Mining, Exploration and Geoscience
Department of Regional NSW

Practical guide

Post mining land use

January 2023

Published by the Department of Regional NSW

Title: Practical guide: Post mining land use

First published: January 2023

Department reference number: RDOC22/269275

Acknowledgements

Cover image: Duralie – Stratford mine site (2019) © Salty Dingo

Amendment schedule		
Date	Version	Amendment
January 2023	1.0	First published

Table of Contents

1. Introduction

1.1. Our vision for post mining land use

The NSW Government is committed to promoting economic development in regional NSW, including attracting new investment, creating jobs and ensuring a high quality of life for communities. Areas disturbed by mining provide significant opportunities for economic development and diversification.

1.1.1. Our commitment

In 2020, the NSW Government released the *Strategic Statement on Coal Exploration and Mining in NSW* (Future of Coal Statement), which committed to investigate beneficial uses of coal mining land once mining ended.

Key actions in the *Future of Coal Statement* include:

- facilitating the beneficial uses of coal mining land once mining has ended
- addressing community concerns about coal mining by strengthening the regulatory requirements for mine rehabilitation and closure planning and facilitating the benefits of coal mining land once mining has ended
- supporting the diversification of coal-reliant regional economies to phase out thermal coal mining, including developing and implementing location-specific plans to diversify the regional economies that are heavily dependent on coal mining.

Post mining land use (PMLU) represents a significant opportunity for NSW to harness the existing infrastructure, skilled workforce and transport links from mines approaching closure, to continue economic activity on mined land.

1.2. Purpose

This document provides practical guidance for mining lease holders about post mining land use planning, mine closure and transitioning to future land uses. This document will assist and encourage mining lease holders to explore opportunities for alternative and innovative PMLUs for mine sites.

It is important to understand that this document provides general guidance only and is not intended to be a definitive guide for mining lease holders. This guide should be supported by appropriate specialist advice on a site/project-specific basis.

2. Post mining land use: the facts

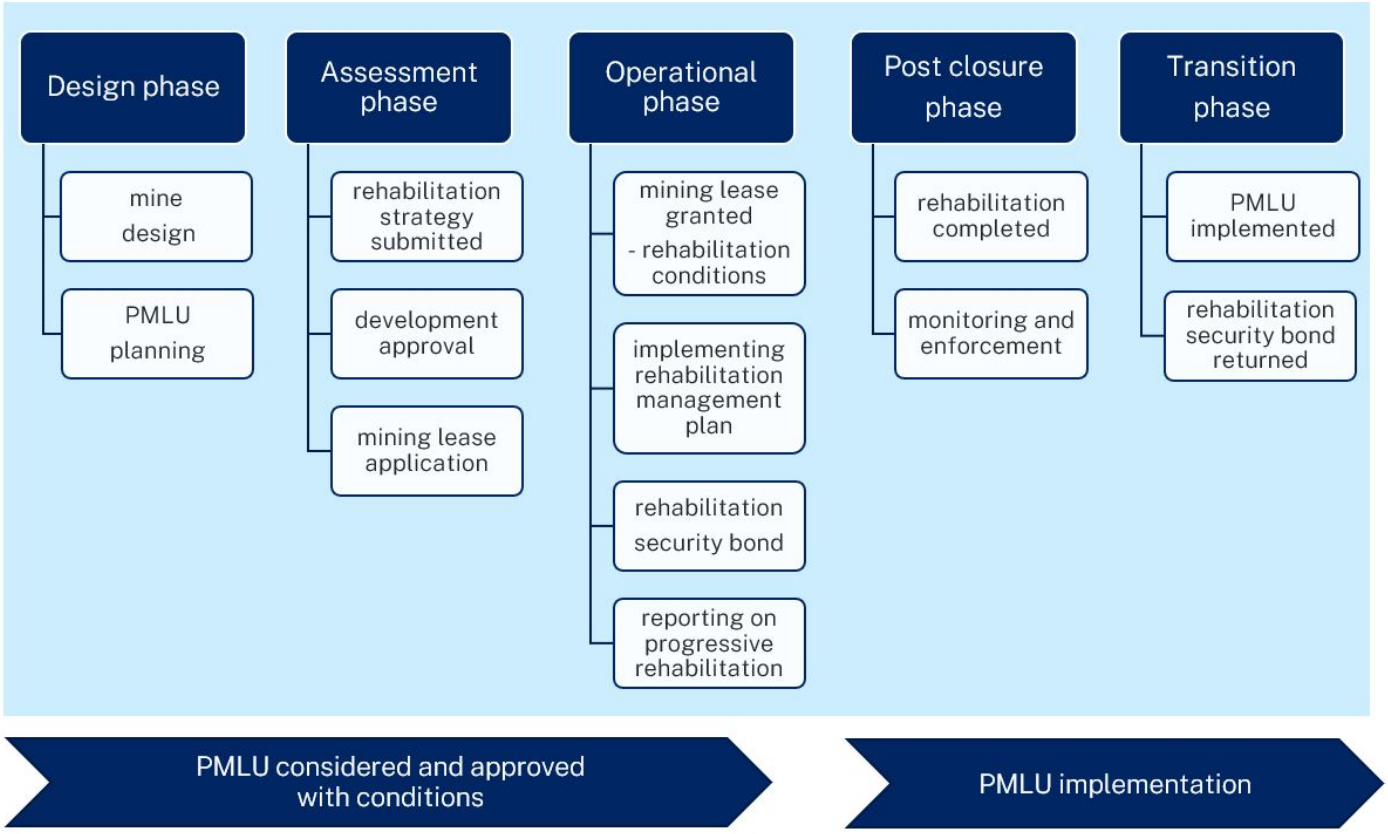
2.1. What is post mining land use?

Post mining land use is used to describe the process of implementing a new use/s for mine sites that are nearing the closure stage. Identifying a post-mining land use is required under the *Mining Act 1992* as all land disturbed by mining activities must be rehabilitated back to a state that is safe and stable while having regard to an identified PMLU.

