Preventing Mud Rush and Rapid Material Outflow

A risk pathway from water ingress and material conditions to ore-pass loss of control

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The risk is systemic, not a single-point failure

The detailed map shows several conditions converging on one hazardous material state.

Water can enter and accumulate

Ingress sources include production water, fissure water, runoff, mud and slurry.

Material can change behaviour

Fine content, backfill, oversize, foreign material and moisture alter flow characteristics.

The ore pass can lose resilience

Geometry, degradation, rate deposition and seismic triggers can reduce stability.

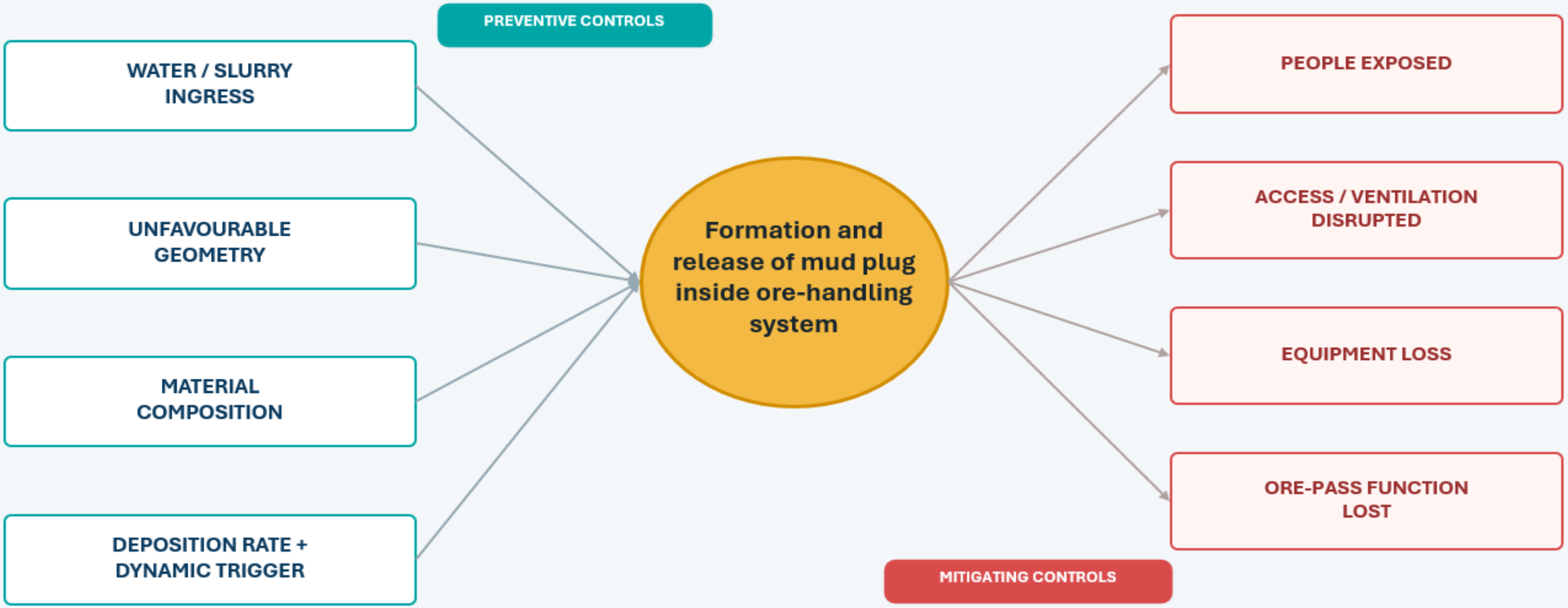
Consequences spread beyond production

People, access, ventilation, equipment and ore-pass functionality can all be affected.

Management question: are controls integrated and verified?

A bow-tie view clarifies where intervention is strongest

Prevent the hazardous material mixture, detect deterioration early, and limit exposure if control is lost.



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Five cause families shape the material-flow hazard

The source diagram groups contributing conditions into a practical control architecture.

01	**Ingress / accumulation**	Divert or reroute water; clean drains; control backfill density; use mud press; manage mine-water balance.
02	**Excavation geometry**	Design and survey ore passes; include deadman boxes or stubs; rehabilitate degraded passes.
03	**Material composition**	Control blast fragmentation and foreign objects; separate waste; manage grizzly size.
04	**Rate deposition**	Maintain draw frequency; manage shifts, train capacity and maintenance; preserve a buffer.
05	**Dynamic trigger**	Account for seismic liquefaction potential through mine design and extraction sequence.

Controls should operate as one connected system

A strong programme combines engineered barriers, operational discipline, real-time insight and exposure management.

