2022–23 Report

Queensland Mine Rehabilitation Commissioner

Queensland Government

The Office of the Queensland Mine Rehabilitation Commissioner acknowledges the Aboriginal and Torres Strait Islander peoples on whose lands the resources industry operates.

Purpose of this report

The report forms part of the Office of the Queensland Mine Rehabilitation Commissioner's corporate governance framework and fulfils the Commissioner's obligation under section 444O of the *Environmental Protection Act 1994* to provide the Minister (Minister for the Environment and the Great Barrier Reef, Minister for Science and Minister for Multicultural Affairs) with an annual report about the operations of the rehabilitation commissioner during the year, within four months of the end of financial year.

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Disclaimer

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Queensland Mine Rehabilitation Commissioner 2022–23 Report

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1 Introduction

This is the second report provided by the Queensland Mine Rehabilitation Commissioner (the Commissioner). The report describes our engagement on mine rehabilitation, summarises the leading practice rehabilitation research and analysis undertaken by the Commissioner, and presents the performance and trends in progressive mine rehabilitation in Queensland.

1.1. The Commissioner's role

The Commissioner is an independent person, appointed under the *Environmental Protection Act 1994* (the EP Act) to provide advice to the responsible Minister on rehabilitation management practices, outcomes and policies. The Commissioner's role covers 'resource activities' in Queensland, including mining and petroleum activities.

The Commissioner also monitors and reports on rehabilitation practices and trends, raises awareness of rehabilitation management matters, and provides advice and reports on rehabilitation performance. The role of the Commissioner is independent and separate from the administering authority that regulates resource activities.

The Commissioner was appointed by the Governor in Council on the recommendation of the Minister responsible for the EP Act and reports directly to the Minister. The Commissioner and staff of the Office of the Commissioner (QMRC team) are dedicated to working collaboratively with all interested parties, including Aboriginal peoples and Torres Strait Islander peoples, industry, environmental and scientific groups, communities and government. See Appendix A for details on the administration of the QMRC team.

Our approach

The vision of the Commissioner and QMRC team is to *lead Queensland to achieve best practice in mined land rehabilitation*. We do this through four key strategies:

Connect

- Consult with stakeholders to raise awareness on technical, scientific and engagement matters.
- Synthesise stakeholder perspectives and best practice mine rehabilitation to optimise environmental, social and economic outcomes.

Research

- Identify rehabilitation priorities for Queensland.
- Produce advice informed by global best practice.
- Collaborate with stakeholders to undertake research.
- Identify opportunities and challenges to achieve leading practice mine rehabilitation by optimising environmental, social and economic outcomes.

Advise

- Provide advice to the Minister on mine rehabilitation and management practices, outcomes and policies.
- Provide advice to the Minister on public interest evaluation processes and performance.

Report

- Report annually to the Minister and Parliament on leading practice mine rehabilitation.
- Publish advice, reports and guidance.
- Report on rehabilitation performance and trends in Queensland.

2 Stakeholder engagement

The Commissioner and QMRC team have consulted with a broad range of stakeholders. In 2022–23, we held 132 consultation meetings with First Nations organisations, academia, professional associations, peak bodies, conservation stakeholders, resource companies, local governments and government agencies. We also visited 24 mine sites and wish to acknowledge the cooperation of the industry generally in affording access (only one mining company refused access to their sites).

Stakeholders expressed a wide range of views regarding progressive rehabilitation, closure planning and post-mining land uses. We will continue to engage with affected parties to better understand aspirations and perspectives to inform our advice and publications.

2.1. Local governments in resource communities

Engaging with local governments in resource communities has been a key focus in 2022–23. Local governments representing resource communities have unique perspectives on mine rehabilitation and the transformation of mining economies. In 2022–23, we engaged with the Isaac Regional Council and Central Highlands Regional Council, the two regional councils with the largest number of metallurgical and thermal coal mines in Queensland, to better understand their communities' priorities and perspectives on mine rehabilitation.

A recurrent theme through our engagement was that mine rehabilitation and closure need to be viewed holistically. Resource communities acknowledged that environmental factors are important but felt equal recognition and prioritisation of the socio-economic aspects of mine rehabilitation and closure are required. The economic transition of resource communities is a key priority of local governments, particularly with some major mines in these areas closing in coming decades. The QMRC team will continue to consult with local governments to better understand the viewpoints of resource communities.

2.2. Workshops and conferences

This year, we hosted and participated in technical workshops and conferences to inform stakeholders of our research on leading practice and raise awareness of rehabilitation and management matters.

We presented a conference paper at the Mine Closure 2022 conference, drawing on the findings of our native ecosystem rehabilitation work. The paper has been published on the QMRC website.[1] We also presented at the Cooperative Research Centre for

[1] https://www.qmrc.qld.gov.au/research/post-mining-land-uses/native-ecosystems

Transformations in Mining Communities Forum in Perth, to discuss opportunities for post-mining land use and leading practice rehabilitation.

The Commissioner presented to the World Renewable Energy Congress in December 2022, on the potential for utility-scale renewable energy generation as a post-mining land use. The paper has been submitted for publication in the *Renewable Energy and Environmental Sustainability* open access journal.

In February and March 2023, we hosted workshops on our native ecosystem rehabilitation and void modelling research. Six workshops were held in Brisbane and Emerald and on-line, attracting over 330 attendees. Participants were provided the opportunity to engage with the authors of the technical papers and understand the key learnings and recommendations of the work. Professionals from a variety of disciplines attended the sessions, including government officers, mine site personnel and consultants, sharing valuable insights to improve our research and guide future work programs.

We attended and presented at the World Mining Congress 2023. The Commissioner delivered a presentation on *More and better mine rehabilitation – lessons from Queensland*. The paper, published in the Proceedings of the World Mining Congress 2023, can be viewed on the QMRC website.[2]

[2] https://www.qmrc.qld.gov.au/research/other-publications

3 Research on leading practice

The QMRC team continues to conduct research on leading practices based on three main areas of focus:

- Post-mining land uses
- Final landforms
- Water management.

This year we commenced preparation of 'implications for leading practice' papers. The intent of these papers is to distil key findings published in technical papers, explore how the commissioned work can be incorporated into leading practices and identify outstanding matters which need further consideration. To assist stakeholders, we published guidance on how we determine leading practice on the QMRC website.[3]

Table 1 provides information and links to the papers referenced in this section.

Table 1. Key QMRC research topics

Research Topic	Contract Award Date	Partner	Status
Post-mining land uses			
Native ecosystem rehabilitation	4 March 2022	Aspect Ecology Pty Ltd	Delivered https://www.qmrc.qld.gov.au/research/post-mining-land-uses/native-ecosystems
Identifying post-mining land uses for residual voids	4 March 2022	Centre for Water in the Minerals Industry, Sustainable Minerals Institute, University of Queensland	Delivered https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0030/315849/leading-practice-approaches-select-pmlu-residual-mine-voids.pdf
Review of post-mining land uses for open-cut coal mine voids in Queensland	7 March 2022	Higher Degree Industry Placement student, Queensland University of Technology	Delivered https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0033/298590/review-open-cut-coal-mine-void-rehabilitation-planning-practices-Queensland.pdf

[3] https://www.qmrc.qld.gov.au/about/what-we-do/leading-practice-advice

Research Topic	Contract Award Date	Partner	Status
Grazing as a post-mining land use	28 March 2023	Highlands Environmental	First stage delivered.
Mapping biodiversity corridors and rehabilitation opportunities	2 March 2022	Centre for Mined Land Rehabilitation, Sustainable Minerals Institute, University of Queensland	Technical paper submitted.
Landform design			
Mine waste cover systems	12 January 2022	Okane Consultants	Technical papers submitted. Stakeholder engagement ongoing.
Water management			
Modelling residual void hydrology and water quality	27 January 2022	Australasian Groundwater and Environmental Consultants Pty Ltd and WRM Water and Environment	Delivered https://www.qmrc.qld.gov.au/research/water-management/modelling-residual-mine-voids
Water treatment options	26 July 2021	Higher Degree Industry Placement Student, University of Queensland	Delivered https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0040/285799/student-report-approaches-treat-coal-mine-affected-water-qld.pdf
Transition of water rights and infrastructure	(internal)	QMRC	Delivered https://www.qmrc.qld.gov.au/__data/assets/pdf_file/0028/290692/managing-water-during-and-after-mine-rehabilitation.pdf

3.1. Post-mining land uses

Successful rehabilitation ensures post-mining land uses (PMLUs) are achieved and can be sustained. A fundamental aspect underpinning the Progressive Rehabilitation and Closure (PRC) Plan framework is the appropriate selection of final land use within mining tenures.

