

9.0 Rehabilitation and closure

9.1 Introduction

This chapter discusses the rehabilitation and closure requirements proposed for the Ensham Life of Mine Extension Project (hereafter referred to as ‘the Project’). It should be noted that the rehabilitation of the mining disturbance within the existing seven mining leases which includes the current underground mine, the open cut mine and associated surface infrastructure has been previously approved in the Ensham Mine EA EPML00732813 and will not be changed by or as a result of the Project.

Environmental objectives and outcomes

The Project seeks to protect environmental values in the Project Site relating to land use. Predominant land uses within the wider region include cropping, grazing and resource activities. The Project Site comprises nine registered land parcels, waterways, with fringing riparian vegetation. There will be a need for disturbance associated with exploration activities in zones 1, 2 and 3. Exploration activities in Zone 1 are covered under Environmental Authority MIN 104395712. Exploration in Zones 2 and 3 is covered under the current Environmental Authority EAML 00732813. All disturbance associated with exploration activities will be rehabilitated in accordance with the respective existing environmental authorities. Four flares will be established in Zone 2 (non PAA/SCA mapped land) and Zone 3 and will generate minor disturbance. Establishment of flaring infrastructure would be located in already disturbed areas so as to not require any vegetation clearing in either Zone 2 or Zone 3.

Surface Land use within Zone 1 of the Project Site would remain as agriculture throughout the life of the Project and post mining. The post mine land use for land in Zone 2 and Zone 3 will be returned to cattle grazing consistent with Appendix 3 of the existing Environmental Authority.

Subsidence from bord and pillar operations, if it were to occur, is predicted to be negligible based on the Project Subsidence Report (Gordon Geotechniques, 2020), lidar survey data, and visual inspections of land located above currently mined bord and pillar areas.

Waste rock from the CHP will be placed into Pit C and Pit D. The quantity of rock has been quantified in **Chapter 8** (Land resources) to occupy 0.6% of the overall volume of overburden material to be placed in pits C and D for rehabilitation purposes and therefore will be consistent with and have a negligible impact on the approved rehabilitated final landform including the height of water in the final voids. Spoil has been characterised as non-acid forming (NAF) and the risk of acid mine drainage is negligible. Metals/metalloids are sparingly soluble from spoil materials and low concentrations of dissolved metals/metalloids are expected to be generated from these materials (RGS, 2021).

Ensham Mine currently manages impacts to land in accordance with Environmental Authority (EA) conditions in Schedule G & H of EA EPML00732813. Existing management measures at Ensham Mine include returning mining areas into safe, stable and non-polluting landforms (H4), removal of infrastructure on cessation of mining (H12 and H14) and monitoring of rehabilitation against success criteria (H4).

Potential impacts to land use are not considered to be significant for this Project and therefore rehabilitation and closure is not considered a critical matter in the environmental impact statement (EIS).

9.2 Closure planning

Closure planning for the Project has been undertaken having consideration for the requirements of the Mine Land Rehabilitation Policy, the *Environmental Protection Act 1994* (Qld) and the PRCP Guideline which includes the rehabilitation hierarchy¹.

9.2.1 Rehabilitation hierarchy

The strategies listed higher in the hierarchy should be adopted in preference to those listed lower, unless there are significant environmental, economic or social issues that override such a selection. The rehabilitation hierarchy, in order of decreasing capacity to prevent or minimise environmental harm, is as follows:

1. Avoid disturbance that will require rehabilitation
2. Reinstatement a “natural” ecosystem as similar as possible to the original ecosystem
3. Develop an alternative outcome with a higher economic value than the previous land use
4. Reinstatement previous land use
5. Develop lower value land use
6. Leave the site in an unusable condition or with a potential to generate future pollution or adversely affect environmental values.

The approach adopted by Ensham is to avoid any additional surface disturbance to Zone 1 thus allowing existing agricultural activities to continue while underground mining occurs. There will be need for flaring infrastructure in Zone 2 and Zone 3 (**Figure 4-3, Chapter 4** (Project description and alternatives)). This will allow coal seam gas pre-drainage from the underground workings to occur. Flaring in Zone 2 will be located on non-Strategic Cropping Area (SCA) and Priority Agricultural Area (PAA) which is largely disturbed with large areas of cleared land and includes seismic lines, and tracks. It contains areas of rehabilitated spoil as well as unrehabilitated spoil and pre-strip areas from open-cut mining. Flaring will also occur in Zone 3 which is disturbed land with borrow pits, dragline spoil, levees, topsoil stockpiles, pre-strip areas, tracks, and seismic lines associated with the existing open-cut operations at Ensham Mine. Zone 3 is largely cleared with sparse stands of vegetation across the area. The majority of Zone 3 is mapped as SCA and PAA. Zone 3 is also used for grazing.

