long-term stable embankments to protect the residual voids from flood ingress. SLR adjusted the provided residual void landform along the existing Blackwater Creek diversion and between X Pit and Curragh North to provide additional protection. Modelled results for the 0.1% AEP flood event show that no voids are inundated, however inundation of Curragh North, X Pit West, X Pit East, E Pit, C Pit, B Pit, H Pit, and J Pit occurs in the PMF event.

Based on the results of the flood modelling undertaken, the main outcomes are:

- All pits are not inundated in events up to and including the 0.1% AEP, as required by PRCP guidelines.
- Scour and erosion potential of landforms is unlikely for the 1% AEP, as high shear stresses and velocities occur in localised areas within the existing watercourses.
- Inundation of Curragh North, X Pit West, X Pit East, E Pit, C Pit, B Pit, H Pit, and J Pit occurs in the PMF event (Note there are no requirements that pits be flood free in a PMF event).
- High velocities and bed shear stress are predicted within the Blackwater Creek diversion, which may require ongoing monitoring in accordance with legislative requirements; and
- High velocities and bed shear stress are predicted in the 0.1% AEP and PMF events north of Curragh North.

It should be noted that the flood assessment undertaken was unable to include adjacent mining disturbance by other companies due to limited public information. It is recommended that flood modelling be reassessed over the life of the mine as changes to the catchment occur around Curragh Complex.

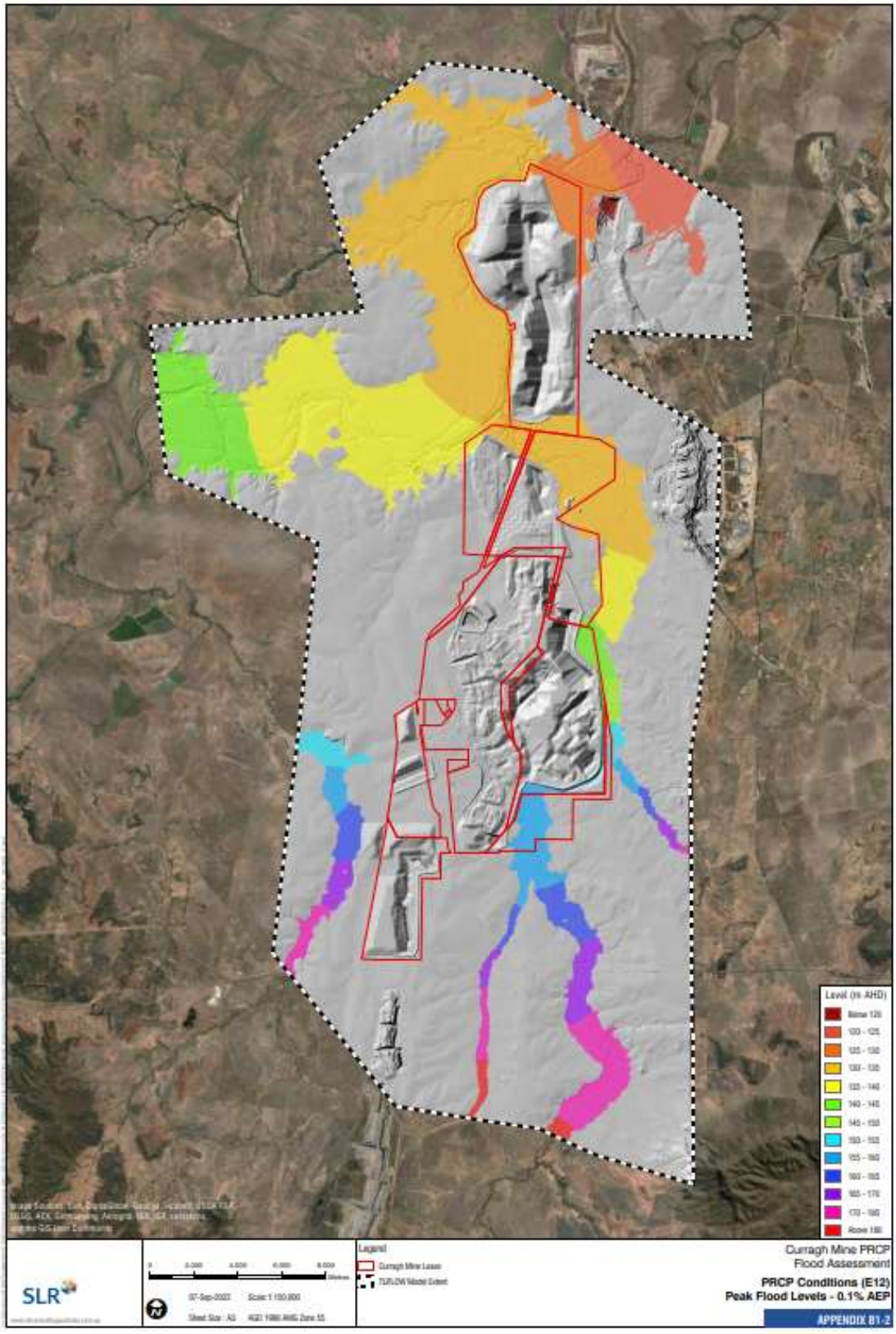

Figure 30: Flood extent for 0.1% AEP Event

7.1.2.1 Final Voids

A void water balance model was developed to assess the predicted void water levels and salinity concentration (**Appendix K**). Following closure of the mine, 19 residual void areas are expected to remain. The arrangement of these voids for the purpose of the Water Balance Model (WBM) to determine void water volume, quality and spill frequency is listed below with multiple pits grouped where hydrologically linked:

- Curragh North.
- Curragh Main: Pit I; Curragh Main Other; The Void; D Pit; F Pit North and Pit E North; E, C, B and H Pits; E, C, B and H Tailings; F Pit; L Pit; K Pit; G Pit; Ramp 9; J Pit; and
- Expansion Areas: X Pit (East and West), Y Pit, J Pit, Z Pit (North and South).
- A WBM was developed using the Goldsim software package to assess the long-term water level and water quality was of the residual voids following closure of the Curragh Complex.
- The model simulates daily changes in the volumes of stored water in response to inflows (rainfall, groundwater) and outflows (evaporation and controlled releases/overflows). The WBM was run for daily time step over 200-year simulation period, represented by 500 climate sequences, allowing the model to assess long term water levels, quality and risk of overflow for each void.
- The water balance model was developed to include a high-level salt balance to track both the quantity and quality of water on-site. The salt balance tracks the water quality in all of the inflows into the voids and subsequent effects from evaporation and releases on the storage water quality. The water quality values are presented in Table 31. These adopted values are consistent with those adopted for other Queensland mine sites.
- Based on groundwater monitoring data at the mine, an EC of 12,500 µS/cm was adopted as the average salinity concentration of groundwater inflows. Salinity parameters for surface runoff were determined based on prior experience in the area.

Inflow	Salinity (EC) (µS/cm)
Void	3000
Rehabilitation	250
Groundwater Inflow	12,500

Table 31: Adopted Salinity Generation Parameters

The above salinity values are converted to a concentration in milligrams per litre using an average multiplication factor of 0.67 (Measuring Salinity DERM, June 2007) to quantify the mass of salt transferred in the model.

The WBM was predicted to stabilise after approximately 100 years to the approximate levels for the median condition shown in Table 32 **32.** It is noted that some individual voids within the WBM reached equilibrium level in less than 20 years.

Table 32: Residual Void Water Level Summary (2022 Final Landform)

Void	Residual Void Level (50%ile) (mAHD)	Depth (m)	Surface Area (ha)
Curragh North	23	71	197
I Pit	135	1	5
Curragh Main Other	135	15	2
The Void	100	7	1
D Pit	62	33	12
F Pit North and Pit E North	49	23	24
E, C, B and H Pits	70	30	45
Pit B	112	4	13
F Pit	111	19	12
L Pit	103	38	6
K Pit	77	14	8
G Pit	137	7	6
Ramp 9	132	54	39
J Pit	111	18	8
X Pit East	67	33	39
X Pit West	98	20	19
Y Pit	123	8	8
Z Pit North	108	30	27
Z Pit South	105	17	13

The relative size of external catchment to the void footprint results in water levels that stabilise well below the indicative spill level with evaporative losses balancing inflows into the voids. A similar trend in water level is seen across all the residual voids. Water depths range from 1 m to 71 m within the voids for median conditions (50th percentile). During dry climatic conditions (5th percentile) water levels are approximately 0.1 m to 6 m lower. During very wet (99th percentile) climatic conditions the water level increases by 0.4 m to 9 m depending on the void and generally causes greater fluctuation in the equilibrium water level. Median final water levels range from 11 m to 109 m below the indicative spill levels and are not expected to overtop.

Water within the residual voids becomes highly saline throughout the simulation. This was not unexpected due to the high salinity of groundwater in the region and the assumption that the only loss from the system is evaporation (through which no salt is lost). Within the WBM, salinity is capped at a maximum EC of 532,836 µS/cm, which is equivalent to the point where the concentration of salt becomes high enough that the solution is saturated, and any additional salt will precipitate out of solution. All voids are expected to exceed hypersaline EC levels (>50,000 µS/cm) within approximately 120 years of closure, with some exceeding this value within 30 years. The average salinity of the voids throughout the simulation period are provided in **Table 33.**

Table 33: Average Stage Salinity (EC µS/cm)

Void	Year 10	Year 30	Year 200
Curragh North	**13,900**	**20,100**	**>50,000**
I Pit	>50,000	>50,000	>50,000
Curragh Main Other	11,700	25,700	>50,000
The Void	10,200	15,600	>50,000
D Pit	16,500	28,800	>50,000
F Pit North and Pit E North	27,500	>50,000	>50,000
E, C, B and H Pits	15,700	33,700	>50,000
B Pit	>50,000	>50,000	>50,000
F Pit	18,200	38,600	>50,000
L Pit	13,800	24,200	>50,000
K Pit	28,400	>50,000	>50,000
G Pit	40,700	>50,000	>50,000
Ramp 9	17,300	25,600	>50,000
J Pit	23,300	49,300	>50,000
X Pit East	15,600	27,500	>50,000
X Pit West	19,200	39,600	>50,000
Y Pit	40,600	>50,000	>50,000
Z Pit North	19,800	37,600	>50,000
Z Pit South	23,400	48,500	>50,000

At Curragh Complex the median residual void water levels are expected to range from 23 mAHD to 137 mAHD with water depths of 1m to 71m. The results indicate that the mine is not a net accumulator of water after approximately 100 years when the equilibrium water levels are reached. The final water levels remain below the spill level and the voids are unlikely to overtop in the 99th percentile climate scenario.

A significantly high concentration of salt is expected to accumulate within the residual voids. The elevated salinity of the groundwater inflows input a high level of salt into the voids which is not lost from the system via evaporation. The salinity of the voids is expected to exceed that of the groundwater and form highly concentrated solution. Although poor quality, water within the voids is not expected to interact with surrounding surface water given the final water levels.

The Flood Protection Landform is a permanent component of the Curragh final landform designed to deliver a safe, stable, non-polluting, and sustainable Post-Mining Land Use (PMLU) in perpetuity. The Flood Protection Landform isolates residual voids from catchment flows and provides long-term flood immunity consistent with the Environmental Protection Act 1994 (Qld) the PRCP Guideline (DES, 2019) and accepted Bowen Basin practice for hydraulic performance (DNRME, 2019; ACARP, 2002).

Design basis

The Flood Protection Landform is configured to exclude Mackenzie River and Blackwater Creek floodwaters from residual voids under the 0.1% AEP design event. Conceptual parameters (4) include crest levels with +1 m freeboard above the 0.1% AEP water surface derived from the adopted hydraulic method in Appendix N.

Parameter	Value
Height	Meets 0.1% AEP level + 1 m freeboard (Appendix N). Flood Modelling Report (1)
Crest width	35–45 m (to be confirmed at detailed design).
Water-facing slope	≤ 25%; targeted rock armouring where interface velocities exceed ~2.5 m/s. Flood Modelling Report (1)
Residual-void-facing slope	≤ 25%; targeted rock protection where required.
Factor of Safety	FoS ≥ 1.5

Table 34: Indicative Flood Protection Landform parameters

Note: Final geometries and surface protection will be refined during detailed design using site geotechnical investigations, landform-evolution considerations, and flood modelling.

Model construction and assumptions (Appendix N summary)

- Solver and domain: Two-dimensional floodplain hydraulics were simulated in TUFLOW 2D (HPC) on a gridded domain representing the post-mining landform.
- Topography: The computational surface was generated from a post-mining landform DEM compiled from post-mining contours and available LiDAR, explicitly representing residual voids and The Flood Protection Landform.
- Hydraulic roughness. Land-use-based Manning's n was mapped across the floodplain and channels (e.g., grassland 0.04; light scrub 0.05; thick scrub 0.08), forming the basis of velocity and shear predictions that inform surface-protection selection. Rehabilitation will be established and maintained to match or exceed the vegetated roughness assumptions used in the model.

Flood Velocity Modelling

- Hydrologic forcing: Inflow hydrographs derived from WBNM were applied to Mackenzie River, Blackwater Creek and other contributing systems; minor sub-catchments were area apportioned.
- Boundary conditions: Downstream tailwaters were set as stage–discharge boundaries placed beyond the area of interest with gradients aligned to local ground slope.
- Design rainfall treatment: Separate ARFs and temporal patterns (ARR2019/GTSMR) were adopted for the large Mackenzie system versus smaller local catchments for assessed durations per Appendix N.
- Adopted design flows and outputs: The 0.1% AEP peak flows (Appendix N Table 14) and critical storm durations (Table 16) drive the hydraulics; maximum water levels and velocities are summarised in Table 17 and mapped in Figure 8.

Hydraulic performance

Appendix N indicates that velocities interacting with the FPL under the 0.1% AEP event are typically < 2.0 m/s, with localised peaks up to ~3.0 m/s at discrete interfaces. Velocities > 3.5 m/s are predicted to occur within the floodplain and not with the post closure landform. For interpretation of protection needs, the Bowen Basin hydraulic criteria (velocity/stream power/shear) are applied following Queensland guidance and ACARP research (DNRME, 2019; ACARP, 2002). For conservatism in closure, a 2.5 m/s armouring trigger is used at localised hydraulic stress points when assessing the rarer 0.1% AEP condition.

Surface-protection specification

- Vegetated surfaces. Vegetation (grass–shrub–tree mixes appropriate to site) is the baseline protection for water-facing slopes where interaction velocities fall within the vegetated regime and are consistent with Manning's n assumptions adopted in Appendix N.
- Armoured surfaces. Where modelled interface velocities exceed 2.5 m/s, selective rock armouring/rock mulch will be installed at hydraulic stress points (e.g., toe segments, localised shear zones) to ensure long-term erosion resistance.

Performance outcomes

- Safe. Residual voids are excluded from floodwater under the 0.1% AEP event plus 1 m freeboard.
- Stable. Conservative geometries (slopes ≤ 25%) with FoS ≥ 1.5 and targeted armouring ensure resistance to erosion and scour under design conditions (DNRME, 2019; ACARP, 2002).
- Non-polluting. By maintaining erosional stability and preventing flood ingress into residual voids, potential water-quality risks are minimised and downstream Environmental Values (EVs) under the *EPP (Water and Wetland Biodiversity) 2019 (Qld)* are protected.
- Sustainable. Vegetation-led protection complemented by targeted engineering controls provides a long-lived, low-maintenance solution consistent with the approved PMLU.
- Appendix N concludes that all pits remain with flood immunity up to and including the 0.1% AEP, confirming the FPL meets the flood-immunity performance requirement in the PRCP.

2025 Revision of Flood Protection Landform

The 2025 revision of the Curragh North flood protection landform was undertaken to refine the final layout, reduce potential flood interactions, and enhance long-term hydrological and geotechnical performance. As part of this update, the southern pit footprint at Curragh North was reduced following approval of the Mammoth Underground, and the associated flood protection landform was realigned further north. This change increases the setback from Blackwater Creek, resulting in the retention of existing riparian vegetation and the expansion of the active floodplain. The broader floodplain improves hydraulic roughness and provides additional flood storage capacity at the landform–floodplain interface, strengthening both environmental and engineering outcomes.

As a result of these refinements, the 0.1% AEP interface velocities previously derived from Appendix N are considered conservative when applied to the revised layout. Nevertheless, existing armouring trigger thresholds will be retained as a precaution until detailed design or updated hydraulic modelling confirms reduced exposure. This conservative approach ensures compliance with the controlling design criteria, which remain unchanged:

- Flood immunity: 0.1% AEP + 1 m freeboard
- Geotechnical stability: Factor of Safety (FoS) ≥ 1.5

Operations and post-closure

Design and construction of FPLs (regulated structures) will follow the EM635 Manual process, including consequence-category assessment and RPEQ certification at design and construction, consistent with EA Conditions D1–D6 (EPML00643713). Post-closure, the FPLs operate as integrated elements of the final landform to maintain stability, exclude flood ingress, and achieve a safe, stable, non-polluting, and sustainable outcome in perpetuity.

7.1.3 Geotechnical

- Raine Associates (2021) undertook a geotechnical stability assessment of the residual voids (Appendix N). Final landform designs were geotechnically assessed using deterministic slope stability analysis, using two-dimensional limit equilibrium methods and Rocscience's proprietary software SLIDE 2.0 (SLIDE). Nine (9) selected cross-section locations through the supplied final landform designs were analysed.
- The following assumptions, comments and qualifications are made in relation to the analyses completed:
- Static and dynamic scenarios have been considered. To consider the potential impacts of earthquakes (i.e. dynamic scenarios) a peak ground acceleration (g) of 0.02 has been applied, equivalent to an event with an exceedance probability of 2% in 50 years (refer to Section 2.3).
- For design acceptance criteria, a minimum factor of safety (FoS) of 1.5 for static conditions and 1.1 for dynamic conditions have been adopted for these analyses.
- The Spencer method has been adopted for these analyses.
- The Path Search method has been adopted for these analyses.
- The slope stability analysis considers Global Stability of the slope.
- For the purpose of these analyses a slope angle of 7-degrees in the soil materials has been assumed. It is understood that this is to help prevent and minimise surface erosion, rather than to maintain long term stability of the relevant final landform slopes.
- A Disturbance (D) Factor of 0.7 has been applied when determining Hoek-Brown material parameters for a blast affect Permian rock mass.
- A Disturbance (D) Factor has been applied to a width equal to approximately half the bench height, where the final landform comprises final excavated pitwall geometries in the Permian rock.
- The analysis of final excavated pitwall geometries in the Permian rock only considers potential failures through the rock mass and does not consider the potential impact(s) of individual fault planes, fault orientation(s) and fault interaction(s); and
- Groundwater and surface water can have a significant and adverse impact on the stability of pitwalls and must therefore be appropriately understood and considered. Limited groundwater and/or hydrogeological information is available.
- The Steady State FEA tool provided in SLIDE has been utilised to model groundwater movement and hydrostatic pressures through the materials based on the adopted ground models, for the assumed water levels and adopted material hydraulic conductivities (Table 5-7).
- Flood levels have been adopted as per Section 6.1.5. A 1m freeboard was added to the provided flood levels for the presented analysis. Values were converted to the CCPL mine grid coordinate system prior to use.
- The final voids have been assumed to be dry for the presented analyses.
- Perched water tables have not been considered

Slope Stability Analysis Results The analysis results for the critical failure surfaces analysed are provided in Table 35.

Pit	Scenario	Estimated Static Factor of Safety	Estimated Dynamic Factor of Safety
U Pit	Planned Final Landform Option - Highwall Side	1.8	1.7
S Pit South	Planned Final Landform Option - Highwall Side	1.8	1.7
	Planned Final Landform Option - Lowwall Side	1.7	1.6
X Pit	Planned Final Landform Option - Highwall Side	1.8	1.7
D Pit	Planned Final Landform Option - Highwall Side	2.4	2.3
	Alternative Final Landform Option - Highwall Side	3.2	2.7
	Alternative Final Highwall Re-Shaped Final Slope Option - Highwall Side	1.6	1.5
F Pit South	Planned Final Landform Option - Highwall Side	1.9	1.8
	Alternative Final Highwall Re-Shaped Final Slope Option - Highwall Side	1.8	1.7
	Planned Final Landform Out Board Slope	1.7	1.6
	Planned Final Landform Option - Lowwall Side	2.9	2.6
K Pit	Planned Final Landform Option - Highwall Side	2.5	2.4
	Alternative Final Landform Option - Highwall Side	3.2	3.1
	Alternative Final Highwall Re-Shaped Final Slope Option - Highwall Side	1.7	1.6
J Pit	Planned Final Landform Option - Highwall Side	1.7	1.6
	Planned Final Highwall Re-Shaped Final Slope - Highwall Sid	1.6	1.5
Y Pit	Planned Final Landform Option - Highwall Side 2.7 2.5	2.7	2.5
	Planned Final Highwall Re-Shaped Final Slope - Highwall Side	2.0	1.9
Z Pit	Planned Final Landform Option - Highwall Side	1.8	1.7
	Planned Final Highwall Re-Shaped Final Slope - Highwall Sid	1.6	1.5

Table 35: Critical Failure Surfaces of Final Landform Options

Deterministic analysis results for the final landform designs, based on the adopted ground models and analysis methodology and assumptions, indicate that the final landform designs meet the adopted design acceptance criteria (a minimum factor of safety (FoS) of 1.5 for static conditions and 1.1 for dynamic conditions).

Past pitwall performance at Curragh indicates that geological structures are a key factor requiring consideration as part of the design process and CPS. The analysis of sections that include remnant pitwalls in the Permian rock only considers potential failures through the rock mass and does not consider the potential impact(s) of individual fault planes, fault orientation(s) and fault interaction(s). Where adverse fault orientations and interactions, relative to pitwall geometries and locations are present, the planned final pitwall geometries (as provided) may not be appropriate for CCPLs long-term final landform stability requirements. In such cases alternative design options such as the construction of softwalls in blasted Permian rock may be required. Due to potential surface erosion mitigation requirements and in order to meet the adopted design acceptance criteria for long-term slope stability, it may be necessary to re-shape softwalls to reduce slope angles. A re-shaped slope angle of approximately 22-degrees has been considered in the analysis undertaken for ground models that consider re-shaping of softballs constructed in blasted Permian rock. The associated cut-fill balance of these options is to be further investigated as detailed design works are completed.

The ability to identify geological fault locations and geometries accurately for the final pitwall is limited by existing data coverage and density. Fault interpretations and geotechnical ground models for final pitwalls are to be developed as mining progresses and/or additional geology and geotechnical data is collected and obtained.

To consider the provided flood levels for X-Pit the proposed final landform has been raised by approximately 10 m for the purpose of these analyses.

7.1.4 Waste Characterisation

7.1.4.1 Overview

Waste rock characterisation is fundamental to demonstrating that rehabilitation outcomes at the Curragh Complex will be safe, stable, non-polluting and sustainable, in accordance with s.112 of the Environmental Protection Act 1994 (Qld), the PRCP Guideline (DES, 2019), and conditions of the Curragh Environmental Authority EPML00643713.

Since the early 1980s, extensive spoil geochemistry studies have been undertaken across Curragh Main, East and North (Table 36). These studies, supported by more recent sampling campaigns (2009 and 2022), confirm that the spoil is overwhelmingly non-acid forming (NAF), with localised potentially acid forming (PAF) material in thin interburden seams, coal rejects, and limited Permian mudstones/siltstones.

The review integrates more than 40 years of investigation, including:

- Stuart Miller & Associates (1980, 1984) – foundational spoil chemistry studies.
- Emmerton (1993); Land Reclamation Services (1993); HLA-Envirosciences (1998) – targeted spoil and overburden analyses at Curragh Main.
- Environmental Geochemistry International (1993) – comprehensive Curragh East characterisation.
- AustralAsian Resource Consultants (1999); Wesfarmers Curragh (2003) – Curragh North feasibility and EIS studies.
- Curragh EIS updates (2002, 2004, 2009) – integrated spoil geochemistry with mine planning.
- SLR (2022) – updated sampling program across WRDs.
- CBPMP EAR Appendices (2024) – synthesis of spoil and soils datasets (Appendix H).

Mining Area	WRDs / Dumps	Historic Sampling Programs	Recent Sampling (SLR 2022)	Planned Drillholes / Future Sampling
Curragh Main	Pits B–E, Ramp 11–12, North-East Dump	Stuart Miller & Associates (1980, 1984) – dragline spoil characterisation; Emmerton (1993) – Ramp 11–12; LRS (1993) – grab samples; HLA-Envirosciences (1998).	5 WRD samples tested (ANC, NAPP, ESP, EC).	Ongoing validation drilling as part of spoil lift extensions.
Curragh East	East Spoil Dumps	EGI (1993) – 119 samples from 16 drillholes, full geochemical suite.	4 WRD samples tested for ANC/NAPP.	Proposed infill drilling during progression of East dumps.
Curragh North	North Spoil Dumps (raised dumps, North-East Spoil Dump)	AARC (1999) – 36 samples; Wesfarmers Curragh (2003) feasibility studies; EIS updates (2002, 2004, 2009).	11 WRD samples tested (incl. 2009 NAG/ANC/NAPP program; reconfirmed 2022).	Additional drillholes to target fine-grained Permian mudstones/siltstones for closure verification.
Curragh West	Not yet developed	No historic data.	No recent data.	Indicative waste characterisation program outlined – drilling to be completed prior to WRD development.
Curragh Extension	Not yet developed	No historic data.	No recent data.	Indicative waste characterisation program outlined – drilling to be completed prior to WRD development.