Native ecosystem rehabilitation

We engaged Aspect Ecology Pty Ltd to prepare three technical papers evaluating options for native ecosystem rehabilitation on mine sites in Queensland. A conference paper on the

findings of this work was presented at the Mine Closure 2022 conference in Brisbane. The technical papers have been published on the QMRC website.

Several implications for leading practice were identified following completion of the technical papers. While restoration of the historical ecosystem is considered leading practice, more often an alternative ecosystem will be instated on these heavily disturbed landforms. Where rehabilitation to the historical ecosystem is not feasible, establishment of another regionally occurring ecosystem, more suited to the characteristics of the post-mine landscape, should become the rehabilitation objective.

Other types of ecosystems, described as hybrid and novel ecosystems, inherently involve greater uncertainty of ecosystem sustainability and resilience compared to rehabilitated natural ecosystems. Deployment of these ecosystems must be adequately justified and must not be used to 'lower the bar' on quality of ecosystem rehabilitation. Rehabilitation practices should focus on local species, with species combinations reflecting naturally occurring communities within the bioregion (where post-mining biophysical conditions allow). An ongoing challenge for the industry and regulators is the promotion of historical approaches as 'leading practices' which has resulted in a variety of rehabilitation outcomes and standards.

Identifying post-mining land uses for residual voids

We engaged the Centre for Water in the Minerals Industry (University of Queensland) and Quantified Strategies to describe leading practice approaches in identifying PMLUs for residual voids. Given most residual voids will host water of poor quality, maintaining suitable PMLUs can be challenging. This paper describes an approach for comparing potential uses for post-mining voids and provides a basis for justifying a preferred option. The paper has been published on the QMRC website.

The key implication of this leading practice approach is that PMLU options need to be considered during the mine planning process rather than as a subsequent step once mine plans are in place. Although this would be a departure from current industry practice, it provides a basis for considering the complex and interconnected aspects that influence the viability of a PMLU. Factors to consider include the shape and size of pits, mine scheduling, landform and void design, waste characteristics, and the water balance and water quality of residual voids. A multi-criteria analysis is recommended to compare the options and support the selection of a PMLU during mine planning. However, we acknowledge the challenges involved with comparing PMLU options to gain an accurate picture of the financial, social and environmental costs and benefits to multiple stakeholders over long timeframes.

We hosted a student from QUT to undertake a three-month higher degree industry placement. The student's project focused on identifying post-mining land uses for coal mine voids and considered the opportunities and challenges for their implementation. The student's project report has been published on the QMRC website.

Grazing as a post-mining land use

Grazing is the most common PMLU nominated by miners. For grazing to be successful within the post-mining landscape, the land must first be safe, stable and non-polluting. We engaged Highlands Environmental to provide advice on how to assess the suitability of post-mining land for grazing, considering the physical and chemical attributes of the rehabilitated land. The work focused on the northern Bowen Basin, host to the highest concentration of thermal and metallurgical coal mines in Queensland. The project clarified that only land rehabilitated to land suitability assessment classes 1–3 is suitable for beef cattle grazing as a PMLU.

Mapping biodiversity corridors and rehabilitation opportunities

Land disturbed by mining activities is often planned to be rehabilitated to native ecosystems. Linking native ecosystem rehabilitation areas in a coordinated way across multiple mine sites can create movement pathways (e.g., potential corridors) with greater net biodiversity benefit than a single rehabilitation area in isolation. We engaged the Centre for Mined Land Rehabilitation (University of Queensland) to assess the potential for mine rehabilitation areas in the Fitzroy Basin to connect high value ecosystems and enhance biodiversity. The centre has submitted its findings to an academic journal and it is expected to be published in the near future.

3.2. Landform design

Rehabilitating a site to support a PMLU requires a suitable final landform with long-term stability. Many factors influence a mine's final landform. These must be considered in the design and implementation phases to ensure the final landform can sustain the desired PMLU.

Mine waste cover systems

Last year we commenced investigations into the design of mine waste cover systems. This area of mine rehabilitation is a highly contested area of research and practice. Our initial work focused on geochemical stability. The design, construction and management of cover systems is multi-disciplinary and must consider landform stability, water management and vegetation establishment. There is a lack of robust, field-scale research trials of cover systems and little transparent data on the performance of these systems. The QMRC team

will continue to work with industry, academia and regulators to advance our leading practice knowledge.

3.3. Water management

There are many ways that mining can influence surface water and groundwater, during and after operation. Mine sites need to manage water appropriately to minimise long-term environmental risks and, where required, sustain a PMLU.

Modelling residual void hydrology and water quality

We engaged Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) and WRM Water and Environment (WRM) to develop leading practice approaches for modelling the water balance and water quality of residual voids. The technical papers have been published on the QMRC website.

The investigations identified several implications for leading practice. Rigorous modelling of groundwater and surface water interactions with the void, and the geochemistry of void waters over time, are essential for successful mine closure. This is especially important for open residual voids that will remain after closure. These must demonstrate they will remain a contaminant ‘sink’ in perpetuity and not contaminate the receiving environment. Voids should not impact adjacent groundwater and groundwater users. Water held in residual voids must be of sufficient quality to support a PMLU unless otherwise approved as a ‘non-use management area’. Applying the practices developed in these studies will provide a more consistent and transparent approach to modelling and reporting.

Water treatment

Water held in mine voids is often unsuitable for use unless it is treated. We hosted a higher degree industry placement student from the University of Queensland to review the scientific literature on water treatment technologies suited to the coal industry and develop a framework to identify, assess and compare water treatment options. The student’s project report has been published on the QMRC website.

Water rights

The transition of water rights and water infrastructure from the operational phase of mining to rehabilitation and closure can be complex. We prepared advice that describes the process for managing water assets during mine closure, including licensing, transfer of water rights and responsibility for ongoing management of water infrastructure. The technical brief has been published on the QMRC website.

4 Rehabilitation performance and trends

This section describes rehabilitation performance and trends for all mines subject to a PRC plan in Queensland. Appendix B – Sectoral groupings of mines used in this report explains the prioritisation and grouping of different sectors of the mining industry for the purpose of performance reporting in this document.

We used calendar year (CY) annual return data (provided by companies to the Department of Environment and Science by 31 March each year) to analyse progressive rehabilitation and area of disturbance. Where available, we also used financial year data and 'effective date' data to provide the most up-to-date analysis possible. Our analysis included land reported by companies in the annual return as 'rehabilitation certified' or 'rehabilitation completed'. We excluded land reported as 'rehabilitation commenced' as the interpretation of rehabilitation commenced differs widely across the industry. Our analysis relied on the accuracy of the data provided by companies in their annual returns.

Our analysis in this year's report was expanded to provide greater insight into the rehabilitation performance and trends in the state. To do this, we used publicly available data on the dates that mines commenced, planned to cease operations or had ceased operations.

Challenges in measuring rehabilitation performance

As we stated last year, establishing definitive performance measures and sector-wide trends in mine rehabilitation is challenging. Every operation has site-specific factors affecting the type and rate of rehabilitation, such as mining method, age, site configuration and spoil disposal method. The quality and durability of rehabilitation is also influenced by external factors, such as weather, availability of topsoil and economic conditions. Technology, commodity prices and other factors heavily influence the commercial viability of extracting resources, which can change rapidly, sometimes meaning today's wastes can become tomorrow's resource.

Shallow strip mining and open cut highwall methods remain best suited to progressive rehabilitation—land becomes available for rehabilitation as the working face of the mine moves across the landscape. By contrast, deep open cut and underground base and precious metals mines are less suited to progressive rehabilitation and present a different set of challenges for assessing performance and trends. Usually, waste rock dumps (WRD), tailing storage facilities (TSF), heap leach pads (HLP) and the active mine itself are unsuitable for rehabilitation during the mine's life (although old mine features or distinct unused areas may be suitable for progressive rehabilitation).

Industry feedback highlighted the potential shortcomings of ‘rehabilitation against disturbance’ as a performance measure, given the challenges raised by the term ‘…as land becomes available…’ as outlined in section 126D the *Environmental Protection Act 1994.* For example, an exhausted pit, now void, may remain open for a number of years due to the sequencing of operations. However, after such time, the void may be used for tailings disposal. In-pit disposal of waste materials is a leading practice but is not reflected in progressive rehabilitation reporting until the infill ceases and the landform is rehabilitated. New technologies, regulatory requirements and commercial and economic drivers influence rehabilitation decisions. Much fixed infrastructure is also required until the end of the mine’s operational life.