2.1.1. How is PMLU managed?

Under the 2023 framework, PMLU planning is an ongoing process that should occur at all stages of the mining project lifecycle. Figure 1 shows the typical pathway a mining lease holder would follow to implement PMLU, in cases where the identified or approved (during design and assessment) PMLU is implemented.

Figure 1: Default or approved PMLU pathway



2.1.2. Opportunities for new land uses

Recent reforms to NSW's mine rehabilitation framework created opportunities for mining lease holders to depart from the typical pathway (Figure 1), in which standard rehabilitation conditions and final landforms are set during the initial development consent. 'Default' PMLUs are not typically land uses that support significant economic benefits when compared to benefits generated through mining activity. Default PMLUs generally include low-intensity agricultural uses such as grazing land and native woodland/forest.

Under the framework, mining lease holders are encouraged to take advantage of the benefits of departing from their default PMLU and implementing an alternate PMLU, regardless of which stage the mining lease holder is in. Alternate PMLUs offer the ability to comply with rehabilitation obligations, while also supporting new economic opportunities in regional communities.

2.2. Why consider alternate post mining land use?

There are a range of benefits and advantages for embracing alternate PMLU in NSW, for the mining sector and the broader communities that are reliant on the coal industry (see below Figure 1).

2.2.1. Key benefits – mining lease holder

The key benefit for the mining industry in shifting its approach to alternate PMLUs, is that the rehabilitation of mine sites for higher value and employment-generating beneficial uses is likely to result in improved asset value for mining lease holders, who own the land where mining is carried out.

Also, the rehabilitation associated with these PMLUs may often be achieved faster and at a lower cost than the 'default' PMLUs.

Figure 2: Benefits associated with alternative PMLUs

2.3. Suitability of mines for alternative post mining land use

Mine sites often contain a range of beneficial features and attributes that make them well suited to generating significant economic and social benefits for the local community and the state. Some of the beneficial features and attributes are:

Figure 3: Suitability of mines for alternative post mining land use

3. Key considerations and constraints for alternate post mining land use

There are many key considerations and constraints that mining lease holders must contemplate when determining whether a proposed alternate PMLU is suitable for a specific mine site.

Below is an overview of the key considerations and constraints relevant when planning for alternate PMLUs. These are not an exhaustive list or prescriptive instructions for mining lease holders, rather they are designed to prompt internal decision-making processes.

3.1. Considerations

3.1.1. Physical and environmental considerations

Physical and environmental considerations are the most influential consideration in determining whether a proposed alternate PMLU is suitable and feasible, as the site characteristics dictate to a large extent the final landform and consequently the final land use. These site characteristics include approval requirements, proposed final landform (e.g topography, land and soil capability and compatibility with surrounding land uses).

However, the nature of mining means terrain features such as void shape and depth and overburden shapes, construction and height can all be tailored as part of active mining operations to suit different and desired land uses if these decisions are made early enough to inform the refinement of the mine design. This is a key consideration for mining lease holders that are in the mine design stage.

Practical tip: Expression of interests or tender processes undertaken in the early stages may assist mining lease holders in identifying alternate PMLUs that were not previously considered and potential PMLU development partners or future interested parties.

3.1.2. Economic considerations

Economic considerations for alternate PMLUs are the costs associated with rehabilitating the land in accordance with the default or approved PMLU, in comparison with the costs and benefits of alternate PLMUs.

While it is vital for mining lease holders to understand what is economically possible and feasible before undertaking broader stakeholder engagement, mining lease holders should not be deterred by higher costs without also considering the potential economic benefits and savings from alternate PMLUs. These may include:

- increased mining asset and residual land values
- reduced financial burden/security requirements through partial relinquishment
- decreased time frames to complete mine closure works
- avoiding expensive decommissioning and removal costs.

Practical tip: For mining lease holders approaching mine closure stage, community interest in future mine use is likely to be high. During this stage, community expectations of what is a feasible alternate PMLU may be managed through having a deep understanding of the both the costs and benefits of alternate PMLUs.

3.1.3. Social considerations

Effectively considering social matters when planning or implementing an alternate PMLU leads to both highly desirable outcomes for the mining-reliant community and improved social licence for the mining lease holder.

Regardless of the mining phase, mining lease holders can identify suitable alternate PMLU through considering social impacts and issues that are important to the community such as:

- identifying local needs and key community values
- minimising significant fluctuations in local workforce numbers
- assisting mining-reliant community resilience through transition or change periods
- managing community expectations through effective and early engagement.

Practical tip: Social impact assessments are a useful tool to inform PMLU planning as they provide a relevant social baseline and the framework to understand social impacts through identifying key stakeholders, potential social constraints, opportunities and community values.

3.1.4. Legislative considerations

The key legislative considerations for determining alternate PMLUs include:

