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A Study on the Landscape Strategy for Abandoned Mines Based on Ecological Restoration: A Case Study of the Zeirong Area (Zhenjiang, China)

Qualification work for obtaining the SVO «Master»
in the specialty B2 Design OPP «Design of the architectural and landscape environment»

Kharkiv State Academy of Design and Arts
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Presentation Structure

01 Research Background & Question

02 Theory & Methodology

03 Case Studies & Site Diagnosis

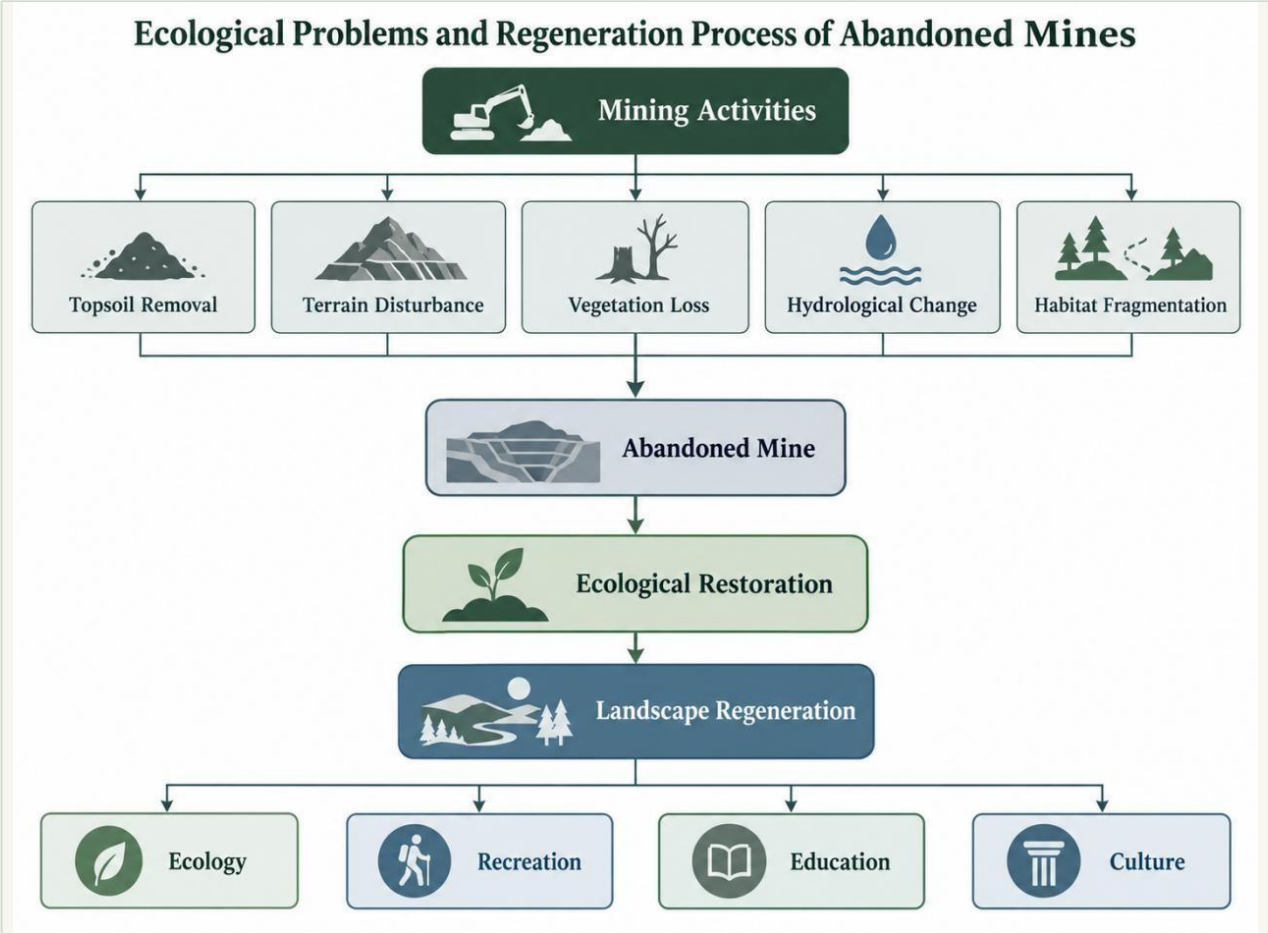
04 Regeneration Strategy & Design

05 Findings, Limitations & Conclusion



Research Background

Abandoned mines combine ecological degradation, spatial abandonment and distinctive post-mining landscape resources



Terrain Disturbance

Altered landform, steep slopes and exposed rock surfaces increase safety and restoration difficulty.

Ecological Degradation

Vegetation discontinuity weakens habitat connectivity between the mine interior and surrounding forest.

Hydrological Change

Pit water and altered runoff create ecological uncertainty, but also potential for wetland-based restoration.

Functional Decline

After mining stops, land function declines and access is limited, requiring a new low-intensity use framework.

Post-mining regeneration must solve ecological and safety problems while transforming existing terrain, water and vegetation into long-term landscape assets.

Source: Thesis Figure 1.1; drawn by the author.

From Abandonment to Regeneration

Landscape design connects ecological recovery with spatial reuse

01 Problems

Degraded land and exposed substrate

Fragmented vegetation and habitats

Steep terrain and safety constraints

Loss of productive and public functions

02 Ecological Restoration

Stabilize disturbed terrain and slopes

Rebuild vegetation and habitat continuity

Improve water–land ecological relationships

Support natural succession and resilience

03 Regeneration Opportunities

New wetland and woodland habitats

Readable post-mining landscape identity

Geological and ecological education

Low-intensity recreation and community use

The goal is not simply to beautify abandoned land. Ecological restoration provides the foundation, while landscape design translates recovery processes into spatial structure, public experience and long-term management.

Research Gap

Where the thesis positions itself

Existing research provides extensive knowledge on

Land reclamation and landform treatment

Soil/substrate improvement and erosion control

Vegetation restoration and ecological succession

Post-mining land reuse and public-space transformation

BUT

Research gap

The translation from ecological restoration principles into spatial landscape design remains insufficient.

Many studies explain how damaged land can be restored, but fewer clarify how restoration priorities should determine spatial structure, intervention intensity, circulation and public use.

This thesis therefore treats ecological restoration as a design-generating framework rather than an isolated technical measure.

Source: Thesis Introduction, Section 1.3.

Research Question

The central question guiding the study

How can ecological restoration guide the landscape regeneration of an abandoned mine while balancing ecological protection, site identity and public use?



Research Objectives

Four tasks structure the study from diagnosis to design

01 Diagnose
Terrain · water · vegetation · access

Identify terrain, water, vegetation, habitat and accessibility constraints through site investigation and spatial analysis.

02 Understand

Clarify how ecological restoration, landscape ecology, resilience and green infrastructure can guide post-mining regeneration.

03 Develop

Translate diagnosis into differentiated strategies for terrain, vegetation, water, habitat, public space and interpretation.

04 Apply

Apply the strategy to the Gaolishan mine through spatial structure, circulation, landscape nodes, planting and design visualization.