Our approach

For the purpose of this report, we allocated the 200 Queensland mines subject to PRC plan requirements (as at 30 June 2023) into sectoral groupings:

- metallurgical and thermal coal mining
- large-scale strip mining other than coal (for example, bauxite, phosphate, silica and mineral sand)
- base and precious metals operations
- smaller strip operations (for example, monument stone and clays).

These groupings are the same as in last year’s QMRC report. See Appendix B – Sectoral groupings of mines used in this report for details on the groupings used and section 4.6 for the status of PRC plans as of 30 June 2023.

The primary focus of this report remains on large-scale mining operations that are required to prepare PRC plans. Such operations have been identified as the highest priority for reporting on trends and performance in progressive rehabilitation. Other mining activities have a smaller land disturbance footprint and present a much lower potential environmental impact. As such, smaller strip operations, small mining claims, seismic lines and other exploration activities are not a priority for evaluation in this report. While we continue to include large scale metals mines in this year’s report, our analysis was limited in comparison to large scale strip mines due to the nature of their operations and limited ability to undertake progressive rehabilitation.

The results of our analysis are presented as ‘waterfall’ graphs for each sectoral grouping. Historical disturbance up to the end of CY2019 was used as the starting point, calculated as the total disturbance companies reported up to the end of CY2019. Annual data for disturbance and rehabilitation is then presented for CY2020, CY2021 and CY2022 as well as net level of disturbance. The 31 sites described as ‘other resource activities’ subject to PRC

plan requirements are included in the total rehabilitation analysis (Figure 2) but not presented as a separate grouping.

The calculated figures for historical rehabilitation and disturbance (total net disturbance to end 2019, and rehabilitation and disturbance figures for CY2020 and CY2021) have changed from our 2021–22 report. We have changed our calculation methodology to account for some instances of rehabilitation and disturbances being reported in different years and some double counting. To end CY2019, total net disturbance reported was 4.6 percent higher under the new methodology than in the 2021–22 report, and coal disturbance reported was 4.9 percent higher than in the 2021–22 report.

We continued to identify a small number of discrepancies in annual reporting and refer anomalies back to the regulator for checking with the reporting entities. The discrepancies were not identified by the independent auditor in last year's report. The number of mines subject to PRC plan requirements also changed year-on-year, as new mines commenced and other mines fell out of the PRC plan framework.

4.1. Industry-wide

We analysed the 200 mines across the sector subject to PRC plan requirements. The most recent data shows there continues to be consistent growth across the mining sector in outstanding rehabilitation liability.

Figure 1 shows the trend of increasing estimated rehabilitation cost (ERC) over the last 30 years. The trend figures are indicative only, as the consistency and rigour of the data points have varied over time. Despite this, the figure does provide an indication of the trend in rehabilitation liability over the period.

Several factors explain the change in ERC:

- Area of disturbance—the area of land disturbed by mining yet to be rehabilitated has increased year-on-year (see Figure 2).
- Number and type of mine waste structures—more complex waste structures, such as metalliferous tailings storage facilities, carry a greater ERC than more benign mine-affected lands.
- Area of rehabilitated land—certified rehabilitation of mined land removes areas from the ERC calculation.
- Schedules of rates—the cost of rehabilitation is subject to market forces and inflation.
- Change in liability calculators—the sector's transition from the previous financial assurance system to one based on ERC has removed the discount system, introduced a contingency provision and updated unit costings.

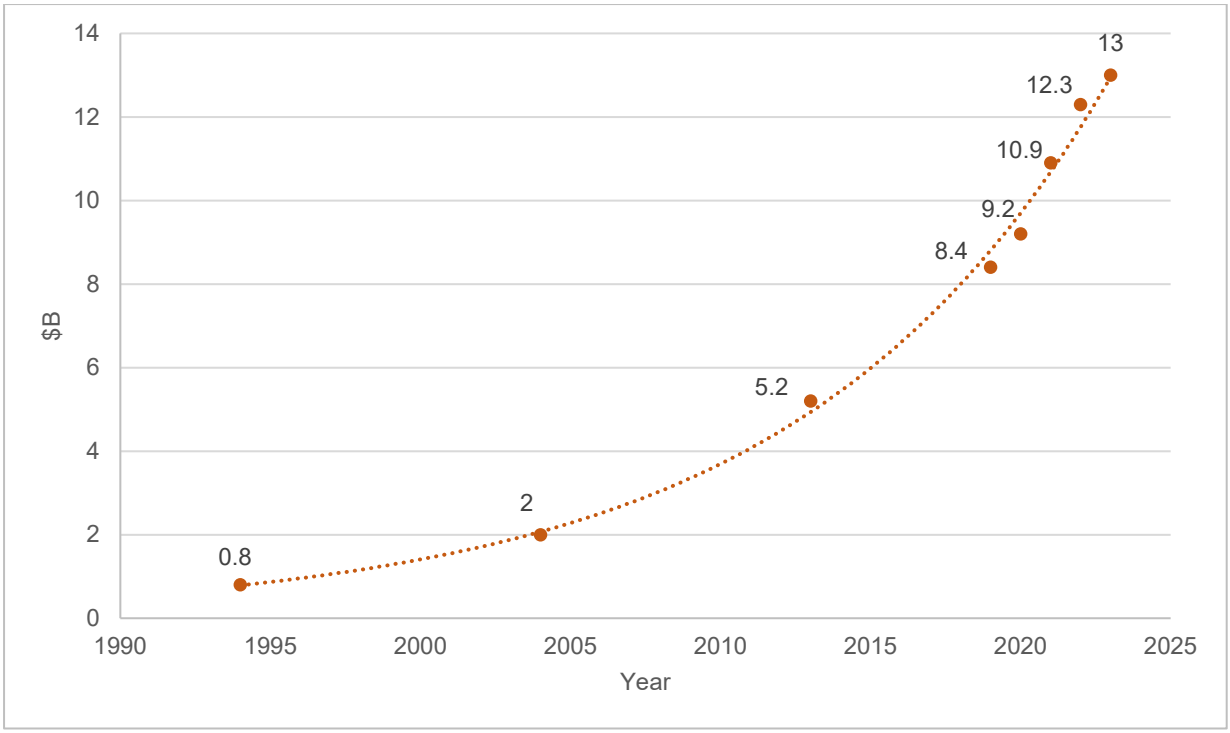

Figure 1. Industry-wide ERC liability (estimated) in Queensland 1994–2023

Figure 2 shows the industry's cumulative areas of disturbance (shown as Dist. in the graphs) and rehabilitation (shown as Rehab. in the graphs) to the end of CY2022, from data provided by companies in their annual returns.