Accordingly, the absence of any additional surface disturbance in Zone 1 is aligned with Hierarchy 1. Zone 2 and Zone 3 will be reinstated to the previous land use of grazing (Hierarchy No:4) which forms part of the land rehabilitation work already approved in the mine’s current EA.

¹Guideline, Resource Activities, Progressive rehabilitation and closure plan for mined land, ESR/2019/4957, Department of Environment and Science, 1 November 2019

9.3 Progressive rehabilitation plan

9.3.1 Overview

The following sections provide an overview of both the Rehabilitation Planning and Schedule aspects required to support the Project.

9.3.2 Rehabilitation planning

9.3.2.1 Resource tenure

The Project surface footprint is approximately 2,737 hectares (ha) and includes three zones listed below and shown in **Figure 4-1 Chapter 4** (Project description and alternatives):

- Zone 1: located on MDL 217 and requires a ML application to be lodged (approximately 2,134 ha)
- Zone 2: partially includes existing leases ML 70326, ML 70365 and ML 7459 (approximately 394 ha)
- Zone 3: partially includes existing leases ML 7459 and ML 70366 (approximately 209 ha).

The Project Site comprises nine registered land parcels. The tenure of these properties consists of freehold, reserve, and lands lease. Part of the Project Site is also subject to a secondary interest, being a strata easement. No off-lease activities are proposed as part of the Project.

9.3.3 Site relevant activities

There will be no additional surface mining disturbance or surface infrastructure located in Zone 1. As discussed, there will be the need for flaring infrastructure to be located in Zone 2 (two locations) and Zone 3 (two locations) as described in **Chapter 4** (Project description and alternatives), however, this will not impact compliance with existing EA conditions as flaring sites are in locations already approved for open-cut mining. Flaring infrastructure (pump, flaring stack, and fencing) would require an area of approximately 80 m by 20 m and would utilize existing vehicle tracks located on the existing mining leases for access. Gas flaring currently occurs on site to the west of D pit.

No change to the existing water supply surface infrastructure would be required to accommodate the Project. As discussed in **Chapter 10** (Surface Water Resources) and **Appendix E-2** (Mine Water Balance), the existing water management system will be adequate for the Project.

Waste rock from the CHP will be placed into pits C and D. The quantity of rock has been quantified based on available data from a dry processing module currently being trialled at the CHP. As discussed in **Chapter 8** (Land resources), the volume has been measured at approximately 225,000m³ for the Project life or 0.6% of the overall volume of overburden material to be placed in Pit C and Pit D of Domain 1. Therefore this is expected to be consistent with and have a negligible impact on the approved rehabilitated landform outcomes including void water height as listed in Appendix 3 of the EA. Waste rock will be transferred from the CHP intermittently and placed in Pit C and Pit D until 2037 when the underground mine will be closed. Spoil has been characterised as non-acid forming (NAF) and the risk of acid mine drainage is negligible. Metals/metalloids are sparingly soluble from spoil materials and low concentrations of dissolved metals/metalloids are expected to be generated from these materials (RGS, 2021). Accordingly, no impact from metalloids is expected from this waste rock.

Demand modelling conducted for the Project indicates there is sufficient capacity to supply power for the Project and therefore no new surface electrical infrastructure will be required.

No change to the existing water supply surface infrastructure would be required to accommodate the Project. As discussed in **Chapter 10** (Surface Water Resources) and **Appendix E-2** (Mine Water Balance), the existing water management system will be adequate for the Project.

The proposed Project is not anticipated to generate any increase in traffic volumes on the adjacent road network (**Chapter 23** (Transport)), and no additional roadways will be required. Existing roads and tracks will continue to be used.

Demand modelling conducted for the Project indicates there is sufficient capacity to supply power for the Project and accordingly no new surface electrical infrastructure will be required.

Therefore, the relevant activities associated with the Project Site that are considered as part of this rehabilitation and closure assessment will just include the underground mining operation footprint extending into Zones 1, 2 and 3 including associated underground supporting infrastructure. At closure, the three existing mine portals will be sealed and covered with spoil as part of the rehabilitation of both Pit C and Pit D. The rehabilitation of both Pit C and Pit D will be undertaken consistent with what is authorised under the current EA.

The rehabilitation of all surface infrastructure will be undertaken consistent with that which is authorised by the current EA.

9.3.4 Consultation

Consultation undertaken for the Project is described in **Chapter 2** (Consultation), **Chapter 21** (Social), and **Appendix I-1** (Social Impact Assessment).