Table 36: Location of Waste Rock Dumps and Planned Waste Characterisation Drillholes – Curragh Complex

7.1.4.2 Historic Characterisation (1980–2009)

Curragh Main

Early studies (Stuart Miller & Associates 1980, 1984) characterised dragline spoil in Pits B–E, identifying spoil as generally alkaline with high ANC (sufficient to neutralise sulphur contents of 0.03–2.8%). A thin (<0.5 m) interburden seam between the Aries/Castor and Pollux seams was occasionally acid forming, but readily neutralised when blended with bulk spoil. Spoils were highly sodic and moderately saline, requiring consideration in rehabilitation planning. Emmerton (1993) identified localised acidity in Ramp 11–12, though quantities were minor. LRS (1993) confirmed sodicity and salinity as key constraints, with only 6 of 81 samples showing acidity.

Curragh East

EGI (1993) analysed 119 samples across 16 drillholes. Sulphur contents were uniformly low (<0.36%), ANC was moderate to high, and all NAPP values were negative. Eleven samples were tested by NAG, confirming an excess of neutralising capacity. All samples were classified as NAF. Trace enrichment of Ag, As and Se was observed but remained well below environmental or agronomic concern. Spoils were generally sodic, consistent with Curragh Main.

Curragh North

Feasibility and EIS studies (AARC 1999; Wesfarmers 2003) analysed 36 samples, most of which were NAF, with a small number of Permian mudstones returning positive NAPP. Median ANC values (10–12 kg H_2SO_4/t) exceeded APP (0.5–1 kg H_2SO_4/t). Subsequent EIS updates (2002, 2004, 2009) reconfirmed low AMD risk, sufficient neutralising capacity, and no incidents of AMD. Trace As and Se enrichment was noted but considered minor (Table 37).

Study	Scope	Key Findings
Stuart Miller & Associates (1980, 1984)	Curragh Main (Pits B–E)	Spoil alkaline; ANC sufficient to neutralise sulphur (0.03–2.8%). Thin Aries/Castor interburden occasionally PAF but not problematic when blended. Spoils sodic and saline.
Emmerton (1993)	Ramp 11–12	Small quantities of acidic material; not significant.
Land Reclamation Services (1993)	81 grab samples, Curragh Main	Most spoil sodic/saline; 6 acidic samples (oxidised coal/clay).
HLA-Envirosciences (1998)	20 borehole samples	2 acidic pH samples; others strongly alkaline; NAG confirmed NAF.
EGI (1993, Curragh East)	119 samples (16 drillholes)	Low sulphur (<0.36%); ANC high; NAPP negative; all NAF. Trace Ag, As Se not significant. Spoil sodic.
AARC (1999, Curragh North)	36 samples	Most NAF; 6 positive NAPP (Permian mudstones). Median ANC exceeded APP.
Wesfarmers (2003), Curragh North EIS updates (2002, 2004, 2009)	EIS & feasibility	Overburden overwhelmingly NAF; sufficient ANC; no AMD incidents; minor trace metal enrichment.

Table 37:Summary of Historic Waste Rock Characterisation Studies (1980–2009)

2009 Characterisation

A targeted 2009 program (Appendix H, Table 72) analysed 11 spoil samples:

- **pH:** 7.4–9.4, with only two acidic results (Permian and Tertiary spoil at Curragh North-East).
- **NAG:** <0.5 kg H_2SO_4/t for most samples; one result of 3.5 kg H_2SO_4/t.
- **ANC:** 6–67 kg H_2SO_4/t, confirming buffering capacity.
- **NAPP:** All negative, confirming strong neutralising potential.

2022 Characterisation

A site-wide campaign was undertaken by SLR (2022) to update the spoil geochemistry dataset. Twenty WRD samples were tested for ANC, NAPP, NAG, EC and ESP (Appendix H, Table 72). Key results include:

- 17 NAF, 2 uncertain, 1 PAF.
- NAPP: –88.8 to +6.7 kg H_2SO_4/t.
- ANC: 6–89 kg H_2SO_4/t.
- 16 of 20 samples alkaline (pH 7.8–9.0).
- The dataset confirms that spoil is overwhelmingly NAF, with isolated low-volume PAF material manageable by selective placement and encapsulation.

Parameter	Range/Classification	Key Observation
Classification	17 NAF; 2 uncertain; 1 PAF	Confirms dominance of benign spoil.
NAPP (kg H_2SO_4/t)	–88.8 to +6.7	Only one PAF sample (low risk).
ANC (kg H_2SO_4/t)	6.1–89	Strong neutralising capacity across dataset.
pH	7.8–9.0 (16 of 20 alkaline)	Consistent with historic datasets.

Table 38: 2022 Waste Rock Characterisation Results (SLR2022)

Consolidated Geochemical Properties

- Acid-forming potential: ~90–95% NAF, ~5% PAF, ~5% uncertainty allowance. PAF is spatially restricted to fine-grained Permian mudstones/siltstones (Curragh North), coal rejects, and thin interburden seams (Curragh Main).
- Neutralising capacity: ANC values consistently exceed potential acidity, providing robust buffering.
- Sodicity: Sodic spoil is common (ESP 5–35) and poses erosion/revegetation risks; requires burial below root zone or gypsum amelioration.
- Salinity: EC values range 80–1,180 µS/cm (average ~350 µS/cm); generally, not limiting for plant growth.
- Metals: Trace enrichment of Ag, As and Se has been detected but is not of environmental significance; continued monitoring will ensure no adverse outcomes.

Analysis	Summary of Results	Rehabilitation Implications
Acid producing potential	Neutral–alkaline pH (7.3–10.1); only 6 of 33 samples with positive NAPP (all fine-grained Permian mudstones/siltstones). ANC moderate–high (avg. 35 kg/t).	Spoil overwhelmingly NAF; PAF confined and manageable via encapsulation with ≥2 m inert cover.
Sodicity	ESP 5–35; sodicity risks include dispersion, erosion, surface crusting, poor aeration. Tertiary alluvium more dispersive than Quaternary/Permian.	Sodic spoil placed below root zone or ameliorated (gypsum).
Salinity	EC 80–1,180 µS/cm (avg. 352). Highest in Permian sandstone but below agronomic concern.	Salinity not limiting; no specific management required.
Metals	Trace Ag, As Se enrichment in Curragh East & North; all below environmental thresholds.	Not a constraint; continued monitoring under EA Schedule C.

Table 39: Summary of Waste Rock Geochemical Properties – Curragh Complex

Rehabilitation and Maintenance Implications

- PAF and rejects: All PAF and coal rejects will be encapsulated within NAF spoil with ≥2 m inert cover (Appendix H, Figure H3).
- Sodic materials: Placed below root zone; gypsum amelioration trialled where unavoidable in growth media.
- Monitoring: Groundwater and surface water monitoring networks under EA Schedule C verify that spoil does not cause off-site contamination (Appendix G – Monitoring Program).
- Future characterisation: Additional sampling at Curragh West and Extension will validate classification; PRCP amendments will be lodged if material properties differ.

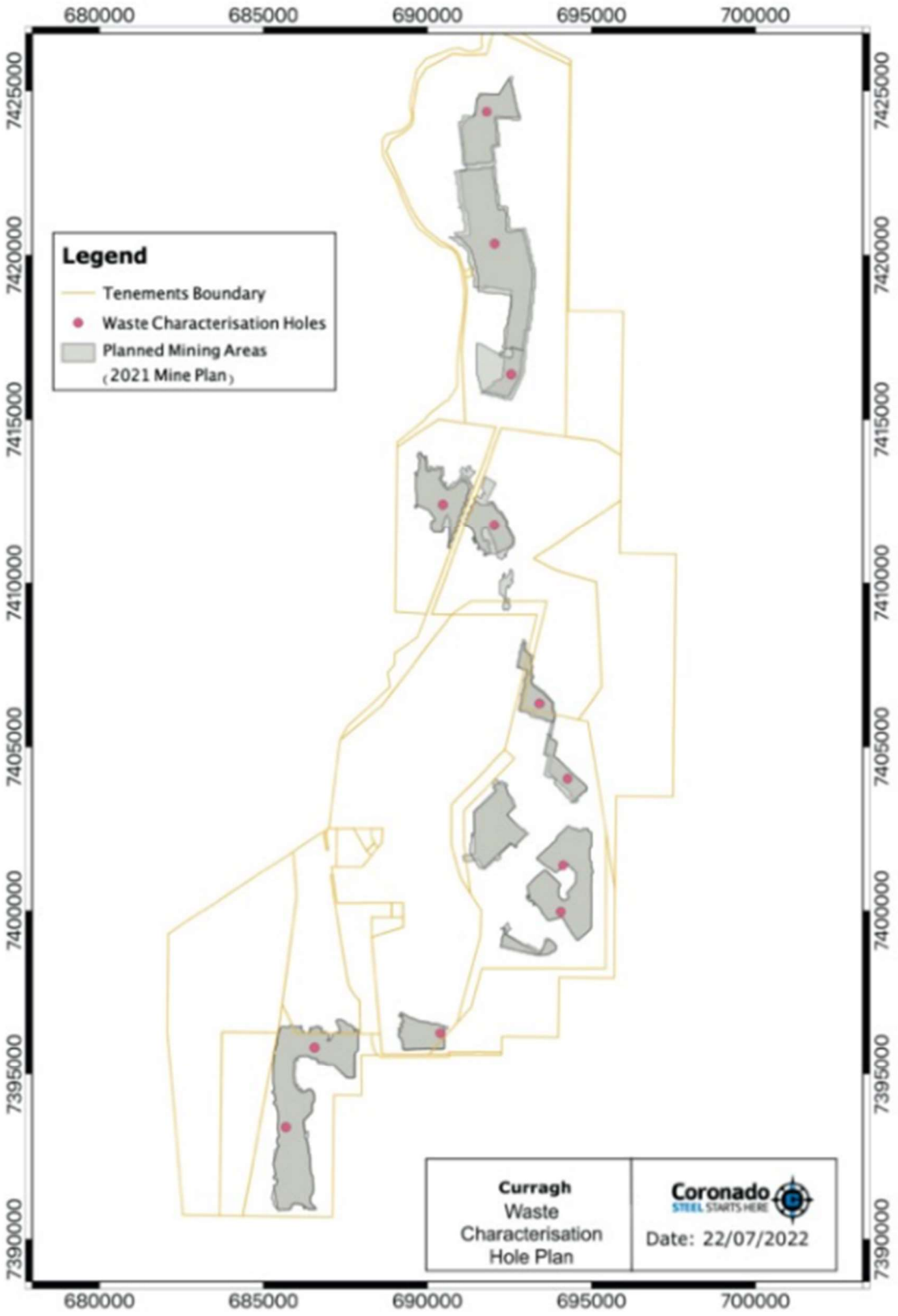

Figure 31: Proposed Waste Characterisation Holes

Linkage to EA and PRCP Milestone Criteria

Table 40 outlines how waste characterisation outcomes at the Curragh Complex align directly with conditions of the Environmental Authority EPML00643713. This ensures that waste management obligations under the EA are carried forward into measurable PRCP milestone criteria.

Table 40: EA Conditions vs PRCP Milestone Criteria – Waste Geochemistry

EA Reference	EA Objective	PRCP Milestone Criteria (Waste Geochemistry)	Justifications on Transition
Schedule C – Monitoring (Tables C12, C16–C20)	Maintain groundwater and surface-water quality; monitor pH, EC, sulphate, metals; apply triggers and report annually.	Runoff and seepage from waste rock landforms are monitored through the approved EA network. Prior to certification, results demonstrate no exceedance of EA trigger values. Any exceedance triggers investigation and corrective action before milestone sign-off.	Direct translation of EA monitoring into closure verification criteria.
General conditions (s.319 EP Act duty)	Activities must not cause environmental harm, including generation of acid or metalliferous drainage (AMD).	WRDs exhibit no AMD indicators: field pH ≥6.5, no acidic drainage, sulphate and metal trends stable or improving. Verification sampling confirms PAF materials are encapsulated.	Converts the general environmental duty into measurable closure evidence.
Schedule G – Rehabilitation outcomes (Condition G9)	Rehabilitated land must form a stable landform with a self-sustaining vegetation cover.	WRDs are re-profiled to stable slopes. Sodic materials placed below root zone or ameliorated with gypsum. Growth media meets agronomic criteria (pH 5.5–8.5; EC <1.5 dS/m; ESP <15%). Vegetation established to minimum 70% ground cover (native or sown species mix).	Links geochemistry (sodicity, salinity) to revegetation outcomes and landform stability.
Schedule G – Erosion and soil loss (Condition G13)	Erosion and soil loss from rehabilitated areas must be no greater than comparable unmined areas.	Waste landforms show no active gullies >0.3 m and erosion rates are equal to or less than analogue/reference sites. Drainage systems function as designed without sediment instability.	Demonstrates that spoil placement and cover materials are geochemically suitable for stable landforms.
Schedule G – Weeds (Condition G14)	Declared pest plants and weeds must not compromise rehabilitation success.	Weed cover does not exceed 5% of total ground cover within rehabilitated WRDs at certification.	Supports vegetation establishment and ensures geochemical treatments are not undermined by invasive species.
Schedule F – Waste management (Condition F1)	Mine wastes must be managed to prevent contamination of waters, land or the atmosphere.	All PAF and coal rejects are encapsulated within NAF material with a minimum 2 m inert cover. Confirmatory testing demonstrates no leachate generation. Sodic materials verified as placed below root zone or ameliorated.	Provides closure-specific evidence that waste management obligations have been achieved.
Schedule C – TSF/contact water controls (Condition C22–C25, where applicable)	Contain and manage mine-affected water and prevent uncontrolled releases.	WRD drainage integrated into site water-management system. Monitoring demonstrates that all contact water is captured and treated in accordance with EA requirements. No uncontrolled off-site release occurs prior to certification.	Ensures that waste-geochemistry risks are addressed through water-management controls.

The integrated dataset (1980–2022) demonstrates that Curragh spoil is predominantly NAF, with low AMD risk, sodicity as the primary constraint, and salinity/trace metals not limiting. The management framework — selective placement, PAF encapsulation, sodicity burial/amelioration, monitoring, and adaptive future characterisation — ensures waste rock landforms can be rehabilitated to safe, stable, non-polluting and sustainable outcomes, fully consistent with EA EPML00643713 and the PRCP Guideline (DES, 2019).

7.1.5 Soil and Capping Material

Topsoil Management

Topsoil is managed in accordance with the Curragh Complex Environmental Management System (EMS), which includes procedures for stripping, storage, and placement. Key governance documents include EMS PROC 1.3 Topsoil Management Procedure and EMS PROC 1.2 Permit to Disturb Procedure, which together establish the controls for vegetation clearing, stripping depth, and stockpile management.

The depth of topsoil to be removed is determined from site-specific soil mapping, with all suitable topsoil stripped to the defined depth prior to mining. Curragh's topsoil management program targets a stockpile surplus sufficient to ensure that areas of stripped topsoil unable to sustain vegetation cover (e.g. due to drought) can be re-covered where required, that bare spoil unable to sustain vegetation cover can be topsoiled where appropriate, and that any deterioration of topsoil quality in some stockpiles does not compromise the overall rehabilitation program. Regular reconciliations of topsoil volumes are undertaken by the Survey Team using surveyed and LiDAR-derived volumes, ensuring that a reliable balance of growth media is maintained across the site.

Where immediate placement is not possible, stripped topsoil is stockpiled to a maximum of two lifts, placed by rear dump trucks or scrapers to a height of approximately four metres to minimise degradation and maintain viability. Topsoil replacement is undertaken in accordance with EMS PROC 1.3 Topsoil Management Procedure and EM PLAN 1.3 Rehabilitation Management and Monitoring Plan, which provide guidance on replacement depths, placement methods, and integration with rehabilitation milestones. This approach ensures that topsoil is preserved in a condition suitable to support vegetation establishment and long-term sustainability of rehabilitated areas.

Topsoil inventory management at Curragh is supported by a consolidated database and mapping system. The Topsoil Quality Assessment (CCPL, 2020) provides baseline information on the volumes and quality of stockpiles across the Complex (Table 41). Each new stockpile is assigned to a zone, allocated a sequential identification number, and incorporated into the inventory. Relocation of stockpiles during mining progression is tracked, with comments recorded in the inventory to indicate the new location and whether the original ID has been retained or reallocated. Stockpiles are surveyed as they are generated and reconciled monthly using aerial LiDAR data, with volumes and locations recorded in both a spatial mapping layer and an inventory list. This integrated process maintains an accurate and transparent topsoil balance to support ongoing and progressive rehabilitation.

By maintaining a reconciled topsoil inventory, implementing controlled stripping and storage practices, and aligning placement with rehabilitation milestones, Curragh ensures that sufficient volumes of viable growth media are available to support the revegetation strategies described in Section 0. This approach demonstrates that the final landform will be underpinned by adequate topsoil resources to achieve safe, stable, non-polluting, and self-sustaining outcomes consistent with the PRCP Guideline, while supporting long-term ecological resilience across Grazing, Open Woodland, Watercourse, and Flood Protection and TSF PMLUs.

Table 41: Topsoil Inventory June 2022

Location	Description	Volume m^3	Total m^3
Curragh Main	Zone 1	893,942	5,620,304
	Zone 2	70,284	

Location	Description	Volume m^3	Total m^3
	Zone 3	533,081	
	Zone 4	255,829	
	Zone 5	626,809	
	Zone 5	433,939	
	Zone 7	955,893	
	Zone 8	785,359	
	Zone 9	1,065,168	
Curragh North	Zone 10	56,461	7,294,292
	Zone 11	119,893	
	Zone 12	134,156	
	Zone 13	856,792	
	Zone 14	849,045	
	Zone 15	4,180,573	
	Zone 16	1,097,372	
Total			12,914,596

Topsoil Quality

In 2020, CCPL conducted topsoil sampling program which included at least one stockpile from each zone (**Appendix H**). Zones with a collective volume of greater than 650,000m^3 of topsoil, were required to have two stockpiles from each zone sampled. Zones with a collective volume of less than 650,000m^3 were required to have only one stockpile from each zone sampled. Stockpile locations within each zone were chosen after a spatial assessment of all stockpile locations, taking into consideration adjacent zones.

Two composite samples, consisting of four grab samples each, were taken within every assessed stockpile. Each composite sample was collected in a north / south or east / west cross section dependent on the form and location of the stockpile.

The sampling strategy resulted in 23 stockpiles being sampled and a total of 45 individual samples being collected. The samples were taken by the Curragh environment personnel and sent to the Australian Laboratory Services (ALS) Laboratory for analysis of physical and chemical properties.

Both field and laboratory analysis were undertaken. The field observations recorded included, but was not limited to:

- Vegetation cover.
- Soil surface.
- Erosion impacts present.
- Soil colour; and
- Inclusion of waste or foreign objects.
- All of the samples were sent to an ALS laboratory for analysis of the below parameters:
- ADMC at 40°C.
- pH plus EC 1:5.

- Total N, Nitrate, Nitrite, Ammonia.
- Bicarbonate Ext P (Oslen - Alkaline Soils).
- Organic Matter Content.
- Exchangeable Cations (Ca, Mg, K, Na), CEC, Ca/Mg ratio, ESP.
- Metals (Mn, Cu, Fe, Zn, B, Al).
- Sulphur (Total as S); and
- Chloride.

Table 42 and Table 43 were used as the basis for the infield assessment of all soil samples.

The results of the infield assessments are presented in Table 42and indicate that of the 45 samples taken across 23 stockpiles on site, 32 samples or 71% place within the suitable range for field dispersion, 32 or 71% place within the suitable range for slaking behaviour and 45 or 100% of the samples place within the suitable range for dispersive behaviour.

Table 42: Field Dispersion Analysis

Score	Field Analysis
0	Very stable soil
1	Stable soil, will resist dispersion after tillage
2/3	Soil is prone to compaction and hard setting
4/5	Soil will disperse if cultivated wet
6	Soil disperses strongly if cultivated wet
7	May benefit from stubble retention If complete dispersion is observed within both initial wetting and remoulded aggregate tests, it is likely that dispersive attributes of the soil may require soil amelioration and provide a poor environment for plant growth. Laboratory analysis will assist with further analysis

Table 43: Field Slaking Scores

Score	Slaking Behaviour	Field Analysis
0	If the aggregate remains intact	This soil is stable to wetting. This is typical pasture soils. No action is needed.
1	If the aggregate collapses around the edges but remains mainly intact	
2	If the aggregate collapses into angular pieces	This is typical of self-mulching clays. If the soil does not disperse no action is necessary.
3	If the aggregate collapses into small (less than 2 mm diameter) rounded pieces, forming a cone	Surface may form a crust. However, this is only a problem in non-swelling.
4	If the aggregate collapses into single grains	This soil is very likely to crust and hard-set (sands and loams). Reduced cultivation, stubble retention and more frequent irrigations may be necessary on these soils.

Table 44: Dispersive Behaviour

Score	Dispersive Behaviour
0	Nil dispersion
1	Slight dispersion, recognised by slight milkiness of water adjacent to the aggregate
2	Moderate dispersion with obvious milkiness
3	Strong dispersion with considerable milkiness and about half of the original volume of the aggregate dispersed outwards
4	Complete dispersion, leaving only sand grains in a cloud of clay

Topsoil Stockpile #	Zone #	Volume (m^3)	Dominant Texture	Field Dispersion Score	Field Slaking Score	Dispersive Behaviour
CN364_1	11	305,894	Clay, loam sandy	2 - 3	3	0
CN364_2	11	305,894	Clayey sand	2 - 3	1	0
CN385_1	11	26,135	Clayey sand	4 - 5	1	1
CN385_2	11	26,135	Clayey sand	4 - 5	3	2
CN387_1	11	51,624	Clayey sand	4 - 5	3	2
CN387_2	11	51,624	Sandy loam	4 - 5	3	0
CN212_1	12	22,240	Clay loam	1	2	0
CN212_2	12	22,240	Clay loam	1	2	0
CN413_1	13	420,158	Sandy clay loam	1	1	1
CN413_2	13	420,158	Sandy clay loam	4 - 5	3	0
CN55_1	13	38,570	Clay loam	1	1	1
CN55_2	13	38,570	Clay loam	1	1	2
CN326_1	14	46,764	Light medium clay	1	1	1
CN326_2	14	46,764	Light clay	2 - 3	1	0
CN400_1	14	66,387	Clay loam	1	4	0
CN400_2	14	66,387	Clay loam	1	4	0
CN93_1	15	328,172		2 - 3	1	0
CN93_2	15	328,172	Medium Clay	2 - 3	1	2
CN225_1	16	17,600	Medium heavy clay	4 - 5	3	0
CN225_2	16	17,600	Medium clay	4 - 5	1	0
CN414_1	16	28,087	Sand	4 - 5	0	1
CN414_2	16	28,087	Sand	4 - 5	4	1

Table 45: Curragh North Field Dispersion and Slaking Behaviour

General topsoil stockpile categorisation values can be assigned to each stockpile based on the overall presence of vegetation and percentage of uncontaminated material observed as per the categories defined in Table 46.

Table 46: Stockpile Quality Category

Topsoil Stockpile Category	Value Description
A	High value. Low levels of contaminated material. Uncontained soil content at least 70% of the stockpile. Quality Topsoil.
B	Moderate value. Soil purity 50-70%. Higher levels of contamination and variable quality. Useable topsoil value but preferable in lower sloping areas or as subsoil material or capping
C	Marginal. Significant levels of contamination present (>50%). Quality better than spoil present but only useful a capping/subsoil material in rehabilitation
D	Unsuitable. No Better than spoil material present

In total 23 Stockpiles were sampled during the study and the categories assigned to the stockpiles show a 50:50 split of Category A and Category B stockpiles, with 48% and 52% respectively. At Curragh Main the results split was 58%:42% for Category A and Category B stockpile qualities. With Curragh North stockpiles had 41% assigned a stockpile quality Category A and 59% assigned a Category B.

The laboratory results were also assessed using categories for primary parameters tested. Soil pH is important as it affects the ability of nutrients in soil. Ensuring the pH of the soil is as close as possible to the neutral range as indicated below in Table 47 will ensure satisfactory results when the topsoil is used for planned rehabilitation activities.

Table 47: pH Rating

Rating	pH
Acidic	5.6 – 6.5
Neutral	6.6 – 7.5
Mild Alkalinity	7.6 – 8.5
Alkaline	>8.5

The laboratory results of all pH (1:5 soil/water) samples show soil pH within the 7.3 – 9.2 range. Topsoil at Curragh Main ranges from 7.6 – 8.4 with the average value of 8.13. Topsoil at Curragh North ranges from 8.4 – 9.2 with the average of 8.71. A graph of all samples analysed is shown in Figure 32.