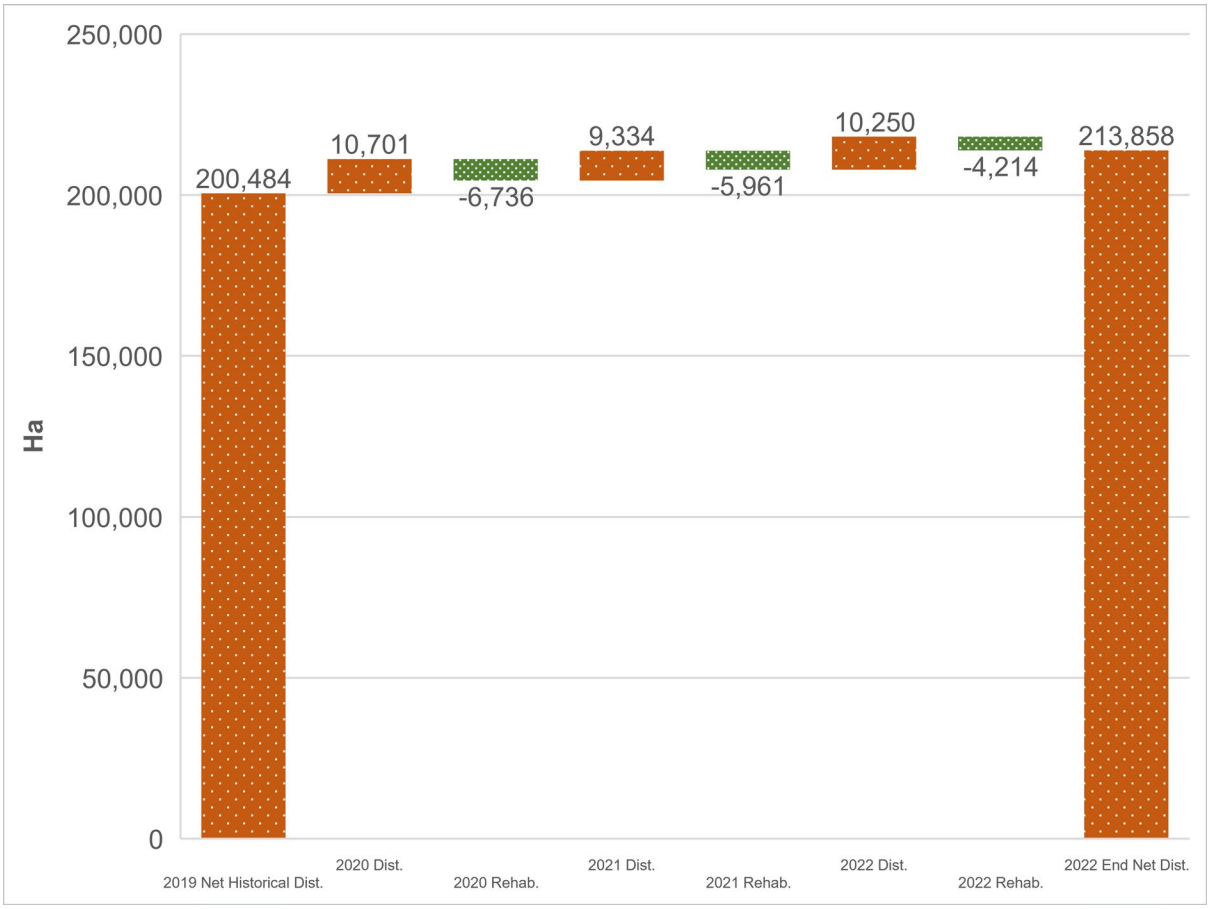

Figure 2. Progressive rehabilitation for all mines required to prepare a PRC plan

Figure 2 shows the total net disturbance remaining after rehabilitation at the end of CY2022 was 213,858 hectares. This is an increase of 13,374 hectares (6.7 percent) since 2019. Total reported rehabilitation (historically to the end of 2022) for all mines required to prepare a PRC plan is 82,361 hectares and total disturbance for the same period is 296,219 hectares. The percentage of land reported as rehabilitated to that disturbed is 28 percent.

Figure 3 shows the industry's total rehabilitation by land that is 'rehabilitation certified' and land reported by miners as 'rehabilitation completed' (not certified).

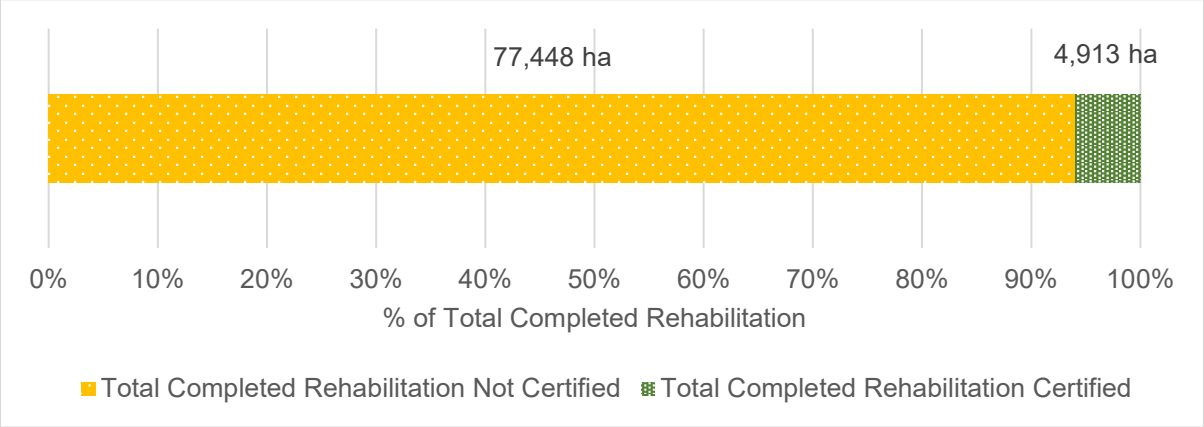

Figure 3. Completed rehabilitation and certified rehabilitation for all mines required to prepare a PRC plan

Figure 3 shows that of the 82,361 hectares of total rehabilitation (historically to the end of 2022), 4,913 hectares is certified (6 per cent) and 77,448 hectares is reported by miners as completed but not certified. Certified rehabilitated land represents less than 2 percent of all land disturbed. Of the total area of certified rehabilitation, 34 percent relates to underground mining operations and 66 percent relates to above ground mining operations.

4.2. Metallurgical and thermal coal

We analysed 88 mines and related infrastructure that extract metallurgical and thermal coal and are subject to PRC plan requirements. Figure 4 shows the cumulative areas of disturbance and rehabilitation to the end of CY2022, from data provided by companies in their annual returns. Open cut and underground operations are both included, as some mines have a combination of methods operating simultaneously.

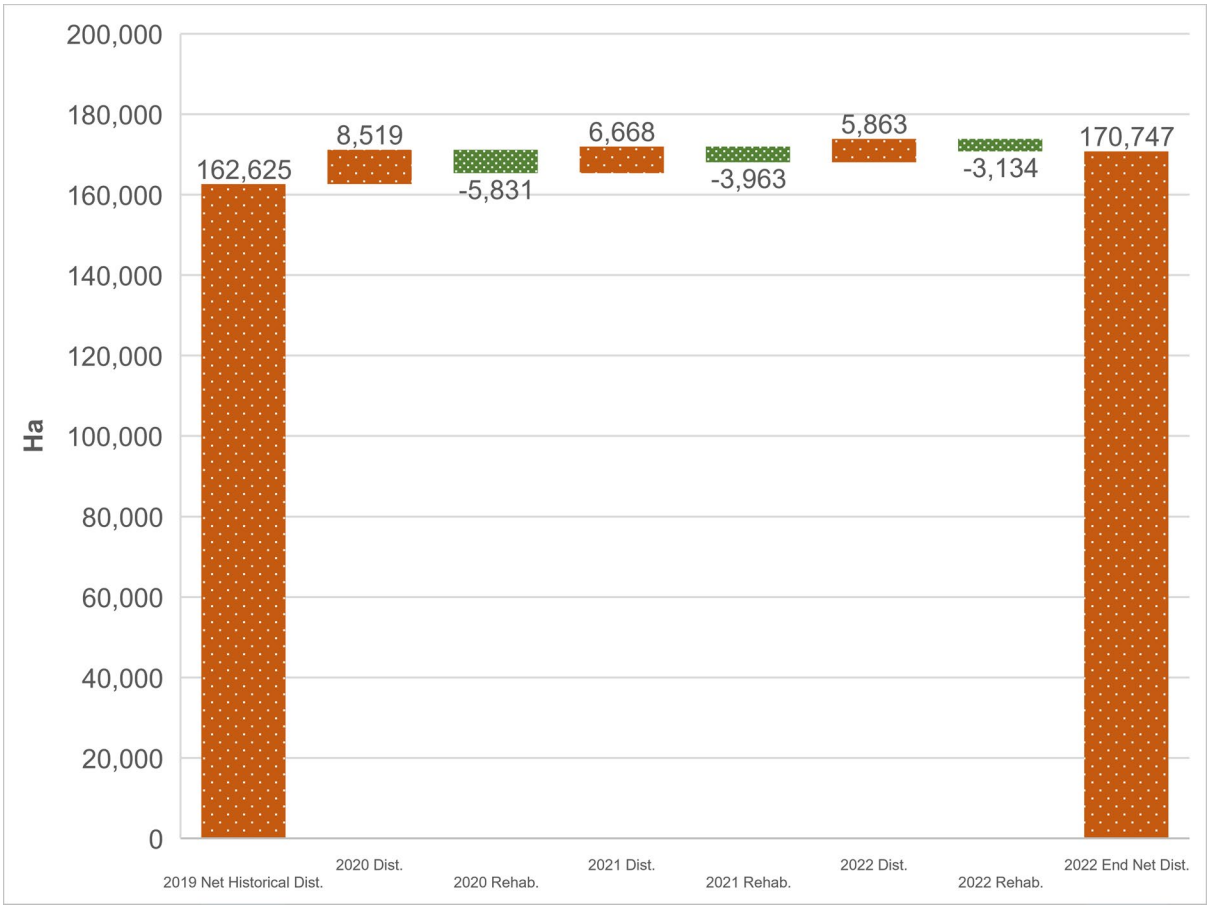

Figure 4. Progressive rehabilitation for metallurgical and thermal coal mines

Figure 4 shows net disturbance remaining after rehabilitation between 2019 and 2022 has increased by 8,122 hectares to 170,747 hectares. Total reported rehabilitation (historically to the end of 2022) is 52,175 hectares and total disturbance for the same period is 222,922 hectares. The percentage of land reported as rehabilitated to that disturbed is 23 percent.