Currently authorised surface disturbance for Zone 1 will be rehabilitated consistent with the obligations in Environmental Authority MIN 104395712. Surface disturbance in Zones 2 and 3 of the Project will be rehabilitated consistent with Appendix 3 of the existing Environmental Authority EPML 00732813.

Given that there are no changes to existing assessed and authorised surface activities, for the EA, no new rehabilitation conditions or amendments to rehabilitation conditions are required. The amendment to the EA will be limited to the inclusion of the new mining lease for Zone 1. In summary, the additional 225,000m³ of waste rock will not change landform outcomes including void water height and post mining land use outcomes.

Consultation including the mining method (bord and pillar), and rehabilitation of the underground mine, was undertaken during Project consultation sessions in Emerald and Comet as well as ongoing discussions with land owners and holders (lessees), and, the Central Highland Regional Council and Central Highland Development Cooperation. Consultation also included discussions regarding subsidence related to the Project's bord and pillar mining operations, and included discussions about flaring locations being in Zone 2 and Zone 3.

Future consultation related to closure of the Project is described in **Chapter 2** (Consultation), **Chapter 21** (Social), and **Appendix I-1** (Social Impact Assessment).

9.3.5 Post mining land use

9.3.5.1 Current land use

The Project is located within a rural setting, typical of the Central Queensland region. The Project Site is located within the rural margins between a range of central township nodes. The largest nearby townships include Emerald, which is located approximately 25 km south-west, and Blackwater which is located 49 km south-east.

The predominant land uses within the wider region include cropping, grazing and resource activities. The existing land uses of the Project Site include:

- Zone 1 – Cropping, grazing land and waterways with fringing riparian vegetation. Two homesteads are located within the Project Site (Braylands Homestead and Chelbrook Homestead) both on freehold land.
- Zone 2 – within the existing Ensham Mine mining leases ML 70326, ML 70365 and ML 7459. All surface disturbance is covered under the existing approved resource activities. A large portion of this area is actively grazed as part of the pastoral activities of Nogoia Pastoral Company.
- Zone 3 – within the existing Ensham Mine mining leases ML 7459 and ML 70366. All surface disturbance is covered under the existing approved resource activities. A large portion of this area is actively grazed as part of the pastoral activities of Nogoia Pastoral Company.

9.3.5.2 Post mining land use areas

The underground mining method is bord and pillar, and, unlike longwall mining, pillars will remain post mining to support the roof, with the mined areas of the coal seam remaining. Subsidence, if it were to occur above the panel pillars in the Project Site, is predicted to be typically less than 40 mm (Gordon Geotechniques, 2020). This is within the 50 mm seasonal variation in surface levels as a result of changes in moisture content as stated by the Department of Agriculture, Water and the Environment (IESC, 2015).

Subsidence of this magnitude would be essentially undetectable because natural processes such as changes in vegetation, soil shrinkage or swelling due to variations in moisture content, or fluvial processes of erosion and deposition could produce similar (or greater) variations in surface levels.

LIDAR surveys flown in March 2016 and February 2017 have been used to assess potential subsidence effects above bord and pillar mined areas at Ensham (Gordon Geotechniques, 2020 – Appendix B). Locations assessed showed that ground movement was less than the ± 50 mm accuracy of the surveys, consistent with the subsidence prediction of less than 40 mm in the Project Area. Furthermore, no observed surface cracking or ponding has been observed above the mined bord and pillar areas.

Subsidence modelling and actual surface inspections of bord and pillar mined areas are consistent in outcome which supports that the post mining land uses already authorised in Environmental Authority EAML 00732813 are achievable. Given this, it is expected that the same mining technique at greater depth in Zone 1 will result in less surface disturbance than current experienced in the existing bord and pillar mined area. Based on this, the existing agricultural activities in Zone 1 are expected to continue.

With no measurable subsidence, there will be no potential for cracking of stream beds. Areas of verified remnant vegetation and existing vegetation corridors associated with tributaries of the Nogoia River would continue to remain intact throughout mining and in the post-mining landscape.

The proposed post mining land uses are therefore as follows:

- Zone 1 – existing agricultural land use for Zone 1 is expected to remain unchanged as no additional surface disturbance is proposed and subsidence if it were to occur is predicted to be within the 50 mm seasonal variation currently experienced. There is not expected to be a need to undertake surface rehabilitation (other than for currently approved exploration activities) as there is no intended disturbance.
- Zone 2 – land which exists within the Ensham Mine mining leases ML 70326, ML 70365 and ML 7459. Surface disturbance and final rehabilitation requirements are specified under the existing approved resource activities, with the final landform and land use details identified in Appendix 3 of the EA. The final land use will be cattle grazing.