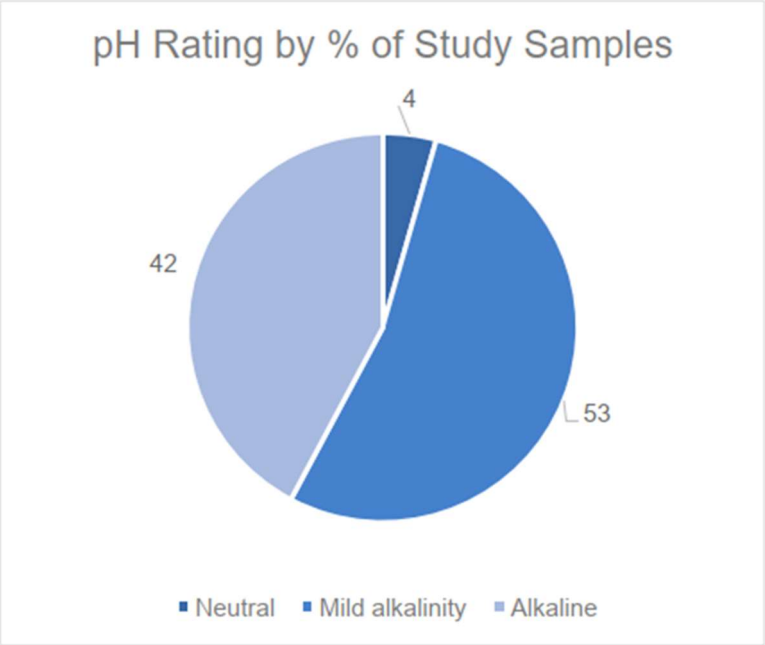

Figure 32: pH Rating by % of Study Samples

Cation Exchange Capacity (CEC) is the measurement used to assess the overall nutrient holding capability of soil. The stockpiled topsoil has been surface soil stripped and placed into stockpiles predominantly using scrapers. The samples sent for laboratory analysis were all taken from within a depth of 300mm of the stockpile surfaces and results interpreted in accordance with Table 48.

Table 48: Cation Exchange Capacity Rating and Results

Rating	CEC/ECEC (meq/100g of soil)	Number of Samples	Percentage of Study Area
Very Low	<5	3	7
Low	5 – 15	11	24
Moderate	15 – 25	25	56
High	25 – 40	6	13
Very High	>40	0	0

The results of all CEC samples indicate a range of results regarding cation exchange (nutrient holding) capacity. The results indicated 13% of samples were in the moderate CEC range and 31% in the low to very low range with the higher results coming from the Curragh Main area and the lower results from the Curragh North area. The average CEC for Curragh Main is 20.26meg/100g soil and Curragh North is 13.96meg/100g soil.

Exchangeable sodium percentage (ESP) is used to assess the relative abundance of exchangeable sodium. Where high levels of exchangeable sodium are present relative to other cations the soil material physical property is deemed to be of a sodic nature. Table 49 provides the rating table used for analysis of the sample results. Soils with a high exchangeable sodium percentage disperse readily.

Table 49: Exchangeable Sodium Percentage Rating

Rating	Exchangeable Sodium Percentage (%)
Non-sodic (low)	<6
Sodic (moderate)	6 – 15
Strong Sodic (high)	15 – 20

Extremely Sodic (very high)	>20

Calcium Magnesium ratio provides a guide to the relative abundance of the two major cations (Calcium and Magnesium) and is useful when used in conjunction with Exchangeable Sodium Percentage to predict soil physical behaviour. Soils with a high Calcium dominance, as described by the rating in Table 50, will counteract the dispersive nature of the ESP.

Table 50: Calcium Magnesium Ratio Rating

Rating	Ca/Mg Ratio	Comments
Very Low	<0.10	Mg is > 10 times more dominant than Ca
Low	0.10 – 0.50	Mg is 5 – 10 times more dominant than Ca
Moderate	0.51 – 1.0	Ca and Mg becoming co-dominant
High	1.1 – 2	Ca more dominant than Mg
Very High	>2	Ca >2 times dominant than Mg

The laboratory results of both the ESP and calcium/magnesium ratio indicate majority of soils across site (80%) rated as non-sodic with 18% being sodic and 2% (one sampled stockpile) with a strongly sodic rating. The strongly sodic stockpile is located at Curragh North. Correspondingly, of the soils sampled across site, 88% and 12% identify as having a very high and high dominance of calcium resulting in majority (80-100%) of soils across site physical property being non dispersive.

Bicarbonate Extractable Phosphorus is the current measurement for the assessment of relative differences in soil fertility. Using the rating table adapted from Ahern provided in McCann, R (2019) (Table 51), 46.7% of the samples taken during the assessment returned a moderate or higher soil fertility rating. 37.8% returned a low fertility rating and 15.6% returned a very low soil fertility rating. On average Curragh North samples indicated almost two times greater soil fertility than Curragh Main with the reading being 15.8ppm and 8.31ppm respectively. Curragh North samples ranged from 1ppm to 48.2ppm, whilst Curragh Main samples ranged for 1ppm to 26.7ppm.

Table 51: Bicarbonate Extractable Phosphorus Rating

Rating	Bicarb. Extr. P (ppm)
Very Low	<5
Low	6 – 9
Moderate	10 – 15
High	16 – 40
Very High	>40

Total Organic Carbon is generally used to assess surface soil fertility. All topsoil stockpiles on the mine site are surface topsoil stripped and placed in stockpiles. Therefore, the assessment of total organic carbon is relevant to each stockpile in its entirety.

Using the rating table from Bruce and Rayment (1982) (Table 52) the Laboratory results for Total Organic Carbon indicate that 44% of the samples taken during the assessment returned a moderate or higher soil fertility. 53% returned a low fertility rating and 2% a very low rating. Curragh Main samples were on average higher than Curragh North samples, with average values of 1.9% and 1.1% respectively. Curragh Main results ranged from 1% to 4.2%, whilst Curragh North results ranged from 0.5% to 2.4%.

Rating	Organic Carbon (%)
Very Low	<0.5

Low	0.5 – 1.5
Moderate	1.6 – 2.5
High	2.6 – 5.0
Very High	>5

Table 52: Organic Carbon Rating

This topsoil quality assessment study conducted in 2020 has shown most of the stockpiled topsoil at both Curragh Main and Curragh North is of acceptable physical and chemical quality and will not require amelioration during planned rehabilitation activities. With selective placement of topsoil depending on its quality and proposed location, any potential negative effects from poorer soil quality can be further mitigated.

The overall stockpiled topsoil quality is rated as an A or B, based of field observations, indicating high purity and relatively uncontaminated high value topsoil. The results from the topsoil quality assessment indicate a similar quality to that which has historically been found within Brigalow and Eucalypt Scrub plains at Curragh and Curragh Main (McCann, R, 2019).

Amelioration could be considered if rehabilitation of an area is required to be established prior to an upcoming unfavourable weather event such as drought or a severe wet season. Inclusion of amelioration would improve the speed in which the vegetative cover establishes and provide protection from environmental impacts. Similarly, the use of a hydromulch or other materials could be considered in such circumstances.

Material Balance

A topsoil materials balance has been developed outlining the material available and material requirements for rehabilitation as of June 2022 (

Parmeter	Volume (m^3)	Notes
Available stockpiled topsoil (validated)	12,914,596	Surveyed volumes across Curragh stockpiles
Forecast rehabilitation requirement (PRCP LOM)	17,382,250	Based on disturbance footprint and design depths (100–150 mm)
Coverage capacity	10,330 ha	Equivalent area at 50:50 split of 0.15 m and 0.10 m application
Forecast disturbance footprint	12,643 ha	PRCP life-of-mine total disturbance area
Coverage proportion	~82%	Conservative current inventory relative to forecast requirement

Table 53). This material balance will be updated throughout the life of mine as mining and rehabilitation progress.

The Topsoil inventory at Curragh fluctuates each year due to the nature of managing topsoil. Topsoil utilisation during rehabilitation reduces the topsoil balance, whilst topsoil stripping in new mining areas significantly increases the topsoil inventory. As of June 2022, Curragh has a topsoil balance surplus of 3,971,478m^3. At the end of mine life, the surplus will not be as significant as at present as the topsoil will be utilised for rehabilitation.

The location of topsoil stockpiles (as at August 2021) and the associated soil management groups are provided in Appendix E. These stockpile locations and volumes will change over the life of mine as existing stockpiles are drawn down for rehabilitation and new stockpiles are created in advance of mining. The spatial location of stockpiles is recorded within the site's geographic information system (GIS), and a live volume inventory is maintained to support resource tracking and compliance.

Parmeter	Volume (m^3)	Notes
Available stockpiled topsoil (validated)	12,914,596	Surveyed volumes across Curragh stockpiles
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Coverage proportion	~82%	Conservative current inventory relative to forecast requirement

Table 53: Topsoil Balance as of June 2022

The current material balance provides a conservative snapshot of available resources. Several contextual factors confirm that the topsoil inventory is sufficiently robust to meet all PRCP requirements:

- Dynamic balance of resources: Future stripping of additional disturbance areas will generate significant new topsoil volumes, offsetting drawdown and progressively strengthening the inventory. This dynamic balance ensures that coverage increases over the life-of-mine rather than diminishing.

- Significant undisturbed areas: Large portions of the Curragh leases will remain undisturbed and are not subject to PRCP rehabilitation milestones. These intact areas reduce the effective demand on stockpiled resources while maintaining soil function in the post-mining landscape.
- Exclusions for retained infrastructure and dams: Not all disturbed land requires topsoil application. Long-term infrastructure such as haul roads, laydown areas, and retained dams are excluded from rehabilitation coverage, further reducing net demand below the forecast requirement.
- Spatial distribution of resources: Stockpiles are well distributed across the mine footprint, ensuring efficient haul distances and logistical feasibility for progressive rehabilitation across multiple domains.

The validated stockpile inventory confirms that Curragh holds a substantial growth media resource, already capable of meeting the majority of its rehabilitation commitments. When combined with progressive stripping and practical exclusions (such as retained dams, haul roads, and laydown areas), the inventory is more than adequate to deliver the nominated Post-Mining Land Uses (PMLUs). This robust balance provides confidence that final landforms will be vegetated, stable, non-polluting, and capable of supporting sustainable end uses, consistent with the *Environmental Protection Act 1994 (Qld)* and the PRCP Guideline requirements.
The Post-Mining Land Use framework for the Curragh Complex has been designed to align with both the quality and availability of soil resources and the broader regional land use context. The majority of the Complex will be rehabilitated to Light Grazing and Open Woodland, reflecting the dominant pre-mining land uses and supported by soil depths and qualities already present in the landscape. These outcomes are compatible with regional capability classifications and ensure continuity with surrounding land uses.
Additional domains within the framework include:

- Watercourse PMLU – Revegetated with riparian species consistent with Regional Ecosystem benchmarks, stabilising drainage features, protecting water quality, and restoring ecological function.
- Tailings Storage Facility (TSF) PMLU – Capped and revegetated with grassland and shrub cover systems to provide long-term erosion resistance, maintain capping integrity, and reduce dust generation.
- Flood Protection Landform PMLU – Engineered embankments stabilised with native groundcovers and shrubs selected for their hydraulic tolerance, providing both flood immunity and ecological values through vegetative cover rather than reliance on hard armouring alone.

Collectively, these PMLUs are underpinned by Curragh's soil and topsoil management framework, ensuring that placement of growth media is sufficient to establish resilient vegetation communities across all domains. The integration of conservative inventory estimates, dynamic topsoil recovery during mining, and selective handling protocols substantiates that Curragh is well positioned to meet its closure objectives. The result is a post-mining landscape that is safe, stable, non-polluting, and sustainable, consistent with regulatory expectations and regional land use outcomes.

To further strengthen erosion resistance and slope stability, rock mulch will be utilised on steeper final landform slopes. The material will be sourced from mined Permian overburden and interburden, which are present in sufficient quantities on-site to meet all rehabilitation requirements. Application of rock mulch provides multiple functions:

- Erosion resistance – increases surface roughness, reduces runoff velocity, and limits rill/gully initiation on slopes >15%.
- Geotechnical stability – enhances the factor of safety by resisting shallow slumping and surface erosion, consistent with outcomes of erosion studies undertaken at Curragh and across comparable Bowen Basin mines.

- Hydrological performance – dissipates runoff energy, controls flow pathways into drainage structures, and reduces sediment transport.
- Progressive rehabilitation – enables direct placement on reshaped slopes to reduce double handling, with stockpiling used where direct placement is not feasible.

Incorporation of rock mulch into the final landform design ensures achievement of Rehabilitation Milestones for erosion-resistant landforms (see Section 5.3). Catchment-scale hydrological assessments and erosion studies confirm that application of rock achieves acceptable erosion rates over the post-closure timeframe, maintaining landform stability in perpetuity.

The use of geochemically benign Permian materials further mitigates environmental risk by avoiding potential acid and metalliferous drainage (AMD/ARD). This integrated approach—combining a robust topsoil resource, strategic rock mulch application, and domain-specific rehabilitation treatments—ensures that Curragh can confidently achieve its nominated PMLUs while delivering long-term stability, ecological function, and compliance with regulatory requirements.

Amelioration

Prior to placement, an assessment of the growth media characteristics analysis will be undertaken to confirm the required amelioration measures and surface treatments. This assessment will consider:

- Growth media quality – soil structure, organic content, nutrient availability, and salinity/sodicity status.
- Landform design – slope angle, drainage patterns, and stability requirements.
- Rock and spoil integration – potential for blending with benign Permian spoil to achieve target depth or improve physical performance.
- PMLU revegetation requirements – compatibility of growth media with target pasture, woodland, watercourse, or flood protection vegetation species.
- Land suitability framework – alignment with the cattle grazing land use criteria .
- The recommended amelioration and surface treatments will be implemented during rehabilitation execution. Treatments may include gypsum or lime application, deep ripping, contouring, mulching, and nutrient supplementation depending on the PMLU.

The required growth media depths, potential amelioration measures, and indicative surface treatments to support vegetation establishment for each PMLU are summarised in Table 54 54**.** Opportunities to utilise benign Permian spoil as a supplementary growth media will also be assessed where appropriate, to ensure adequate cover depth and to optimise the use of available resources.

Table 54: Growth media ameliorant options and surface treatments for Curragh Mine PMLUs

PMLU	Growth media	Ameliorant options	Surface treatments
Cattle grazing	Topsoil – minimum depth of 150mm is sufficient to store moisture and nutrients to initiate and sustain pasture growth	Elemental Sulphur, Manures, Urea, Diammonium phosphate, Superphosphate, Fertiliser, Gypsum, Incorporated organic matter, Surface mulching (e.g. hay mulch)	Ameliorate growth media as recommended by an AQP (if required), Rip along contour (300-500mm), Direct seed as per seed mixes and rates for cattle grazing revegetation.
Woodland habitat	Topsoil – minimum depth of 100mm to support establishment of woodland species and to limit the effects of competition from exotic pasture species	Elemental Sulphur, Manures, Superphosphate, Fertiliser, Gypsum, Incorporated organic matter, Surface mulching (e.g. hay mulch)	Ameliorate growth media as recommended by an AQP (if required), Deep rip along contour to incorporate rock, Direct seed as per seed mixes and rates for woodland habitat revegetation
Watercourse	Topsoil – minimum depth of 150mm to encourage a vegetative cover to provide erosion resistance	Elemental Sulphur, Manures, Superphosphate Gypsum, Incorporated organic matters, Surface mulching (e.g. hay mulch)	Ameliorate growth media as recommended by an AQP (if required), Deep rip along contour as required, Direct seed as per seed mixes and rates for watercourse revegetation
Flood protection	Rock armouring combined with topsoil cover (minimum 100mm) on engineered levees and flood protection structures	Gypsum (as required for sodic soils) Fertiliser (if nutrient supplementation required) Incorporated organic matter	Apply rock armouring consistent with design requirements for flood protection levees, Apply topsoil layer and ameliorate as recommended by an AQP (if required), Direct seed with native grass mix suited to levee stability (no shrubs or trees)

Topsoil and Growth Media

Effective rehabilitation at the Curragh Complex is underpinned by the availability and management of topsoil and growth media resources. The baseline investigations (Section 3.1.4) confirmed that while the Complex contains an adequate and well-distributed stockpile (>12.9 million m^3), its effective use is constrained by shallow topsoil depths, subsoil sodicity, and nutrient deficiencies. These constraints are typical of Bowen Basin conditions and are well understood and manageable within the framework of the PRCP.

The objective of this Rehabilitation Planning section is to describe how topsoil and growth media will be:

- Recovered through selective stripping and horizon segregation to conserve finite resources.
- Stored and managed in stockpiles to maintain physical, chemical, and biological function until reuse.
- Prepared and placed to ensure effective revegetation and erosion control on reshaped spoil and landforms.
- Amended and verified to address identified soil limitations and ensure suitability for target PMLUs.
- Monitored against milestone criteria to demonstrate that rehabilitation is progressing towards safe, stable, and sustainable Post-Mining Land Use (PMLU)s.

The planning measures outlined below are consistent with the Progressive Rehabilitation and Closure Plan (PRCP) Guideline (ESR/2019/4964), and directly address the soil resource limitations identified in the baseline dataset.

Resource Recovery (Stripping Protocols)

The recovery of finite topsoil and growth media is critical to ensuring that sufficient resources are available to meet the rehabilitation commitments of the PRCP. Baseline investigations confirmed that effective topsoil depths across the Curragh Complex are generally shallow (0.15–0.30 m), with isolated favourable profiles extending to ~0.60 m. Subsoils are consistently constrained by sodicity, dispersion, salinity, or chloride accumulation, and are therefore unsuitable for direct use as growth media.

To maximise the value of available resources, stripping at Curragh is undertaken in accordance with the following protocols:

- Selective stripping of A-horizon topsoil
- Prioritise recovery of the topsoil (0.15–0.30 m) as the principal source of growth media.
- In favourable units (e.g., grey-brown clays over calcareous material), recover up to 0.60 m with segregation into distinct layers (0–30 cm and 30–60 cm).
- Avoidance of unsuitable materials
- Exclude dispersive, saline, sodic, and chloride-rich subsoils from recovery.
- Melonhole clays, grey-brown cracking clays, and strongly sodic Sodosols are not stripped for rehabilitation purposes.
- Horizon segregation
- Maintain separation of horizons where chemical or physical properties differ significantly (e.g., surface vs. subsoil layers in calcareous clays).
- Segregation allows targeted use of higher-quality materials and prevents dilution with constrained subsoils.
- Operational procedures
- Stripping is carried out under dry conditions wherever possible to preserve structure.
- Dozers and scrapers are used with blade control to minimise mixing of horizons.
- Stripped topsoil is directly placed on reshaped spoil where practicable, to reduce double handling and loss of biological function.

Stockpiling and Management

Where direct placement of stripped topsoil onto reshaped landforms is not operationally feasible, resources are stockpiled for later use. The 2020–2022 stockpile validation confirmed that Curragh maintains more than 12.9 million m^3 of growth media in stockpiles across the Complex (Table 6), with ~89% of stockpiles already vegetated, providing stability and retained function.

Stockpiles are managed in accordance with the following principles:

- Location and design
- Stockpiles are placed in stable, low-gradient areas, outside active drainage lines, to minimise erosion.
- Heights are limited (generally <5 m) to reduce compaction, with broader, flatter batters constructed for larger stockpiles.
- Erosion control and stability

- Vegetation cover is established on all stockpiles to minimise erosion and preserve structure and organic matter.
- Approximately 89% of stockpiles are vegetated, with ongoing maintenance (reseeding, weed control) as required.
- Quality preservation
- Segregation of topsoil types is maintained, with sodic or otherwise constrained materials stored separately to prevent contamination of higher-quality resources.
- Handling during placement minimises traffic compaction and mixing of horizons.
- Integration with water management
- Stockpiles are located and contoured to shed clean water, reducing the risk of sediment generation.
- Surface drainage is directed away from stockpiles to prevent gullying and scalding.
- Operational efficiency
- Stockpiles are positioned strategically across the Complex to ensure ready access to rehabilitation domains, reducing haulage distances and handling costs.
- Progressive recovery and stockpiling are aligned with the mine schedule to balance resource conservation and rehabilitation demand.

This approach ensures that topsoil and growth media are conserved in a condition suitable for later use, with stockpiles acting as a secure and biologically functional reservoir for rehabilitation.

Surface Preparation

Following landform reshaping, surfaces are prepared to optimise the placement of growth media and ensure long-term stability.

- Disturbed areas are reshaped to the approved final landform design.
- Surfaces are ripped to ~0.5 m to reduce compaction, improve infiltration, and facilitate root penetration.
- Where required, deep ripping is undertaken using a winged tyne ripper to depths of 0.60–0.75 m, oriented across slope at ~0.5% (1H:200V) off the contour. This promotes infiltration, reduces runoff velocity, and enhances erosion resistance (Figure 33).
- Rip lines are aligned with contour banks to improve surface water management.
- Ripping and seeding are typically undertaken in a single pass to minimise disturbance and stabilise the surface.

Figure 33: Winged tyne used at Curragh

Placement techniques

- Topsoil is placed in loose, uncompacted layers using dozers with rippers or spreaders to maintain structure.
- Traffic across placed material is minimised to prevent compaction.
- Contouring is undertaken to ensure surface stability and compatibility with final landform design.
- For grazing and watercourse PMLUs, topsoil will be placed at a nominal depth of 150 mm, while open woodland habitat, flood protection landforms, and grassland and shrubland PMLUs will receive a 100 mm topsoil cover, reflecting the differing functional requirements and soil resource constraints across domains (Table 57).

Stabilisation and vegetation establishment

- Placement is immediately followed by seeding to establish a protective ground cover.
- Species mixes are tailored to the target Post-Mining Land Use (PMLU) (e.g., cattle grazing, open woodland habitat, or watercourse stability).
- Rapid revegetation reduces erosion risk, stabilises surfaces, and promotes nutrient cycling.

Seeding and Planting

Revegetation follows placement to stabilise surfaces and establish sustainable ecosystems.

- Seeding is applied along the contour using tyned implements with ≤0.5 m spacing.
- Direct seeding of native and pasture species is preferred, achieving higher survival rates than tube stock.
- Tube stock planting is used selectively for targeted species or favourable conditions.
- Typical seed mixes include 13–23 native tree and shrub species on woodland strips and 6–9 grass/legume species on grazing domains.
- Standard practice for Acacia species (excluding A. harpophylla) is to scarify ~50% of seed to promote early germination while leaving ~50% unscarified to ensure delayed germination and secondary recruitment. This staggered germination enhances establishment resilience under variable rainfall (Table 57).

Limitation	Management Measures	Relevant Domains	Milestone Link
Sodicity and dispersion	Gypsum application; exclude dispersive subsoils; place sodic materials as subgrade beneath suitable cover	Spoil reshaping, creek diversions	ESP <6% in placed growth media; ground cover >70% within 2 years
Nutrient deficiencies	Starter fertiliser (MAP/DAP); gypsum/dolomite for Ca/Mg; Zn-coated fertilisers in alkaline soils	Grazing, woodland, diversions, TSF covers	Fertility program applied at seeding; nutrient monitoring within agronomic ranges
Low organic carbon (<1%)	Incorporate organic amendments (mulch, compost, biosolids if approved); promote cover crops	All domains	Soil OC >1% after 3 years; vegetation establishment meets growth targets
Alkalinity (pH >9.0)	Apply zinc fertiliser; blend alkaline soils with neutral soils	Isolated alkaline stockpiles	pH <9 in placed growth media; Zn deficiency not evident in vegetation monitoring
Salinity (EC >0.75 dS/m)	Exclude saline subsoils; monitor EC; restrict placement to tolerant domains	Isolated saline stockpiles/spoil	EC <0.75 dS/m in placed growth media; vegetation cover >70%
Erosion potential	Immediate seeding; slope contouring; strip/patch placement for woodland domains	Slopes >15%, creek diversions	No active erosion gullies >20 cm; slope stability confirmed

Table 55: ***Growth Media Limitations and Management Measures***

Topsoil Quality Requirements

- Growth media must meet the following thresholds or unless otherwise health and suitability is assessed and documented by an AQP as suitable for the PMLU vegetation establishment.
- Cation exchange capacity of above 14 meq/100g for clays and 6 meq/100g for loams.
- Major macronutrient concentrations in root zone (0–0.3m):
- Total nitrogen (N) above 1000 mg/kg.
- Available phosphorus (P) above 10 mg/kg.
- Potassium (K) above 200 mg/kg.
- Total organic carbon (TOC) above 1%.
- Key soil chemical indicators in entire root zone (0–0.5m):
- pH range of soil is between 5.5–9.0.
- Primary growth media salinity (EC1:5) is ≤ 0.75dS/m.
- Sodicity (ESP) is ≤14%.

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Rehabilitation Domain	Target PMLU	Placement Depth	Rationale / Notes
Lower-gradient spoil slopes (≤15%)	Cattle grazing	0.15 m	Provides sufficient rooting depth for pasture species; promotes erosion resistance and forage productivity.
Steeper spoil slopes (>15%)	Open woodland habitat	0.10 m	Shallow cover reduces erosion risk; supports woodland establishment using strip/patch method.
Creek diversions and drainage lines	Watercourse stability (BVG 16a)	0.15 m	Provides rooting depth for riparian grasses, sedges, and shrubs; supports bank stability.
Tailings Storage Facility (TSF) covers	Grassland PMLU	0.10 m	Provides erosion protection and vegetative cover; supports pasture stabilisation of TSF caps.
Flood protection levees (no rock armouring)	Flood protection PMLU	0.10 m	Thin cover sufficient for grass establishment to stabilise levee slopes and prevent erosion.

