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Planning and executing large-scale rehabilitation: the Newlands Coal Mine experience

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Abstract

Newlands Coal Mine (Newlands), one of Australia's largest open cut and underground coal mining operations, operated continuously from 1983 until cessation of mining in 2023. Over its operational life, progressive rehabilitation was undertaken in parallel with mining. However, the transition from operations to closure, which occurred during a period of strong coal market conditions, created uncertainty in closure timing and compressed the period available for detailed closure design to approximately 24 months prior to closure execution.

To date, more than 4,650 ha of land has been rehabilitated at Newlands, including 632 ha formally certified by the Queensland Government under the progressive certification for an environmental authority framework. A further approximately 3,533 ha is planned for rehabilitation during closure implementation.

This paper describes the planning, design and execution of one of Australia's largest coordinated mine rehabilitation and closure programs. Key elements include adaptive closure planning, post-mining land use (PMLU) definition, integration of multiple land uses, landscape-scale landform design and water management, highwall treatment, management of legacy subsidence from former underground operations, and final void assessment and design.

The closure landform includes 25 final voids (including non-use management areas (NUMAs) and voids assigned a PMLU), with design decisions informed by integrated assessments of void lake behaviour, groundwater interaction, surface water hydrology and hydraulics, geotechnical stability, and long-term land use objectives.

Highwalls were reprofiled at scale using controlled blasting techniques to create stable, undulating landforms capable of supporting grazing land use. To improve habitat diversity and connectivity with adjacent conservation areas, large areas of native ecosystem were also planned.

Delivery of rehabilitation at scale required a coordinated transition in workforce, equipment and operating model, together with active water management and staging of landform readiness to enable progressive certification outcomes.

The paper also highlights challenges associated with evolving regulatory frameworks, changing completion standards, updated design rainfall guidance, and emerging climate change considerations.

Lessons emerging from the Newlands experience provide practical insights for operators, regulators and practitioners involved in planning, executing and sustaining large-scale mine rehabilitation and closure programs.

Keywords: mine rehabilitation, mine closure, progressive rehabilitation and closure plan (PRCP), landform design, final voids, Newlands

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1 Introduction

Large-scale open cut coal mining has left a legacy of extensive disturbed landforms across many of Australia's coal basins. In Queensland's Bowen Basin, the shift from active mining toward mine closure is occurring across multiple large operations, creating both challenges and opportunities for rehabilitation practitioners. While progressive rehabilitation has long been a regulatory and corporate requirement, the transition from operations to closure fundamentally changes rehabilitation from an incremental activity to an integrated, site-wide closure design exercise with substantially different scale, pace and risk profile.

Newlands Coal Mine (Newlands), operated by Glencore Coal Assets Australia, provides a representative example of mine operations transitioning to rehabilitation. Detailed closure planning was undertaken while mining remained economically viable, necessitating rehabilitation and closure design in parallel with ongoing operations, while final cessation timing remained uncertain. Following 4 decades of open cut and underground mining, the cessation of operations required the rehabilitation of thousands of hectares of disturbed land, with compressed planning timeframes due to internal governance requirements, and within the context of increasing scrutiny from regulators and evolving closure expectations.

Unlike rehabilitation conducted incrementally during operations, closure-phase rehabilitation at Newlands required the integration of legacy landforms, final voids, underground subsidence zones, and long-term post-mining land uses (PMLUs) into a coherent, stable and sustainable landscape design. This was further complicated by the transition of the workforce from operational mining to rehabilitation delivery, which required a shift from large mining equipment and fleets to civil-scale earthmoving equipment, a transition from continuous to predominantly day-shift operations, and the development of rehabilitation-specific workforce competencies. The transition was further influenced by ageing mining equipment and infrastructure constraints, while retention of experienced personnel remained critical to maintaining continuity in landform knowledge and rehabilitation quality.

This paper presents the Newlands rehabilitation program as a case study in closure-focused planning, rehabilitation design and execution. The objectives are to:

- describe the rehabilitation and closure planning context at Newlands
- summarise key technical approaches applied to the closure design of landscape-scale landforms and water management, highwall treatment, subsidence remediation and final voids
- discuss the role of PMLU planning in guiding rehabilitation and closure design decisions
- describe challenges and share lessons learned that may inform rehabilitation and closure planning at other large mining operations.