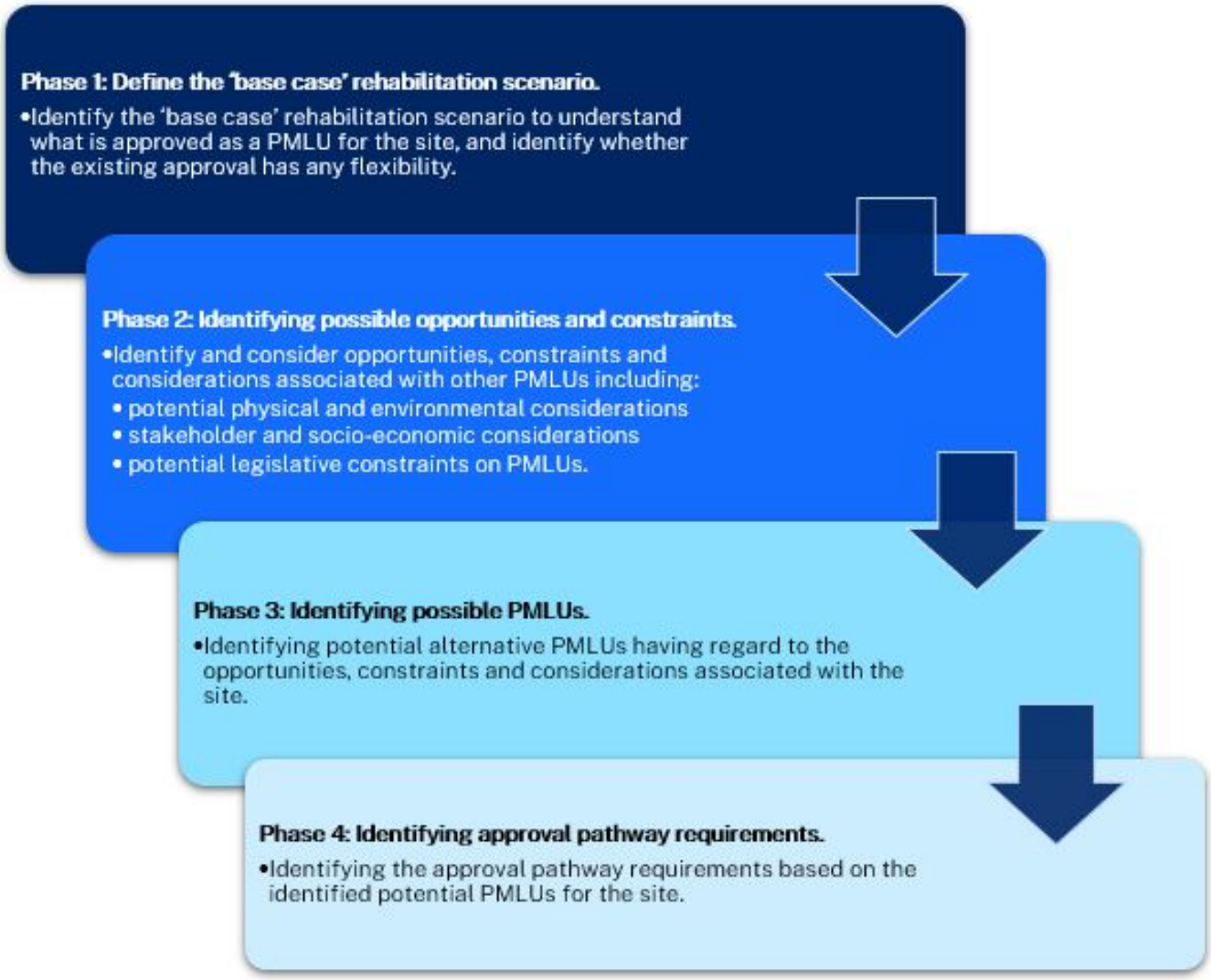
- early engagement with relevant government agencies to support understanding of any legislative constraints that may apply to the project
- understanding statutory or other approvals that may be required to help a future PMLU
- rehabilitation obligations will still remain, consistent with obligations under the *Mining Act 1992* and Mining Regulation 2016 and any conditions of development consent.

4. Pathways to alternate post mining land use

4.1. How to plan for alternative post mining land use?

While each mine site will have its own specific features and considerations, the process of investigating and seeking approval for alternative PMLUs will generally include the four phases set out in Figure 3.

Figure 3: Key phases for alternative PMLU planning



4.2. Key stakeholders for planning alternative post mining land use

Throughout the iterative process of planning for alternative PMLU, there will be a broad range of stakeholders for which mining lease holders will need to engage, consult and collaborate.

Table 2 sets out some of the key stakeholders that mining lease holders should engage to facilitate beneficial uses of mining land once mining has ended.

Figure 4: Key stakeholders for alternate PMLU engagement

In addition to the broader stakeholders, there are also key government agencies (see Table 3 below) that mining lease holders should engage with to ensure they secure the required support and approvals.

Table 3: Key government agencies for PMLU approvals

Stage	Activity	Agency	Role	Legislation
Design	PMLU planning	Regional NSW – Resources Regulator	Best practice: consultation with mining lease holder to plan and discuss potential PMLUs.	*Mining Act 1992*
Assessment	Environment protection licence (EPL) application and approval	For scheduled activities Environment Protection Authority	Issues EPLs. Exercises compliance and enforcement functions.	*Protection of the Environment Operations Act 1997*
		For non-scheduled activities Relevant council	Exercises compliance and enforcement functions.	
	Development consent application and approval	For state significant development/state significant infrastructure matters	Minister or IPC is consent authority DPE exercises compliance and enforcement functions.	*Environmental Planning and Assessment Act 1979*

Stage	Activity	Agency	Role	Legislation
		Department of Planning and Environment (DPE) and in some cases, the Independent Planning Commission (IPC) of NSW	Sets the PMLUs as part of the development consent.	
		For non- state significant development/state significant infrastructure: Relevant council, or in the case of regionally significant development, the relevant planning panel.	Council or planning panel is consent authority. Council exercises compliance and enforcement functions. Sets the PMLUs as part of the development consent.	
	Mining lease application and approval	Regional NSW – Resources Regulator	Provides advice to consent authorities regarding the appropriateness of rehabilitation strategies for mining projects and recommended conditions of consent.	*Mining Act 1992*
		Regional NSW – Mining, Exploration and Geoscience	Reviews mining lease application and grants with rehabilitation conditions.	*Mining Act 1992*
Operations	Mining lease granted – rehabilitation conditions Implementation of Rehabilitation management plan Rehabilitation bond	Regional NSW – Resources Regulator	Reviews rehabilitation cost estimates in determining security deposits and advises relevant sections within Mining Exploration and Geoscience when the security deposit may be returned (either partially or in full).	*Mining Act 1992*
		Regional NSW – Resources Regulator	Exercises compliance and enforcement functions under	*Mining Act 1992*

Stage	Activity	Agency	Role	Legislation
			the Mining Act with a key focus on mine rehabilitation.	
		Regional NSW – Mining, Exploration and Geoscience	Holds and administers rehabilitation security deposits, in accordance with the conditions of the mining lease (including both increases and decreases in security deposits).	*Mining Act 1992*
		Holds and administers rehabilitation security deposits, in accordance with the conditions of the mining lease (including both increases and decreases in security deposits)	Regional NSW – Mining, Exploration and Geoscience.	*Mining Act 1992*
Post closure/transition	Reporting on progressive rehab Rehab completed Monitoring and enforcement	Regional NSW – Resources Regulator	Reviews reporting to ensure compliance Ensures rehabilitation is completed to required standards	*Mining Act 1992*
	PMLU implemented Rehabilitation bond returned	Regional NSW – Mining, Exploration and Geoscience	Administers the return of the rehabilitation bond	*Mining Act 1992*

4.3. What are the pathways available?

Under the 2023 framework, there are 3 existing pathways to help alternate PMLUs, depending on the proposed alternate PMLU in comparison with the default or approved PMLU.