Table 56: Topsoil / Growth Media Placement Depth Guidelines by Domain

	Scientific Name	Common Name
Acacias	*Acacia bancroftiorum*	Bancrofts wattle
	Acacia complanata	Long-Pod Wattle
	Acacia stenophylla	Shoestring Acacia
	Acacia cretata	
	Acacia macradenia	Zig-zag Wattle
	Acacia holosericea	Soap Bush
	Acacia salicina	Sally Wattle
	Acacia harpophylla	Brigalow
	Acacia saligna	Golden Wreath Wattle
Eucalyptus	*Eucalyptus camaldulensis*	River Red Gum
	Eucalyptus cambageana	Blackbutt/Dawson gum
	Eucalyptus tereticornis	Blue Gum
	Eucalyptus populnea	Poplar Box
	Eucalyptus citriodora	Lemon-scented gum
	Eucalyptus crebra	Narrow-Leaved Ironbark
	Eucalyptus longirostrata	Grey Gum
	Eucalyptus punctata	Grey Gum
	Eucalyptus thozetiana	Napunyah
Native Grasses	*Digitaria didactyla*	Blue Couch
	Cynodon dactylon	Bermuda Grass
	Heteropogon contortus	Black Speargrass
	dichanthium sericeum	Queensland Blue Grass
	Astrebla lappacea	Mitchell Grass
	Themeda triandra	Kangaroo Grass
	Paspalidium caespitosum	Brigalow Grass
Legumes	*Clitoria ternatea*	Butterfly Pea
	Chamaecrista rotundifolia	Round-leaf Cassia
	Stylosanthes scabra	Shrubby Stylo

	Stylosanthes hamata	Caribbean Stylo
Introduced/Exotic Grasses	Chloris Gayana	Rhodes Grass
	Urochloa mosambicensis	Bushveld signal grass
	Panicum coloratum	Blue Panic
	Panicum maximum	Guinea Grass
Other Trees/Shrubs	Atalaya hemiglauca	Whitewood
	Brachychiton rupestris	Narrow-leaved Bottle Tree
	Senna artemisioides	Silver Cassia
	Casuarina cristata	Belah
	Lysiphyllum carronii	Northern Bean Tree
	Senna notabilis	Cockroach Bush

Table 57:Typical Seed Mix used in Existing Rehabilitation

The effectiveness of topsoil and growth media management at Curragh Mine is demonstrated through progressive monitoring and milestone verification. These criteria ensure that stripping, storage, placement, amelioration, and vegetation establishment result in safe, stable, and self-sustaining rehabilitation outcomes.

7.1.6 Revegetation Objectives

The revegetation strategy for the Curragh Complex has been developed to ensure that all PMLUs collectively deliver a final landform that is safe, stable, non-polluting, and sustainable, in accordance with the *PRCP Guideline*. Rehabilitation outcomes are designed to integrate with existing undisturbed areas within the mining leases, which currently support a mosaic of productive grazing landscapes and remnant native ecosystems.

Species selection has been guided by regional vegetation benchmarks (BVG 10a / RE 11.10.1 and BVG 16a / RE 11.3.25), Curragh's historical rehabilitation performance, and established Bowen Basin mine rehabilitation practice. All seeded species are native and have been selected for their demonstrated ability to establish on spoil substrates, provide persistent groundcover, and deliver erosion resistance, ecological resilience, and habitat value. Buffel grass (*Cenchrus ciliaris*), while non-native, is acknowledged as being persistent within salvaged topsoil and local seedbanks. Although it will not be deliberately seeded, its contribution to surface stability on poor-quality soils is recognised, and its occurrence will be monitored and managed to ensure it does not suppress the establishment and recruitment of target native species.

The five PMLUs are designed to function complementarily, supporting the final site design as an integrated and resilient land use system:

- Grazing PMLUs will establish productive, erosion-resistant pastures consistent with regional rural land use.
- Open woodland habitat PMLUs will re-establish native open woodland communities consistent with BVG 10a, contributing to slope stability and extending terrestrial habitat connectivity.
- Watercourse PMLUs will restore riparian ecosystems consistent with BVG 16a / RE 11.3.25, stabilising drainage features, protecting water quality, and enhancing habitat connectivity.
- Flood protection landform PMLUs will establish shallow-rooted groundcovers designed to ensure erosional stability and hydraulic performance, with demonstrated tolerance to flow velocities up to 2.5 m/s.
- Tailings Storage Facility (TSF) PMLUs will be revegetated with grassland and shrubland communities suited to the underlying geochemical and structural constraints, providing dust suppression, erosion resistance, and ecological function.

Collectively, these revegetation domains integrate with surrounding undisturbed grazing lands and native ecosystems to ensure the final landform is structurally robust, ecologically coherent, and resilient. This strategy delivers a cohesive and sustainable post-mining landscape that aligns with approved PMLU expectations.

Table 58 summarises the revegetation objectives for each PMLU, demonstrating how each contributes complementary functions that, together, achieve the overarching closure vision for the Curragh Complex.

PMLU	Revegetation Objectives	Key Outcomes	Compatibility with Undisturbed Areas
Grazing	Establish productive and erosion-resistant pastures dominated by 3P grasses and legumes.	Provides reliable groundcover, forage value, and erosion control on spoil substrates.	Aligns with existing rural land uses across the mining leases.
Open Woodland	Re-establish native open woodland communities consistent with BVG 10a.	Enhances slope stability, develops self-sustaining vegetation structure, and provides terrestrial habitat values.	Extends and connects with remnant woodland ecosystems within and adjacent to the leases.
Watercourse	Restore riparian ecosystems consistent with BVG 16a / RE 11.3.25.	Stabilises drainage features, protects water quality, and strengthens habitat connectivity.	Integrates with existing riparian corridors and water-dependent ecosystems.
Flood Protection Landform (FPL)	Establish groundcovers and shrubs that stabilise engineered batters and resist hydraulic exposure.	Achieves long-term erosional stability and hydraulic performance, with species tolerant of flows up to 2.5 m/s.	Complements grazing land and woodland by maintaining structural resilience and ecological continuity.
Tailings Storage Facility (TSF)	Establish shallow-rooted grasses and shrubs to stabilise surfaces without compromising containment integrity.	Provides persistent groundcover, controls erosion, and maintains safe, stable, non-polluting landforms.	Integrates with surrounding grazing and woodland domains while protecting TSF capping performance.

Table 58: Revegetation Objectives by Post-Mining Land Use (PMLU)

Species of Conservation Significance

Curragh Mine has no explicit obligation to re-establish species of conservation significance. However, the revegetation strategy for woodland habitat, watercourse, flood protection landform, and grassland post-mining land uses (PMLUs) has been designed to incorporate habitat elements that support biodiversity connectivity and maintain environmental values in association with adjacent undisturbed vegetation. Watercourse post-mining land uses in particular will provide critical linkages between riparian habitats, enhancing opportunities for species of conservation significance to utilise and move through the post-mining landscape.

Fauna Habitat and Use Requirements

Revegetation of watercourse, woodland habitat, flood protection landform, and grassland post-mining land uses will collectively provide habitat structure, landscape connectivity, and movement corridors for fauna. These outcomes are expected to benefit threatened species identified in baseline and operational surveys, including the Ornamental Snake (*Denisonia maculata*), Yakka Skink (*Egernia rugosa*), and Squatter Pigeon (*Geophaps scripta scripta*), as well as endemic species likely to occur within the Curragh Mine mining leases. By integrating habitat elements into the post-mining land uses, the final landform will support both species persistence and regional ecological connectivity.

7.1.6.1 Revegetation for the Cattle Grazing PMLU

Revegetation of areas assigned to the Cattle Grazing PMLU will be undertaken using a species mix designed to establish a productive, persistent and sustainable pasture system that aligns with both the rehabilitation objectives of the PRCP and the requirements of long-term grazing utility. The target is to establish groundcover dominated by productive, persistent and palatable (3P) pasture grasses, supported by legumes to provide nitrogen fixation and soil fertility benefits, native species to enhance resilience and ecosystem function, and early cover crops to provide rapid soil stabilisation following seeding.

Species selection will be guided by the list presented Table 59 which has been developed from regional pasture recommendations, mine rehabilitation experience in the Bowen Basin, historical seed selections used at Curragh Mine, and species known to deliver successful outcomes in past rehabilitation programs. The list is also informed by technical assessments documented in the PRCP appendices and the extensive knowledge of Curragh Mine rehabilitation professionals, who have a long history of implementing successful rehabilitation across the Curragh Complex. The final seed mix will be adapted to site-specific soil conditions (e.g. heavy cracking clays, dispersive Sodosols, and sodic/saline subsoils), seasonal availability of seed, and the progression of rehabilitation works. The seed mix will comprise:

- 3P grasses (e.g. Rhodes grass, Bluegrasses, Panics, Mitchell grasses) to provide the foundation of productive, sustainable pasture.
- Legumes (e.g. Stylo, Burgundy bean, Desmanthus, Pinto peanut) to enhance nitrogen inputs, improve palatability, and support long-term soil fertility.
- Native pasture grasses (e.g. Black speargrass, Kangaroo grass, Enneapogon, Aristida, Eragrostis) that enhance resilience, provide seasonal grazing value, and maintain cover on dispersive, sodic and low-fertility soils.
- Cover crops (e.g. Shirohie millet) to provide rapid groundcover, erosion control, and soil protection during the establishment phase.

It is noted that Buffel grass (Cenchrus ciliaris) has not been included in the recommended species list. While Buffel is a well-established pasture species in central Queensland, its growth often restricts the establishment and recruitment of other species, including trees and shrubs, and can reduce overall pasture biodiversity. Nonetheless, Buffel is already present in the local soil seed bank and topsoil resources and is expected to persist in rehabilitated areas owing to its regional dominance and presence in surrounding landscapes. Its occurrence will be monitored and, where present, it will contribute to groundcover, grazing outcomes, and interim soil protection alongside the deliberate revegetation mix.

This revegetation strategy will ensure that rehabilitated areas under the Cattle Grazing PMLU achieve the required outcomes of safe, stable, non-polluting and sustainable landforms that provide long-term grazing productivity and erosional stability, consistent with the objectives of the PRCP.

Common Name	Scientific Name	Sowing Rate (kg/ha)	Comments
Rhodes grass	Chloris gayana cvv. Callide[1]	3*	3P grass; Tolerates a range of soils
Rhodes grass	Chloris gayana cvv. Katambora[1]	4*	3P grass; Tolerates a range of soils; Salt tolerant
Bisset Creeping Bluegrass	Bothriochloa insculpta cvv. Bisset	4*	3P grass; Drought tolerant
Qld Blue grass	Dichanthium sericeum	2	3P grass; Suitable for clay soils
Bambatsi panic	Panicum coloratum cvv. makarikariense	3*	3P grass
Purple pigeon	Setaria incrassata	2	3P grass
Kangaroo grass	Themeda australis		Native
Black Spear Grass	Heteropogon contortus		Native
Burgundy bean[2]	Macroptilium bracteatum	2	Legume; requires specific rhizobium inoculum strain CB1717
Stylo[2]	Stylosanthes seabrana cvv. caatinga	2	Legume; requires specific rhizobium inoculum strain CB3481
Shirohie millet	E.g., Echinochloa esculenta[1]	5	Cover crop for soil protection (where required)

Table 59: Recommended Species to be Established in the Cattle Grazing PMLU

This revegetation strategy will ensure that rehabilitated areas under the Cattle Grazing PMLU achieve the required outcomes of safe, stable, non-polluting and sustainable landforms that provide long-term grazing productivity and erosional stability, consistent with the objectives of the PRCP.

7.1.6.2 Revegetation for Open woodland PMLU

Revegetation of areas assigned to the Open Woodland Habitat post-mining land use (PMLU) will be undertaken with the objective of establishing a structurally diverse and self-sustaining vegetation community consistent with Broad Vegetation Group (BVG) 10a – *Eucalyptus crebra, Corymbia citriodora, E. melanophloia* woodland on dissected terrain of the Brigalow Belt (Table 61). These areas are located predominantly on anthropogenic rehabilitated landforms with slopes typically greater than 15%, where vegetation plays a critical role in stabilising erosional surfaces, providing habitat values, and delivering long-term ecological function.Species selection has been guided by Queensland Herbarium classifications, regional ecosystem benchmarks, and rehabilitation experience within the Bowen Basin, including historical performance at Curragh. The recommended species list (Table 61) incorporates upper-storey, mid- and lower-storey, and groundcover components representative of BVG 10a. Species have been selected to align with expected growth media (e.g. spoil-derived soils, sodic and dispersive Sodosols) and slope conditions (>15% rehabilitated landforms), ensuring establishment of a vegetation community that can persist without intensive soil amelioration. Final species mixes will be adapted based on landform position, substrate constraints, trial outcomes, and seasonal seed/tubestock availability.
The revegetation strategy for woodland areas comprises:

- Upper-storey tree species such as *Corymbia citriodora*, *Eucalyptus crebra*, *Eucalyptus fibrosa*, *Angophora leiocarpa* and *Casuarina cristata*, to establish long-term canopy cover, provide shade, and contribute to habitat function.
- Mid- and lower-storey species such as *Alphitonia excelsa*, *Acacia leiocalyx*, *Petalostigma pubescens* and *Capparis canescens*, to provide structural diversity, soil stability, and food resources for fauna.
- Groundcover species dominated by native pasture grasses (*Themeda triandra*, *Heteropogon contortus*, *Cymbopogon refractus*, *Eragrostis sororia*), which provide persistent cover, enhance erosion resistance, and support woodland understorey development. These species also retain a secondary role for grazing in limited areas where slope and landform design allow safe cattle access, without compromising the primary woodland habitat objective.
- Native forbs and graminoids such as *Lomandra confertifolia*, *Chrysocephalum apiculatum*, and *Dianella revoluta*, to enhance floristic diversity and provide additional ecological value.

On steep slopes, vegetation will be established in combination with rock mulch treatments. This approach reduces runoff velocity, protects dispersive substrates, and creates microsites that promote seed retention and moisture infiltration. The combined use of physical (rock mulch) and biological (vegetation) treatments will provide long-term slope stability and habitat functionality.

Species will be established using a combination of direct seeding, broadcast seeding, and tubestock planting, with methodologies selected to suit slope and soil conditions. This flexible approach ensures that vegetation communities can establish and persist under the inherent constraints of rehabilitated substrates, creating a sustainable woodland outcome.

Buffel grass (*Cenchrus ciliaris*) is not included in the recommended seed mix due to its ability to dominate the ground layer and suppress recruitment of native species. However, buffel seed is widespread in salvaged topsoil and the local seedbank and is expected to occur within rehabilitated areas given its prevalence in the region. Where present, buffel will be treated as part of the evolving post-mining ecology, providing immediate groundcover and surface micro-relief, increasing vegetative hydraulic resistance (Manning's n), and reducing overland flow velocities. This will complement the establishment of native species, supporting the development of safe, stable, non-polluting landforms.

BVG	Upper-Storey Tree Species	Mid and Lower Storey Tree and Shrub Species	Groundcover Species
10a	Corymbia citriodora Eucalyptus crebra Eucalyptus fibrosa Corymbia hendersonii Corymbia clarksoniana Angophora leiocarpa Corymbia thozetiana Eucalyptus cambageana Acacia harpophylla Acacia cambagei Casuarina cristata	Alphitonia excelsa Acacia leiocalyx Acacia cretata Acacia longispicata Petalostigma pubescens Breynia oblongifolia Capparis canescens	Cymbopogon refractus Themeda triandra Heteropogon contortus Eremochloa bimaculata Arundinella nepalensis Panicum effusum Desmodium varians Brunoniella australis Cyanthillium cinereum Chrysocephalum apiculatum Eustrephus latifolius Dianella revoluta Phyllanthus virgatus Evolvulus alsinoides Lomandra confertifolia subsp. pallida Lomandra multiflora subsp. multiflora Glossocardia bidens
Persistent Non-Seeded Species Non-native; not seeded but persistent in seedbank. Provides stability and resilience on poor soils.	-	-	Cenchrus ciliaris Other native and non-native pasture grass

Table 60: Recommended Species to be Established for the Open Woodland Habitat PMLU

This revegetation strategy ensures that areas allocated to the Open Woodland Habitat PMLU develop into safe, stable, non-polluting, and sustainable landforms. By combining engineering treatments with carefully selected native species, the approach will establish a self-sustaining vegetation community representative of BVG 10a and deliver long-term ecological function consistent with PRCP objectives.

7.1.6.3 Revegetation for Watercourse PMLU

Revegetation of areas assigned to the Watercourse PMLU will be undertaken with the objective of re-establishing stable, self-sustaining riparian vegetation communities that provide hydraulic stability, erosion control, and habitat function consistent with Regional Ecosystem (RE) 11.3.25 – *Eucalyptus tereticornis* woodland along rivers and streams (Table 62). Species selection has been guided by BVG 16a benchmarks, ensuring that rehabilitation outcomes are ecologically relevant, resilient under post-mining conditions, and consistent with local and regional watercourse ecosystems.

A representative suite of species from BVG 16a has been identified for watercourse rehabilitation. This approach maintains floristic diversity and ecological resilience, while allowing flexibility to adapt to site-specific soil, hydrological, and seed availability constraints. Importantly, all proposed species have been screened to avoid livestock health risks, recognising that riparian areas may be intermittently or unintentionally accessible to cattle.

The revegetation strategy for Watercourse PMLUs includes:

- Upper-storey tree species (*Eucalyptus camaldulensis*, E. *tereticornis, E. coolabah, Melaleuca spp*., *Corymbia tessellaris, Casuarina cunninghamiana*) to provide canopy cover, shading, bank stabilisation, and long-term channel resilience.
- Groundcover species, incorporating native 3P grasses (*Heteropogon contortus, Themeda triandra)*, stabilising graminoids (*Imperata cylindrica, Eulalia aurea*), and a diverse mix of native forbs and small shrubs (*Cyanthillium cinereum, Phyllanthus virgatus, Eustrephus latifolius, Brunoniella australis, Evolvulus alsinoides, Sida* spp.). Collectively, these species provide dense cover, bind soils against erosive flows, and contribute to riparian biodiversity and connectivity.
- Zonal establishment across upper, mid, and lower banks to align species with their natural ecological niche, habitat functionality and hydrological tolerance.
- Establishment methods will include direct and broadcast seeding for groundcover species, supplemented by targeted tubestock planting of riparian trees and shrubs in high-erosion risk zones or areas with limited natural recruitment potential. A total seeding rate of approximately 5 kg/ha across riparian zones will be adopted, consistent with regional rehabilitation practice.

Cenchrus ciliaris (buffel) is not included in the watercourse PMLU seed mix due to its non-native status and capacity to dominate ground layers and suppress emergence and recruitment of native species. Nevertheless, buffel persists in regional soils and salvaged topsoil and based on previous experience at Curragh, is likely to establish opportunistically. Where present, it is treated as an accepted component of the evolving post-mining ecology—providing immediate ground cover and surface micro-relief, increasing vegetative hydraulic resistance (Manning's *n*), and thereby reducing overland-flow velocities, attenuating splash erosion, and limiting sediment export—supporting safe, stable, non-polluting landforms alongside the deliberate native revegetation mix.

The primary objective of the Watercourse PMLU is to establish functioning riparian ecosystems that stabilise drainage features, protect water quality, and provide long-term ecological connectivity. The inclusion of selected 3P native grasses (*Themeda triandra, Heteropogon* contortus) also provides a secondary benefit to landholders, as these species can support incidental grazing where cattle access occurs, without undermining riparian rehabilitation outcomes. This integrated strategy ensures that Watercourse PMLUs develop into safe, stable, non-polluting and sustainable post-mining landforms, supporting riparian vegetation communities that enhance ecological resilience and maintain watercourse integrity in the long term.

Table 61 presents a representative species list for revegetation of the Watercourse PMLU, consistent with BVG 16a and RE 11.3.25. Species selection focuses on hydraulic stability, erosion control, and long-term riparian habitat values. Species have been screened to avoid livestock health risks, recognising that riparian areas may be intermittently or unintentionally accessible to cattle.

Table 61: Recommended Species to be Established for the Watercourse PMLU

Vegetation Layer	Common Name	Scientific Name	Functional Role / Comments
Upper-storey Trees	Vegetation Layer	Eucalyptus camaldulensis	Riparian canopy species; stabilises banks; provides habitat and shading.
	Forest red gum	Eucalyptus tereticornis	Riparian canopy tree; stabilises floodplains and terraces.
	Coolibah	Eucalyptus coolabah	Floodplain species; tolerates periodic inundation.
	Paperbarks	Melaleuca spp.	Waterlogging tolerant; stabilises banks and wet areas.
	Moreton Bay ash	Corymbia tessellaris	Contributes to riparian canopy structure and diversity.
	River oak	Casuarina cunninghamiana	Strong root systems stabilise banks and resist erosion.
	Angophora species	Angophora spp.	Adds canopy diversity; important for habitat resilience.
Groundcovers	Black speargrass	Heteropogon contortus	3P grass; drought tolerant; stabilises banks and provides resilient sward.
	Kangaroo grass	Themeda triandra	3P grass; binds soils; persistent cover under variable hydrology.
	Golden beard grass	Chrysopogon fallax	hardy groundcover; stabilises riparian terraces.
	Blady grass	Imperata cylindrica	Rapid coloniser; reduces erosion risk along channel margins.
	Silky browntop	Eulalia aurea	Dense cover; tolerant of poor soils; supports slope stability.
	Cyanthillium	Cyanthillium cinereum	Forb; enhances floristic diversity in riparian understorey.
	Leaf-flower	Phyllanthus virgatus	hardy shrub/forb; supports groundcover diversity.
	Wombat berry	Eustrephus latifolius	Climber; provides additional habitat value.
	Native brunoniella	Brunoniella australis	Forb; soil stabilisation and floristic diversity.
	Blue convolvulus	Evolvulus alsinoides	Forb; drought tolerant; persistent groundcover.
	Sida species	Sida spp.	hardy groundcover; stabilises disturbed soils.
	Rostellularia	Rostellularia adscendens	Forb; adds to species diversity and ground stabilisation.

7.1.6.4 Revegetation for Grassland and Shrubs PMLU (TSF Domains)

Revegetation of tailings storage facility (TSF) domains will be undertaken with the primary objective of achieving safe, stable, non-polluting and sustainable landforms. Rehabilitation of these areas is designed to ensure long-term encapsulation of tailings and waste materials, erosional stability, and integration into the broader final landform.

Because of the geochemical and structural characteristics of TSF surfaces, revegetation strategies are tailored to provide persistent groundcover and shallow-rooted vegetation that stabilises surfaces without compromising capping or containment integrity. At the same time, species selection is directed towards providing habitat values and ecological resilience, consistent with broader PRCP outcomes.
Two primary approaches will be applied, depending on final slope profiles and surface conditions:

- Grassland and Shrub Cover (BVG 10a species)
- Establishment of a grassland–shrubland community drawing from BVG 10a species, adapted for TSF rehabilitation where deep-rooted trees are not appropriate.
- Groundcover is dominated by persistent native 3P grasses (Themeda triandra, Heteropogon contortus, Enneapogon avenaceus, Eragrostis sororia), supported by shallow-rooted shrub species such as Acacia leiocalyx, Petalostigma pubescens, and Breynia oblongifolia.
- This assemblage provides long-term surface stability, habitat diversity, and resilience, while maintaining shallow root structures to avoid impacts on capping performance.
- Rock Mulch Stabilisation with Opportunistic Vegetation Establishment
- Where slope or substrate conditions present higher erosion risk, rock mulch is applied to provide immediate and enduring physical stability.
- Vegetation establishes within mulch interstices, dominated by hardy groundcover species (*Enneapogon avenaceus, Cymbopogon refractus, Aristida leptopoda*) that tolerate low-fertility and sodic conditions.
- This treatment is designed primarily for erosional stability, with vegetation contributing surface roughness, cover persistence, and ecological function.

It is noted that Buffel grass (*Cenchrus ciliaris*) is not included in the recommended seed mix due to its non-native status and its tendency to dominate and restricting the establishment of native species. However, Buffel is persistent in the regional seedbank and topsoil and is expected to establish opportunistically within TSF rehabilitation areas. Where it occurs, Buffel contributes positively to surface stability, resilience under drought conditions, and persistence on nutrient-poor or dispersive substrates, supporting the safe and sustainable performance of the final landform. Its presence will be monitored to ensure that it does not compromise the establishment of the broader native vegetation community.

The final rehabilitation approach for each TSF domain is determined by landform design, capping performance requirements, and substrate limitations. All seeded species are native and selected for their erosional stability function, shallow rooting depth, and capacity to contribute to long-term resilience and habitat values, without compromising containment integrity.

Table 62 presents species recommended for TSF rehabilitation. All seeded species are native and have been selected for their capacity to establish persistent groundcover, stabilise erosive substrates, and contribute to ecological resilience. Buffel grass (Cenchrus ciliaris) is a non-native species and is not included in the seed mix; however, it is persistent in regional soils and, where it establishes, contributes positively to stability on poor-quality substrates. Its presence will be monitored and managed to avoid dominance over the target native community.