2 Site and operational overview

Newlands is located in central Queensland within the Bowen Basin, and operated as a large, multi-pit open cut and underground coal mining complex from 1983 to 2023. Mining occurred across 15 mining leases and a total land area of 32,633 ha, producing extensive spoil landforms, open pits, final voids, underground panels, fixed processing and service infrastructure, major haul road networks and infrastructure services corridors.

Progressive rehabilitation was implemented throughout the operational life of the mine in accordance with contemporary regulatory and corporate requirements applicable at the time. Figure 1 shows the rehabilitation history of the mine, with over 4,500 ha completed to date. To date, the regulator has certified 632 ha of rehabilitation.

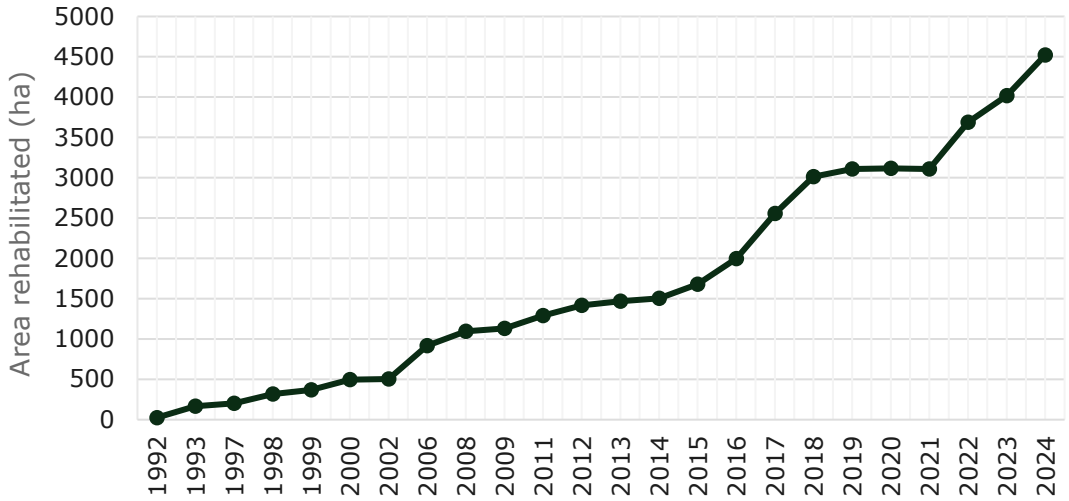

Figure 1 Progressive rehabilitation at Newlands

Despite this progressive approach, large areas remained either partially rehabilitated or unavailable for final shaping and rehabilitation until mining ceased. These included:

- areas adjacent to active pits and highwalls
- final void margins awaiting definitive closure design
- major infrastructure areas which were required to remain operational until late in the mine life, including the coal handling and preparation plant (CHPP), workshops, offices and services
- landforms constrained by short-term operational or water management requirements.

The climatic setting is characterised by highly variable rainfall, intense storm events and extended dry periods, which strongly influenced rehabilitation design standards and execution planning. The surrounding landscape includes grazing land uses and extensive areas of remnant and native vegetation regrowth, including protected areas adjacent to the mine.

3 Rehabilitation planning framework

3.1 Regulatory context

Persons carrying out mining activities in Queensland are legally obligated to rehabilitate disturbed land. In 2018, the Queensland Government introduced a comprehensive package of reforms aimed at improving rehabilitation and financial assurance outcomes across the resources sector, including the introduction of PRCPs under the *Mineral and Energy Resources (Financial Provisioning) Act 2018 (Qld)* and amendments to the *Environmental Protection Act 1994 (Qld)* (State of Queensland 2018).

The PRCP framework requires mine operators to articulate final land condition, define PMLUs and demonstrate how progressive and final rehabilitation will be designed, implemented, monitored and measured over time. For Queensland mines, this represented a material step-change from earlier activity-based rehabilitation approaches to an outcomes-focused, closure-oriented framework (Department of Environment, Tourism, Science and Innovation 2024).

At Newlands, implementation of the PRCP framework necessitated reassessment of historical rehabilitation concepts and alignment with updated government expectations for landform stability, ecosystem function, water management performance and long-term stability.