Diagnosis → Strategy → Design Translation

Source: Thesis Section 1.2.

Research Scope

Ecological and landscape dimensions are examined together

Ecological Dimension

Terrain and slope safety

Soil / substrate conditions

Mine-pit water and runoff

Vegetation succession

Habitat connectivity

Approx. 40 ha study scope defined by preliminary design data and site investigation.

Landscape Dimension

Spatial structure and zoning

Slow circulation and accessibility

Low-intensity public use

Geological / historical interpretation

Monitoring and adaptive management

Gaolishan Abandoned Mine
Jurong · Zhenjiang · Jiangsu

Source: Thesis Section 4.1 and preliminary design data.

Research Methodology

A combined research-by-design approach

01 Literature Review

Review ecological restoration, landscape ecology, resilient landscape and mine-regeneration research to establish the theoretical basis.

02 Case Study

Compare Pan'an Lake and Sudbury to identify transferable principles rather than copy design forms.

03 Field Investigation

Document terrain, rock walls, water, vegetation, access and surrounding landscape through field observation and photographs.

04 GIS & Remote Sensing

Use available imagery and spatial information to understand landform, ecological context and design relationships.

05 Landscape Design

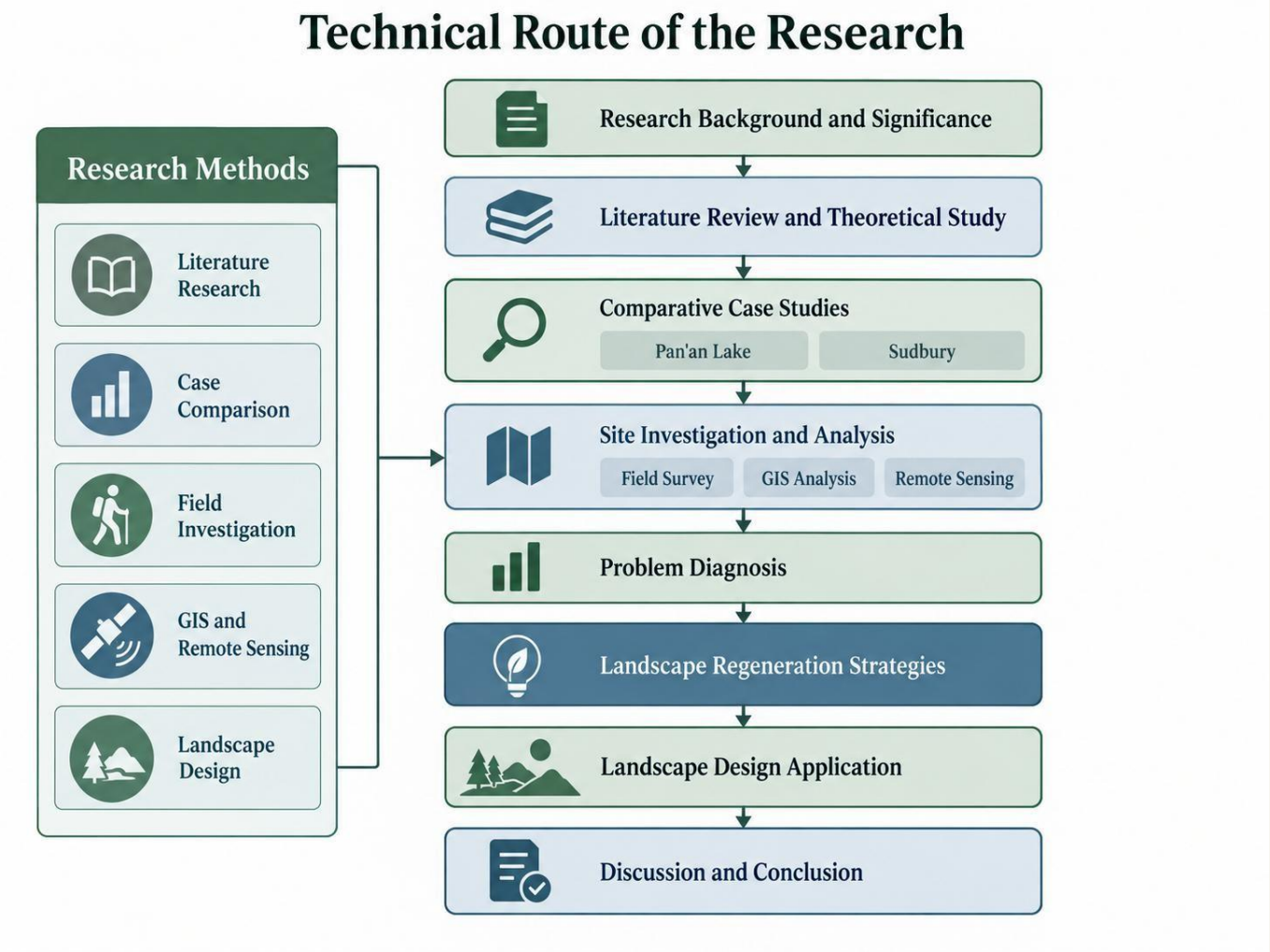
Convert ecological diagnosis into spatial structure, restoration priorities, circulation and conceptual landscape design.

Literature & cases → Site evidence → Ecological diagnosis → Regeneration strategy → Design application

Source: Thesis Section 1.4.

Technical Route

From theoretical research and site diagnosis to design application



Source: Author's technical route diagram.

Theoretical Foundation

Four perspectives support the regeneration framework

01 Ecological Restoration

Restore ecological structure and processes while supporting natural succession and long-term ecosystem stability.

02 Landscape Ecology

Use patches, corridors and ecological networks to reconnect fragmented habitats and organize spatial relationships.

03 Resilient Landscape

Accept uncertainty and change; design for phased restoration, monitoring and adjustment rather than a fixed final state.