Pathway 1 – substantially the same as approved or default PMLU

The mining lease holder seeks to modify the mining development consent to assist with the intended final landform to support PMLU, provided the use is substantially the same as the approved or default PMLU.

Pathway 2 – permissible with relevant planning controls

The mining lease holder or new proponent submits a new development application seeking approval for alternative PMLU on the site that is permissible with relevant planning controls. This may also require modification to the original mining development consent, dependent on approved final landform.

Pathway 3 – not permissible with relevant planning controls

The mining lease holder or new proponent may submit a planning proposal to achieve either rezoning of mined land, or permit additional land uses, in instances where planning controls prohibit the proposed new use.

4.4. Opportunities for PMLU – Hunter region

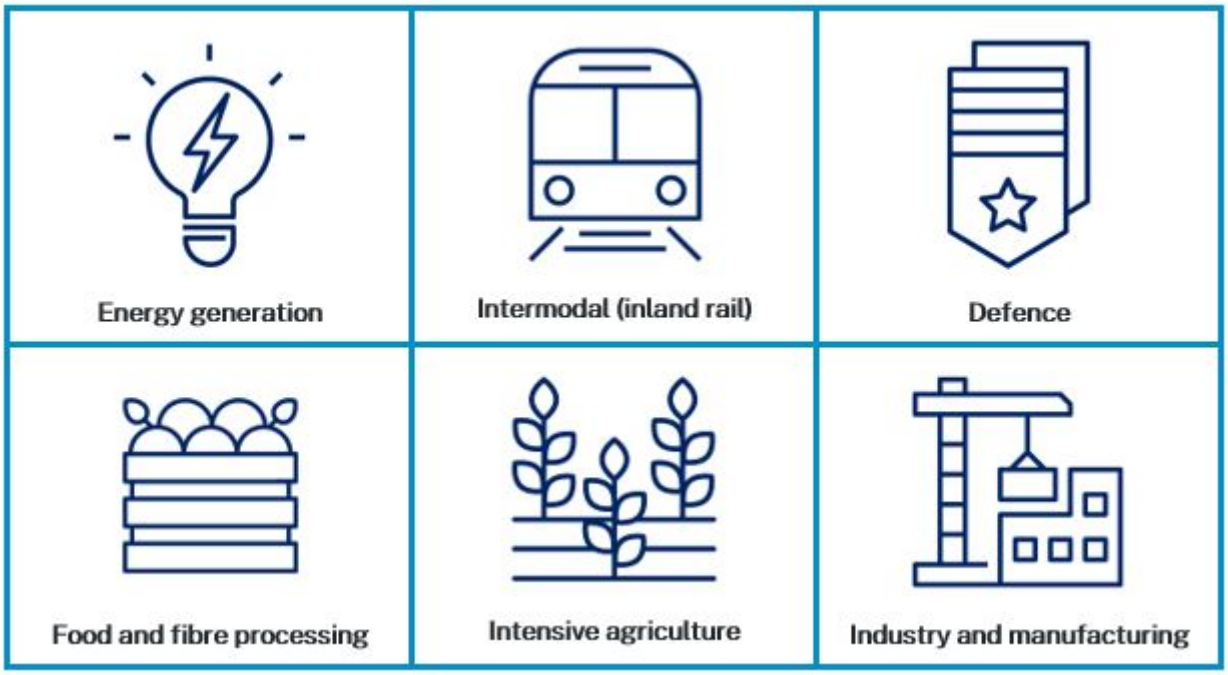
The Hunter region in NSW is an example of a region seeking to maximise the opportunities resulting from mine closures, including using rehabilitated mine land, mine buffer lands, mine infrastructure and the skilled mine workforce to attract investment in existing, emerging and future industries.

The *Hunter Regional Plan 2041* includes an analysis of potential PMLUs for established mining operations within the Hunter region. This analysis identifies 3 categories of mining land:

- **Operational land:** Land historically or actively used for mining operations. This land will have been directly affected by mining and will require rehabilitation.
- **Non-operational land:** Land that is managed by mining operations but is not part of active or historical mining operations. This land will not require rehabilitation and may be used as a buffer.
- **Areas of interest:** Operational land identified as being well suited for alternative PMLUs that generate employment. This is land where mine infrastructure such as hard stand areas, workshops, stores, treatment plants and rail loops are concentrated.

The plan includes a spatial analysis of 'areas of interest' within established mine sites in the Hunter and identified potential land use opportunities for each mine. These land use opportunities include:

Figure 5: Land use opportunities



5. Case studies of alternate post mining land use

The following case studies are provided as examples of different uses of post mining landforms that have taken advantage of the site attributes provided by mining. These case studies may be used by mining lease holders to assist in identifying alternate PMLUs. Tourism, recreation and residential development

Penrith Lakes – Penrith, NSW, Australia

Penrith Lakes is a planned redevelopment of one of the largest sand and gravel quarries in Australia. Penrith Lakes is a water-based parkland comprising a range of land use zones, including residential, employment and tourism zones. Penrith Lakes will provide a

significant area of regional open space within the Western Parkland City.
Further information is available at: www.planning.nsw.gov.au/penrithlakes

Hornsby Park – Hornsby, NSW, Australia

Hornsby Park is a planned development of the Hornsby Quarry. Hornsby Park will comprise a retained lake for water-based recreation and approximately 60 hectares of bushland and open space, including a 'canopy skywalk'.
Further information is available at: hornsbypark.com.au/