To date, Newlands has achieved 632 ha of formally certified rehabilitation from the Queensland Government under the progressive certification for an environmental authority framework. This has provided Newlands

with regulatory confidence and a robust evidentiary foundation to refine and operationalise PRCP framework requirements. Progressive certification outcomes have been used to inform and support the validation of design standards, sequencing and completion criteria across the remaining mine footprint.

3.2 Rehabilitation objectives

The overarching rehabilitation objectives at Newlands are to:

- achieve landforms that are geotechnically stable, non-polluting, and capable of enduring a range of climatic conditions, including extreme events and climate change scenarios
- support sustainable PMLUs consistent with regional land use and stakeholder expectations
- minimise ongoing maintenance and intervention requirements following lease surrender
- integrate rehabilitated areas with surrounding landscapes to enhance ecological and land use connectivity (Glencore 2026).

These objectives guided rehabilitation design and prioritisation across the mine footprint and were supported by PMLU-specific revegetation strategies aimed at establishing self-sustaining vegetation communities appropriate to the intended land use. For grazing land uses, this included the establishment of productive and resilient pasture systems, while for native ecosystem and riparian areas, revegetation focused on the use of locally appropriate species adapted to long-term site conditions to maximise ecological function and sustainability.

3.3 Rehabilitation staging and scale

The scale of rehabilitation at Newlands necessitated careful staging and prioritisation. With more than 8,000 ha of disturbance over the life of mine, closure phase rehabilitation focused initially on areas with the highest risk, including:

- large spoil landforms with completed final shaping
- decommissioned infrastructure corridors
- highwall-dominated pit margins requiring stability treatment
- catchments critical to downstream water quality and flood behaviour (Glencore 2026).

Staging of rehabilitation activities also considered the readiness of landforms for revegetation, including the availability of suitable growth media, completion of final drainage controls and the ability to establish self-sustaining vegetation aligned with the nominated PMLU. This ensured that revegetation outcomes could be achieved progressively and contribute toward certification objectives without rework or ongoing intervention being required.

4 Post-mining land use and non-use management area planning

PMLU and NUMA planning was fundamental to rehabilitation and closure design at Newlands. A NUMA is an area of land that cannot be rehabilitated to a stable condition after all the relevant activities for the PRCP carried out on the land have ended (Department of Environment, Tourism, Science and Innovation 2024). Rather than applying uniform rehabilitation treatments, landforms were designed to support multiple PMLUs where achievable across the site, reflecting land capability, stakeholder expectations and long-term sustainability considerations. NUMAs were also integrated into the closure design to support the management of residual risk that could not be eliminated through rehabilitation.

All PMLUs were designed to achieve final land conditions that are safe, stable and non-polluting, with rehabilitation approaches tailored to landform attributes, available growth media, and long-term functional performance requirements. Vegetation strategies did not seek to replicate specific regional ecosystems, but

instead focused on establishing self-sustaining vegetation communities using species suited to local conditions and intended land uses (Glencore 2026).

4.1 Grazing land use

Grazing forms a dominant PMLU across much of the rehabilitated area. Landforms intended for grazing were designed to replicate the function of surrounding pastoral landscapes, with moderate slopes, coherent drainage patterns, and sufficient soil profile depth to support pasture establishment. Highwalls and steep batters were either reprofiled or isolated from grazing areas to minimise erosion and safety risks.

Vegetation establishment for grazing areas focuses on developing productive and self-sustaining pasture systems, incorporating a mix of native and naturalised species suited to the anticipated long-term land capability. Landform and growth media design considered the availability and quality of materials, as well as regulatory constraints and surrounding land uses, to support sustainable grazing outcomes.

Where suitable, retained water features were incorporated within grazing areas to provide stock water supply, and select infrastructure such as access tracks and fencing were retained where compatible with PMLU objectives and their retention was agreed with landholders (Glencore 2026).

4.2 Native ecosystem restoration

In parallel, large areas were designated for restoration of native ecosystems. These areas were strategically located where possible to:

- connect with adjacent remnant vegetation and protected areas
- increase habitat diversity within the rehabilitated landscape
- provide buffers along drainage lines and around final voids.