Of the 88 facilities extracting metallurgical and thermal coal that we analysed, 58 mines primarily extract metallurgical coal and 30 mines primarily extract thermal coal. Some mines extract both metallurgical and thermal coal, and these were grouped based on the predominant coal type extracted. Given metallurgical and thermal coal mines account for 80 percent of total land disturbance, we undertook additional analysis of this sector below.

Comparing metallurgical and thermal coal mine rates of rehabilitation

Figure 5 plots the amount of land reported as disturbed and rehabilitated to the end CY2022 for metallurgical and thermal coal mine sites requiring PRC plans. The dashed lines represent the percentage of land rehabilitated to that disturbed for the two coal mine types - metallurgical and thermal.

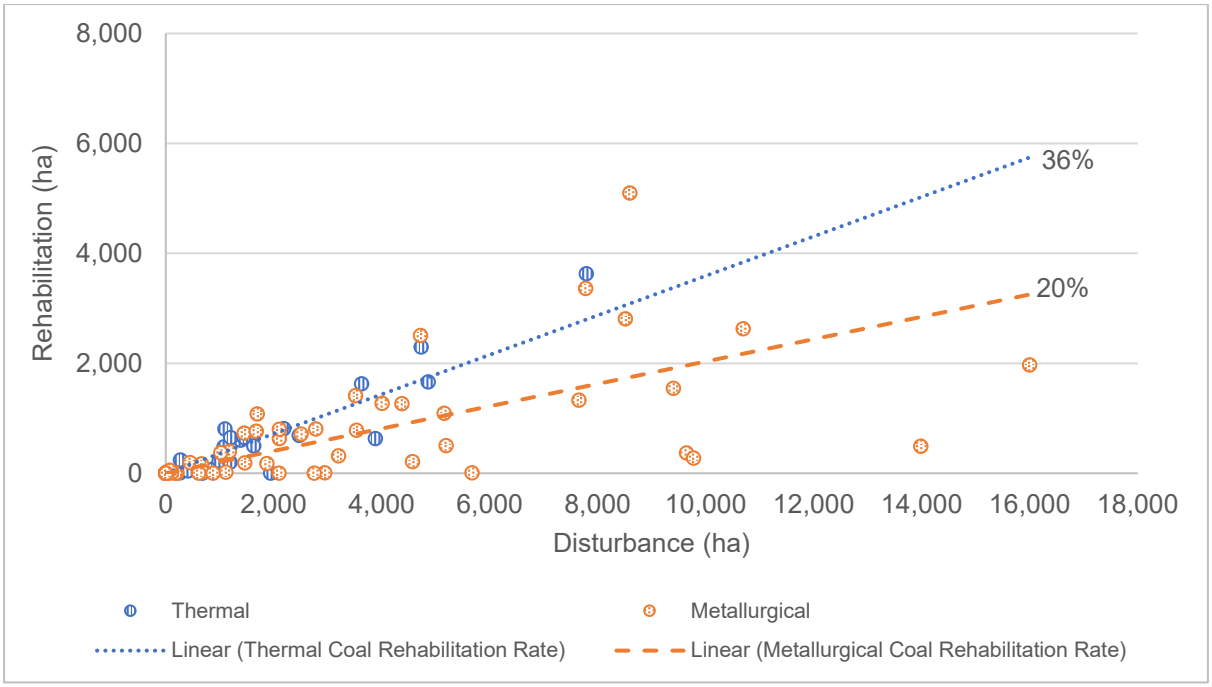

Figure 5. Scatter graph of rehabilitation to disturbance for all metallurgical and thermal coal sites subject to PRC plan requirements

Figure 5 shows that the percentage of rehabilitated land to disturbed land for metallurgical coal mines is 20 percent and for thermal coal mines is 36 percent. For metallurgical coal mines, total reported rehabilitation (historically to the end of 2022) is 36,370 hectares and total disturbance for the same period is 178,909 hectares. For thermal coal mines, total reported rehabilitation (historically to the end of 2022) is 15,805 hectares and total disturbance for the same period is 44,012 hectares.

Metallurgical and thermal coal mine rehabilitation rates by mine life cycle stage

To provide more detailed insights into rehabilitation and disturbance trends for metallurgical and thermal coal mines, we incorporated estimated production life for each mine into our analysis. Table 2 describes the groupings and number of metallurgical and thermal coal mines we examined, by quartile of estimated production life at the end of CY2022.

Table 2. Groupings of metallurgical and thermal coal mines by quartile of estimated production life

Groupings / number of mines	Description
1st Quartile of Production Life (7 mines)	Metallurgical and thermal coal mines that are >0 percent and ≤25 percent of the way through their estimated production life at end of CY2022.
2nd Quartile of Production Life (16 mines)	Metallurgical and thermal coal mines that are >25 percent and ≤50 percent of the way through their estimated production life at end of CY2022.
3rd Quartile of Production Life (25 mines)	Metallurgical and thermal coal mines that are >50 percent and ≤75 percent of the way through their estimated production life at end of CY2022.
4th Quartile of Production Life (15 mines)	Metallurgical and thermal coal mines that are >75 percent and <100 percent of the way through their estimated production life at end of CY2022.
Finished Production (4 mines)	Metallurgical and thermal coal mines that have finished production at end of CY2022.
Note: Of the 88 metallurgical and thermal coal mines analysed, production life information was not available or mines have not commenced operations for 21 sites, and therefore were not included in this analysis.	

Figure 6 plots the amount of land reported as disturbed and rehabilitated to the end CY2022 for coal mine sites required to produce a PRC plan for different stages of the mine's production life. The dashed lines represent the percentage of land rehabilitated to that disturbed for each production life quartile.

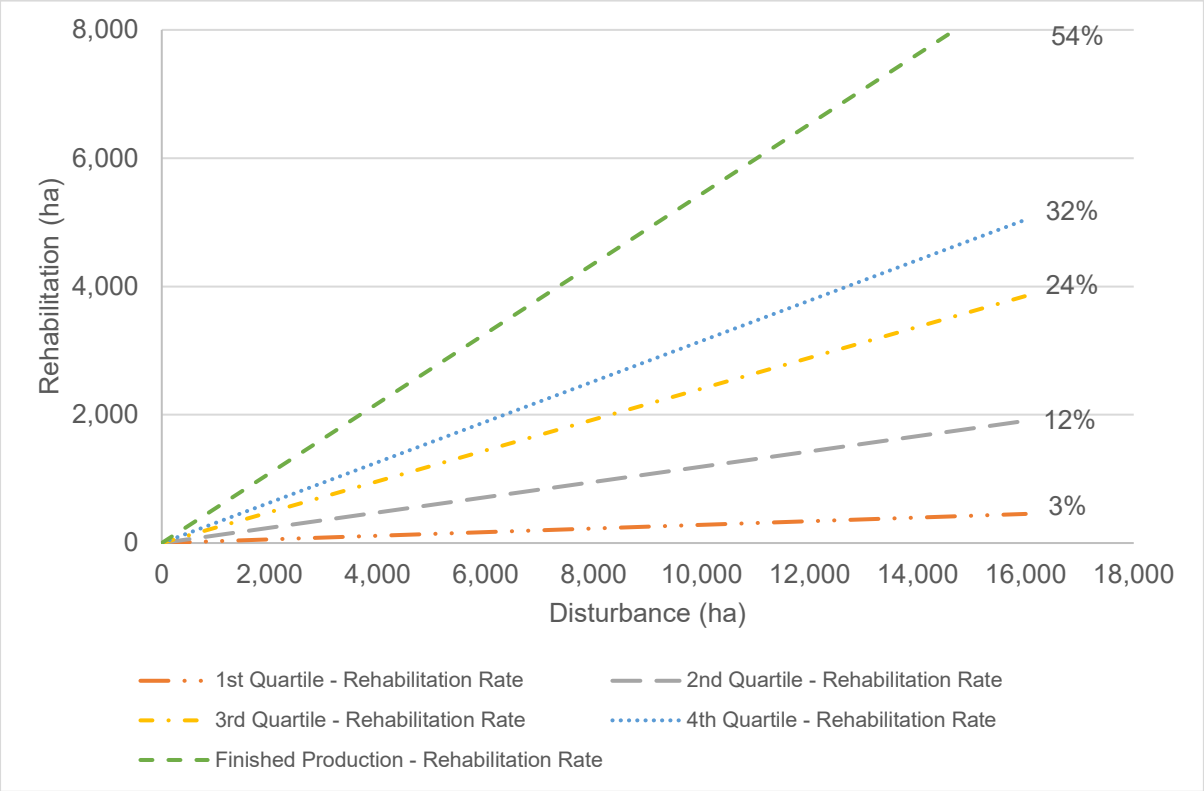

Figure 6. Line graph of rehabilitation to disturbance for all coal sites subject to PRC plan requirements at different quartiles of estimated production life