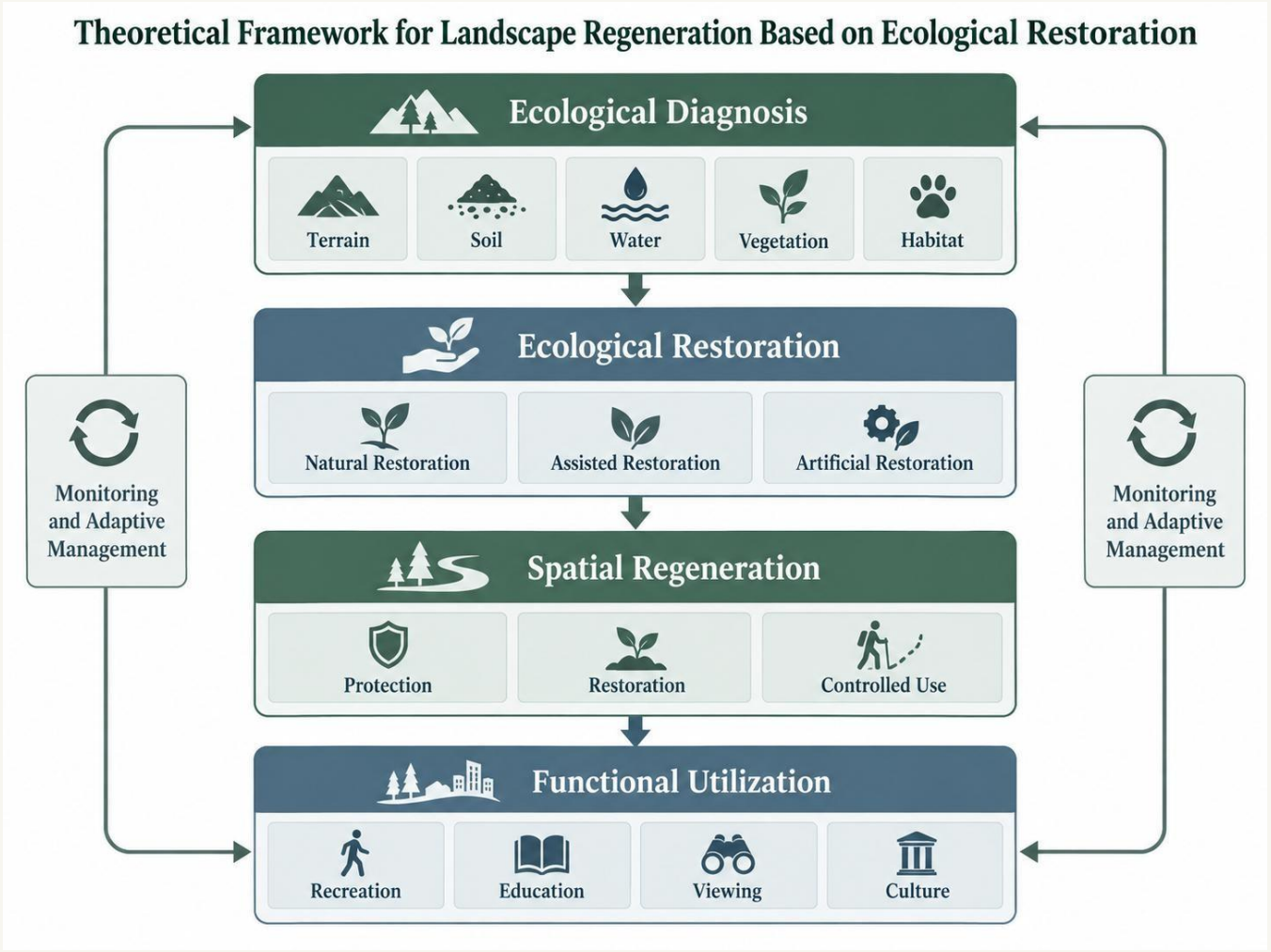
04 Green Infrastructure

Integrate ecological functions with stormwater management, recreation, access and environmental education.

POST-MINING LANDSCAPE REGENERATION

Integrated Research Framework

Ecological conditions determine the intensity and form of landscape intervention



Source: Author's theoretical framework based on Chapter 2.

Comparative Case Studies

Two contrasting restoration paths inform the Gaolishan strategy

Pan’an Lake · Xuzhou, China

Mining subsidence and long-term water accumulation
Adaptive use of existing hydrological conditions
Wetland restoration combined with land reclamation
Ecological landscape integrated with public recreation

Adaptive hydrology

Sudbury · Ontario, Canada

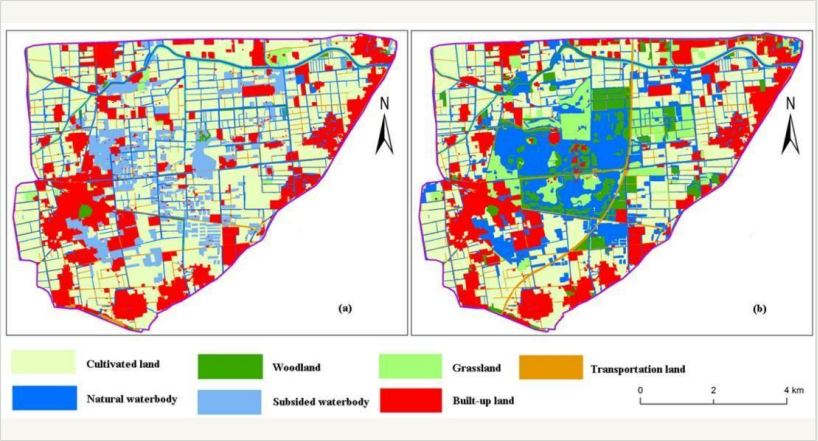
Severely degraded soil and vegetation system
Long-term regreening rather than one-time construction
Soil improvement followed by phased revegetation
Monitoring, succession and continuous management

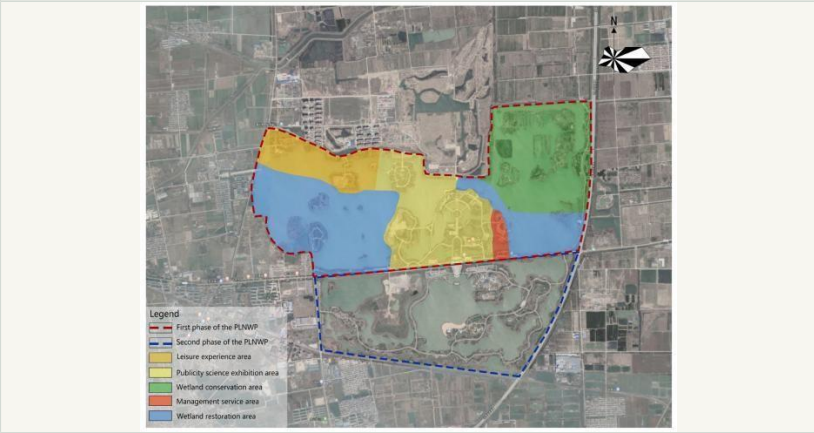
Long-term succession

Source: Thesis Chapter 3.

Pan'an Lake Mining Subsidence Area

Adaptive reuse of subsidence water as ecological infrastructure





Problem

Mining subsidence created extensive low-lying areas and persistent water accumulation, making hydrology the key restoration condition.

Strategy

Restoration adapts to the existing water regime through wetland construction, land reclamation and ecological shoreline treatment.

Transformation

Ecological recovery is combined with controlled recreation, allowing restored water landscapes to support public use.