Rather than attempting to recreate specific regional ecosystems, revegetation focused on establishing diverse, self-sustaining native vegetation communities using species representative of those found within the surrounding region and on comparable landforms and soils. This approach supports long-term resilience while increasing habitat diversity, including the introduction of features such as rocky slopes, open water bodies, and drainage lines that provide varied ecological niches (Glencore 2026).

4.3 Integration of multiple land uses

A key challenge at Newlands was integrating grazing and conservation objectives within a single rehabilitated landscape. This required careful planning of boundaries, drainage pathways and landform transitions to avoid land use conflicts and to ensure that each PMLU could be sustainably managed over the long term.

Integration was further influenced by the need to coordinate land use outcomes across adjacent agricultural landholdings, including Glencore's pastoral entity, Colinta Holdings Pty Ltd. Notwithstanding common ownership, rehabilitation planning required detailed stakeholder engagement to align expectations regarding final land uses, operational interfaces, and decisions on infrastructure to be retained or removed as part of closure.

Landholder agreements were also required to facilitate access to land for rehabilitation activities, as well as ongoing access for monitoring and maintenance. The landholder agreements set out compensation and access arrangements, including responsibilities for infrastructure operation and maintenance, access and land stewardship. New agreements are required in locations where the mining lease expires but access is still required to enable efficient delivery of closure works and the long-term management of rehabilitated areas.

4.4 Non-use management areas

At Newlands, NUMAs predominantly comprise final voids and associated features, where rehabilitation is focused on achieving long-term geotechnical stability, ensuring public safety and delivering acceptable

environmental outcomes. Rather than supporting active land uses, remedial works for NUMAs are designed to minimise residual risk and maintenance requirements, while remaining compatible with the surrounding rehabilitated landscape and agreed post-closure objectives (Glencore 2026).

The identification and design of NUMAs were informed by integrated technical assessments, including void lake behaviour, groundwater interaction, surface water flooding and geotechnical stability, to support the understanding and management of long-term risks. In some areas, revegetation contributes to stabilisation outcomes within NUMAs, particularly along highwall transitions and drainage features.

5 Closure implementation and rehabilitation delivery

5.1 Rapid adaptive closure planning

A key challenge at Newlands was that detailed closure planning occurred while mining remained economically viable, during a period of strong coal markets and ongoing operational uncertainty.

The decision to cease mining operations in 2023 followed a period of declining coal quality, increasing strip ratios, and tightening operating margins, after continued efforts to maintain efficient and economically viable operations. As a result, whole-of-operation closure planning was initiated approximately 24 months prior to the cessation of mining, requiring an adaptive and staged rehabilitation design approach. Closure planning rapidly progressed in parallel with active mining and evolving commercial decisions, necessitating flexible rehabilitation sequencing, contingency planning for the continuation of operations, and early engagement with regulators regarding potential closure scenarios.

Closure required a significant transition in workforce skills, equipment and operating model. Key changes included:

- shift from mining fleet to civil-scale earthmoving equipment
- transition from continuous operations to predominantly day-shift work
- training of personnel in rehabilitation-specific competencies.

Retention of experienced personnel during closure was identified as a key success factor, enabling continuity in landform knowledge and rehabilitation quality.

5.2 Landscape-scale landform design

Some rehabilitation of spoil landforms occurred progressively throughout operations; however, closure has enabled final reshaping at scale, including:

- regrading of outer batters to reduce erosion risk
- integration of landform ties between adjacent mining areas
- removal of legacy haul roads and operational berms.

Closure planning and implementation has allowed the application of consistent slope geometries, drainage controls and soil profiles across large contiguous areas, with the objective of improving long-term stability and reducing maintenance requirements.

5.3 Landscape-scale water management

Water management was identified as a critical constraint and enabler of rehabilitation at Newlands. At closure, significant volumes of mine-affected water were stored across multiple pits and dams, requiring coordinated planning prior to rehabilitation works. The water inventory over the last decade is provided in Figure 2.