Figure 7 shows the data for coal mines at different quartiles of estimated production life and those finished production. This includes total reported historical rehabilitation to end of 2022 (shown as 'Total Rehabilitation'), net disturbance remaining at the end of 2022 (shown as 'Net Disturbance'), and the amount and percentage of land reported as rehabilitated to the total area of land disturbed to the end of 2022.

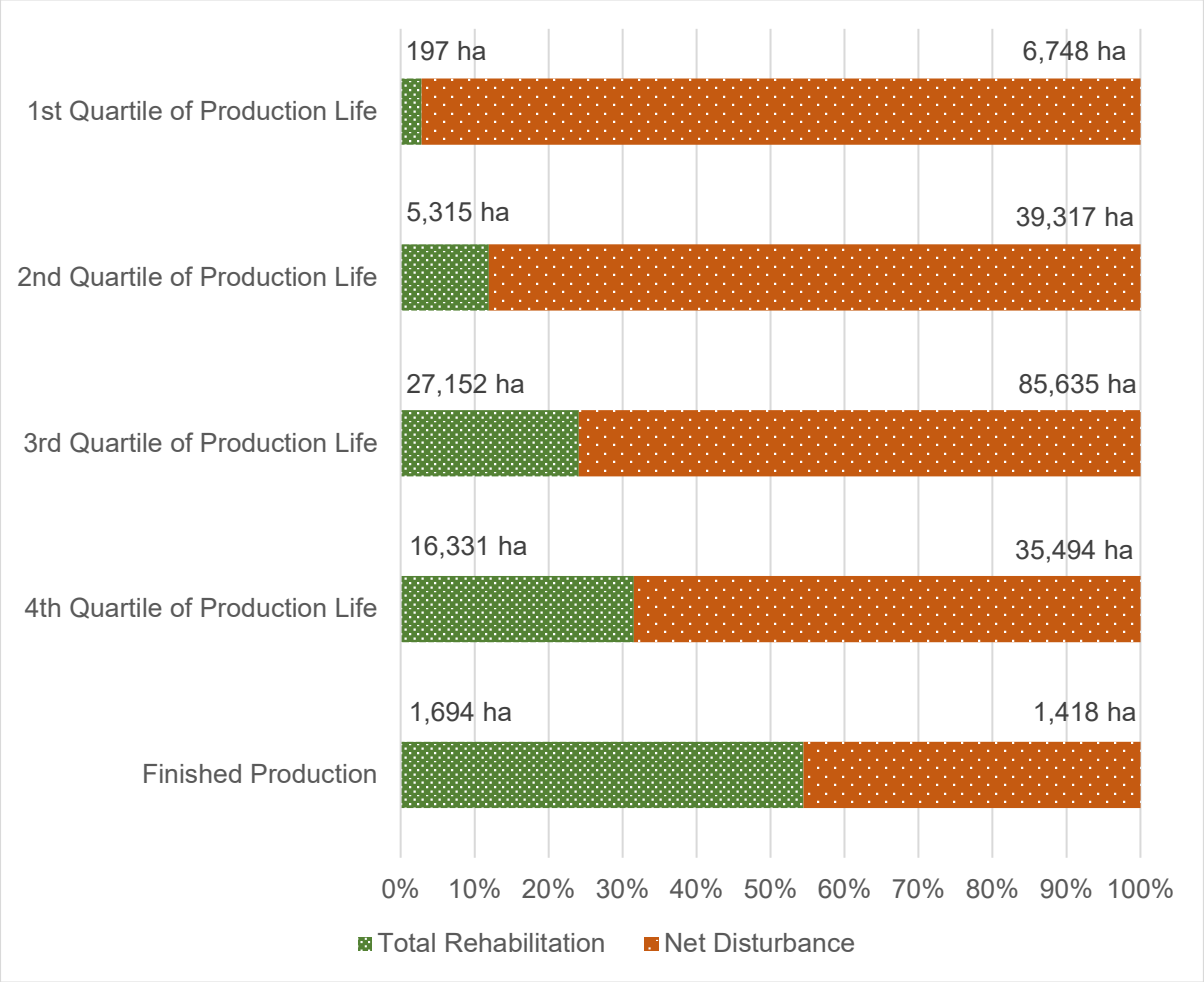

Figure 7. Rehabilitation and disturbance statistics for metallurgical and thermal coal mines of different quartiles of estimated production life

Figure 7 shows that the percentage of land reported as rehabilitated to that disturbed for coal mines in the 1st quartile of production life is 3 percent, for those in the 2nd quartile is 12 percent, for those in the 3rd quartile is 24 percent, for those in the 4th quartile is 32 percent and for coal mines that have finished production is 54 percent.

4.3. Large-scale strip mining (other than coal)

We analysed 18 mines extracting bauxite, phosphate, silica and mineral sands. Figure 8 shows the cumulative areas of disturbance and rehabilitation to the end of CY2022, from data provided by companies in their annual returns.