Table 62: Recommended Species to be Established for the TSF Grassland and Shrub PMLU

Vegetation Layer	Common Name	Scientific Name	Functional Role / Comments
Groundcover – Native Pasture Grasses	Kangaroo grass	Themeda triandra	3P native grass; deep-rooted perennial; provides excellent erosion control and persistent cover.
	Black speargrass	Heteropogon contortus	3P native grass; drought tolerant; stabilises poor soils and supports resilience under low fertility conditions.
	Bottle washer grass	Enneapogon avenaceus	hardy coloniser; suited to sodic and nutrient-poor soils; provides persistent groundcover.
	Native lovegrass	Eragrostis sororia	Dense sward former; effective on dispersive soils; stabilises slopes.
	Wiregrass	Aristida leptopoda	Tolerant of infertile substrates; persistent cover for erosional stability.
	Barbed-wire grass	Cymbopogon refractus	Perennial tussock grass; tolerant of poor soils; contributes to slope stabilisation.
Groundcover – hardy Graminoids / Forbs	Blady grass	Imperata cylindrica	Rapid coloniser; stabilises loose or dispersive tailings; assists early erosion control.
	Lomandra species	Lomandra confertifolia, L. multiflora	Rhizomatous graminoids; excellent erosion control and surface binding.
	Native daisy	Chrysocephalum apiculatum	Forb; adds cover diversity; stabilises fine substrates.
Low Shrubs	Golden-flowered wattle	Acacia leiocalyx	Hardy nitrogen-fixing shrub; improves soil fertility and stability.
	Quinine bush	Petalostigma pubescens	Shrub tolerant of poor soils; provides habitat and structural diversity.
	Coffee bush	Breynia oblongifolia	hardy shrub; establishes on poor substrates; contributes to shrubland structure.
Persistent Non-Seeded Species	Buffel grass	Cenchrus ciliaris	Non-native; not included in seed mix. Persistent in topsoil/seedbank; contributes positively to surface stability and resilience on nutrient-poor or dispersive substrates. Managed to prevent dominance over native species.

Revegetation for Flood Protection Landform:
This strategy ensures that TSF domains are rehabilitated in line with PRCP objectives, resulting in safe, stable, non-polluting and sustainable post-mining landscapes that integrate with the broader ecological and land use outcomes of the Curragh Complex.

The flood protection landform (FPL) is a critical component of the final landform design, constructed to provide long-term protection of mine domains against external flood events. Rehabilitation of the FPL is undertaken with the primary objective of delivering safe, stable, non-polluting and sustainable landforms that maintain structural and hydraulic performance while integrating with the surrounding landscape.

Revegetation is central to achieving these objectives. Vegetation treatments provide durable erosion resistance, surface roughness, and ecological function, ensuring the FPL maintains integrity during design flood events. The revegetation strategy has therefore been developed to establish native grassland and shrubland communities capable of stabilising engineered slopes and resisting erosional forces, while also contributing to habitat values and land use resilience.

Stabilisation Approach

- Vegetation is the preferred treatment, with native species selected to form continuous, self-sustaining cover across outer batters and slopes. Hydraulic performance benchmarks adopt a 2.5 m/s velocity threshold for grass cover, consistent with design criteria for flood bunds and levees.
- Where hydraulic modelling identifies exposure exceeding this benchmark, targeted rock mulch or rock armouring will be applied to critical zones (e.g. water-side batters, toe slopes, and outlet structures). Vegetation will be established in and around rock treatments, combining mechanical stability with ecological resilience.

The above approach ensures structural requirements are met while maximising ecological outcomes through vegetation-led stabilisation.

Species Selection Principles
Species were selected on the basis of:

- Native provenance, consistent with BVG 10a and local riparian–floodplain assemblages.
- Tolerance of spoil substrates, including sodic and dispersive soils typical of engineered flood bunds.
- Persistence under variable moisture conditions, ensuring cover is maintained during wet–dry cycles.
- Proven hydraulic performance, with 3P grasses selected for capacity to withstand flow velocities up to the 2.5 m/s benchmark.
- Contribution to habitat values, enabling the FPL to support ecological function beyond its hydraulic role.

Buffel grass (*Cenchrus ciliaris*) is not included in the seed mix due to its non-native status and competitive growth habit. However, Buffel is persistent in regional seedbanks and topsoil and is expected to establish opportunistically. On the FPL, Buffel contributes to surface stability, drought resilience, and persistence on poor-quality substrates. Its presence will be monitored to ensure it does not dominate or displace native species.

The revegetation strategy for the FPL ensures the structure performs its protective role under design flood conditions while also contributing to long-term ecological resilience. By prioritising native vegetation treatments and restricting rock stabilisation to critical hydraulic zones only, the FPL will develop into a self-sustaining landform that aligns with the PRCP objectives of achieving safe, stable, non-polluting and sustainable post-mining landscapes.

Table 63 presents species recommended for FPL rehabilitation. All seeded species are native and selected for their proven tolerance of spoil substrates, erosional stability under flows up to 2.5 m/s, and contribution to ecological resilience. Buffel grass (Cenchrus ciliaris) is non-native and not included in the seed mix; however, it persists in regional seedbanks and contributes to stability on poor-quality substrates. Its presence will be monitored and managed to avoid dominance over the target native community.

Table 63: Recommended Species to be Established for the Flood Protection Landform PMLU

Vegetation Layer	Common Name	Scientific Name	Functional Role / Comments
Groundcover – Native Pasture Grasses	Kangaroo grass	Themeda triandra	3P grass; persistent sward; strong erosion control; tolerates flows up to benchmark velocities.
	Black speargrass	Heteropogon contortus	3P grass; drought tolerant; stabilises poor soils; erosion resistance under variable conditions.
	Bottle washer grass	Enneapogon avenaceus	hardy coloniser; suited to sodic and low-fertility soils; establishes cover on steep batters.
	Native lovegrass	Eragrostis sororia	Dense sward; effective on dispersive soils; stabilises slopes under hydraulic exposure.
	Wiregrass	Aristida leptopoda	Tolerant of infertile substrates; persistent stabilising cover.
	Barbed-wire grass	Cymbopogon refractus	Perennial tussock grass; reduces runoff velocity and binds surface soils.
	Blady grass	Imperata cylindrica	Rapid coloniser; effective early stabiliser of disturbed or exposed soils.
Shrubs and Small Trees	Golden-flowered wattle	Acacia leiocalyx	hardy nitrogen-fixing shrub; improves fertility; reinforces slope resilience.
	Quinine bush	Petalostigma pubescens	Tolerant of poor soils; adds structural habitat diversity.
	Coffee bush	Breynia oblongifolia	Establishes on spoil substrates; contributes to shrubland cover.
	Red ash	Alphitonia excelsa	Small tree; slope stabilisation and canopy structure.
Persistent Non-Seeded Species	Buffel grass	Cenchrus ciliaris	Non-native; not seeded but persistent in seedbank. Provides stability and resilience on poor soils. Managed to prevent dominance over native species.

7.1.6.5 Revegetation Summary

The revegetation strategy for the Curragh Complex has been developed to ensure that all Post-Mining Land Uses (PMLUs) are underpinned by vegetation communities capable of supporting long-term stability, ecological resilience, and beneficial land use outcomes. Rehabilitation measures have been tailored to the functional requirements of each PMLU, recognising differences in slope conditions, substrate characteristics, hydrological exposure, and PMLU expectations.

For areas assigned to the Grazing PMLU, the objective is to establish resilient, productive pastures that provide reliable groundcover and forage value while maintaining erosion control. Species selection focuses on persistent 3P grasses and complementary legumes, supported by early establishing cover crops to stabilise disturbed soils during the establishment phase. The seed mix has been derived from regional pasture recommendations, long-term rehabilitation monitoring at Curragh, and proven Bowen Basin practice. While Buffel grass (*Cenchrus ciliaris*) is not seeded due to its non-native status, it remains persistent in local topsoils and is expected to occur in rehabilitated areas, contributing positively to groundcover stability and resilience on poorer soils.

In the Open Woodland PMLU, revegetation is directed towards the establishment of native woodland communities consistent with Broad Vegetation Group (BVG) 10a. Woodland treatments are primarily applied on rehabilitated slopes exceeding 15%, where vegetation structure and rooting depth contribute to long-term landform stability. Species selection includes a diverse assemblage of eucalypts, bloodwoods, and angophoras in the upper storey, supported by acacias, quinine bush, and coffee bush in the mid-storey, and a native groundcover dominated by 3P grasses such as *Themeda triandra* and *Heteropogon contortus*. This approach ensures the development of self-sustaining vegetation communities that provide habitat values, ecological connectivity, and slope stabilisation consistent with regional reference communities.

The Watercourse PMLU requires revegetation strategies that prioritise riparian stability, water quality protection, and habitat connectivity. Species selection has been guided by BVG 16a and Regional Ecosystem (RE) 11.3.25 benchmarks, ensuring floristic diversity and ecological resilience. The upper storey includes riparian species such as *Eucalyptus camaldulensis*, *E. tereticornis*, and *Casuarina cunninghamiana*, while the understorey incorporates stabilising graminoids and groundcovers including *Themeda triandra*, *Heteropogon contortus*, and *Imperata cylindrica*. These species have been selected to provide hydraulic resistance and bank stabilisation while supporting habitat diversity. All species have been screened to avoid potential livestock health risks, recognising that riparian areas may be intermittently or unintentionally accessible to cattle. While incidental grazing benefits may occur through the inclusion of 3P native grasses, these are secondary to the primary objective of re-establishing functioning riparian ecosystems.

Revegetation of the FPL and TSF has been tailored to ensure structural stability and compliance with design performance requirements, while also contributing to ecological values. On the FPL, vegetation treatments are the preferred stabilisation method, with species selected for their capacity to withstand hydraulic velocities up to 2.5 m/s. Native pasture grasses such as *Themeda triandra*, *Heteropogon contortus*, and *Eragrostis sororia* provide continuous cover across engineered batters, while shrubs and small trees such as *Acacia leiocalyx* and *Alphitonia excelsa* enhance long-term resilience and habitat function. Rock mulch and armouring are incorporated only in localised zones where modelling identifies velocities exceeding vegetation tolerance thresholds. On TSFs, where protection of containment integrity is paramount, species selection is restricted to shallow-rooted grasses and shrubs that deliver persistent cover and erosion resistance without compromising capping performance. Deep-rooted trees are excluded from TSF rehabilitation to maintain structural integrity.

Across all domains, Buffel grass (*Cenchrus ciliaris*) is not included in seed mixes but is acknowledged as persistent within the local seedbank and topsoil. Where it establishes, it contributes positively to surface stability and resilience under drought and poor soil conditions, but its occurrence will be monitored and managed to ensure it does not suppress native recruitment or reduce vegetation diversity.

7.1.7 Landform Design

The final landform design for the Curragh Complex has been developed through an iterative process of technical assessment, operational experience, and regulatory engagement. Over more than three decades of mining, rehabilitation performance has been informed by erosion studies, geotechnical investigations, hydrological modelling, and monitoring of progressive rehabilitation areas, together with comparative benchmarks from across the Bowen Basin. Each design iteration has integrated new datasets, regulator feedback, and operational learnings to improve confidence and demonstrate alignment with the requirements of the *Environmental Protection Act 1994 (Qld)* and the PRCP Guideline for landforms that are safe, stable, non-polluting, and sustainable in perpetuity.

The approval of the Mammoth Underground Mine has further refined the closure landform. Specifically, the reduction of open-cut disturbance in the southern portion of Curragh North has enabled residual voids and associated flood protection infrastructure to be shifted further north, away from Blackwater Creek. This refinement increases the effective floodplain width, retains riparian vegetation, and improves hydraulic performance at the creek interface—representing a positive closure outcome that reduces environmental risk and enhances integration with surrounding landforms.

Importantly, the Mammoth approval has also provided an opportunity to ensure that all Post-Mining Land Use (PMLU) Rehabilitation Areas (RAs) are contained within Environmental Authority (EA) approved disturbance boundaries and the defined mining lease footprint. This alignment ensures consistency between the PRCP schedule, EA conditions, and statutory tenure limits, while providing a clear basis for closure planning and long-term compliance.

A consolidated closure design map (Figure 37) and representative cross-sections (Figure 34) illustrate the final landform configuration, including spoil dumps, residual voids, drainage features, PMLU's and NUMAs. These figures demonstrate how the final landform incorporates engineered stability measures, functional drainage networks, and designated land uses, consistent with the requirements of the EP 1994 (Qld) and the PRCP Guideline.

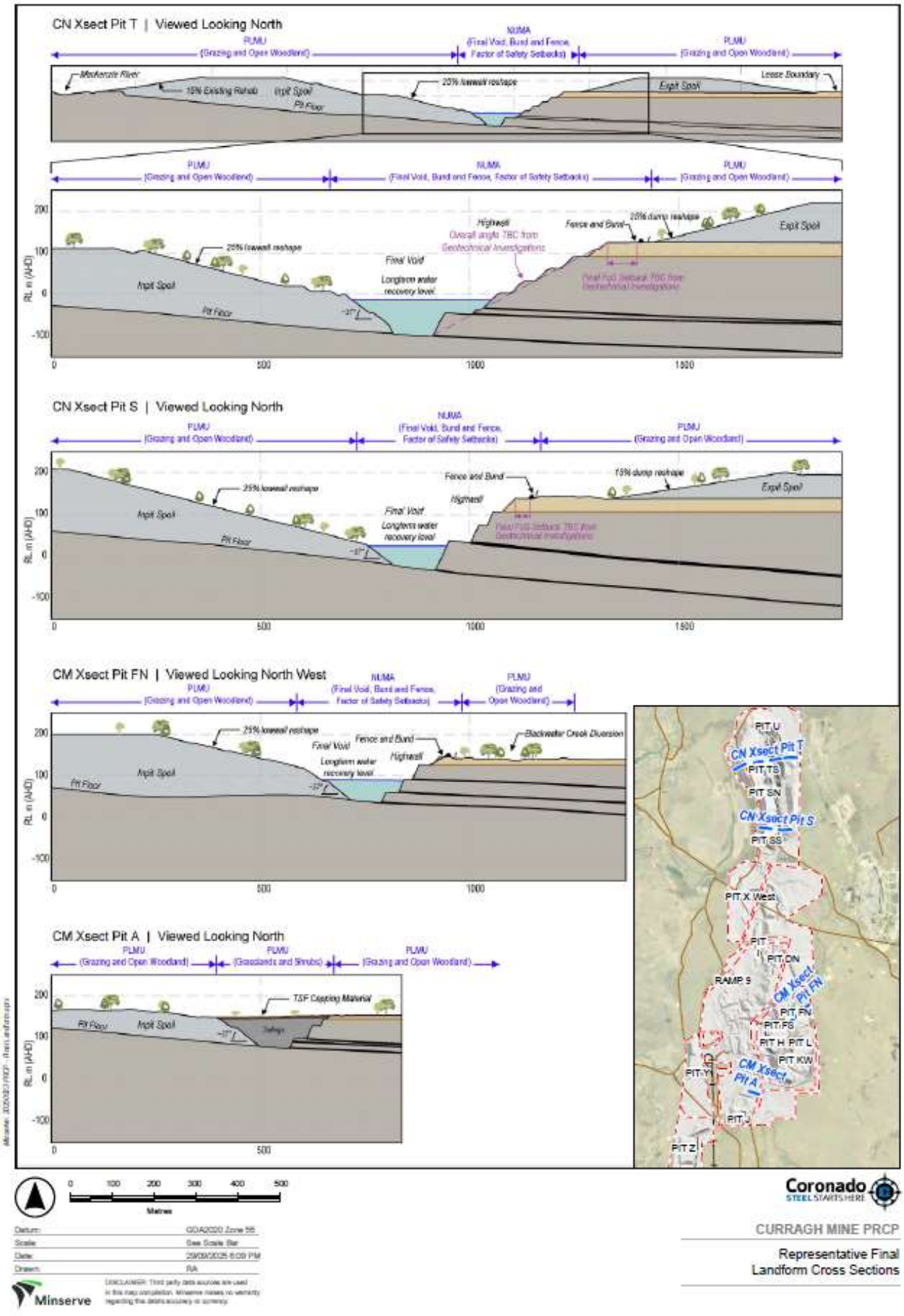

Figure 34: Representative Final Landform Cross Sections.

Reshaping of Overburden Dumps and Ramps

Overburden dumps will be reshaped to achieve stable slope geometries and drainage-integrated surfaces. Outer batters will generally be reprofiled to ≤15% (1V:6.6H). Where slopes exceed 15%, engineered treatments such as rock mulch armouring (sourced from geochemically benign Permian overburden and interburden) will be applied to improve erosional stability. Rock mulch provides surface roughness and resistance to rill and gully initiation, ensuring acceptable erosion rates over the closure timeframe.

Surface drainage will be integrated with contour drains, crest bunds, and engineered waterways. Drainage structures are designed to maintain erosional stability, with drop structures and rock-lined sections incorporated at points of concentrated flow. These measures minimise sediment export and protect downstream water quality. Reshaping will be aligned with progressive rehabilitation to reduce final closure liabilities and accelerate vegetation establishment. Geotechnical verification of spoil slopes will confirm stability, with a minimum Factor of Safety (FoS ≥1.5) required under closure conditions.

Flood Protection Landform

Flood protection embankments are designated as Improvement Area 1 (IA1) and form a critical component of the closure landform, ensuring hydraulic isolation of residual voids in perpetuity. The embankment system has been designed to integrated into the final landform while also ensuring flood immunity against the 0.1% AEP event plus 1 m freeboard, consistent with the Environmental Authority (EPML00643713) and the Regulated Structures Guideline (ESR/2016/1933).

Rehabilitation treatments will integrate erosion-resistant vegetation with engineered armouring. Buffel grass, although not prescribed, is expected to recruit naturally from topsoil and contribute to persistent cover alongside seeded natives. Drainage networks within the embankment system will be managed using rock armouring to control flow velocities to ≤2.5 m/s. Outlets, drop structures, and discharge points will be stabilised to prevent scour and sediment export, ensuring long-term functionality with engineered armouring, ensuring that levees remain stable and non-polluting in perpetuity.

Parameter	Design
Height	Actual will be 0.1% AEP plus 1 m freeboard
Top width	30-45 m (actual to be determined during design)
Water facing slope	≤25%
Residual void dump facing slope	≤25%
Factor of Safety	≥1.5

Table 64: Indicative Flood Protection Landform Standard Parameters

Improvement Areas (IA1)

Residual voids at the Curragh Complex are designated as NUMAs under section 112 of the *Environmental Protection Act 1994 (Qld)*. This designation applies where backfilling is not technically feasible, and no safe or sustainable Post-Mining Land Use (PMLU) can be assigned. NUMAs incorporate the residual voids themselves, associated permanent geotechnical setback zones, and engineered flood protection structures.

The long-term management of NUMAs is focused on ensuring containment, safety, and stability. Key design and management measures include:

- Geotechnical stability – Void batters have been designed and will be verified to maintain a Factor of Safety (FoS) ≥1.5 under closure conditions. Permanent geotechnical setback zones will be established to ensure stability and provide a physical barrier to public access.

- Access restriction – Bunds and fencing will be installed around void perimeters to prevent inadvertent access and ensure public safety.
- Flood protection – Residual voids are hydraulically isolated from external catchments by engineered levees designed to the 0.1% AEP plus 1 m freeboard standard, consistent with Environmental Authority EPML00643713 and the *Regulated Structures Guideline* (ESR/2016/1933).
- Water quality and geochemistry – Waste characterisation (Appendix H) confirms that spoil is predominantly non-acid forming (NAF). Isolated potentially acid forming (PAF) material is encapsulated within inert cover, avoiding risks of acid or metalliferous drainage. Monitoring of pit water quality will continue to validate these assumptions.
- Hydraulic performance – Ongoing monitoring of levees, drainage structures, and void water levels will ensure compliance with design criteria and verify that long-term containment is maintained.

Improvement Areas (IAs), which include the residual voids, geotechnical setback zones are not assigned a productive PMLU. However, they are an integral part of the closure landform. Their function is to provide engineered stability and environmental protection, ensuring that the final landscape remains safe, stable, non-polluting, and contained in perpetuity.

Landform Design Summary

The final landform design for the Curragh Complex has been developed under the transitional PRCP framework, ensuring consistency with the Environmental Protection Act 1994 (Qld) and the PRCP Guideline. The design reflects more than three decades of operational experience, technical assessment, and regulatory engagement, progressively refined through geotechnical investigations, erosion studies, hydrological modelling, and monitoring of progressive rehabilitation areas.

Rehabilitation Areas are assigned to Post-Mining Land Uses including Light Grazing, Open Woodland, Watercourses, Grassland and Shrubs. These domains are designed with slope geometries and drainage configurations that ensure long-term geotechnical stability, erosion resistance, and ecological functionality consistent with the nominated end uses.

Improvement Areas (IAs) incorporate residual voids, permanent geotechnical setback zones, and associated containment structures. These features are managed as NUMAs in accordance with section 112 of the EP Act 1994 (Qld), recognising that backfilling is not technically feasible and that no safe or sustainable alternative PMLU can be assigned. Their management focuses on geotechnical stability (Factor of Safety ≥1.5), flood immunity (≥0.1% AEP + 1 m freeboard), and avoidance of long-term geochemical risks.

The closure design has been refined through ongoing monitoring, technical studies, and regulator feedback, ensuring that the final landform delivers a cohesive and integrated outcome. Together, these measures provide confidence that the Curragh Complex will transition to a post-mining landscape that is safe, stable, non-polluting, and sustainable in perpetuity, consistent with statutory requirements and regional land use expectations.

7.1.7.1 Erosion Assessment

An erosion assessment of the conceptual final landform was undertaken by SLR (2022) (Appendix F). The erosion assessment utilised the revised universal soil loss equation (RUSLE) to calculate the potential soil loss from the conceptual landform. This method was used as an early indicator into whether the proposed slopes would be erosionally stable.

Topsoil and spoil samples were taken from across the mine and analysed in a laboratory in order to provide input for the RUSLE calculations. A number of cover methods were assessed including different levels of grass cover, the application of hydromulch, a cover crop with straw mulch and a cover crop with stone.

There is currently no broad agreement on what constitutes an 'acceptable rate of erosion' on a rehabilitated landform. Spatial data available from CSIRO (2020) provides estimates of broad scale and in situ soil erosion in Australia. The soil erosion estimates provided for the Curragh site range from 0.026 to 31.4 t/ha/y. SLR have used the Food and Agricultural Organisation (FAO) soil loss classes for assessing an acceptable soil loss criterion at Curragh Complex, as shown in Table 66.