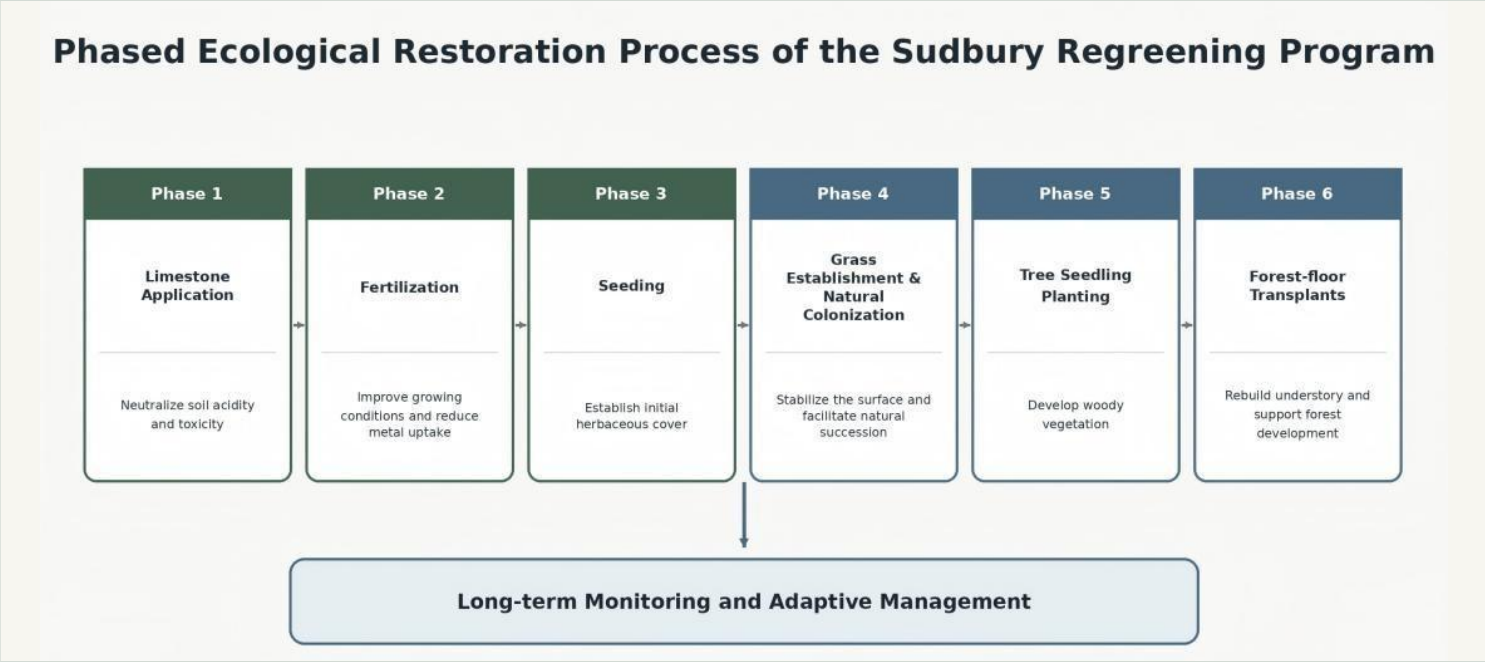
LESSON 01

Adapt to existing hydrological conditions rather than completely reshaping the site. For Gaolishan, the mine-pit water body should therefore be assessed first and then integrated into restoration according to actual water and shoreline conditions.

Sources: Xu et al. (2020); thesis Figures 3.1–3.2.

Sudbury Mining Area

Long-term restoration as an evolving ecological process



Problem

Historic mining and smelting produced severe soil degradation and widespread vegetation loss across the Sudbury landscape.

Strategy

The regreening process combines soil improvement, pioneer planting, community development and long-term ecological succession.

LESSON 02 · Restoration requires long-term ecological succession, monitoring and adjustment. The case supports a phased vegetation strategy for Gaolishan instead of short-term decorative greening.

Source: Thesis Figure 3.4; based on City of Greater Sudbury Regreening Operations.

Lessons for Gaolishan

Four transferable principles rather than direct copying

01 Respect Existing Landforms

Retain recognizable rock walls, elevation differences and mine-water characteristics where ecological and safety conditions permit.

02 Differentiate Water and Land Restoration

Treat water, slopes, forest edges and disturbed land differently according to their ecological conditions and restoration potential.

03 Allow Ecological Succession

Use natural succession and assisted restoration to establish more stable plant communities over time.

04 Restoration Before Intensive Use

Locate intensive activities on stable, accessible land and maintain low disturbance in ecologically sensitive areas.

Source: Thesis Section 3.4.

Regional Context

Gaolishan is embedded in a mountain–forest–rural landscape with regional connections to Jurong, Zhenjiang and Nanjing

Location

Biancheng Town, Jurong City, Zhenjiang, Jiangsu Province

Regional Connections

Regional access connects the site with Jurong, Zhenjiang and the broader Nanjing–Zhenjiang area.

Landscape Character

Continuous low mountains, forest vegetation and rural landscapes create a strong ecological background and an existing basis for hiking and outdoor recreation.

Design implication: regeneration should connect the mine with surrounding mountain, forest and recreation resources rather than treat it as an isolated urban park.



Source: Cjsy2026, Wikimedia Commons, 2022, CC BY-SA 4.0; thesis Section 4.1.

Site Overview

The study area is defined by a mine pit, water body, rock walls and surrounding forest



≈40 ha
Approx. 40 ha study scope defined by preliminary design data and site investigation.

Mine Pit

Open-pit landform with exposed rock, elevation differences and disturbed ground.

Water Body

Existing pit water forms the primary visual focus and a potential basis for wetland and shoreline restoration after assessment.

Peripheral Forest

Existing woodland provides ecological sources for succession and habitat connectivity.

Source: Thesis Figure 4.4; author's analytical diagram based on imagery and field investigation.

Natural Conditions

The site combines strong topography, pit water and a surrounding forest matrix



Mountainous Terrain

Pronounced elevation variation creates both safety constraints and opportunities for multi-level landscape experience.

Forest Background

Peripheral woodland provides seed sources, habitat continuity and a natural background for assisted restoration.

Mining Landscape

Rock walls, pit water and disturbed slopes form a recognizable post-mining identity that should not be erased by excessive reshaping.

Source: Thesis Section 4.2 and Figure 4.1.

Existing Mining Landform

Field evidence reveals both constraints and visually distinctive resources



Exposed Rock Wall

Steep Mining Slope





Mine Pit Water

Vegetation–Bare Ground Interface



Source: Photographed by the author during field investigation.

Cultural & Social Context

The site combines geological, historical and recreational values



Cultural Resources

Gaolishan Formation and geological education
Mining-site memory and post-mining landscape traces
Weigang Battle and regional historical context

Outdoor Context

Existing hiking activities
Landscape viewing and photography
Nature-based recreation around Gaolishan and nearby water landscapes

Hikers & Nature Enthusiasts

Families & Ecotourists

Students & Academic Groups

Local Residents

Design implication: public functions should support outdoor experience, ecological education, local culture and community leisure without exceeding ecological limits.

Source: Xinhua News Agency, 2025; thesis Section 4.3.

Key Constraints

Four issues define the regeneration problem

01 Terrain & Safety

Steep slopes, exposed rock walls and large elevation differences require safety assessment before public access or landscape intervention.

02 Water Uncertainty

The pit water is visually important, but insufficient water-quality data limits direct recreational or ecological claims.

03 Habitat Fragmentation

Bare rock, bare ground and vegetation discontinuity reduce habitat continuity between the mine interior and surrounding forest.

04 Spatial Interpretation

Existing outdoor use is not yet integrated with geological, mining, ecological and historical interpretation.

Design principle: ecological and safety limits are assessed first; restoration intensity, access and public functions are then differentiated by site condition.

Source: Thesis Section 4.4.