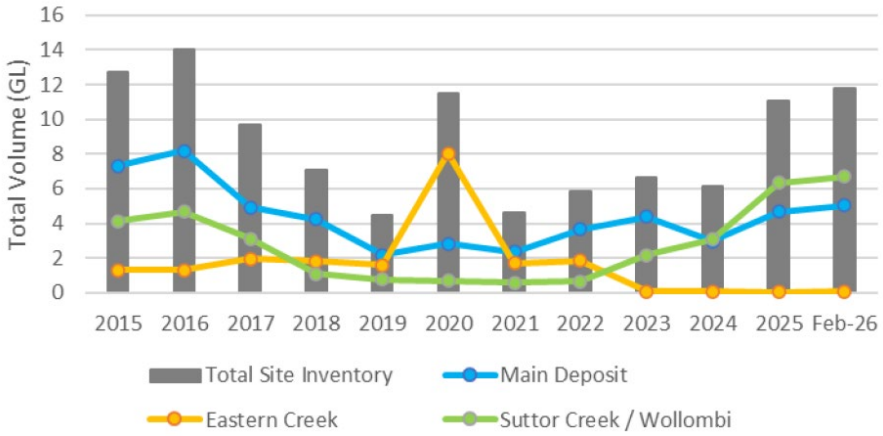

Figure 2 Water inventory (Glencore 2026)

Key challenges included:

- transfer of water inventories between deposits to enable landform drying and reshaping
- high pumping volumes over extended periods and geographical areas
- temporary duplication of pipeline infrastructure
- maintaining compliance with Environmental Authority EPML00817713 (Department of Environment, Tourism, Science and Innovation 2026) conditions throughout closure.

A live and adaptive closure water management plan was implemented and maintained for closure, to support alignment of rehabilitation sequencing with dewatering milestones.

Rather than relying solely on localised erosion controls, rehabilitation planning adopted a catchment-scale approach to drainage design. Rehabilitated landforms are shaped to establish coherent drainage networks that broadly reflect natural catchment behaviour, incorporating long, gently concave slopes, defined drainage lines with adequate capacity, and controlled discharge points aligned with natural waterways. An example of the large-scale reshaping at ramps 15–17 is shown in Figure 3.

(a) (b)

Figure 3 Ramps 15–17 (Suttor Creek). (a) April 2023; (b) February 2026

Rehabilitation designs at Newlands were influenced by updated design rainfall guidance adopted over the life of the final rehabilitation program. Increasing recognition of climate variability and potential intensification of rainfall events required reassessment of earlier drainage designs, and in some cases, retrofitting of rehabilitated areas to improve resilience.

Water quality objectives were integrated into rehabilitation planning, particularly in catchments draining toward final voids and downstream environments. Sediment control, stable drainage pathways, and effective vegetation establishment were essential to minimising offsite impacts during and after rehabilitation.

5.4 Highwall treatment and landform reprofiling

Highwalls are a defining feature of large-scale open cut coal mines and represent a significant rehabilitation challenge. At Newlands, many pits exhibited extensive highwalls that were unsuitable for long-term stability or grazing land uses in their original form.

Following confirmation of full mine closure, a cost–benefit reassessment was undertaken that supported large-scale highwall blasting as the preferred long-term closure strategy in many locations. Controlled blasting of highwalls was used to:

- reduce slope angles from near vertical to typically 15–22% and create undulating landforms capable of retaining soil placement and supporting vegetation
- improve long-term geotechnical stability
- reduce highwall exposure height, thereby reducing rockfalls and erosion risks
- enable integration of former pit margins into a single rehabilitated landscape.

The use of blasting allowed rehabilitation outcomes that would not have been achievable through conventional earthmoving alone, particularly over large areas. In the few situations where highwalls were retained, exclusion zones and land use restrictions were incorporated into PMLU planning.

Examples of highwall reshaping at ramps 10 and 2 are shown in Figures 4 and 5, respectively.

(a) (b)

Figure 4 Ramp 10 (Eastern Creek). (a) October 2022; (b) February 2026

(a) (b)

Figure 5 Ramp 2 Southern Underground (Main deposit). (a) August 2022; (b) February 2026

5.5 Subsidence and legacy underground mining impacts

Historical underground mining beneath parts of the site resulted in surface subsidence, cracking and altered drainage patterns. Closure phase rehabilitation planning requires a risk-based approach consistent with PRCP requirements, with the objective of ensuring subsidence does not present a safety or environmental hazard in the context of the nominated PMLU(s) (Glencore 2026).