Soil loss (ton/ha/yr.)	Class
< 5	**very low**
5 – 12	low
12 – 25	moderate
25 – 60	high
60 – 150	very high
> 150	extremely high

Table 65: FAO soil loss classes after Bergma et al (1991)

The results of the RUSLE calculations are provided in Table 67 for Permian, Quaternary and Tertiary spoil and Table 67 for topsoil from Curragh North and Curragh Main. The results indicate the following:

- Stable 16% slope gradients can be achieved on all spoil types by applying hydromulch.
- Permian and Quaternary spoil with 16% slope gradients will be stable once 50% cover is established.
- Tertiary spoil will only be stable when at least 80% cover is established.
- Spoil stability is increased as a result of stone fragments which provide additional cover.
- Stone cover offer the best protection against erosion with soil losses classified as very low to low where this is applied.
- Topsoil from Curragh North is less erodible and will reach a low annual soil loss once 60% cover is established; and
- Topsoil from Curragh Main is more erodible and gentler slopes should be considered

Table 66: Soil loss (t/ha/yr.) for Spoil at Curragh Complex

Lithology	Slope angle (%)		35%	25%	18%	16%	14%	12%	10%	8%	6%
	Slope length (m)		31m	45m	45m	55m	70m	80m	90m	105m	115m
	Cover management				Calculated annual soil loss (t/ha/yr.)						
Permian	Newly established grass cover no canopy	0	219.0	204.9	116.9	110.4	106.1	88.0	69.6	52.3	38.2
		20	98.6	92.2	52.6	49.7	47.7	39.6	31.3	23.5	17.2
		40	43.8	41.0	23.4	22.1	21.2	17.6	13.9	10.5	7.6
		50	32.9	30.7	17.5	16.6	15.9	13.2	10.4	7.8	5.7
		60	21.9	20.5	11.7	11.0	10.6	8.8	7.0	5.2	3.8
		80	6.6	6.1	3.5	3.3	3.2	2.6	2.1	1.6	1.1
	Hydromulch		15.3	14.3	8.2	7.7	7.4	6.2	4.9	3.7	2.7
	Cover crop with 2.5 t/ha straw mulch		43.8	41.0	23.4	22.1	21.2	17.6	13.9	10.5	7.6
	Cover crop with 3.8 t/ha straw mulch		26.3	24.6	14.0	13.2	12.7	10.6	8.4	6.3	4.6
	Cover crop with 330 t/ha stone		11.0	10.2	5.8	5.5	5.3	4.4	3.5	2.6	1.9
	Cover crop with 600 t/ha stone		4.4	4.1	2.3	2.2	2.1	1.8	1.4	1.0	0.8
Quaternary	Newly established grass cover no canopy	0	148.9	139.4	79.5	75.1	72.1	59.9	47.4	35.6	26.0
		20	67.0	62.7	35.8	33.8	32.5	26.9	21.3	16.0	11.7
		40	29.8	27.9	15.9	15.0	14.4	12.0	9.5	7.1	5.2
		50	22.3	20.9	11.9	11.3	10.8	9.0	7.1	5.3	3.9
		60	14.9	13.9	7.9	7.5	7.2	6.0	4.7	3.6	2.6
		80	4.5	4.2	2.4	2.3	2.2	1.8	1.4	1.1	0.8
	Hydromulch		10.4	9.8	5.6	5.3	5.0	4.2	3.3	2.5	1.8
	Cover crop with 2.5 t/ha straw mulch		29.8	27.9	15.9	15.0	14.4	12.0	9.5	7.1	5.2
	Cover crop with 3.8 t/ha straw mulch		17.9	16.7	9.5	9.0	8.7	7.2	5.7	4.3	3.1
	Cover crop with 330 t/ha stone		7.4	7.0	4.0	3.8	3.6	3.0	2.4	1.8	1.3
	Cover crop with 600 t/ha stone		3.0	2.8	1.6	1.5	1.4	1.2	0.9	0.7	0.5
Tertiary	Newly established grass cover no canopy	0	236.5	221.3	126.3	119.2	114.6	95.1	75.2	56.5	41.3
		20	106.4	99.6	56.8	53.7	51.6	42.8	33.8	25.4	18.6
		40	47.3	44.3	25.3	23.8	22.9	19.0	15.0	11.3	8.3
		50	35.5	33.2	18.9	17.9	17.2	14.3	11.3	8.5	6.2

Lithology	Slope angle (%)		35%	25%	18%	16%	14%	12%	10%	8%	6%
	Slope length (m)		31m	45m	45m	55m	70m	80m	90m	105m	115m
	Cover management				Calculated annual soil loss (t/ha/yr.)						
		60	23.7	22.1	12.6	11.9	11.5	9.5	7.5	5.7	4.1
		80	7.1	6.6	3.8	3.6	3.4	2.9	2.3	1.7	1.2
	Hydromulch		16.6	15.5	8.8	8.3	8.0	6.7	5.3	4.0	2.9
	Cover crop with 2.5 t/ha straw mulch		47.3	44.3	25.3	23.8	22.9	19.0	15.0	11.3	8.3
	Cover crop with 3.8 t/ha straw mulch		28.4	26.6	15.2	14.3	13.7	11.4	9.0	6.8	5.0
	Cover crop with 330 t/ha stone		11.8	11.1	6.3	6.0	5.7	4.8	3.8	2.8	2.1
	Cover crop with 600 t/ha stone		4.7	4.4	2.5	2.4	2.3	1.9	1.5	1.1	0.8

Table 67: Soil loss (t/ha/yr.) for Topsoil at Curragh Complex

Lithology	Slope angle (%)		35%	25%	18%	16%	14%	12%	10%	8%	6%
	Slope length (m)		31	45m	45m	55m	70m	80m	90m	105m	115m
	Cover management				Calculated annual soil loss (t/ha/yr.)						
Curragh North	Percentage newly established grass cover no canopy	0	184.0	172.1	98.2	92.7	89.1	73.9	58.5	43.9	32.1
		0.2	82.8	77.5	44.2	41.7	40.1	33.3	26.3	19.8	14.5
		0.4	36.8	34.4	19.6	18.5	17.8	14.8	11.7	8.8	6.4
		0.5	27.6	25.8	14.7	13.9	13.4	11.1	8.8	6.6	4.8
		0.6	18.4	17.2	9.8	9.3	8.9	7.4	5.8	4.4	3.2
		0.8	5.5	5.2	2.9	2.8	2.7	2.2	1.8	1.3	1.0
	Hydromulch		12.9	12.1	6.9	6.5	6.2	5.2	4.1	3.1	2.2
	Cover crop with 2.5 t/ha straw mulch		36.8	34.4	19.6	18.5	17.8	14.8	11.7	8.8	6.4
	Cover crop with 3.8 t/ha straw mulch		22.1	20.7	11.8	11.1	10.7	8.9	7.0	5.3	3.9
	Cover crop with 330 t/ha stone		9.2	8.6	4.9	4.6	4.5	3.7	2.9	2.2	1.6
	Cover crop with 600 t/ha stone		3.7	3.4	2.0	1.9	1.8	1.5	1.2	0.9	0.6
Curragh Main	Percentage newly established grass cover no canopy	0	245.3	229.5	130.9	123.7	118.8	98.6	78.0	58.6	42.8
		0.2	110.4	103.3	58.9	55.6	53.5	44.4	35.1	26.4	19.3
		0.4	49.1	45.9	26.2	24.7	23.8	19.7	15.6	11.7	8.6
		0.5	36.8	34.4	19.6	18.5	17.8	14.8	11.7	8.8	6.4

		0.6	24.5	23.0	13.1	12.4	11.9	9.9	7.8	5.9	4.3
		0.8	7.4	6.9	3.9	3.7	3.6	3.0	2.3	1.8	1.3
	Hydromulch		17.2	16.1	9.2	8.7	8.3	6.9	5.5	4.1	3.0
	Cover crop with 2.5 t/ha straw mulch		49.1	45.9	26.2	24.7	23.8	19.7	15.6	11.7	8.6
	Cover crop with 3.8 t/ha straw mulch		29.4	27.5	15.7	14.8	14.3	11.8	9.4	7.0	5.1
	Cover crop with 330 t/ha stone		12.3	11.5	6.5	6.2	5.9	4.9	3.9	2.9	2.1
	Cover crop with 600 t/ha stone		4.9	4.6	2.6	2.5	2.4	2.0	1.6	1.2	0.9

7.1.8 Cover Design

Tailings storage facilities (TSFs) at the Curragh Complex require specific closure and capping strategies to ensure that final landforms are stable, non-polluting, and capable of supporting the proposed Post-Mining Land Use (PMLU)s (PMLUs). Consistent with the cover design principles outlined in Section 3.6.1.6 of the PRC Plan Guideline, the proposed approach has been informed by site-specific geotechnical and geochemical investigations. The strategies are intended to maintain erosional stability, support vegetation establishment, and reduce the potential for long-term impacts to surface water and groundwater.

These approaches remain consistent with the geochemical findings presented Section 7.0 which indicated that waste materials across the site have a low potential to generate Acid Mine Drainage (AMD), Neutral Mine Drainage (NMD), or Saline Drainage (SD). Accordingly, complex engineered barrier systems are not considered necessary, and cover designs are focused on erosion protection and sustainable revegetation outcomes.

Accordingly, complex engineered barrier systems are not considered necessary, with cover designs instead focused on erosional stability protection, sustainable revegetation, and encapsulation measures that support the objective of safe, stable and non-polluting landforms. A summary of the current TSF closure and cover strategies is provided in Table 68 below.

Table 68: Summary of Curragh Complex TSF Capping and Closure Strategies

Facility / Location	Reference Study	Proposed Cover / Capping Approach	Key Objectives	Notes / Further Assessment
Old Tailings Dam (Out-of-Pit)	Parsons Brinckerhoff (2016) – Geotechnical Investigation and Assessment for Capping (Appendix L)	Coarse reject or inert granular spoil; oversized boulders (>500 mm) removed; up to ~2.0 m capping thickness; progressive dozer push placement	- Provide stable geotechnical surface- Reduce risk of punching failure- Promote drainage to spillway- Enable vegetation establishment	Additional geotechnical testing required during placement to confirm shear strength for heavier equipment access
All In-Pit (A and B)	ERC Calculator – latest approved design Golders Associates (2017) – B-Pit TSF Design Plan (Appendix M)	Low-risk cover design:- ~2.0 m rock/overburden- ~0.10 m growth media	- Stabilise tailings surface- Promote vegetation- Reduce infiltration and seepage- Support grazing land use PMLU	Adopted as a low-risk planning basis; subject to refinement with future site-specific investigations

7.1.9 Water Management and Diversions

Subject to landholder agreement (where applicable), CCPL proposes to retain all dams post-closure to provide a reliable stock water source that supports the target PMLUs of light grazing and open woodland. Stock water availability is critical to ensuring the long-term functionality of grazing areas, and the presence of permanent water points will enhance both land utility and ecological resilience.

All dams will be subject to land contamination investigations to confirm their suitability for post-closure use. Rehabilitation and management measures will be implemented as required to address any risks identified. The overarching objective is that water resources are managed to achieve outcomes consistent with the ANZECC Guidelines for stock watering.

Typical rehabilitation works may include sediment removal, battering of dam walls, placement of topsoil, ripping to relieve compaction, and seeding with appropriate species. The final rehabilitation and management approach for each dam will be guided by the outcomes of the contamination investigations and aligned with the milestone criteria established under the PRCP**.**

7.1.9.1 Erosion and Sediment Control

Erosion and sediment control is fundamental to ensuring that post-mining landforms remain stable, safe, and non-polluting. CCPL's approach to landform design is to emulate natural catchment drainage patterns wherever practicable, reducing the reliance on engineered structures.
Where required, erosion and sediment controls are implemented consistent with the Erosion and Sediment Control Management Plan (EM Plan 2.1).

- Contour banks may be constructed on steep or long slopes to intercept surface runoff and reduce flow velocity. Their design is informed by industry guidelines, including:
- Low alignment gradients (~0.5%) to encourage controlled drainage.
- Flow velocities generally designed to remain below 1.0 m/sec under bare soil conditions.
- Construction from spoil material capped with 200 mm of topsoil, with the invert left bare to convey runoff.
- Batter slopes typically 1:2 (upslope) and 1:3 (downslope).
- Banks less than 400 m in length generally constructed to ~1 m high (spoil plus topsoil).
- Discharge and protection measures include directing flows into energy dissipation basins or stable waterways. Where higher velocities are expected, rock armouring may be used, with sizing determined using methods such as the Ishbash equation. Rehabilitation waterways are generally designed to withstand events in the order of a 50-year ARI storm. Hydraulic jump basins may also be constructed at slope bases to dissipate energy and reduce channel length.
- Progressive management recognises that contour banks are primarily short- to medium-term stabilisation features. Once vegetation establishes, the need to retain contour banks will be reassessed. Where overtopping risks are identified, banks may be removed by grading or scraping, followed by reseeding and re-topsoiling.

7.1.9.2 Blackwater Creek Diversion (BWCD)

The Blackwater Creek Diversion (BWCD) was approved in 2008 to enable mine expansion to the east and is now fully constructed. The diversion extends for approximately 10.2 km and incorporates a meandering low-flow channel, high-flow channel, batter banks, and terraces. The objective of the BWCD is to provide a stable, permanent diversion that replicates the ecological and hydrological functions of the original channel.

The BWCD was engineered by Parsons Brinckerhoff to mimic the bed grade, cross-sectional form, and planform geometry of natural Blackwater Creek reaches. The diversion integrates structural and ecological elements, with rehabilitation works designed to reinstate in-stream and riparian processes. Key measures include:

- Riparian revegetation using locally occurring native groundcovers, shrubs, and trees.
- Strategic planting to stabilise banks, provide shading, and increase habitat diversity.
- Physical channel features such as meanders and terraces to replicate natural geomorphic and aquatic habitat processes.

Rehabilitation Zones
The diversion was designed with distinct zones to address stability and function across the cross-section:

- Channel – low-flow channel.
- Zone A – low-flow channel batter (1V:3H).
- Zone B1 – high-flow terrace extending to Zone B2.
- Zone B2 – high-flow terrace extending to Zone C.
- Zone C – high-flow batters, levees, and drains extending to natural ground.

Regulatory Framework and Compliance
Because the BWCD is already constructed, compliance obligations are tied to the Environmental Authority (EA) EPML00643713, specifically:

- Condition G18: Rehabilitation of the BWCD must be conducted in accordance with the approved Blackwater Creek Diversion Monitoring and Maintenance Plan (EM Plan 1.4).
- Condition G19: A rehabilitation monitoring program must be implemented to demonstrate that the diversion continues to meet required outcomes for stability and ecological function.

These obligations ensure that the BWCD is assessed and maintained against the original design objectives rather than requiring new design submissions (which apply to diversions not yet constructed).

Rehabilitation Outcomes
Consistent with the EA and PRCP framework, the following outcomes apply:

- Ground cover: At least 75% established vegetative groundcover within riparian and channel zones.
- Weeds: Weed presence not exceeding 5% cover.
- Vegetation function: Riparian and channel vegetation established to provide functional stabilisation consistent with predicted flow conditions.
- Stability and ecological function: Demonstrated through staged monitoring, including geomorphic assessments, vegetation surveys, and hydrological performance checks.

The BWCD is designed to operate as a self-sustaining, ecologically functional creek alignment that continues to provide hydraulic stability, habitat diversity, and biodiversity connectivity. Compliance with EA Schedule H ensures the diversion is maintained in a safe, stable, and non-polluting condition. Within the PRCP, the BWCD milestone criteria therefore directly reference compliance with the approved EA monitoring and maintenance plan, ensuring alignment between statutory obligations and closure outcomes.

Table 69: Milestone Criteria for Water Management Features

Feature	Post-Closure Function	Milestone Criteria	Monitoring & Verification
Dams	Provide stock water sources to support grazing and open woodland PMLUs	All dams subject to land contamination investigations. Water quality meets ANZECC Guidelines for stock watering. Rehabilitation measures (as required: sediment removal, battering, topsoiling, ripping, seeding) applied where necessary.	Water quality sampling against ANZECC parameters. Visual inspection of dam structure and stability. Vegetation cover >70% on batters within 2 years.
Contour Banks	Short- to medium-term erosion control on spoil slopes	Constructed at ~0.5% grade with batter slopes 1:2 (upslope) and 1:3 (downslope). Flow velocity <1.0 m/sec (bare soil case). Discharge into energy dissipation basin or stable waterway. Removed or integrated into landform once adequate vegetative cover is established.	Visual inspections post-rainfall events. Verification of bank stability, no overtopping or gully initiation. Vegetation cover >70% within 2 years.
Blackwater Creek Diversion (BWCD) (Constructed)	Permanent, self-sustaining diversion channel providing ecological corridor	≥75% ground cover established. Weed cover ≤5%. Vegetation established to provide scour resistance under predicted velocities, shear stress, and stream power. Riparian vegetation consistent with BVG 16a established within 2 years. Ongoing monitoring and maintenance undertaken in accordance with the Blackwater Creek Diversion Monitoring and Maintenance Plan (EA Condition G18, EM Plan 1.4).	Annual monitoring of ground cover and weed % cover. Hydrological performance monitoring. Vegetation surveys to confirm species composition and riparian function. Reporting consistent with EA Condition G19 rehabilitation monitoring program.
Minnie Creek and Bonnie Doon Creek Diversion (Not Yet Constructed)	Permanent diversion channel accommodating mine access and restoring ecological connectivity	Detailed design and certified design plan submitted and approved prior to construction (EA Schedule H). Diversion maintains pre-existing hydrologic regime. Incorporates natural geomorphic features; channel remains stable without ongoing maintenance. Sediment transport and water quality regimes maintained to be self-sustaining. Riparian vegetation established consistent with Section 7.0 (Revegetation) species list. Opportunistic species (e.g. Buffel) managed to avoid dominance.	AQP certification of design and post-construction performance. Hydrological and geomorphic monitoring to confirm design objectives achieved. Vegetation surveys to verify species composition and riparian establishment. Monitoring to confirm performance under a suitable range of flow events.

7.1.9.3 Approved Watercourse Diversions (Not Constructed)

Two permanent watercourse diversions have been approved under the Curragh Extension Project but are yet to undergo detailed design or construction. These comprise the Minnie Creek Diversion and the Bonnie Doon Creek Diversion (see Figure 35).

Minnie Creek Diversion

The western portion of Curragh Central intersects with Minnie Creek. To maintain catchment connectivity, an approximately 6.9 km diversion is proposed along the western perimeter of Curragh Central, discharging into Blackwater Creek.

Bonnie Doon Creek Diversion

A portion of the mine vehicle haul road along the western perimeter of Curragh South intersects Bonnie Doon Creek. To accommodate mine access, an approximately 1.1 km diversion is proposed along the western side of the haul road.

In accordance with Schedule H of Environmental Authority EPML00643713, both diversions must:

- Undergo detailed design prior to construction, with a certified design plan prepared by a suitably qualified and experienced person submitted to the administering authority for approval.
- Provide 'As Constructed' drawings and specifications to the administering authority within 60 days of completion.
- Demonstrate that diversions are designed and constructed to maintain hydraulic performance, ensure geomorphic stability, and avoid unacceptable impacts to sediment transport and water quality.

The proposed PRCP milestone criteria build upon these EA requirements by embedding them into measurable rehabilitation outcomes, requiring that:

- Hydrology – diversions maintain the pre-existing hydrologic characteristics of surface water and groundwater systems.
- Geomorphic stability – diversions incorporate natural geomorphic features (gradient, banks, bedforms) and remain stable under expected flow events without ongoing maintenance.
- Sediment transport and water quality – diversions maintain sediment and water quality regimes that allow them to be self-sustaining while minimising impacts upstream and downstream.
- Ecological function – riparian vegetation is established consistent with Section 7.0 (Revegetation) (e.g. River Red Gum, Coolibah, Paperbark, River Oak, Black Speargrass, Kangaroo Grass, and associated native shrubs/forbs). Opportunistic species such as Buffel may establish but will be managed to avoid dominance.
- Functionality – diversions must operate under the full range of expected flow events and substrate conditions without requiring ongoing engineered intervention.
- Monitoring and verification – post-construction monitoring must confirm that the diversion has been subjected to a suitable range of flow events and continues to achieve hydraulic, geomorphic, and ecological objectives. Assessment and sign-off must be completed by an appropriately qualified person (AQP).

The milestone criteria for watercourse diversions have been developed directly from the EA requirements, while extending these obligations to reflect long-term rehabilitation and closure objectives. Specifically:

- The EA's requirement for certified design informed milestone criteria around incorporating geomorphic and hydrologic features assessed by an AQP.
- The EA's requirement for 'As Constructed' documentation informed milestone criteria around ongoing monitoring and verification of performance.
-
- EA obligations for hydraulic and stability performance are translated into milestone criteria requiring diversions to be self-sustaining and functional without long-term intervention.

The PRCP expands beyond EA engineering requirements by explicitly incorporating ecological function. This provides dual benefits:

- Erosional stability – riparian vegetation and natural features increase resistance to erosion, stabilise banks, and dissipate flow energy.
- Ecological connectivity – restored riparian zones maintain habitat linkages, biodiversity values, and landscape resilience.

Together, these requirements ensure that the approved watercourse diversions are designed, constructed, and rehabilitated to achieve outcomes that are safe, stable, non-polluting, and consistent with Curragh's final land use and closure objectives.

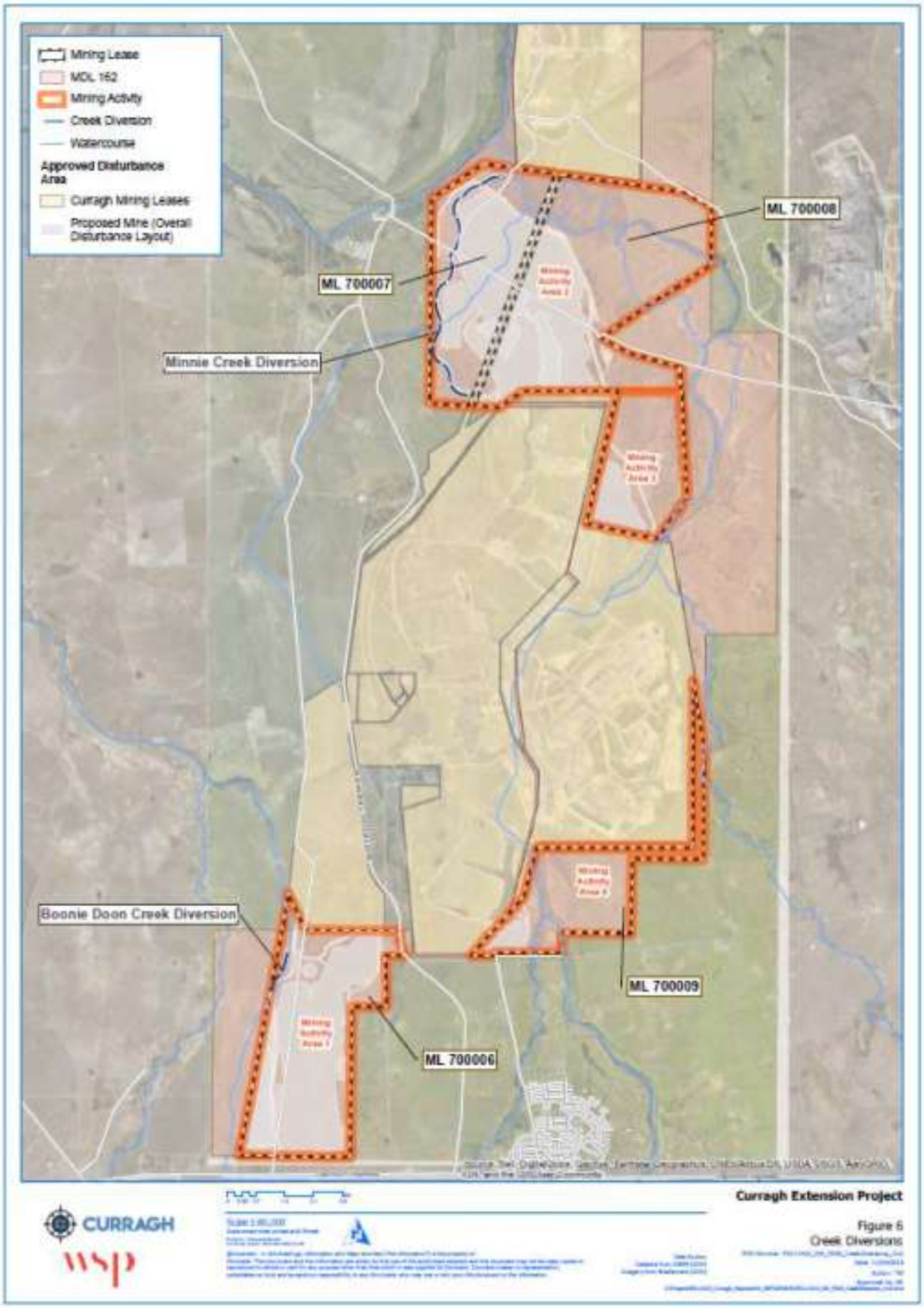

Figure 35: Approved Watercourse Diversions

7.1.10 Voids

Within the Curragh Complex closure landscape, NUMAs are applied to landforms where a safe and sustainable Post-Mining Land Use cannot be assigned. This designation, provided under section 112 of the EP Act 1994 (Qld), ensures that such areas are managed to an equivalent standard of safety, stability, and containment as rehabilitated domains, despite not being repurposed for productive land use.

NUMAs comprise several integrated components:

- Residual voids where backfilling is not technically feasible, and which are designed to remain as permanent features of the closure landscape.
- Geotechnical setback zones established around highwalls, steep batters, or void edges to preserve long-term stability and limit erosion.
- Safety bunds and fencing to physically prevent access and mitigate public safety risks.
- Drainage and containment structures designed to ensure hydraulic stability and protect surrounding catchments.

Residual voids represent the most prominent component of the NUMA system at Curragh Complex. These voids are managed collectively under Improvement Area IA1 in the PRCP Schedule, which defines milestone criteria to demonstrate compliance with the PRCP Guideline. Technical studies completed in support of the PRCP demonstrate that residual voids meet the statutory requirements for NUMAs:

- Geotechnical stability: Deterministic slope stability analysis confirms that spoil and void batters achieve a Factor of Safety >1.5, ensuring long-term stability under closure conditions.
- Hydraulic protection: Flood modelling (Appendix N) confirms that voids are protected from ingress under the 0.1% AEP plus 1 m freeboard design criterion, consistent with the Regulated Structures Guideline (ESR/2016/1933).
- Geochemical safety: Waste rock characterisation (Appendix H) shows spoil is predominantly non-acid forming (NAF). Localised potentially acid forming (PAF) materials have been encapsulated under NAF cover, removing the risk of acid or metalliferous drainage (AMD).
- Containment and monitoring: NUMAs will remain subject to containment controls and ongoing monitoring to ensure they remain safe, stable, and non-polluting in perpetuity.

IA1 Milestone Criteria provide the measurable framework to demonstrate NUMA performance. These criteria include:

- Construction and maintenance of geotechnical safety bunds and fencing around residual void perimeters.
- Retention of setback zones to ensure batter stability and reduce erosion susceptibility.
- Implementation of drainage controls to maintain hydraulic separation from external catchments.
- Verification that spoil and void walls remain stable with no evidence of ongoing erosion, slumping, or AMD generation.

Together, these measures ensure that NUMAs form a contained and stable component of the final landform, consistent with the closure objective of delivering a post-mining landscape that is safe, stable, non-polluting, and sustainable in perpetuity.

7.2 Tailings and Rejects

There are currently five tailings/rejects disposal facilities on site: Out-of-pit Tailings Storage Facility, Pit A, Pit B, Ramp 8 and Ramp 3 (Figure 36). Only Pit B is currently in use with all other storages at capacity or no longer planned to receive additional material. Pit B is anticipated to provide tailings storage for the rest of the current mine life.

The Out-of-pit tailings storage facility will be rehabilitated in accordance with the Parson Brinckerhoff (2016) Design report. Once the cover design is installed and signed off by a RPEQ qualified person, the area will be topsoiled and seeded with predominantly grass species.