Regeneration Potentials

Existing site characteristics become the foundation for design

Mining Landform
Rock walls and elevation differences become spatial identity and viewing resources.

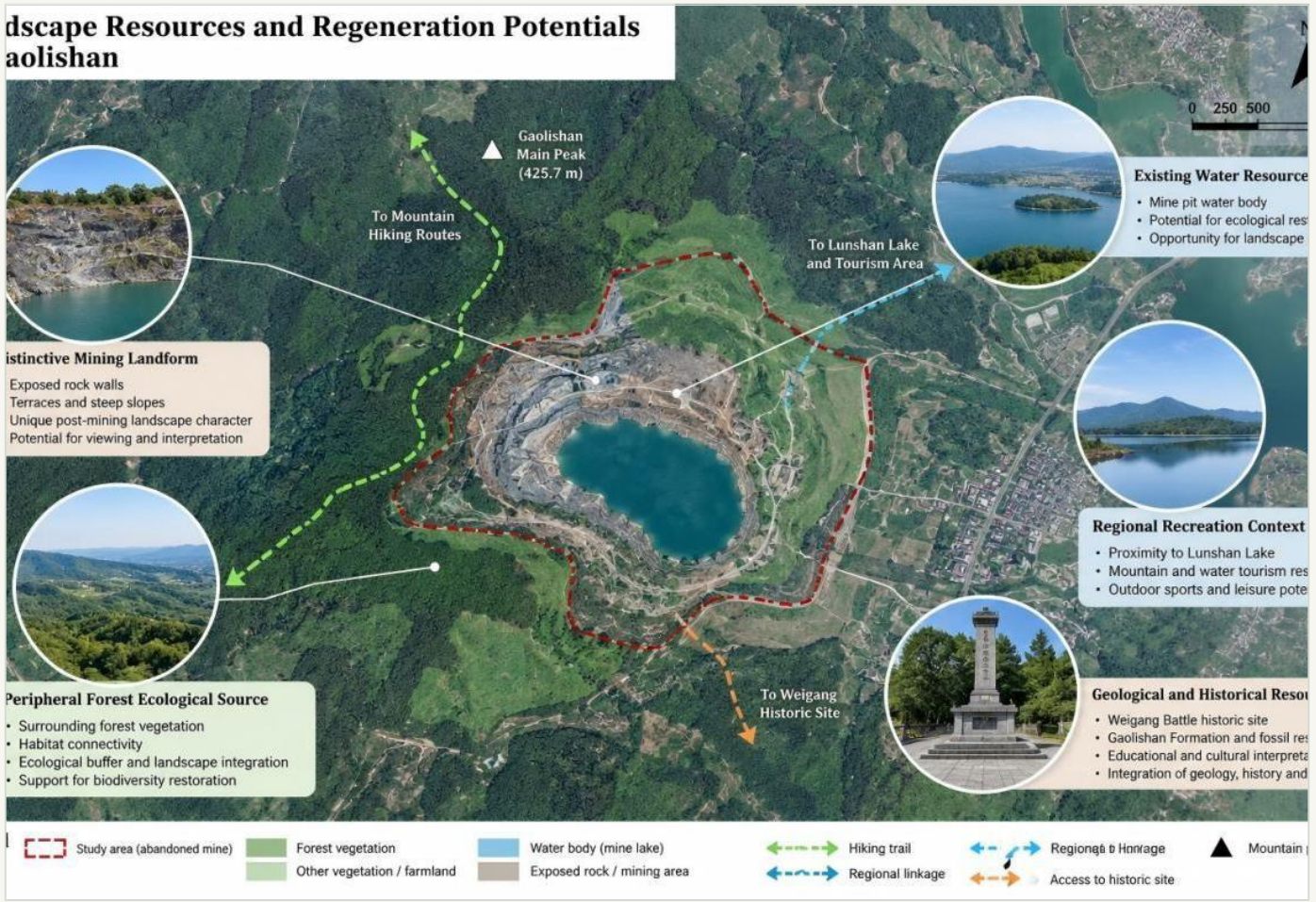
Water Resource
Pit water can support wetland and shoreline systems after testing and ecological assessment.

Peripheral Forest
Existing woodland provides ecological sources for succession and habitat connectivity.

Geological Resource
The Gaolishan Formation supports geological interpretation and environmental education.

Cultural & Recreation
Weigang history, hiking and regional outdoor use broaden the site narrative and user base.

CONSTRAINTS → REGENERATION ASSETS



Source: Thesis Figure 4.4.

Design Concept — “Return to the Source”

Restore ecological stability while retaining the identifiable character of the post-mining landscape

01 RESTORE

Restore vegetation, habitat and water–land relationships to rebuild a stable ecological foundation.

02 RETAIN

Retain readable rock walls, pit water and elevation differences where safety and ecological conditions allow.

03 RECONNECT

Reconnect natural processes, low-intensity public experience and the geological / mining memory of the site.

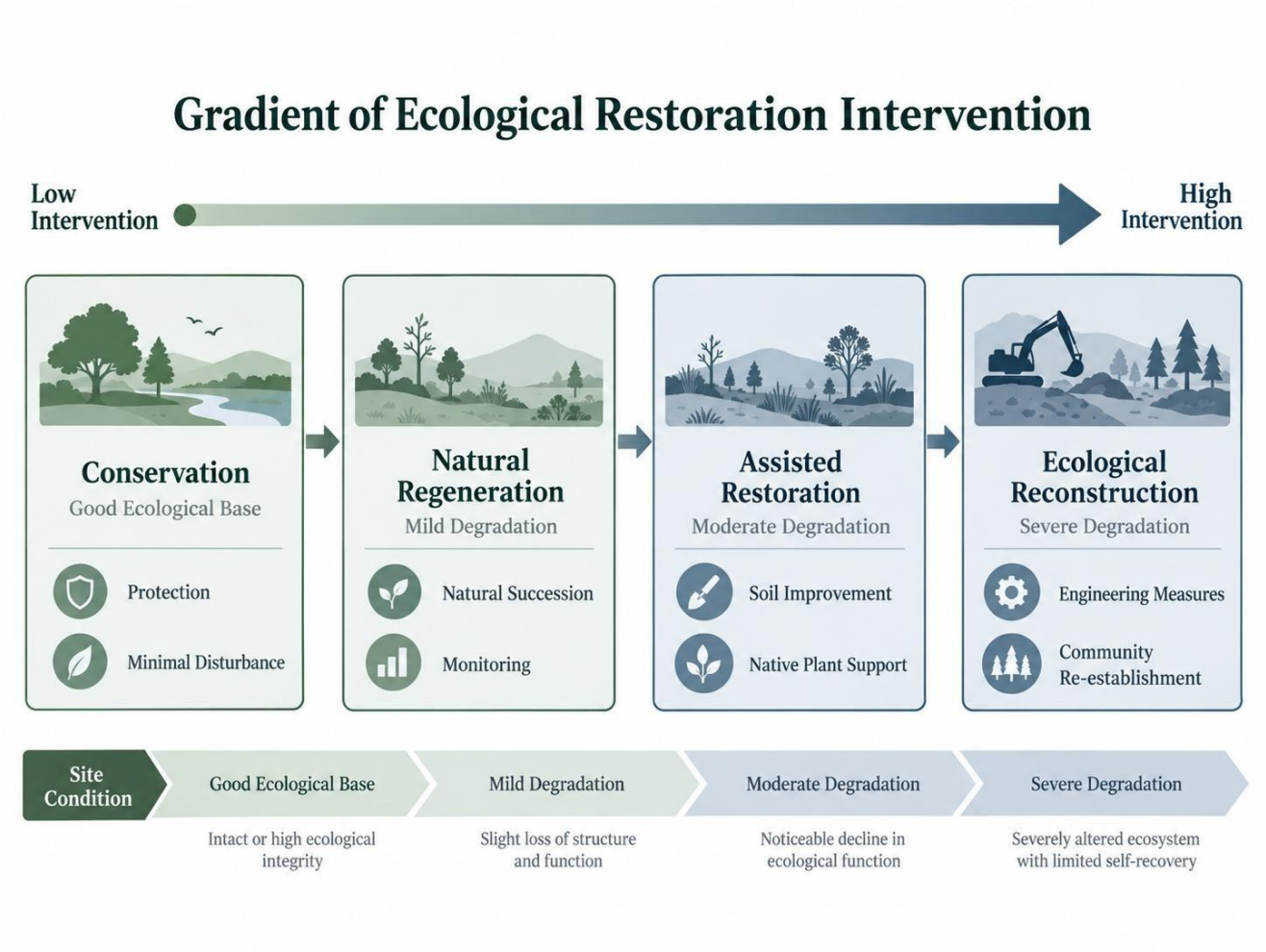
“Return to the Source” does not mean reconstructing a pre-mining condition. It means rebuilding ecological stability while allowing the mine’s rock walls, water body and terrain traces to remain legible as part of the regenerated landscape.