Canberra Brickworks Precinct – ACT, Australia

The Canberra Brickworks Precinct is a proposed redevelopment of an historic brickworks and quarry in Yarralumla, ACT. The proposed redevelopment includes a combination of residential, commercial/retail and recreational land uses.
Further information is available at: www.planning.act.gov.au/development-applications/da_assessment/environmental_assessment/environmental_impact_statements/canberra-brickworks-redevelopment

The Eden Project - Cornwall, United Kingdom

The Eden Project is a tourist attraction established from a reclaimed china clay quarry. It comprises a series of indoor biomes and outdoor gardens, associated visitor and educational facilities. Since it opened to the public in 2001, the Eden Project has attracted more than 20 million visitors to the site (Eden Project Anglesea).
Further information is available at: www.edenproject.com/

5.1. Renewable energy

Maxwell Solar Farm - Hunter Valley, NSW, Australia

The Maxwell Solar Farm is a State significant 25-megawatt (MW) solar farm development which is to be established on a rehabilitated overburden emplacement area at Maxwell Infrastructure, formerly known as the Drayton Coal Mine, southeast of Muswellbrook. The Project was approved by the former Minister for Planning and Public Spaces in August 2020. Further information is available at: www.planningportal.nsw.gov.au/major-projects/projects/maxwell-solar-farm

West Coast Wilderness Railway - Queenstown-Strahan, Tasmania, Australia

The West Coast Wilderness Railway is a tourist train between the towns of Strahan and Queenstown in Tasmania and utilizes a former rail line established to service the mining operations at Queenstown. The rail line uses historic team engines and takes advantage of the historic aspects of mining at Queenstown including the terrain scarred by former mining and processing operations.

Fernleigh Track - Newcastle/Lake Macquarie, NSW, Australia

The Fernleigh Track is a repurposed rail line that services coal mining operations in suburbs in the Newcastle/ Lake Macquarie Local Government Areas. The Fernleigh is now used for walking and bike riding and utilises the low gradients associated with the former rail line and a former rail tunnel, providing a social benefit as a recreational and active transport corridor.

Slate Mines – Snowdonia, Wales

Go Below is an underground adventure tourism facility established within a former slate mine. The facility includes zip-lining, climbing and boating activities, generating visitation and economic activity.
Further information is available at: www.go-below.co.uk/

The Lusatian Lake District – Saxonbury and Brandenburg, Germany

The Lusatian Lake District is a chain of artificial lakes in Germany, where a regeneration program has transformed several decommissioned lignite opencast mines into Europe's largest artificial lake district.

Kidston Clean Energy Hub – Queensland, Australia

The Kidston Clean Energy Hub comprises the operating 50MW stage 1 Solar Project and the 250MW Kidston Pumped Storage Hydro Project with potential for further multi-stage wind and solar projects.

The Kidston Clean Energy Hub utilises the decommissioned Kidston Gold Mine in North Queensland with the solar farm aspects located on former tailings facilities and the planned pumped hydro facilities using the two disused mine pits and existing mine infrastructure to generate and store renewable energy.

Further information is available at:
genexpower.com.au/

Utility-Scale Solar on a Tailing Disposal Facility Chevron Questa Mine Superfund Site - Questa, New Mexico, United States of America

This project involves the establishment of a 21-acre solar farm generating 4.6 million kilowatt hours of electricity, located on an inactive tailing facility.

Further information is available at:
https://semspub.epa.gov/work/06/300190.pdf

Elizabeth Mine Superfund Site in Strafford, Vermont, United States of America

This project involves the establishment of a multi-use development including a 7 mega-watt solar farm and 10 acres of restored wetlands that utilised on-site material for backfill.

Further information is available at:
semspub.epa.gov/work/HQ/100002282.pdf

5.2. Redevelopment of industrial and contaminated sites

BHP Steelworks – Newcastle, NSW, Australia

Since 2006, Hunter and Central Coast Development Corporation (HCCDC) has led the remediation of BHP's Mayfield Steelworks site and Kooragang Island Waste Emplacement Facility, NSW. The remediation project aims to facilitate the potential re-use of the sites for ongoing operation of industry to support the regional economy.

Remediation works at the Mayfield Steelworks were formally completed in 2019 and included the establishment of a new freight rail line and major civil works. Remediation works at the Kooragang Island Waste Emplacement Facility remain ongoing, with closure works designed to be sympathetic to nearby Ramsar Wetlands and provide migratory corridors for the Green and Golden Bell Frog.

In 2016, the HCCDC received a NSW Premier's Award for 'Protecting the Environment' for the project.

Further information is available at:
www.hccdc.nsw.gov.au/remediation#steelworks

Catherine Hill Bay Coal Preparation Plant – NSW, Australia

This project involves the successful completion of rehabilitation of the Catherine Hill Bay coal preparation plant, coal bin and coal stockpile areas. The rehabilitated area covers nine hectares of the 72-hectare approved development area, which includes a residential subdivision of about 540 lots for residential development, village reserve and recreational/open space land use pursuits.

Further information is available at:
www.resourcesregulator.nsw.gov.au/news-articles/successful-rehabilitation-at-former-catherine-hill-bay-mining-areas

Former Pasminco Smelter - Lake Macquarie, NSW, Australia

The site located at Boolaroo, New South Wales previously operated as a lead and zinc smelter from 1897 to 2004. Ongoing management of the contaminated soil collected and emplaced in 22ha containment cells is being completed by Waste Assets Management Corporation. As remediation works are being completed the land is gradually being subdivided into industrial, commercial, and residential uses.

Further information is available at:
www.dpie.nsw.gov.au/housing-and-property/divisions/property-and-development-nsw/environmental-service-group/pasminco,-boolaroo-former-smelter

Horsley Park Quarry – Western Sydney, NSW, Australia

This project involves the successful completion of 11 hectares of rehabilitation on part of the Horsley Park Quarry in western Sydney. The quarry rehabilitation works were associated with the redevelopment of the Oakdale East Industrial Estate. The approved

industrial development includes several new warehouses and a masonry plant.