The in-pit tailings disposal areas will be covered in at least 1 m of inert rock as part of the reshaping of the overburden dumps and low walls. The area will then be topsoiled within at least 0.2 m of growth media, ripped then seeded. The cover design of the TSF is outlined in Section 7.1.8.

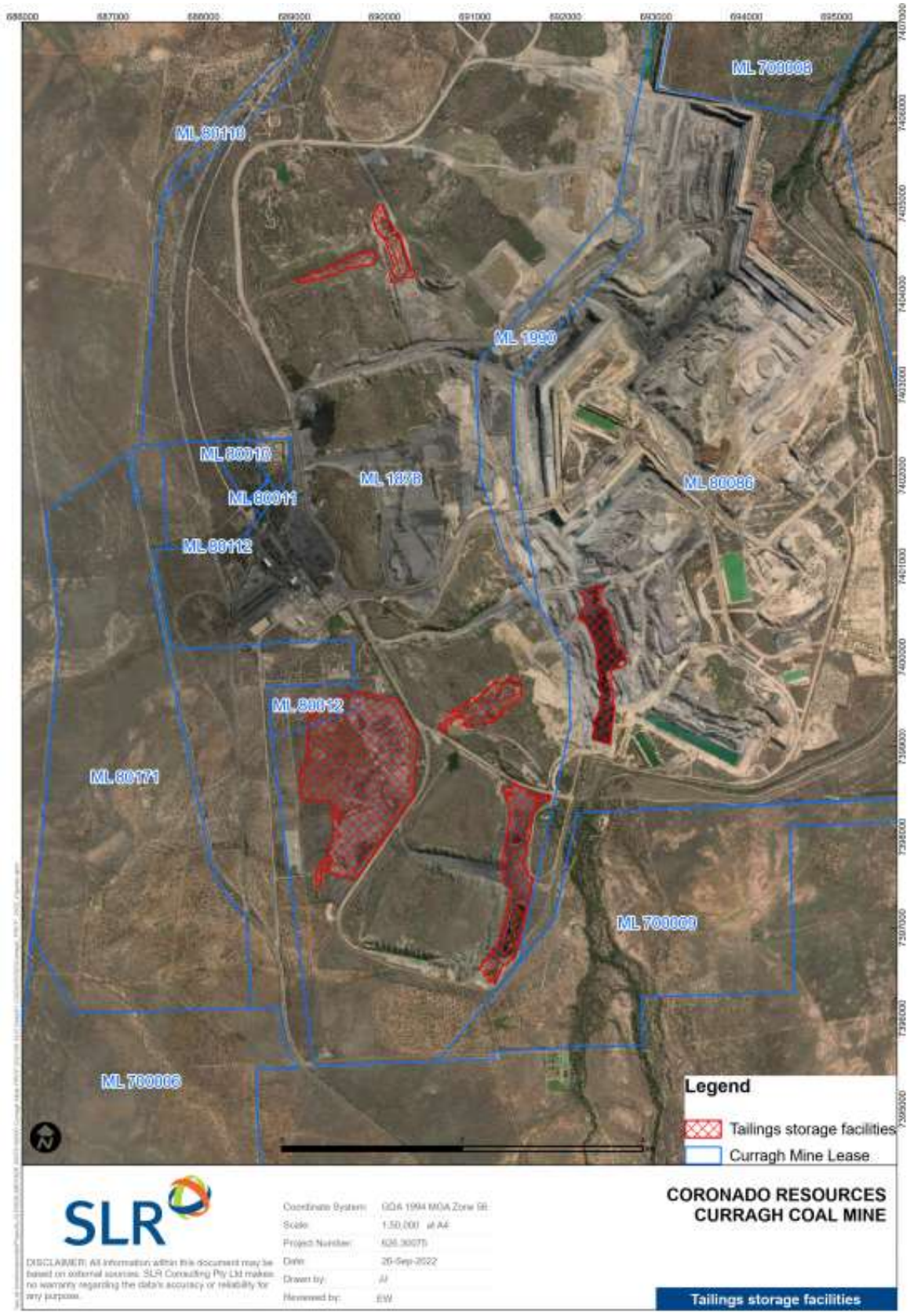

Figure 36: Curragh Complex Tailings Storage Facilities

Tailings samples were collected from Pit A in July 2022, including 6 samples taken from 10 cm depth and 7 samples from 40 cm depth. All samples were analysed by ALS Laboratory for a plant growth suite including pH, Electrical Conductivity (EC), and Sulfur content (both as soluble major anions and total Sulfur content). Samples collected from a 40 cm depth were also analysed for sample Particle sizing, and soil classification (based on particle size).

Key findings from the analysis of the 40 cm depth samples include:

- Majority of the samples were predominantly sand (>63 µm particle size).
- pH ranged from 7.6 to 8.7, with sample one an outlier at 3.5 pH.
- EC ranged from 1,100 to 3,020 µS/cm; with Sample 7 recording 8,590 µS/cm.
- Moisture content ranged from 5.2 – 15.4% with an average of 8.9%; and
- Total Sulfur for Samples 2-7 ranged from 810 – 6,470 mg/kg with an outlier of 23,000 mg/kg recorded in Sample 1.

Key findings from the analysis of the 10 cm depth samples include:

- pH ranged from 5.5 – 8.6 pH for Samples 2-6 with Sample 1 recording 2.4 pH.
- EC ranged from 2,080 to 7,080 µS/cm.
- Moisture content ranged from 6.6 to 15.1% with an average of 11.33%; and
- Total Sulfur for Samples 2-6 ranged from 5,500 – 11,300 mg/kg with an outlier recorded in Sample 1 at 38,900 mg/kg.

The results suggest that the majority of material has a low EC and Sulfur content with a few samples identified as outliers. The moisture content from both sampling depths is relatively low and therefore indicates that the surface is well crusted and dry. However, further sampling would be required to determine trafficability.
Golders (2017) summarised Curragh's geotechnical tailings physical and geochemical characteristics in and respectively.

Table 70: Tailings Physical Characteristics

Parameter	Value	Unit	Source
Annual production rate	1,040,000	tpa	Curragh
Particle size	≤0.5	mm	Sedgman
Particle density	1.65	t/m^3	Curragh
Solids concentration – m/m	37.4	%	Curragh
Solids concentration – v/v	26.5	%	Curragh
Slurry density	1.17	t/m^3	Curragh
Tailings initial settled dry density	0.8	t/m^3	Golder
Tailings beaching angle			
Above water	0.5	%	Golder
Below water	3.0	%	Golder

Table 71: Tailings Geochemical Properties (CHPP Data for Tailings Liquor 2013)

Date	pH		EC (µS/cm)	
	CHPP1	CHPP2	CHPP1	CHPP2
24/09/2013	8.22	8.25	4,630	756
27/09/2013	7.38	7.89	1,656	650
30/09/2013	8.49	8.08	3,950	2,050
14/10/2013	7.66	8.21	4,750	4,000

A summary of other tailings/rejects characterisation available is provided in Table 72.

Table 72: Tailings Characterisation Summary

Tailings Facility	Source	Tailings Characteristics
Old Tailings Dam	Parsons Brinkerhoff (2016)	Laboratory results indicate that the tailings are of medium to high plasticity and is predominantly silt sized. Moisture contents generally increase with depth
Old Tailings Dam – Core Samples	Mitra PTS (2019)	100% passing 1mm Ash 30-48% Relative density 1.63 - 1.78 t/m^3 Exposed tailings dry on surface 0-3m (13-20% free moisture) Damp 1-9m (24-26% free moisture) Wet below 9 (26-30% free moisture)
Old Tailings Dam	FDP Mining (2020)	Particle Size Distribution analysis indicated an average of approximately 60% at < 38µ
Pit A tailings	ALS (2022) EB2220646	Predominately neutral to alkaline, EC (1:5) 1100 to 8590, Soluble Sulfur as S (mg/kg) 770 to 6970
Pit A Tailings	ALS (2022) EB22003071	Organic Sulphur <0.02 – 1.00% Inorganic Sulphur 0.39 – 3.86% % less than 1mm 98.7 – 99.9% Dominant fractions 0.25 – 0.5mm and <0.038mm)
Tailings (General)	Curragh (2015)(Appendix I)	pH (average) = 8.02 EC (average) = 3,000 µS/cm

7.3 Underground Mining

The Curragh Bord and Pillar Project involves underground extraction of the Mammoth Seam (and locally the Castor Seam), accessed from highwall portals developed in Curragh North Pit S. Bord and pillar mining has been selected as a low-impact methodology that avoids caving of overlying strata. The method retains a network of robust pillars, supplemented by bell-out and barrier pillars, to ensure long-term stability. Roadways, typically 6.5 m wide and 3.5 m high, are excavated using continuous miners, with coal transported via shuttle cars to conveyor systems and onward to existing Curragh coal handling and processing infrastructure.

Portals and the Underground Mine Industrial Area (UMIA) are located within the existing Pit S void, leveraging pre-existing disturbance and avoiding the need for new box cuts, ventilation corridors, or external spoil emplacement. This integration substantially reduces additional surface disturbance. Ancillary disturbance outside the void is limited to bore pads (<1 ha each), short access tracks, and utilities for groundwater and gas monitoring. These features are temporary and progressively rehabilitated following decommissioning, consistent with mapped Post-Mining Land Uses identified in the final site design map (Figure 37)

The mine plan covers northern, central, and southern underground panels, extending approximately 10 km along strike. Extraction ratios range from 28–59% depending on seam thickness and cover depth, with floor coal recovery limited to thicker central areas. Barrier pillars up to 40 m wide separate panels to minimise load transfer and ensure independent stability across the mine layout.

Geotechnical Stability and Subsidence

A detailed geotechnical assessment (Gordon Geotechnics, 2024) confirmed that the Curragh Underground mine design meets or exceeds accepted industry standards for pillar stability and subsidence control. The University of New South Wales Pillar Design Procedure, together with mechanistic stability frameworks, was applied to evaluate pillar strength, overburden loading, and long-term deformation behaviour. Production pillars consistently achieve a Factor of Safety (FoS) ≥1.5, satisfying the previously committed PRCP milestone criterion for geotechnical stability of PMLUs. Barrier and bell-out pillars achieve FoS >2.0, providing additional safety margins, while secondary floor coal extraction retains FoS >1.3, which remains within accepted tolerances.

Pillar geometries maintain width-to-height ratios in excess of 4, ensuring deformation remains elastic and controlled. This work-hardening behaviour prevents brittle collapse and provides confidence in the stability of both individual pillars and the panel system. Subsidence modelling predicts maximum vertical settlement of <50 mm, which lies within the natural shrink–swell variability of local Vertosols. Settlement of this scale is indistinguishable from seasonal soil movement and does not generate tensile strains sufficient to cause cracking, ponding, or drainage alteration. Additional analysis of roadway development and shallow cover conditions confirmed negligible risk of sinkhole subsidence. Long-term geomechanical modelling of the flooded post-closure condition demonstrated that inundation will not compromise pillar integrity or overburden stability.

Taken together, these results confirm that the underground mine will remain geotechnically stable throughout operations and into closure. The bord and pillar design controls subsidence and eliminates the need for engineered stabilisation or designation of additional NUMAs. Subsidence modelling confirmed that vertical settlement at the surface will be limited to less than 50 mm across the mining footprint. Such magnitudes are within the natural shrink–swell variability of local Vertosols and are therefore indistinguishable from background seasonal movement. The predicted subsidence is elastic in nature and does not generate tensile strains sufficient to cause surface cracking, ponding depressions, or alteration of natural drainage lines. As a result, no impacts to landform stability, soil function, or surface hydrology are anticipated.

Additional analysis of roadway development and shallow cover conditions confirmed a negligible risk of sinkhole subsidence, with competent strata present above all panels. Long-term geomechanical modelling of the flooded post-closure condition demonstrated that inundation of workings will not compromise pillar integrity or overburden stability, further reinforcing the low residual risk profile of the mining method.

Taken together, these findings confirm that the Curragh Underground mine will remain geotechnically stable throughout its operational life and into closure. The bord and pillar design provides robust control of subsidence and eliminates the need for engineered stabilisation measures or designation of additional NUMAs.

7.3.1.1 Hydrogeological Setting

Hydrogeological investigations (CBPMP EAR, 2024) defined three principal hydrostratigraphic units. No functional Quaternary alluvial aquifer occurs beneath Blackwater Creek; instead, the near-surface profile comprises a weathered Permian aquitard of clays, silts, and fine sands underlain by low-permeability mudstones and siltstones. This aquitard restricts vertical hydraulic connectivity. Shallow groundwater within this profile is highly saline (13,000–50,000 µS/cm), unsuitable for consumptive or ecological use. Beneath this lies variably weathered Permian strata (10–60 m thick) of sandstones, mudstones, and thin coal stringers, which have low transmissivity and limited storage. At depth, fresh Permian bedrock, including the Mammoth Seam, acts as a confined aquifer with restricted recharge and minimal connectivity to overlying units.

7.3.1.2 Numerical Modelling and Predicted Impacts

Numerical groundwater modelling was undertaken as part of the hydrogeological assessment (CBPMP EAR, 2024). The model was developed in accordance with the *Australian Groundwater Modelling Guidelines* (Barnett et al., 2012) and the IESC Information Guidelines. It was calibrated against 563 groundwater level observations from 53 sites, achieving a scaled root mean square (SRMS) error of 9.56%, within the <10% benchmark.

The modelling confirmed that depressurisation is confined to the Mammoth Seam, with negligible propagation into the weathered Permian aquitard or Blackwater Creek floodplain. Predicted drawdown in these units is below detection thresholds and does not extend beyond the mining leases. Groundwater levels are predicted to rebound significantly post-mining as workings flood, approaching pre-mining conditions in the medium term.

7.3.1.3 Groundwater Users and Beneficial Use

A review of the DRDMW database confirmed no registered supply bores within the predicted drawdown zone. Salinity precludes beneficial use of shallow aquifers. Hydrogeological and ecological assessments confirm the absence of groundwater-dependent ecosystems, as riparian vegetation along Blackwater Creek is sustained by rainfall and surface flows, not groundwater. Stygofauna were not detected, consistent with saline and low-productivity aquifers.

7.3.1.4 Groundwater Dependent Ecosystems

Hydrogeological and ecological investigations presented in the CBPMP EAR (2024) confirm the absence of groundwater-dependent ecosystems (GDEs) within or adjacent to the project area. Vegetation communities along Blackwater Creek are dependent on rainfall and episodic surface water flows, not groundwater. Salinity and aquitard conditions preclude groundwater support for terrestrial or aquatic ecosystems. Targeted stygofauna sampling recorded no detections, consistent with poor water quality and aquifer productivity.

7.3.1.5 Geochemistry and Water Quality

Geochemical characterisation showed low total sulphur (<0.2%) and high neutralising capacity, indicating negligible risk of acid or metalliferous drainage. No enrichment of trace elements or soluble salts was identified. Flooding of workings post-closure is expected to yield water quality within baseline salinity and pH ranges.

In summary, groundwater impacts are localised, temporary, and confined to the target seam. Natural recovery will occur post-mining, and benign geochemistry ensures no contamination risk. Outcomes are consistent with PRCP objectives of safe, stable, non-polluting, and sustainable Post-Mining Land Use.

7.3.1.6 Surface Hydrology and Fluvial Networks

The project lies within the Blackwater Creek sub-catchment of the Mackenzie River. Blackwater Creek, an ephemeral sand- and silt-bed system, flows intermittently during rainfall events and remains dry for much of the year. Numerous tributaries and gullies discharge to the creek. Historic open-cut landforms have already modified catchment hydrology but are integrated into engineered site drainage systems.

Subsidence modelling predicts <50 mm settlement across the footprint, including <20 mm beneath Blackwater Creek. This is within the natural shrink–swell range of Vertosols and insufficient to cause cracking, depressions, or altered flow paths. Creek channel gradients, catchment boundaries, and hydraulic connectivity remain unaffected.

Flood modelling for the 0.1% AEP event confirmed no change in flood hydraulics under mined and unmined scenarios. Floodplain storage and conveyance remain unaltered. Interface velocities at mine-landform junctions remain below conservative erosion thresholds confirming that erosional stability is preserved.

With no deformation of drainage lines, the underground operations do not alter sediment transport processes. Bore pads and tracks will be subject to erosion controls and rehabilitated progressively, preventing long-term risks to water quality. Monitoring will integrate hydrological inspections, floodplain validation, and cross-checks with groundwater and subsidence datasets.

In summary, hydrological assessments confirm no alteration of natural drainage, channel morphology, or floodplain behaviour. Subsidence magnitudes are negligible, and flood modelling demonstrates no measurable change to hydraulics under extreme events. These outcomes are consistent with PRCP objectives of safe, stable, non-polluting, and sustainable land use.

7.3.1.7 Ecology

The ecological setting at Curragh is dominated by historically cleared grazing land interspersed with rehabilitated spoil and regrowth woodland. Remnant riparian vegetation persists along Blackwater Creek and its tributaries, with values typical of ephemeral drainage systems in the Bowen Basin. While regionally significant communities such as Brigalow (*Acacia harpophylla*) and Coolibah–Black Box occur nearby, the underground project was strategically designed to avoid thus, ensuring no disturbance (directly or indirectly) to prescribed matters.

Hydrogeological and ecological investigations (CBPMP EAR, 2024) confirm that groundwater does not sustain ecological function in the project area. No functional alluvial aquifer occurs within the underground mining footprint, and shallow groundwater is saline and unsuitable for ecological use. Riparian vegetation is dependent on rainfall and surface flows. Field investigations verified that neither terrestrial nor aquatic groundwater-dependent ecosystems occur within or adjacent to the underground footprint.

Subsidence (<50 mm) is within the natural shrink–swell range of soils and will not alter drainage patterns or riparian condition. Disturbance is limited to small bore pads and tracks (<10 ha), which will be rehabilitated to mapped Light Grazing and Open Woodland PMLUs (Figure 37) through recontouring, topsoil replacement, and seeding with appropriate species. Rehabilitation success will be assessed against PMLU-specific criteria, ensuring reinstatement of ecological function.

In summary, ecological risks are negligible. The project avoids prescribed ecological values, does not affect groundwater-dependent ecosystems, and will not alter riparian function or connectivity. Rehabilitation will restore land capability and habitat values consistent with PRCP objectives.

7.3.1.8 Risk Assessment

A synthesis of geotechnical, groundwater, hydrological, and ecological investigations confirms that the Curragh Bord and Pillar Project presents a low residual risk profile fully consistent with PRCP objectives.

Geotechnical risks are minimised through conservative pillar design, ensuring FoS ≥1.5 for production pillars and >2.0 for barrier/bell-out pillars, with subsidence limited to <50 mm. No stabilisation measures or NUMAs are required. Hydrogeological risks are localised and temporary with drawdown being confined to the Mammoth Seam, with negligible effects on overlying aquitards or surface systems. Recovery will occur naturally, and benign geochemistry ensures no acid generation or contamination risk. No groundwater-dependent ecosystems or registered users are affected. Hydrological risks are negligible, as subsidence is too small to influence drainage, floodplain function, or flood hydraulics. Flood modelling confirms no measurable change in flow hydraulics under extreme events, and sediment/water quality risks are avoided through progressive rehabilitation of ancillary disturbances.

Ecological risks are minimal, with surface disturbance limited to small borehole footprints in cleared land. Rehabilitation will return these areas to mapped PMLUs of Light Grazing and Open Woodland. The absence of GDEs, negligible subsidence effects, and protection of prescribed communities ensure ecological integrity is maintained. Closure risks are well defined. Portals within the approved Curragh North Pit S NUMA will be sealed with engineered concrete plugs certified by an RPEQ, with no new voids or residual features created. Minor ancillary areas will be fully rehabilitated.

Collectively, these outcomes demonstrate that underground mining does not introduce material new risks beyond those already managed within the Curragh Complex. The project leverages existing disturbance, maintains stability and environmental function, and ensures that Post-Mining Land Use values are maintained.

7.4 Built Infrastructure

In accordance with Environmental Authority (EA) Condition G7, all infrastructure constructed by, or on behalf of, the EA holder during mining activities—including water storage structures—must be removed from the site prior to surrender, unless otherwise agreed in writing by the post-mining landowner or landholder (except where the landowner/landholder is also the EA holder).

Table 73 outlines the infrastructure associated with mining activities at Curragh Mine. Surface infrastructure owned by CCPL that is not beneficial to the approved Post-Mining Land Use will be removed in accordance with EA requirements. Infrastructure proposed for retention will be limited to items that provide a demonstrable and ongoing benefit to the approved PMLUs. Such infrastructure may include but is not limited to fencing; access tracks; service-related infrastructure; sheds and buildings; hardstand and transport logistics areas; and water management infrastructure.

Any infrastructure proposed for retention to support the approved PMLUs will require the written agreement of the relevant post-mining landholder at the time. This agreement will be obtained prior to the commencement of rehabilitation milestones.

Where infrastructure is required to be removed, priority will be given to repurposing, salvaging, or recycling materials. Demolition and disposal will only occur where reuse or recycling options are not considered viable. This approach is consistent with the waste and resource management hierarchy under the *Queensland Waste Management and Resource Recovery Strategy*, prepared in accordance with the *Queensland Waste Reduction and Recycling Act 2011*.

Category	Infrastructure
Built Infrastructure	MIA (e.g., administration, crib rooms, workshop, warehouse, storage and sheds). Fuel, oil, and chemical storage. Fuel and wash bays. Communications towers. Fences.
Supporting Services	Pipes and pumps. Switchyard and substations. Communication and lighting towers. Concrete pads and bitumen. Culverts.
Offsite Infrastructure	Rail and train loadout and related infrastructure. Power lines.
Water Infrastructure	Process water dams. Raw water dams. Drains and pipelines.

Table 73: Infrastructure Associated with the Approved Curagh Mine Mining Activities

8 Risk Assessment

8.1 Principles and Methodology

The key steps to the risk assessment process were:

- **Establish the Context:** Consideration should be given to both the internal and external environment, the limits within the risk assessment are valid, the activity being assessed and the cross section of people contributing to the risk management process.
- **Identification of Hazards:** Risk identification refers to the process of identifying risks against a pre-defined set of business objectives, taking into account the context, the previous risk assessments, incidents and the findings of audits performed onsite.
- **Risk Analysis:** each potential consequence should be analysed separately, and existing or current controls should be identified, and their effectiveness and efficiency taken into account.
- **Risk Evaluation:** to assist in making decisions, and to define which risks need treatment and the priority for treatment implementation; and
- **Risk Treatment:** selecting control options for modifying risks and implementing those controls to reduce residual risk factors to a level as low as is reasonably achievable (ALARA). Costs and efforts of the controls versus the benefits derived should be reviewed. Reduction of the risks should be according to the hierarchy of controls:
    - Elimination.
    - Substitution.
    - Engineering controls.
    - Administrative controls; and
    - Personal protective equipment.
    -

A PRCP Closure Risk Workshops were facilitated by SLR over two days 6th and 7th June 2022. Attendees were as per Table 75.

Name	Employer	Department	Date of Attendance
Mark Stokes	Coronado Curragh	Development	06/06/2022 07/06/2022
Margaret Stewart	Coronado Curragh	Development	06/06/2022 07/06/2022
Brad Radloff	SLR Consulting	Environmental Approvals and Management	06/06/2022 07/06/2022
Emma Williams	SLR Consulting	Environmental Approvals and Management	06/06/2022 07/06/2022
Kim Tuart	Coronado Curragh	Technical Services	06-06-2022
Madeline Bourke	Coronado Curragh	Technical Services	06-06-2022
Kelly Smith	Coronado Curragh	Technical Services	06-06-2022
Amanda Dawson-Evenhuis	Coronado Curragh	Technical Services	06-06-2022

Connor Jacklin	Coronado Curragh	Technical Services	06-06-2022
Liz Blythe	Coronado Curragh	HR and Social	07-06-2022
Anne Palmer	Coronado Curragh	HR and Social	07-06-2022
Tania Fitzgerald	Coronado Curragh	HR and Social	07-06-2022
Danny Millers	Coronado Curragh	Mine Planning	07-06-2022
Brett Mason	MineOp Consulting	Mine Planning	07-06-2022
Eugene Cooper	Coronado Curragh	Mine Planning	07-06-2022
Anthony De Domenico	Coronado Curragh	Management	06/06/2022 07/06/2022
Scott Weatherall	Coronado Curragh	Mine Planning	07-06-2022
Eaton Sheridan	Coronado Curragh	Mine Planning	07-06-2022

Table 74: Risk Assessment Attendee

8.1.1 Risk Matrix

A risk matrix was used to assess the level of risk with certain events. The risk matrix considers the consequence and likelihood of each event. The consequence and likelihood categories have been developed based on the criteria from the Integrated Mine Closure Good Practice Guide, 2nd Edition (ICMM, 2019). The risk matrix is shown in Table 76

Likelihood		Consequence				
		1 - Insignificant	2 - Minor	3 - Moderate	4 - Significant	5 - Major
		No lasting rehabilitation impact, no remediation required, no rehabilitation delivery impacts	Minor rehabilitation impact requiring minor remediation or repair, delivery impact of <6 months	Moderate rehabilitation impact requiring moderate remediation or repairs, delivery impact of <2 years	Significant rehabilitation impact requiring significant remediation or repairs, delivery impact of <10 years	Major rehabilitation impact requiring major remediation or repairs, delivery impact of >10 years
5 - Almost Certain	Greater than 90% likelihood of occurring Has happened, will probably happen during the mine life/closure and there is no reason to suspect it won't happen	**11 - Medium**	**16 - Significant**	**20 - Significant**	**23 - High**	**25 - High**
4 - Likely	Likelihood of occurring is equal to or more than 30% and less than 90% This consequence is not uncommon in the mining and metals industry/area	**7 - Medium**	**12 - Medium**	**17 - Significant**	**21 - High**	**24 - High**
3 - Possible	Likelihood of occurring is equal to or more than 10% and less than 30% There is a possibility of this risk occurring as it has occurred before (albeit infrequently) in the mining and metals industry/area	**4 - Low**	**8 - Medium**	**13 - Significant**	**18 - Significant**	**22 - High**
2 - Unlikely	Likelihood of occurring is more than or equal to 3% and less than 10% There are no specific circumstances to suggest this could happen	**2 - Low**	**5 - Low**	**9 - Medium**	**14 - Significant**	**19 - Significant**
1 - Rarely	Likelihood of occurring is less than 3% it would require a substantial change in circumstances to create an environment for this to occur, and even then, this is a rare occurrence	**1 - Low**	**3 - Low**	**6 - Medium**	**10 - Medium**	**15 - Significant**

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Table 75: Risk Matrix

8.1.2 Summary of Key Closure Risks

The risk assessment outcomes are outlined in **Appendix O**. A total of 30 risks were identified and assessed. No high risks, 11 significant risks, 13 medium risks and 6 low risks were classified in accordance with the risk matrix.