Source: Thesis Section 5.1; conceptual design visualization.

Terrain, Vegetation & Habitat Strategy

Intervention intensity responds to actual site conditions



Terrain

Assess slope stability and public-access risk first; retain characteristic landforms only where safety conditions allow.

Vegetation

Combine natural succession with native / adaptive planting according to substrate, moisture and disturbance intensity.

Habitat

Use forest-edge restoration, shrub–grass transition and ecological corridors to strengthen habitat continuity.

Strategy principle: avoid large-scale slope cutting or pit filling; use differentiated intervention to balance safety, restoration and site identity.

Source: Thesis Sections 5.2 and 2.2.

Water & Wetland Restoration

Testing and ecological assessment precede landscape intervention

01 Water Testing

Establish water-quality and hydrological baseline before deciding restoration or recreational use.

02 Ecological Assessment

Evaluate ecological suitability, shoreline conditions and potential risk before intervention.

03 Wetland Buffer

Create localized shallow-water and wetland buffers rather than converting the entire pit into wetland.

04 Ecological Shoreline

Use ecological shoreline treatment to improve the transition between terrestrial and aquatic habitats.

05 Controlled Experience

Guide visitors through controlled boardwalks and viewing points to reduce direct disturbance.



LID Measures

Rain gardens
Vegetated swales
Permeable paving
Localized stormwater infiltration

Wetland Elements

Emergent wetland plants
Ecological islands
Natural / soft shoreline
Habitat-oriented planting

Source: Thesis Section 5.3; conceptual visualization.

Sustainable Public Space Strategy

Public activities are concentrated where ecological carrying capacity is higher

Low-impact Development

Permeable paving reduces sealed surfaces.

Rain gardens and vegetated depressions manage local runoff.

Hardscape is concentrated only where circulation and safety require it.

Public Activities

Walking and hiking connections
Viewing and photography

Resting and social interaction

Nature-based family activities and environmental education

Spatial Principle

Locate public nodes on relatively stable terrain.

Avoid sensitive restoration and habitat areas.

Connect activities to clear, accessible routes.

Concentrate use rather than dispersing disturbance across the site.

Public space is intentionally low-intensity: recreation supports landscape experience and education without turning the mine into a conventional high-density urban park.

Source: Thesis Section 5.4.

Interpretation & Long-term Management

Landscape narrative and adaptive management continue beyond design completion

LANDSCAPE NARRATIVE

GEOLOGICAL FORMATION
Explain the Gaolishan geological context and visible rock characteristics.

↓

MINING ACTIVITIES
Interpret terrain change, quarry traces and the transformation of the site.

↓

ECOLOGICAL REGENERATION
Show how vegetation, wetland and habitat processes reshape the post-mining landscape.

ADAPTIVE MANAGEMENT

Vegetation monitoring

Track vegetation establishment and succession; adjust maintenance where recovery is weak.

Water-quality monitoring

Test water quality periodically before expanding contact-based or wetland-related public use.

Habitat monitoring

Observe habitat continuity and disturbance; protect areas where ecological recovery is sensitive.

Visitor disturbance monitoring

Monitor visitor pressure and trail impac ts; adjust access, signage and maintenance when necessary.

Adaptive management is part of the design logic: monitoring results should inform maintenance intensity, visitor access and future ecological adjustment over time.

Source: Thesis Section 5.5.

One Core · Two Belts · Multiple Nodes

The regeneration strategy is translated into a spatial system that organizes ecological restoration, circulation, recreation and interpretation