- Zone 3 – land which exists within the Ensham Mine mining leases ML 7459 and ML 70366. Again, surface disturbance and final rehabilitation requirements are specified under the existing approved resource activities, with the final landform and land use details identified in Appendix 3 of the EA.

No non-use management areas (NUMA) are proposed for this Project.

The above land uses are consistent with consultation undertaken for the Project with the community, land owners and government as described in **Section 9.3.4**.

9.3.5.3 Method for Rehabilitation

Rehabilitation of the Project Site will be carried out according to the following general approach after completion of underground mining in approximately 2037:

- Removal of underground infrastructure will occur progressively as mining areas are exhausted. Once the final mining infrastructure has been removed, pumping of mine groundwater-make to the surface water management system will cease and the underground mine will fill with groundwater.
- The three existing underground mine portals will be sealed and covered with spoil and done in conjunction with the rehabilitation of C and D pits consistent with the final landform and completion criteria specified in Appendix 3: Rehabilitation Success Criteria of the EA.
- Surface flare infrastructure (pump, flare stack and fencing) will be removed, and the area ripped and seeded. Removal of other associated infrastructure such as the workshop and CHP is addressed for the rehabilitation of the existing open cut mine as described in **Appendix 3** of the EA.

9.4 Rehabilitation milestones

Rehabilitation and closure of the underground workings for the Project would commence upon cessation of underground coal production in approximately 2037. An indicative rehabilitation schedule which identifies all rehabilitation activities being undertaken for the site by year is shown in **Figure 9-1**. This schedule shows that the decommissioning of the underground mine (the Project), which primarily involves sealing of the portals, is scheduled to occur between approximately 2037 to around 2039. This milestone is indicative and may vary due to operational requirements.

A PRCP schedule consistent with ESR/2019/4957 will be prepared for the Project (if varied from **Figure 9-1**) and submitted to the administering authority prior to the Project EA amendment application being lodged.

Ensham Mine Rehabilitation Schedule

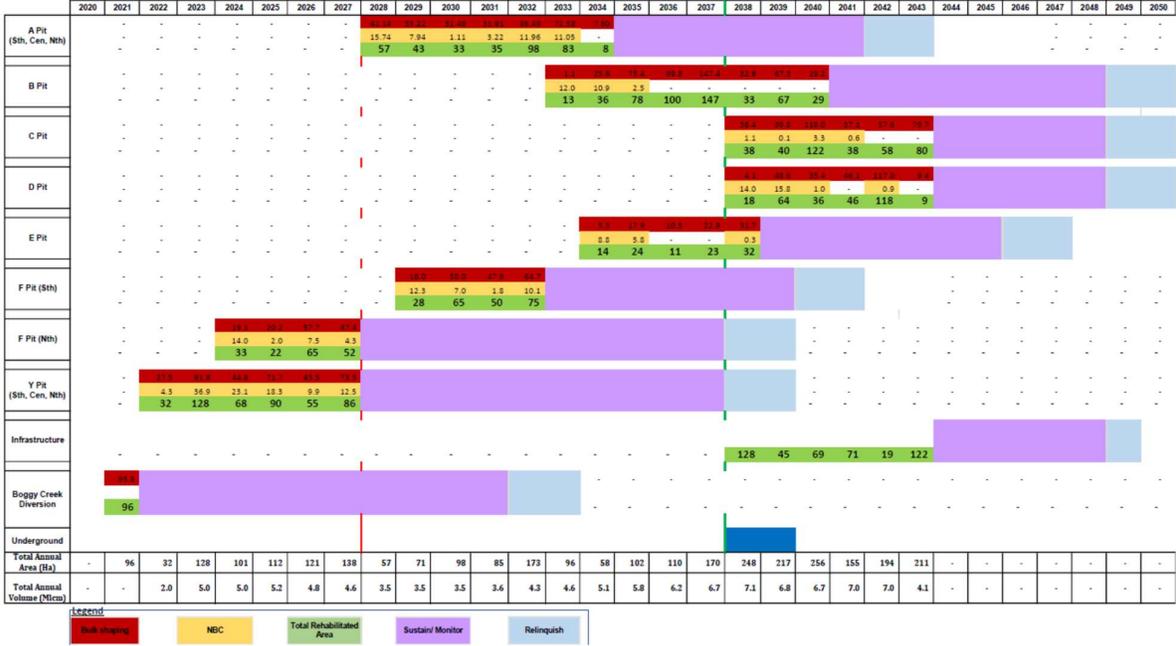


Figure 9-1 Ensham Mine Rehabilitation Schedule