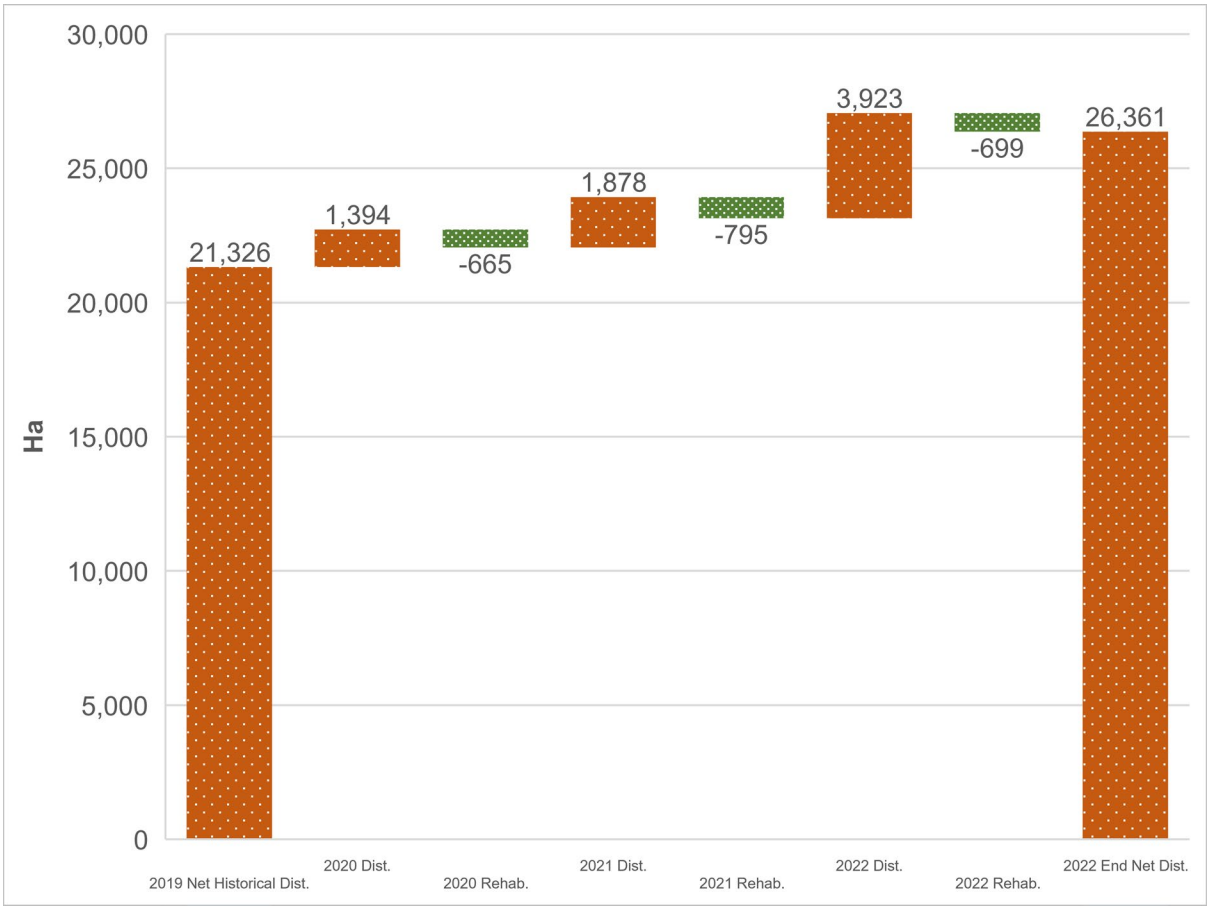

Figure 8. Progressive rehabilitation – bauxite, phosphate, silica and mineral sand

Figure 8 shows net disturbance remaining after rehabilitation between 2019 and 2022 has increased by 5,035 hectares to 26,361 hectares. Total reported rehabilitation (historically to the end of 2022) is 24,211 hectares and total disturbance for the same period is 50,572 hectares. The percentage of land reported as rehabilitated to that disturbed (historically to the end of 2022) is 48 percent.

4.4. Base and precious metals

We analysed 63 mines extracting base and precious metals. Figure 9 shows the cumulative areas of disturbance and rehabilitation to the end of CY2022, from data provided by companies in their annual returns.

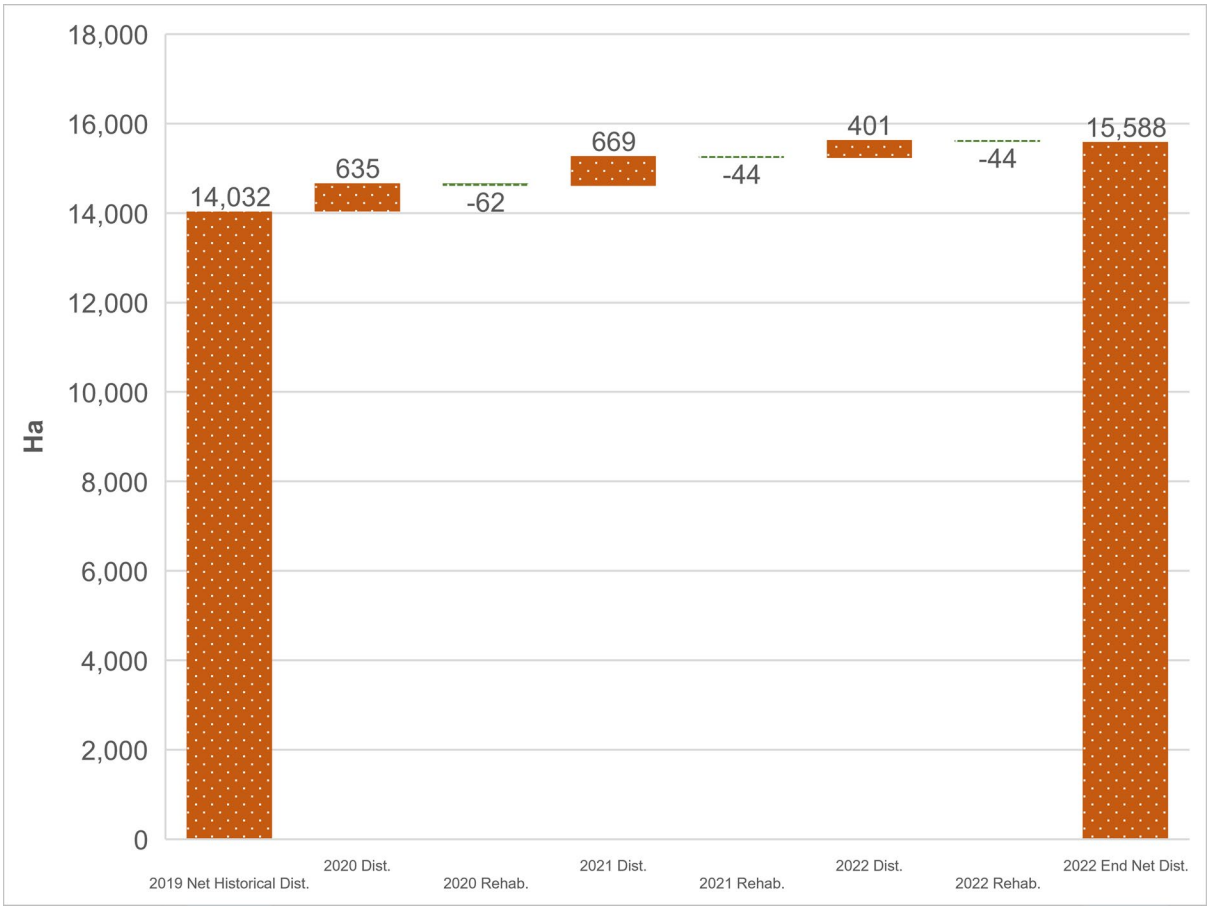

Figure 9. Progressive rehabilitation – base and precious metals

Figure 9 shows net disturbance remaining after rehabilitation between 2019 and 2022 has increased by 1,556 hectares to 15,588 hectares. Total reported rehabilitation (historically to the end of 2022) is 3,119 hectares and total disturbance for the same period is 18,707 hectares. The percentage of land reported as rehabilitated to that disturbed is 17 percent.

Base and precious metals – mine waste structure rehabilitation planning

Providing meaningful reporting on progressive rehabilitation trends for metals mining operations is challenging due to the nature of the operations (for example, metals mines typically operate within a fixed disturbance footprint). After consulting with stakeholders, we decided to investigate alternative measures of rehabilitation performance and closure preparedness for this sector.

Although base and precious metals operations possess a smaller disturbance footprint than that of strip mining operations, metals mines still face rehabilitation and closure challenges. Rehabilitating mine waste structures including TSFs, WRDs and HLPs is a critical challenge for the sector. Effective planning and management of these structures is key to preventing impacts on the surrounding environment and is therefore critical to the effective rehabilitation and closure of metals mines.

We analysed each of the 63 metals mines across Queensland required to prepare a PRC plan, to assess the readiness of base and precious metals operations to rehabilitate and close their mine waste structures. First, we determined whether mine waste structures were present on site. If so, we identified whether the operation had current documentation on the rehabilitation and closure of the structures.

For the purposes of this analysis, a ‘mine waste structure’ included TSFs, WRDs and HLPs. We acknowledge there are other types of structures holding mine wastes on some mines. Our analysis was limited to the presence or absence of a current rehabilitation or closure planning document related to the structures and did not assess the quality of the planning documentation.

Our analysis found that of the 63 base and precious metals mines we analysed, 55 operations had mine waste structures on site. Of those 55 operations, we identified 50 operations as having current planning documentation on the rehabilitation and closure of the mine waste structures. The source and format of this planning documentation varied across the 50 operations: four operations had their planning in an approved PRC plan, 18 operations had their planning in a PRC plan application and the remaining 28 operations had planning documentation in a format other than an approved PRC plan or PRC plan application (including Post Mining Land Use Plans, Final Land Use Rehabilitation Plans and Waste Rock and Tailings Disposal Management Plans).

We will continue to engage with metals mining entities and content experts to refine our approach on the best way to assess rehabilitation trends in this sector.

4.5. Other resource activities

A total of 31 of the 200 mines subject to PRC plan requirements fall into the ‘other resource activities’ grouping. These mine commodities such as bentonite, limestone, sandstone and clays. Mines in this grouping have not been assessed for progressive rehabilitation trends or performance, other than as part of the whole-of-industry analysis depicted in Figure 2. As outlined above, the primary focus of this report is large-scale mining operations, which have been identified as the highest priority sites for more and better rehabilitation.