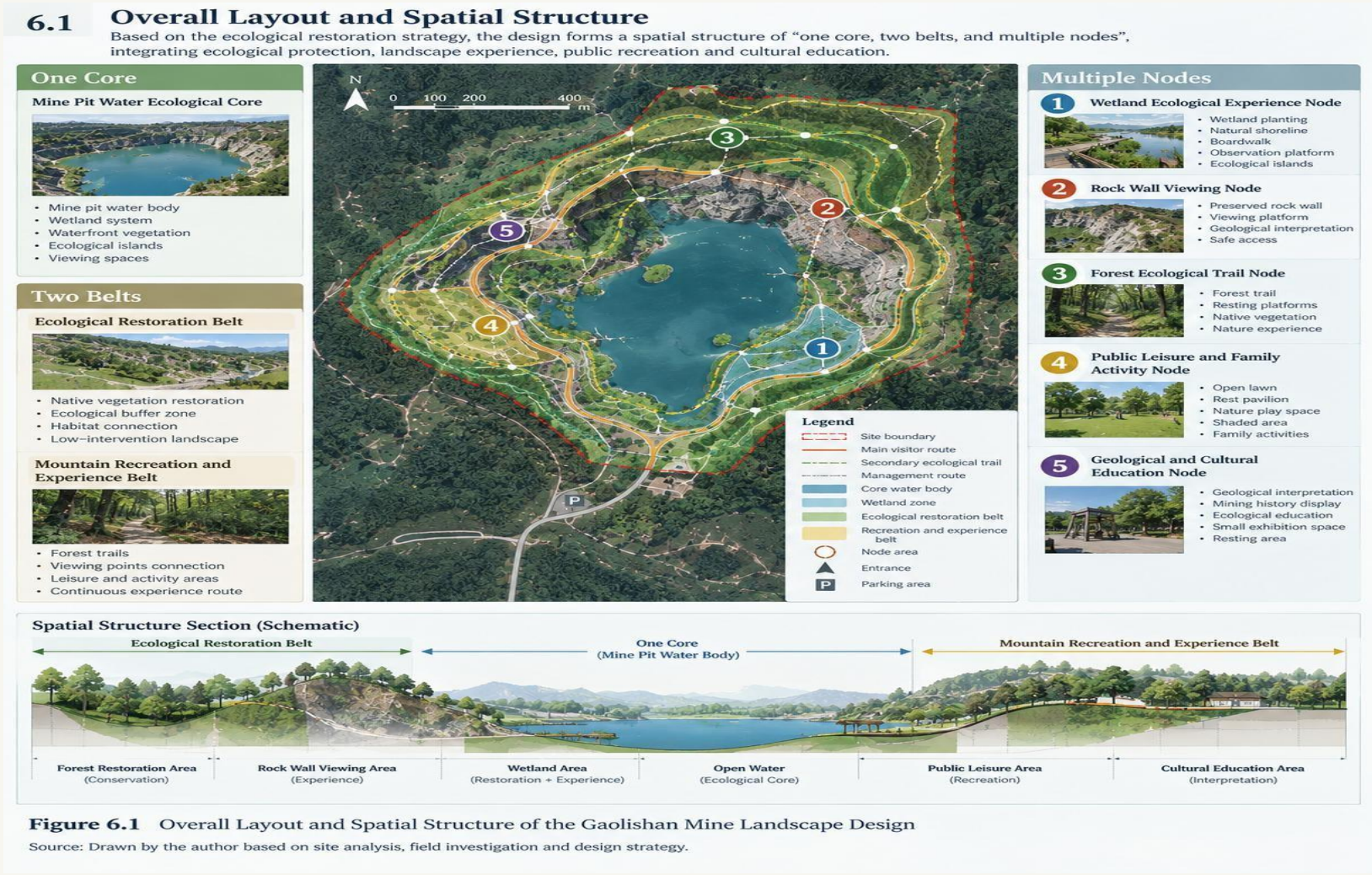


Figure 6.1 Overall Layout and Spatial Structure of the Gaolishan Mine Landscape Design

Source: Drawn by the author based on site analysis, field investigation and design strategy.

Source: Author's Figure 6.1 analytical diagram.

ONE CORE

Mine-pit water ecological core
Water + wetland + ecological shoreline

TWO BELTS

Ecological restoration belt
Mountain recreation & experience belt

MULTIPLE NODES

Wetland · rock wall · forest
Public leisure · geological education

Landscape Master Plan

The master plan retains the mine water body as the ecological and visual center while organizing restoration belts, trails and public nodes around it



Ecological Core

Mine water + localized wetland / ecological shoreline

Restoration Belt

Vegetation restoration + habitat connectivity + ecological buffer

Experience Belt

Terrain-following trails + viewing sequence + low-impact recreation

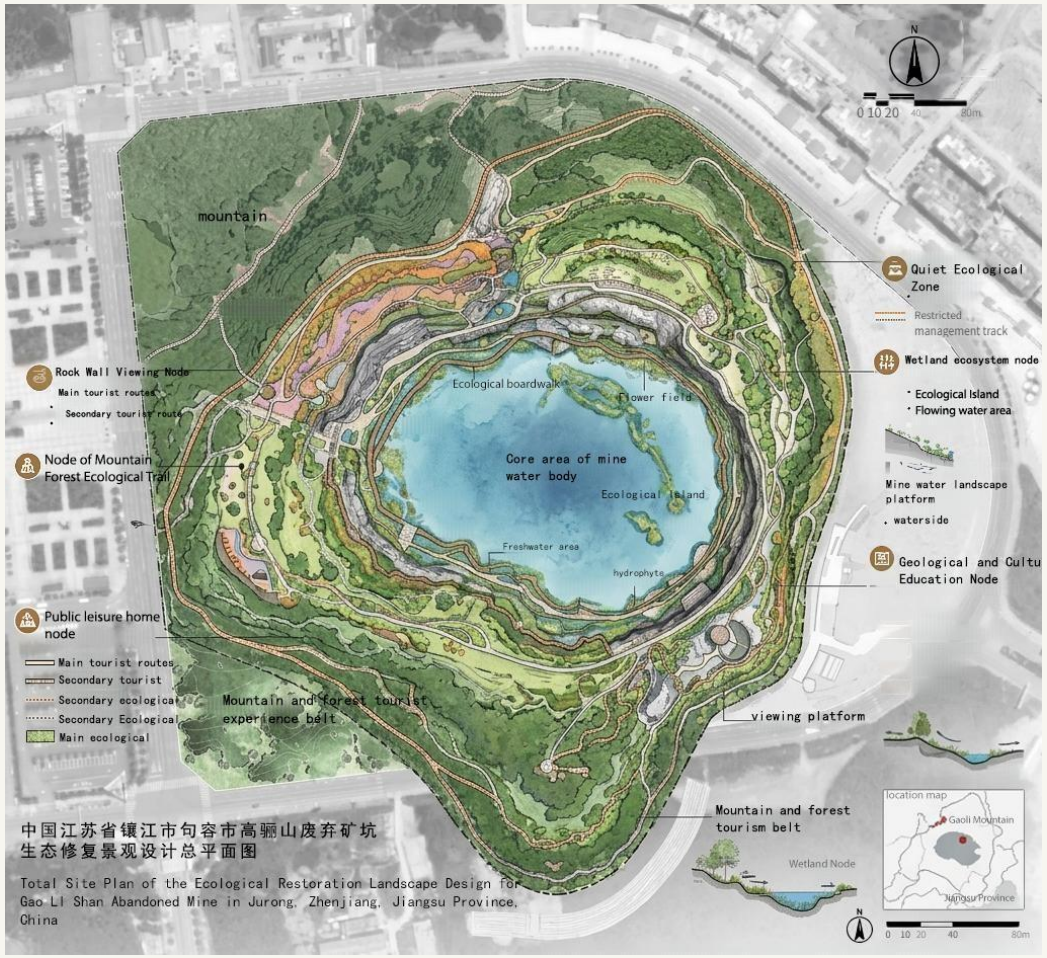
Landscape Nodes

Wetland · rock wall · forest · recreation · geological / ecological education

Source: Author's conceptual master plan.