The 11 significant risks identified include:

- Changes to mine planning resulting in non-compliance with PRCP schedule.
- Change in mining methods.
- Changes in infrastructure requirements over mine life (e.g. tailings/rejects storage).
- Incorrect placement of materials resulting in erosion and/or geotechnical instability.
- Waste characterisation inadequate.
- Grass competition results in insufficient woodland development.
- Inadequate monitoring data to support relinquishment.
- Drought impacting rehabilitation success.
- Uncontrolled bushfire damaging rehabilitation.
- Stakeholder support of Post-Mining Land Use (PMLU)s change.
- Potential changes to regulator rehabilitation expectations / interpretation impacting PRCP schedule amendments.

8.1.3 Risk Treatment Plan

A Risk Treatment Plan (**Appendix O**) has been developed for the risks identified in the risk assessment. The Risk Treatment Plan includes the following:

- Proposed treatments for each risk.
- Reason for the proposed treatment.
- Performance measures and constraints.
- Reporting and monitoring requirements.
- Potential corrective actions.
- Resources requirements.
- Timing; and
- Responsibility.

The outcomes of the risk treatment plan assessment are linked with the monitoring and maintenance programs to ensure that all actions necessary are undertaken to ensure risks are mitigated and minimised.

8.2 Rehabilitation Trials

8.2.1.1 Landform stability

Landform stability of the rehabilitation on the heightened spoil dumps will be assessed using current Light Detection and Ranging (LiDAR) data and remote sensing software to generate 1 m digital elevation models (DEMs) of the landform. DEMs from previous years will be compared to assess stability as it relates to identifying areas of settlement, deposition, subsidence and erosion.

The DEM slope analysis will also be used to assess the as built landform against the landform design criteria with a maximum slope of 16% for the out of pit (OoP) dump slope tying into the final landform and with in-pit dump slopes of up to 27% for the internal rehabilitation batters. Annual erosion and landform stability monitoring will enable early detection of instability of rehabilitated slopes >16%, particularly areas that may be developing deep rills or gullies and/or areas that are either subsiding or were run off is settling. Early detection will enable targeted rework as required to maintain overall landform stability.

8.2.1.2 Species mix

The following measures will be implemented to improve rehabilitation success on steeper slopes associated with the heightened spoil dumps at Curragh North:

- Establishment of additional vegetation reference sites in surrounding vegetation communities on steep slopes (i.e. > 16%) to improve species data and vegetation data to inform rehabilitation on the steeper slopes.
- Tree, shrub and grass species representative of the surrounding vegetation will be included in the species mix for steeper slopes; and
- To establish short-term groundcover, a cover crop such as millet or oats will be included with the revised native tree, shrub and grass seed mix.

Vegetation establishment on steeper slopes

The current rehabilitation method includes deep ripping, with the use of a winged tyne and direct seeding. For steeper slopes, (>16%) there is an increased risk of erosion. To reduce this risk, rehabilitation is focused on establishing a high ground cover to reduce rainfall impact on soils and on establishing deeper roots to stabilise slopes. To improve native tree and shrub establishment on steeper slopes all areas of rehabilitation that have been adequately topsoiled are seeded with the revised native species mix (outlined above).

In areas of rehabilitation lacking suitable topsoil, consideration will be given to hydro mulching slopes >16% to improve vegetation establishment to achieve >50% cover with revised species mix in less than one year to reduce the risk of erosion.

When preparing the soils for direct seeding, consideration will be given to the constraints associated with the material below the depth of ripping (i.e. poor structure from sodicity or subsoil salinity). The addition of soil ameliorants such as lime or gypsum or alternatively a calcium-based soil conditioner in combination with recalcitrant carbon-based soil conditioner, a biologically active fertiliser blend including soil bacteria and mycorrhizal fungi developed for rehabilitation, and a soil binder product may be required to stabilise the soil prior to direct seeding and ripping.

9 Monitoring and Maintenance

9.1 Monitoring Program

The overall aim of the rehabilitation monitoring program is to provide Curragh Complex with accurate information about the performance and development of its rehabilitation over time. Within this broad aim there are number of specific objectives:

- To measure the density, richness and condition of canopy, shrub (overstorey) and shrub (understory) woody species established on rehabilitated land using plot-based methods, and to benchmark the results against completion criteria.
- To measure species richness in the rehabilitation and compare against completion criteria.
- To accurately assess vegetation success against completion criteria.
- Assessment of slope stability, erosion ‘hotspots’ or slumping across the mine using LiDAR (or similar); and

- To determine if any relationships exist between biophysical parameters, such as substrate quality, soil moisture and rainfall patterns at the time of sowing, and rehabilitation success.

9.1.1 Inspection and certification of highwalls

Once IA land becomes available, to ensure the structural stability and integrity of the void highwalls sign off from an appropriately qualified person should be undertaken post any reshaping. Annual inspections should then occur to report on evidence of:

- Cracking or slumping.
- Erosion.
- Water runoff; and
- Void creep.

9.1.2 Surface Water Monitoring

Surface water monitoring will take place in accordance with the Schedule and generally aligned to methodology outlined in the Receiving Environment Monitoring Program (REMP). The Schedule outlines the surface water quality monitoring to be undertaken at locations across the Curragh Complex. To ensure that milestone criteria are met, surface water monitoring will take place throughout the wet season at the frequency outlined in the schedule . However, the climate of the region is generally dry, resulting in periods when surface water is not present, and monitoring is not possible.

9.1.3 Groundwater Monitoring

Groundwater quality and water levels will be monitored in accordance with the locations and frequencies outlined in the Schedule.

9.1.4 Revegetation Monitoring

A modified transect-based approach is used at Curragh to provide continuity with previous monitoring of rehabilitation on site and to inform remotely sensed imagery interpretation. The assessment focuses on collecting data suitable for comparison against the rehabilitation success criteria.

Sites less than one year old

For sites less than one year old the following are recorded:

- plant species richness – native, pasture species and weeds.
- percentage cover; and
- rill and gully erosion.

A walk through of the mine is undertaken to record all native and weed species observed across representative area of the mine, ensuring variation across the mine is assessed, e.g. areas of woodland species, pasture grasses, weedy areas and any area where there are obvious differences in vegetation cover. Following this, a representative location towards the centre of the mine is chosen and a 1m x 1m quadrat is randomly placed in the four compass directions (north, east, south and west).

The species assemblage (including declared weeds) and the following groundcover percentages within the quadrats are recorded. Rill and gully formation are also noted and where significant gullies are forming a GPS waypoint is recorded so that gully stability can be assessed over time.

This assessment is undertaken for each site with a minimum of four quadrat samples per 10 hectares provided the mine is relatively homogeneous. If there is substantial variation in vegetation cover across a site, the mine will be stratified so that an additional four quadrats will be sampled for each stratum, e.g. high cover areas, low cover areas, weed dominated areas.

For each quadrat the following are recorded:

- Native grasses.
- Non-native grasses.

- Native forbs and others.
- Woody species (saplings).
- Non-native forbs and others; and
- Bare ground/rock.

9.1.4.1 Sites greater than one year old

At each new site, three transects of 50m x 14m running downslope will be established and permanently marked for future re-assessment. At each (new and established) transect assessments are undertaken in 50m x 14m, 50m x 8m, 50m x 4m and in 1m x 1m quadrats (listed in Table 9), with the following parameters assessed:

- Species richness – total number of different species in each life form layer as described in the BioCondition Methodology (Eyre et al., 2015).
- Coarse woody debris – total length in metres of all woody debris over 0.5m length and 0.1m diameter; and
- Tree species recruitment – regeneration of canopy and sub-canopy species.

Table 76: Data Attributes Collected in Different Quadrants

50m x 4m quadrats	1m x 1m quadrats
Canopy cover, sub-canopy cover and shrub layer cover using the line intercept method along the transect centre line. Cover is recoded for each layer where it intercepts the tape measure laid out along the centre line	Native perennial grass cover, native other grass, native forbs and other species (non-grass), native shrubs
Stem counts identified into groupings – Eucalypt/Corymbia, Acacia, Other (tree), Shrub based on final life form, i.e. a young Eucalypt in the shrub layer is still recorded as a tree	
estimate of the mean height of the sub-canopy and shrub layer based on field measurements	
number of large trees. A large tree will be determined based on comparison with the relevant reference sites and measured against a DBH threshold	

9.1.5 Soil Sampling

Soil sampling (0-10 cm) at both ends of the transect on newly revegetated sites (or problem sites) across topsoil/spoil media for analysis of EC, pH and nutrient characteristics.

9.1.6 Erosion Monitoring

Erosion data will be collected from a 50 m cross-section along the centre of each LFA transect. Data collected will include:

- Type of erosion.
- Length and width of each site of erosion.
- Erosion depth and
- Stability of erosion.

This information will be used to estimate the scale and current activity of erosion at each monitoring site. The information will be reported in the Rehabilitation Monitoring Report with the LFA status of each monitoring site. Where erosion gullies are greater than 400 mm deep and active rill erosion less than 300 mm deep, action to mitigate erosion including:

- The repair of any contour drains.
- The addition of minor contour drains to disburse and distribute water.
- The installation of sediment fencing and
- The re-establishment of vegetation where required.

9.1.7 Blackwater Creek Diversion

The Blackwater Creek Diversion will be monitored and maintained in accordance with the EMS Plan 1.4 Blackwater Creek Diversion Monitoring and Maintenance Plan (**Appendix C**).

9.2 Maintenance Plan

A range of maintenance and management activities may be required in rehabilitated areas to facilitate achievement of defined success criteria. Rehabilitation areas should be monitored at an early stage and results compared to success criteria. Areas that do not meet the defined success criteria should have maintenance or management activities completed to facilitate achievement of the success criteria. These activities are outlined below (Table 78).

Aspect	Management Action	Maintenance Action
Vegetation	• Identify vegetation cover and compare with success criteria or natural bare areas. • Fence off areas to control grazing. • Utilise (grazing) areas to prevent overgrazing, i.e., correct stocking ration / rotational system depending on maturity of system. • Check for dormancy. • Vegetation assessment to determine if success criteria (cover, diversity, vitality, etc.) are met.	• Apply follow-up fertiliser where specified or based on soil analysis. • Re-seed areas by hand if soil quality is addressed. • Re-seed with selected species if diversity is not acceptable. • Stimulate growth with controlled grazing. • Increase roughness of surface or mulch layer to trap seeds. • All vegetation established including tree species was effective with seeding and re-planting of trees are not needed.
Erosion	• Monitor extent and severity of erosion and determine causes – do not repair erosion if activity will cause excessive additional disturbance – allow another season to monitor the progression or stabilisation of small-scale erosion. • Identify footpath creation during utilisation of area. • Identify unwanted concentration of runoff over large areas.	• Small rill erosion – selected branch or rock packing. • Gullies – backfill where needed by borrowing from surrounds or use small earthworks equipment (e.g., TLB); use coarse material for backfilling. • Large gullies – import material to backfill from stockpiles or borrow pits or construct structures (e.g., silt fences, etc.). • Reinstate / upgrade water control structures. • Spread runoff where concentration occurs. • Improve vegetation cover.
Sediment Control	• Monitor and inspect sediment control structures that were constructed. • Evaluate the need for de-silting in view of stabilisation of rehabilitated areas and buffer capacity of sediment control structures. • Inspect sediment control structures especially after intense rain events and increased erosion.	• De-silt sediment control structures where capacity has been compromised – place silt on areas that is not subject to erosion, ameliorate and vegetate. • Construct new sediment control structures where needed. • Re-route runoff based on evaluation of drainage pattern after rehabilitation. • Repair upstream erosion.

Aspect	Management Action	Maintenance Action
		• Improve vegetation cover.
Water Control Structures (e.g., berms, graded banks)	• Identify reduced capacity due to sedimentation. • Check for vertical alignment, i.e., uneven settlement or consolidation causing low areas. • Check for long-term stability, e.g., scouring. • Check condition of low-lying areas that were constructed on the top of dumps and other flat areas.	• Remove sediment from sediment traps. • Repair damages to berms or channels. • Revisit Surface Water Management Plan after evaluation of drainage pattern after rehabilitation and construct additional structures where needed or remove is no longer required/functional.
Weed Management	• Continue with weed control programme.	• Annual weed inspections and mapping. • Weed control with selected herbicides appropriate to area concerned (e.g., rehabilitated areas vs. firebreaks). • Bush encroachment control follow up on previously cleared areas. • Thin out undesirable species where it may impact/affect grass cover. • Mowing/slashing periodically as removing biomass repeatedly causes reduced vigour in many weed species. Use in combination with herbicides. • Weed removal using a weed wrench or root talon.
Feral Animal Management	• Identify feral animals that can affect rehabilitated areas.	• Implement feral animal control plan. • Liaise with neighbouring stakeholders, where needed, to address the cause of the problem.
Fire Management	• Maintain firebreaks.	• Maintaining firebreaks on boundaries. • Vegetation control along firebreaks. • Clear firebreaks mechanically where needed.
Land Stability	• Monitor land stability.	• Erosion and sediment control structures are appropriately maintained.

Table 77 Monitoring and Maintenance Plan

10 PRCP Schedule

The PRCP Schedule has been provided as a pdf and excel format as per the DES template (**Appendix P**).

10.1 Final Landform Design

The final site design is shown in Figure 37 and delineates the following:

- The maximum disturbance footprint.
- Mining lease boundaries.
- The PMLUs and NUMAs for the area; and
- 0.1% AEP flood extent.

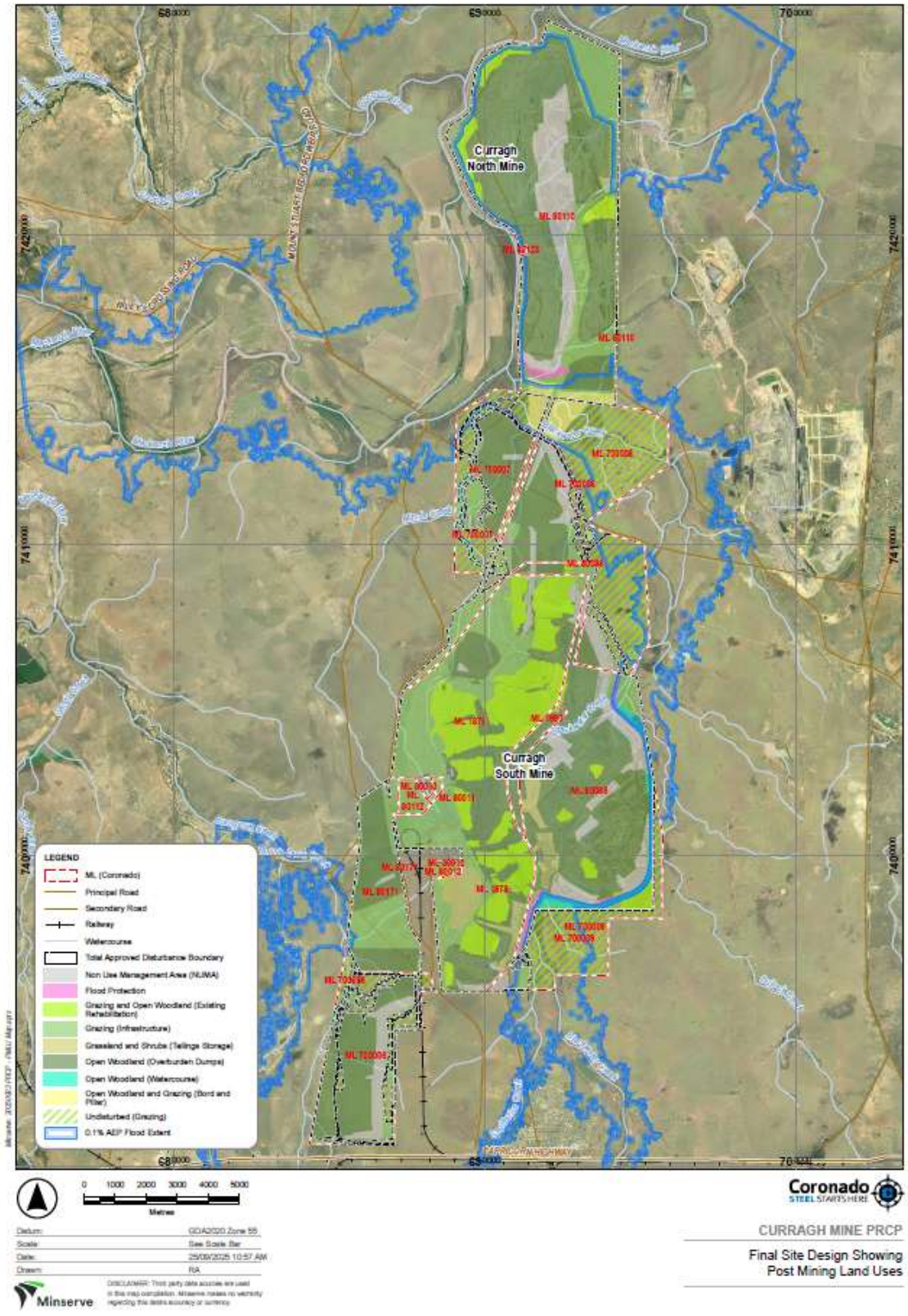

Figure 37: Curragh Complex - Final Site Design

10.2 Rehabilitation and Improvement Areas

A Rehabilitation Area (RA) is defined in the EP Regulation as an area of land in the Post-Mining Land Use (PMLU) to which a rehabilitation milestone for the Post-Mining Land Use (PMLU) relates. The Curragh Complex has three PMLUs of Light Grazing, Open Woodland, Flood Protection Landforms and watercourse. The residual voids expand elements tare proposed as NUMAs. The applicable rehabilitation methodology/milestones have been used to identify different rehabilitation areas.

The proposed rehabilitation areas are detailed in and shown in Table 78 and shown in Figure 38

Table 78: Rehabilitation and Improvement Areas

Rehabilitation Area (RA)	Area (ha)	PMLU	Domain
RA1	5,341.1	Open Woodland	Overburden Dumps and Ramps (<15%)
RA2	2,538.0	Light Grazing	Overburden Dumps and Ramps (>15%)
RA3	2,273.6	Light Grazing	Process and Mine Infrastructure Areas
RA4	1,693.7	Light Grazing	Infrastructure and Miscellaneous Activities
RA5	96.8	Light Grazing	Water Infrastructure
RA6	73.5	Open Woodland (Watercourse)	Watercourse Diversion (Approved, Not Constructed)
RA7	176.5	Flood Protection	Flood Protection Landform
RA8	264.7	Grassland and Shrubs	In-Pit TSF
RA9	185.0	Grassland and Shrubs	Out-of-Pit TSF
RA10	263.7	Light Grazing	Bord and Pillar Underground
RA11	1,873.8	Light Grazing and Open Woodland	Existing Rehabilitation
RA12	185.4	Open Woodland (Watercourse)	Blackwater Creek Diversion – Existing Rehabilitation
IA1	**1691.8**	N/A	Residual voids, geotechnical setbacks, safety bunds and fencing
RA Total	**14965 ha**		

The total rehabilitation areas and Improvement areas for Curragh Complex is 14,965 and 1,691.8 respectively.

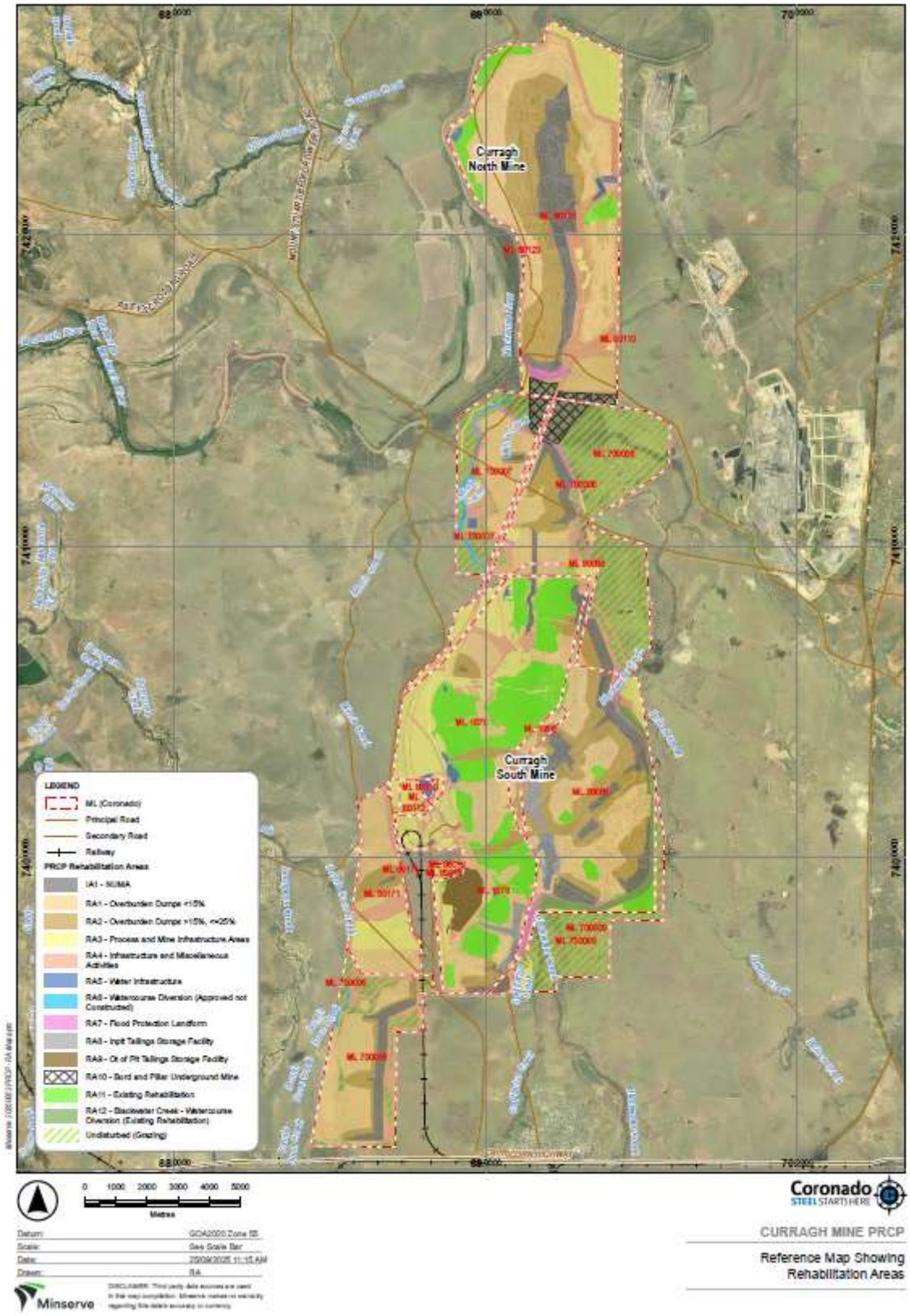

Figure 38: Curragh Complex Rehabilitation Areas

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12 Appendices

Appendix A	Community Consultation Plan
Appendix B	Environmental Authority (EPML00643713)
Appendix C	Blackwater Creek Diversion Monitoring and Maintenance Plan
Appendix D	Concept Residual Void Assessment
Appendix E	Rehabilitation Management and Monitoring Plan
Appendix F	Erosion Assessment
Appendix G	Groundwater Report
Appendix H	Topsoil Quality Assessment
Appendix I	Waste Characterisation Report
Appendix J	Flood Modelling Report
Appendix K	Residual Void Modelling
Appendix L	Geotechnical Investigation and Capping Assessment
Appendix M	Pit B Design Plan
Appendix N	Geotechnical Stability Assessment
Appendix O	Risk Assessment
Appendix P	PRCP Schedule
Appendix Q	Review of Existing Rehabilitation and Completion Criteria