Further information is available at: www.resourcesregulator.nsw.gov.au/sites/default/files/documents/rir20-06-horsley-park-quarry.pdf

Big River Mine Tailings/St. Joe Mineral Corp. Superfund Site - St. Francis County, Missouri, USA

Park Hills Industrial Park was developed following remediation and stabilization of the site, leading to a growth of business and employment opportunities following the mine closure. Site businesses in the response area employ about 5,871 people, providing estimated annual employment income of over $220 million and generating over $670 million in annual sales revenue.

Site properties in the response area are currently valued at nearly $828 million and generate nearly $8 million in annual property tax revenues. Clean-up has allowed residential, commercial, industrial, recreational, public services and agricultural uses to continue on site.

Innovative redevelopment projects led by the private sector and local governments are helping to offset the loss of jobs from mine closures and providing valuable community benefits.
Further information is available at: semspub.epa.gov/work/HQ/100002113.pdf

5.3. Waste disposal/energy generation

Woodlawn Eco Precinct - Tarago, NSW, Australia

The Woodlawn Eco Precinct comprises a range of industrial, agricultural and renewable energy operations located at the former Woodlawn Mine, a zinc and copper mine located east of Lake George, near Canberra.

The Eco Precinct comprises a bioreactor landfill, bioenergy plant (recovering clean energy generated by the bioreactor), mechanical and biological treatment (extraction of organic content for compost production) a 48.3 MW windfarm, a 2.5 MW solar farm, as well as agriculture, aquaculture and horticulture operations.

Further information is available at: /www.veolia.com/anz/WoodlawnEcoPrecinct

Practical tip: Appendix 2 provides an analysis of a range of alternative PMLUs, their respective site requirements, and the potential suitability of mine sites for meeting these requirements. Mining lease holders can use this information to build on the ideas generated via the case studies to determine if their mine site may be suitable for the desired alternate PMLU.

Appendix 1: Alternative uses for mined land attributed

Attribute	Opportunities	Constraints	Potential Alternative PMLUs
Administration and mine infrastructure areas	• Generally flat terrain areas • Existing buildings and other facilities including carparking/ hard stand areas/ sewerage facilities • Existing links to transport and utilities infrastructure • Potential to reduce rehabilitation costs if infrastructure can be repurposed • Already disturbed and minimal biodiversity constraints	• Potential contamination risks	• Industrial • Manufacturing (including agricultural product processing) • Business parks • Residential • Renewable energy and battery storage • Hydroponic/greenhouse horticulture • Intensive Agriculture (eg. Poultry, piggery, cattle feedlots, aquaculture) • Tourism
Mine voids and retained highwalls	• Water holding capacity • Natural amphitheatre formation • Long slopes • Micro-climates associated with altered solar profile • Large void potentially suited for waste disposal, including tailings disposal • Potential to utilize elevation differences between pit floor and surrounding terrain for pumped-hydro or other potential energy electricity storage/generation methods.	• Safety issues associated with retained highwalls and pit lakes • Geotechnical stability of any highwalls or backfilled overburden slopes • Groundwater interactions (inflows, interactions with spoil material, surface water/groundwater interactions) • Pit lake water quality (human and environmental health effects, interactions with groundwater, evaporation effects, temporal changes, surface water inflows/outflows, pit lake depth, stratification effects, water licensing requirements, suitability for PMLUs) • Micro-climate features associated with altered terrain, including shadow effects	• Water storages (recreation and tourism and flood management) • Pumped hydro • Domestic waste disposal facilities • Tailings or waste rock disposal/storage • Ash disposal • Adventure sports • Solar

Attribute	Opportunities	Constraints	Potential Alternative PMLUs
	• Minimal biodiversity constraints	• Suitability for pumped hydro may depend on height difference between void pit lake and surrounding terrain (including overburden emplacements) • Limited access to void	
Tailings storage facilities	• Flat, capped tailings dams may be suitable for PMLUs that require or are suited to large areas. • Minimal biodiversity constraints	• Potential geotechnical constraints • Potential geochemical constraints • Unsuited for deep rooted vegetation or activities that may impact integrity of capping material seals	• Renewable energy sites (particularly solar and/or battery storage) • Waste management • Industrial/business parks • Hydroponic/greenhouse horticulture • Intensive agriculture (eg. poultry, piggery, cattle feedlots) • Manufacturing, including food processing facilities
Transport infrastructure	• Opportunities to utilize existing road network, rail loops, spurs and loading facilities and access to regional rail networks for transport and distribution • Potential to reduce rehabilitation costs if infrastructure can be repurposed • Minimal biodiversity constraints	• Economic viability of rail transport to regional mine sites	• Transport and distribution hubs • Industrial parks
Mine portals and underground workings	• Potential for pumped hydro (subject to geotechnical considerations) • Minimal biodiversity constraints	• Geochemical constraints associated with groundwater inundation in underground workings • Atmospheric constraints (methane etc.) • Spontaneous combustion	• Underground accommodation • Adventure tourism • Pumped hydro • Waste disposal/bioreactor

Attribute	Opportunities	Constraints	Potential Alternative PMLUs
		• Geotechnical considerations key to determining potential PMLUs, for example: — Is the underground mine hard, stable rock or is it viable to install roofs? — Has human safety been considered? Are additional measures required to deter public access to underground workings?	
Waste rock/ overburden emplacement areas	• Elevated terrain • Ability to redesign or reshape where necessary to suit intended PMLUs • Potential resource for extractive materials • Provide visual and acoustic shielding of activities • Potential to reduce rehabilitation and operating costs through targeting design for PMLUs • Minimal biodiversity constraints (subject to rehabilitation commitments/ constraints) • Visual amenity (geomorphic landform design)	• Geotechnical/ slope stability considerations • Geochemical considerations • Micro-climate/shadow effects • Visual amenity • Air quality (dust) emissions if emplacement areas are exposed	• Water storage for pumped hydro • Renewable energy sites • Visual shielding for other PMLUs • Biodiversity values and offsets • Forestry • Adventure sports • Extractive material source • Uses which may take advantage of elevated viewing location, including residential and tourism
Water storages (including pit lakes)	• Established water holding capacity • Existing water entitlements • Ability to manage water quality through treatment/ imported water • Ability to use other mine related infrastructure for related activities (e.g transport, electricity infrastructure)	• Water quality (including temperature) • Storage shape/designs and variable depth • Limited safe access points • Water licensing limits • Potential limited catchment area to replenish storage facility	• Energy storage/generation (including hydrogen production) • Aquaculture • Recreation and tourism • Biodiversity values • Water storage for other mines, PMLUs and