The sealing of historical underground portals has been completed, with works focused on achieving long-term safety and stability. Subsidence features, including surface cracking, are managed based on post-subsidence inspections, with remediation targeted to areas that present erosion risk, public safety concerns, or potential impacts to livestock or native fauna.

This approach enables targeted intervention while avoiding unnecessary disturbance where subsidence does not adversely affect landform performance or the intended PMLU.

5.6 Final voids and non-use management areas

Final void management represented one of the most complex closure considerations for Newlands. A total of 25 final voids were planned to be retained at closure, each with a tailored rehabilitation strategy (Glencore 2026). Decisions regarding final void management were informed by integrated technical studies addressing:

- void lake water balance and long-term water level behaviour extending to 500 years post closure
- groundwater interactions and inflow/outflow dynamics
- surface water hydrology, hydraulics and inundation sequences, including consideration of extreme events
- geotechnical stability of final batters
- safety and access considerations
- compatibility with long-term surrounding land uses and objectives.

Rather than adopting a single closure solution, rehabilitation outcomes were varied to suit site-specific constraints and opportunities. For example, some voids were incorporated as permanent water features within managed catchments and one void (Ramp 13N) was designed to periodically flush to surface water to improve long-term water quality outcomes.

Some voids were designed to be reshaped and isolated to minimise long-term risks.

5.7 Contaminated land

Industrial operations at the site spanned many decades, presenting the possibility of contaminated land impacts. A site-wide preliminary site investigation was undertaken to identify higher-risk areas and guide further investigation using a risk-based approach. Detailed site investigations (DSIs) are being completed in a staged manner, requiring careful sequencing with demolition, landforming and rehabilitation activities. A contaminated land auditor has been appointed as required under the PRCP to provide a suitability statement that the land is suitable for the proposed land use. The CHPP was demolished in 2025 (Figure 6), and the DSI for this area has now been completed to inform monitoring, remediation and closure planning.

(a) (b)

Figure 6 CHPP decommissioning (Main Deposit). (a) 2020; (b) 2025

6 Summary of key challenges in delivering rehabilitation at scale

One of the most significant challenges encountered at Newlands was managing rehabilitation delivery across a period of rapidly evolving regulatory expectations. Design standards for rehabilitation considered acceptable during operations were, in some cases, insufficient to meet closure phase certification criteria, or were considered to have insufficient reliance to address more extreme weather events and therefore requiring adaptive management and ongoing refinement.

Legacy landforms constructed decades earlier posed particular challenges, as they were often designed without consideration of contemporary PMLUs proposed, or certification requirements. Rehabilitation of these areas has required innovative solutions to balance risk reduction, cost and achievable outcomes.

Delivering rehabilitation across thousands of hectares has required careful planning, contractor capability, and sustained organisational commitment. Coordination of earthworks, soil placement and revegetation activities at scale was critical to maintaining quality and consistency.

7 Lessons learned

Lessons emerging from the Newlands experience to date include:

- Early and integrated closure planning is critical and provides a strong foundation for all subsequent rehabilitation decisions, even when mine life remains uncertain.
- Progressive rehabilitation certification can materially de-risk PRCP implementation by providing early feedback on rehabilitation techniques and performance, and provide confidence in rehabilitation outcomes.
- Catchment-scale water management planning is essential for achieving stable, low-maintenance landforms and should be treated as a primary rehabilitation dependency.
- Highwall removal and treatment, while capital intensive, can significantly improve long-term closure outcomes by expanding rehabilitation options and reducing a number of long-term risks.
- Workforce transition planning, including refocusing the workforce from operations to closure execution and establishing a clear sense of purpose and career pathway, is as important as technical design.
- Regulatory flexibility and ongoing engagement with both the regulator and community are critical when delivering rehabilitation over long timeframes.

8 Conclusion

The Newlands rehabilitation program highlights the challenges and opportunities associated with large-scale mine rehabilitation at closure. By integrating PMLU planning, landscape-scale design and adaptive management, the program has delivered significant rehabilitation works to date across a complex and extensive mine footprint.

As more large mining operations across Australia enter closure phases, the lessons from Newlands offer practical guidance for planning and executing rehabilitation programs that are intended to be resilient, certifiable, and aligned with long-term land use outcomes.

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