4.6. Progressive Rehabilitation and Closure Plans

Of the 200 mines required to produce a PRC plan, 197 were existing mines that are transitioning into the PRC plan framework. As there are still 175 sites without an approved PRC plan, it remains difficult to assess the impact of the framework on progressive rehabilitation at an industry level. As more PRC plans are submitted and approved over coming years, a better understanding of the industry’s rehabilitation progress and life-of-mine profile will emerge.

Figure 10 shows the PRC plan status of the 200 mines required to produce a PRC plan.

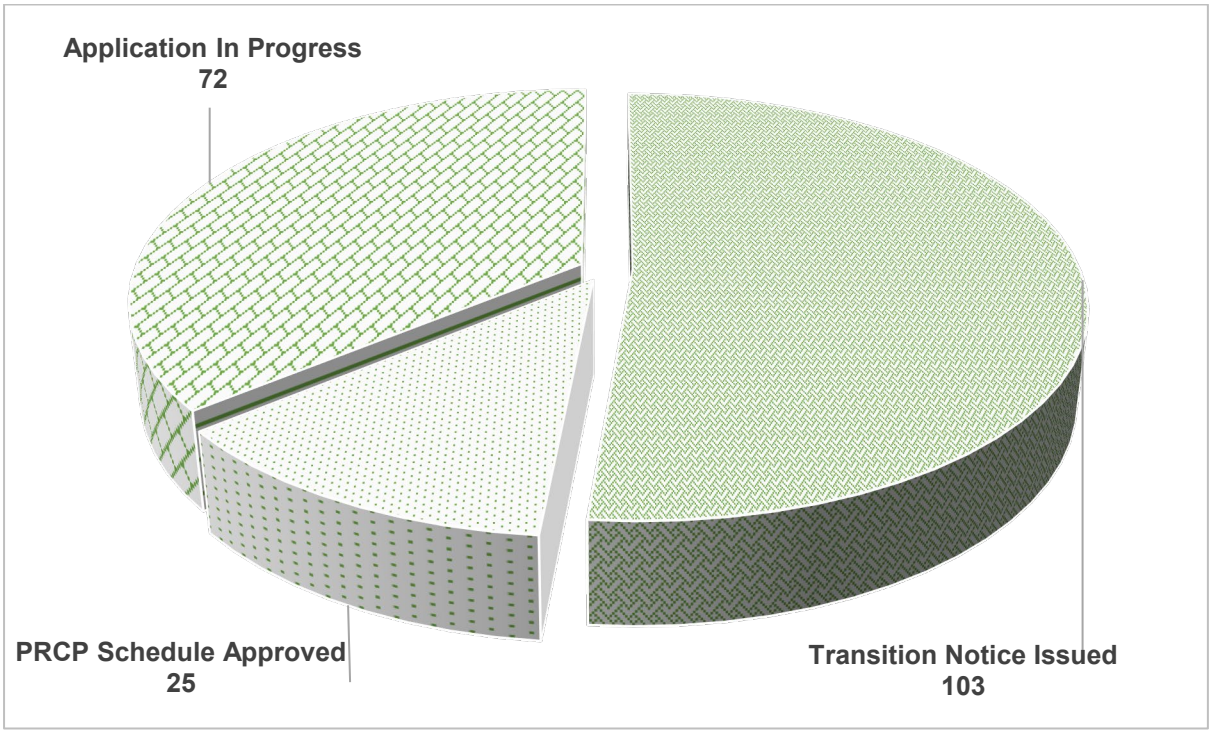

Figure 10. Status of PRC plan delivery as at 30 June 2023

4.7. Public interest evaluations

The Commissioner is required (under s444I of the EP Act) to provide the Minister with advice on public interest evaluation processes and performance. To date, no public interest evaluations have been submitted to the administering authority. Should public interest evaluations be submitted in future, the Commissioner will assess the process and performance as required.

4.8. Petroleum

As previously discussed, this report focuses primarily on large-scale mining operations that are required to prepare and submit PRC plans. However, the QMRC team recognises the value of reporting on, and providing insights into, rehabilitation trends and opportunities for the petroleum and gas sector. We are proposing to examine the decommissioning of expired wells, rehabilitation of well pads and other surface disturbance, and management of brine ponds, as they are important rehabilitation activities for the sector. This analysis will be included in future QMRC reports and work will be informed by planned visits to Queensland's oil and gas fields.

5 Looking forward

We are looking to expand our research program with projects that focus on final landform stability and cover system designs. We are also commencing work to review practices to conserve soil and address topsoil deficits. A student from the University of Queensland will be undertaking a three-month higher degree industry placement to undertake a review of current practices on this topic. We will collaborate with an industry expert to prepare leading practice advice on modelling final mine waste landforms in Queensland. Highlands Environmental will complete the second phase of their project to deliver practical advice on property management planning, which describes how grazing rehabilitated mined land should be managed after mining. As part of a larger body of work related to grazing as a PMLU, we are reviewing rehabilitation planning practices for grazing more broadly to assist with further advice on leading practices.

Upon completion of technical projects, we will continue to consider feedback from relevant stakeholders as we develop papers on the implications for leading practice. We will also host workshops to provide our stakeholders with opportunities to engage with the authors of the technical papers and discuss the key learnings and recommendations of the work.

Appendix A – Administration

Corporate support

The Department of Environment and Science (DES) provided support for the establishment of the Better Rehabilitation Team in June 2020, which became the QMRC in October 2021. This included the secondment of five staff, as well as financial and human resources support. DES continues to provide corporate support to the QMRC.

Human rights

The Commissioner and the QMRC team carry out their role with appropriate consideration of human rights under the *Human Rights Act 2019*, including recognising the unique interests of First Nations peoples. As per section 6 of the EP Act, we consult with, and have regard to, the views and interests of First Nations peoples under tradition and custom.

Integrity Act 2009

The Commissioner is undertaking a higher degree by research program at the University of Queensland. Professor Neville Plint, former Director of the Sustainable Minerals Institute, University of Queensland is the degree supervisor. The Commissioner is involved with the Cooperative Research Centre for Transformations in Mining Economies through those studies.

Directions from the Minister

No directions from the Minister were provided in 2022–23.

Appendix B – Sectoral groupings of mines used in this report

Groupings / number of mines	Description	Example Commodity
Metallurgical and thermal coal (88 mines)	Major coal operations that predominantly mine in a horizontal direction (i.e. shallow deposit or pre-strip operations) such that land can be rehabilitated progressively. Underground coal mines are included as several mines use both open cut and underground workings.	Hard coking coal, pulverised coal for injection (PCI), thermal coal
Base and precious metals (63 mines)	Major operations that predominantly mine in a vertical direction such that land cannot be as readily rehabilitated progressively.	Copper, gold, lead, silver, zinc
Other large-scale strip mining (18 mines)	Major operations that predominantly mine in a horizontal direction (i.e. shallow deposit or pre-strip operations) such that land can be rehabilitated progressively.	Bauxite, phosphate, silica and mineral sands
Other resource activities (31 mines)	Medium/major operations that do not fit into the groupings above. Typically, these operations are bespoke and may progress horizontally, vertically or both.	Clay, bentonite, limestone, sandstone
Note: We grouped operations with multiple commodities or mining styles to best reflect their context (for example, coal infrastructure leases were allocated to the ‘metallurgical and thermal coal’ group).		

Appendix C – Glossary

AGE	Australasian Groundwater and Environmental Consultants Pty
AMD	Acid or metalliferous drainage
Commissioner	Queensland Mine Rehabilitation Commissioner
CY	Calendar year
DES	Department of Environment and Science
Dist.	Disturbance
EHP	Department of Environment and Heritage Protection
EP Act	*The Environmental Protection Act 1994*
ERC	Estimated rehabilitation cost
Ha	Hectare
HLP	Heap leach pad
ICMM	International Council on Mining and Metals
MERFP Act	The *Mineral and Energy Resources (Financial Provisioning) Act 2018*
Minister	Minister for the Environment and the Great Barrier Reef and Minister for Science and Multicultural Affairs
PMLU	Post-mining land use
PRC plan	Progressive Rehabilitation and Closure Plan
Resources sector	Mining, petroleum and gas activities (excludes quarries)
QMRC	Queensland Mine Rehabilitation Commissioner
QMRC Team	The Commissioner and staff of the Office of the Commissioner
QRC	Queensland Resources Council
Rehab.	Rehabilitation
TSF	Tailings storage facility
WRD	Waste rock dump
WRM	WRM Water and Environment