Attribute	Opportunities	Constraints	Potential Alternative PMLUs
	• Can be used for flood mitigation though diversion and storage of high flow events • Biodiversity habitat	• Biodiversity habitat – potential limits beneficial re-use for other PMLU types	surrounding uses (including domestic) • Flood mitigation
Re-established 'natural' ecosystems	• Aesthetic values • Biodiversity habitat • Potential offset value (subject to legislative constraints and existing consent commitments) • Visual screening	• May contain biodiversity constraints for other PMLUs if directly or indirectly impacted by alternative PMLU	• Amenity screening of other uses • Biodiversity and/or carbon offsets • Enhanced amenity for residential or other uses • Recreation areas

Appendix 2: Alternative PMLU site requirements

Potential land use	Beneficial land characteristics/ values required	Comments
Renewable electricity generation, pumped hydro and battery storage	Built assets (offices, workshops, car parks etc).	Mining operations can be managed to optimise the terrain for pumped hydro uses where this land use is identified before activities end, including considering the potential use of underground mining areas (e.g shafts etc). Pumped hydro takes advantage of terrain features that offer height differential between an upper and lower storage. There is significant potential to incorporate aspects of pumped hydro construction activities with mining operations (e.g emplacement of overburden to facilitate upper storage construction, use of underground workings). Underground mines and mining highwalls may also be suited for other forms of potential energy storage/generation that make use of height differentials. Disturbed areas within mine sites would also be suited for wind and solar energy generation subject to solar and wind resource suitability. Rehabilitated (capped) tailings storage facilities provide a potentially ideal site for solar panel and/or battery installation provided the capping is geotechnically capable of supporting the weight of the facilities. These sites are generally flat and have potential constraints on their use for other land uses, such as differential settlement. Mine sites would also be suited for battery storage. Development for renewable energy would align with the NSW Electricity Strategy and Electricity Infrastructure Roadmap.
	Height difference from upper to lower water storages and, for underground mines, the presence of shafts or adits that extend below the surface.	
	Water resources/storage of sufficient volume of water at different levels and sufficient water quality.	
	Connectivity to electricity grid and close proximity to high voltage transmission lines.	
	Site with acceptable direct environmental impacts and with sufficient buffer land to minimise potential impacts (noise, air quality etc.).	
	Land that can be shaped and developed for associated electricity generation/ storage uses such as wind turbines, solar farms, battery storage, transmission etc.	
	Road/rail access to facilitate construction access.	
	Accessible to skilled engineering workforce.	
	Flat areas to facilitate battery storage and/or solar panel installation.	
	Terrain that maximises access to reliable wind resources (for wind turbines).	

Industrial / manufacturing uses	Existing built assets (offices, workshops, car parks etc).	Potential opportunities for manufacturing or industrial land uses, subject to detailed feasibility studies and further development of a regional employment transition strategy. Uses present significant opportunities to repurpose existing infrastructure and reduce rehabilitation costs that would other be incurred through removing this infrastructure. Potential to provide high employment generation. Potential to reduce establishment costs and timeframes through the ability to repurpose infrastructure. Uses less constrained by sight constraints associated with previous mining use (e.g. contamination, soil compaction). Buffers from surrounding land uses established for mining operations may minimise land use conflict issues. Potential to use mining-related terrain features (e.g waste rock/overburden emplacement areas and mining voids) to minimise amenity impacts (e.g. visual, noise). Minimal biodiversity constraints due to pre-existing disturbance.
	Land resources – potential to create landforms suitable for large industrial sites.	
	Water supply infrastructure/storage available to prevent the need for licensed polluted discharge to waters.	
	Proximity to residential areas in terms of worker commute.	
	Remote or shielded from sensitive residential areas or other sensitive users, where heavy industry is being considered which may have potential air (particulates, odour), visual or noise impacts.	
	Access to road, rail and communications infrastructure – for materials and product, access to port or airport infrastructure.	
	Access to skilled engineering/ manufacturing workforce.	
	Proximity to secure energy supply (grid network) and potential for co-location of renewable energy/ storage.	
	Simple land tenure arrangements for zoning and/or subdivision.	
High technology agriculture (agribusiness, including intensive production and processing)	Built assets (offices, workshops, car parks etc).	Sites may be suitable for high technology agriculture, subject to detailed feasibility studies and comparison with other post mining sites. Many mine sites are located on already (pre-mining) degraded soils and, as a result, rehabilitated land is generally not suitable for high value pasture or cropping uses without significant additional inputs. The good transport links, access to water and surrounding agricultural lands all contribute to the potential for use as an industrial agriculture site. Uses present significant opportunities to repurpose existing infrastructure and reduce rehabilitation costs that would other be incurred through removing this infrastructure.
	Land resources – potential to create landforms suitable for large production sites - e.g glasshouses, composting facilities etc.	
	Large spaces – Some agricultural enterprises are not reliant on high quality land and just need open space with a sufficient buffer zone – e.g composting facilities.	
	Access to road, rail and communications infrastructure – for materials and product, close access to sea port and airport infrastructure.	
	Proximity to urban areas in terms of worker commute.	
	Proximity to secure energy supply and potential for co-location of renewable energy/storage.	