Landscape Experience Sequence

The circulation system uses existing elevation differences to create a sequence from forest and rock-wall experience to wetland, waterfront and interpretation spaces



Entrance — Orientation & transition

Forest Experience — Low-impact trail & shade

Rock Wall — Close-range mining-landform experience

High-level View — Panoramic mine & water view

Wetland & Water — Boardwalk & ecological observation

Public Recreation — Rest · family activity · social use

Ecological & Cultural Interpretation — Geology · mining · regeneration narrative

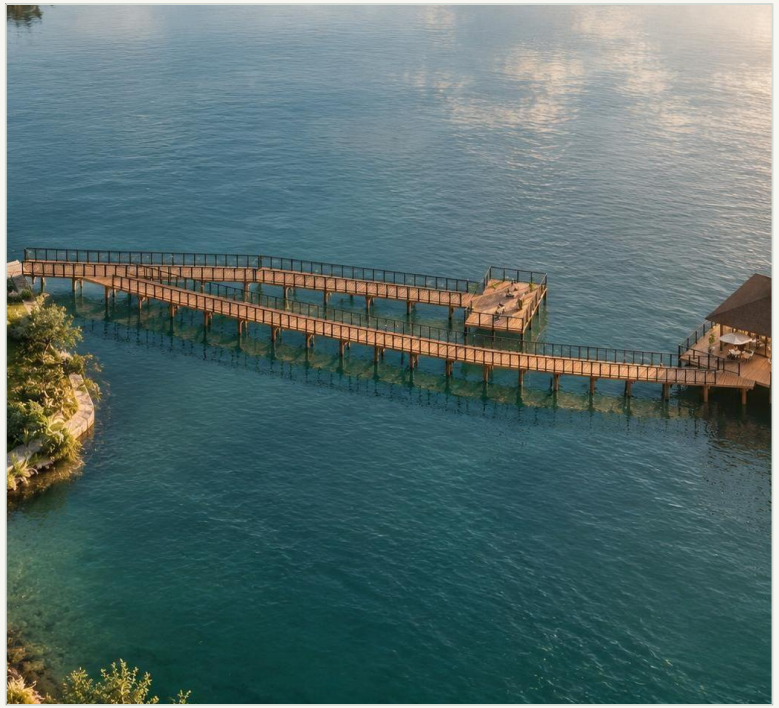
Return — Complete loop & reconnect to entrance

High Level — Panoramic View | Middle Level — Rock & Forest | Low Level — Wetland & Waterfront

Source: Thesis Section 6.2 and author's master plan.

Water & Wetland Landscape

The water landscape combines ecological shoreline restoration with controlled viewing and walking, keeping public access concentrated along designed routes.



Waterfront Viewing Platform

Water view and resting space; access is concentrated on stable platforms to reduce direct shoreline disturbance.



Waterfront Boardwalk

A low-impact boardwalk provides continuous movement while keeping visitors above sensitive wetland and shoreline areas.



Wetland Edge Experience

Localized wetland planting, soft shoreline and ecological islands strengthen the transition between open water and terrestrial habitat.

Conceptual design visualization; not an implemented project.

Forest & Low-impact Recreation

Forest recreation follows existing terrain and vegetation, using narrow trails and small resting nodes instead of a regular urban-park circulation system.



Forest Ecological Trail

Terrain-following trail with minimal grading; native / adaptive vegetation remains the dominant landscape character.



Understory Rest Platform

Small shaded resting platforms are inserted within woodland without fragmenting the continuous forest experience.



Grass Mound Leisure Area

Open grass mounds provide flexible rest and small-scale activity in areas with relatively higher carrying capacity.

Conceptual design visualization; not an implemented project.

Rock Wall & Mine Viewing

Rock walls and elevation differences remain the visual focus. New paths and decks are secondary elements that provide safe observation and interpretation.



Rock Wall Viewing Platform

A controlled viewing platform frames the preserved mining landform while maintaining a safe setback from unstable edges.



Rock Wall Viewing Trail

The trail follows the mine edge and connects key viewpoints while restricting access to higher-risk rock-wall areas.



Rock Wall Observation Deck

An elevated deck provides panoramic views and supports geological interpretation without visually dominating the cliff landscape.

Conceptual design visualization; not an implemented project.

Geological & Ecological Education

The educational system organizes the site narrative as a readable sequence: geological formation → mining disturbance → ecological regeneration.



Geological Education Landscape 01
Outdoor interpretation panels are integrated with planting and circulation to connect geological knowledge with visible site features.



Geological Education Landscape 02

Small-scale exhibition and resting spaces provide places for group learning without introducing a large indoor museum building.



Geological Education Landscape 03
Interpretation is embedded along the walking route so education becomes part of the landscape experience rather than a separate destination.

Conceptual design visualization; not an implemented project.

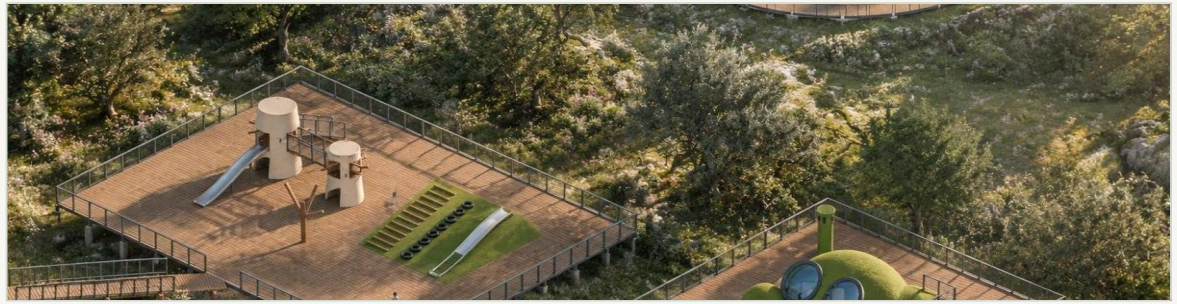
Public Recreation & Supporting Spaces

Public recreation is concentrated on stable, accessible land with relatively higher ecological carrying capacity, while sensitive restoration areas remain low-disturbance.



Public Leisure & Family Activity

Open lawn, shade trees and small resting facilities support flexible community and family use without excessive hardscape.



Children's Natural Play Area

Natural materials, terrain and planting create a play environment focused on exploration rather than standardized amusement equipment.



Low-intensity Outdoor Activity

Camping / outdoor support functions are located only in higher-carrying-capacity areas with clear access and management boundaries.



Seasonal Planting Experience

Seasonal planting adds visual interest to public-use zones while ecological restoration planting remains dominant elsewhere.

Conceptual design visualization; not an implemented project.

Plant Landscape & Ecological Sections

Planting responds to moisture, slope, disturbance and habitat conditions, forming a gradient from woodland and slope restoration to wetland and aquatic communities



Forest | Shrub & Grass | Slope Restoration | Wetland | Aquatic Plants

Source: Author's typical sections and planting analysis; conceptual design.

Findings, Contribution & Limitations

The thesis proposes a transferable process rather than a fixed landscape solution

01 Finding 01

Ecological restoration should precede intensive landscape use; safety, water conditions and habitat sensitivity determine where and how people can enter the site.

02 Finding 02

Post-mining landforms can function as both constraints and landscape resources when distinctive rock walls, water and elevation differences are selectively retained.

03 Finding 03

A spatial gradient is required between ecological protection and public use, ranging from strict protection to restoration, low-intensity experience and concentrated activity.

RESEARCH CONTRIBUTION



LIMITATIONS

- Limited environmental testing
- No post-implementation monitoring
- Qualitative user-demand analysis
- Single-case study

The project is conceptual and has not been implemented. Renderings represent proposed design conditions; ecological outcomes such as water-quality improvement, habitat recovery and biodiversity change require future testing and long-term monitoring.

THANK YOU · QUESTIONS & DISCUSSION

Source: Thesis Chapter 7.