	Water for irrigation is available and water can be managed on site (stored, reused, recycled) to prevent the need for licensed discharge to waters.	Potential to provide high employment generation. Buffers from surrounding land uses established for mining operations may minimise land use conflict issues. Potential to use mining-related terrain features (e.g. waste rock/overburden emplacement areas and mining voids) to minimise amenity impacts (e.g. visual, noise). Minimal biodiversity constraints due to pre-existing disturbance.
	Remote or shielded from sensitive residential areas or other sensitive users, where intensive agricultural uses are being considered which may have potential air (particulates, odour), visual or noise impacts.	
	Simple land tenure arrangements for zoning and/or subdivision.	
Aquaculture/ fish stocking for recreation (final voids)	Terrain suitable (or which can be shaped to be suitable) for aquaculture ponds and related processing activities, including large areas of flat land, land suitable for ponds or varying sizes or for the establishment of in-tank aquaculture areas.	Some final voids are predicted to contain water of appropriate quality for at least several hundred years that would support certain types of fish (e.g. silver perch and Australian bass). Potential to manage water quality through active treatment and/or imported water. Once the final voids were established and sufficiently filled with water, the suitability for fish stocking and potentially aquaculture could be further assessed. The same infrastructure benefits for high technology agriculture and industrial development (e.g. access to power, water, transport links) would provide benefits for such land uses. Requires assessment of suitability of void water (if voids to be used) and effluent management. Tourism and recreational outcomes from fishing activities.
	Reliable water supply infrastructure. Water quality, water treatment and storage management suitable for intensive aquaculture use.	
	Ability to contain potentially high nutrient/organic load within voids and avoid impacts on downstream, estuarine or ocean environments.	
	Access to good road, rail, power and telecommunications infrastructure. Access to port and airport for rapid distribution to international customers.	
	Remote or shielded from sensitive residential areas or other sensitive users, where waste management activities may have potential visual, noise, odour, or other impacts.	
Water storage/flood mitigation (final voids and water storages)	Voids or dams would need to have demonstrated water storage capacity.	There are a number of examples where rivers and flood flows have been diverted into former mine sites for flood mitigation, water storage, landscape redevelopment and/or ecosystem re-establishment purposes. In NSW, the potential licensing requirements associated with such diversions are likely to operate as a constraint to large scale diversion of surface flows.
	For flood diversion and planned water storage dams, sites would need to be able to divert high flow events of use cost-effective pumping to transfer water from rivers or groundwater systems to the storage.	
	Potential water quality impacts associated with geochemical interactions or groundwater inflows would need to be considered.	

Tourism	Historical aspects associated with past mining activities. Elevated terrain that provides scenic viewing opportunities. Aesthetic/ biodiversity values of rehabilitated landform. Access to road or rail transport routes. Ability to use mine related infrastructure – e.g. rail lines for tourist trains or bike tracks.	There are various attributes of mine sites that may make them suited for tourism including the fact the site was a former mine and the associated historical aspects. Aesthetic qualities associated with the rehabilitated landform or surrounding terrain may also lend themselves to tourism activities, including lookouts and walks/bike trails, accommodation, campgrounds, wellness retreats, Aboriginal cultural heritage experiences, night sky experiences due to elevation and location, sculpture trails etc.
Active recreation/ extreme sports (e.g. mountain biking, trail walking/running, rock climbing, motocross, BMX)	Terrain suitable for (or scope to reasonably shape for) diverse physical challenges such as mountain bike trails, zip lines, archery courses, etc. Water storages and pit lakes may also be suited for water recreation activities such as sailing, boating, swimming and fishing). Access to road or rail transport routes. In location that can be marketed with other related tourism experiences – such as Upper Hunter wine tourism and Sydney market. Impacts on ground surface and vegetation can be controlled, with low chance of off-site impacts. Facilities for parking, offices, cafes, accommodation or other associated infrastructure.	A number of mine sites offer terrain suitable for adventure sports developments. More detailed feasibility studies would be required, linked to more detailed regional employment transition planning. Rehabilitated waste rock/emplacement area and final void areas may be the best opportunity for this potential land use. Use of water storages/pit lakes for recreation activities would be contingent on water quality being of appropriate quality.
Grazing/ cropping/ forestry/ horticulture	Close proximity to established markets/industry. Most mine sites already undertaking rehabilitation to meet this objective or land capability of supporting these land uses. Established water supply infrastructure and ability to repurpose mine dams for water storages. Potential to co-locate with processing industries.	Generally a low value land-use per hectare with low employment generation/multipliers. Use is compatible with existing and historical land uses. For some sites, productivity of land is generally limited due to historical degradation of soils from agriculture (pre-mining). Significant inputs to rehabilitation required for improve productive capacity of land.
Residential	Land must be suitable for residential use form a public safety and human health perspective (e.g high wall, water safety and contamination risks).	The use of terrain features and other PMLUs can create desirable locations for residential development due to being in elevated locations (e.g. pit tops located on hill

	Geotechnical stability of landform. Visual amenity preferred. Road and rail access. Accesses to utilities (electricity, sewerage, water). Proximity to employment centres.	sides or escarpments, elevated terrain created by waste rock/ overburden emplacements). Revegetation/ rehabilitation of other disturbed areas can also create high value visual amenity locations and/or locations proximate to recreational uses – e.g. pit lakes, re-established woodlands/ grasslands/wetlands.
Waste, recycling, reuse and product development	Terrain suitable for all aspects of waste processing, including sorting, reprocessing (product development), repurposing, waste to energy, waste disposal. Access to road, rail and communications infrastructure suitable for transporting significant volumes of material. Remote or shielded from sensitive residential areas or other sensitive users, where waste management activities may have potential visual, noise, odour, or other impacts. Connections to waste research organisations and to appropriately skilled workforce.	A number of mine sites have similar potentially beneficial characteristics for use as waste, recycling, reuse and product development sites. Consideration would need to be given to compatibility with established land uses. Any such proposal would require careful design and maintenance of appropriate buffer zones.
Military/other armed forces or specialist training facility, such as extreme terrain exercises, firing ranges etc.	Terrain suitable for diverse training experiences. Remote or shielded from sensitive residential areas or other sensitive users, where military activity may have potential visual, noise, ecological or other impacts.	Some mine sites may be suitable for military and defence-related uses, subject to detailed feasibility studies and comparison with other post mining sites. Mine sites in proximity to existing defence sites and established buffer zones may be particularly well suited for this purpose.