1

Keep water out

Diversion barriers, rerouting, drainage cleanliness and backfill density control.

2

Keep the flow path fit for purpose

Design assurance, survey response, rehabilitation and fragmentation controls.

3

Know the state of the system

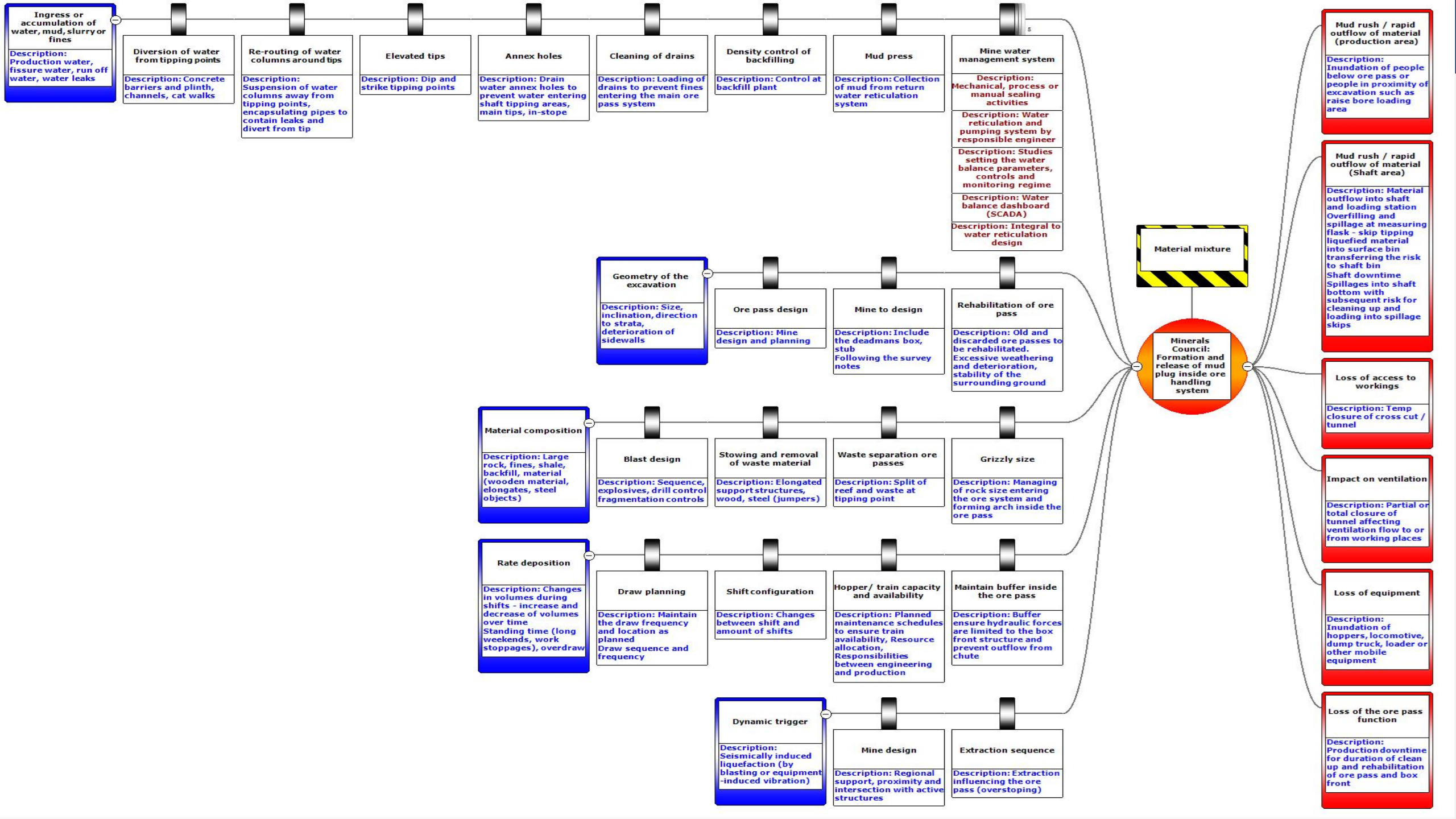
Water-balance parameters, monitoring regime, SCADA dashboard and trigger thresholds.

4

Control exposure and recovery

Barricading, temporary closure, ventilation response, equipment protection and clean-up planning.

Critical principle: control effectiveness must be visible, not assumed.


Ingress or accumulation of water, mud, slurry or fines
Description: Production water, fissure water, run off water, water leaks
Diversion of water from tipping points
Description: Concrete barriers and plinth, channels, cat walks
Re-routing of water columns around tips
Description: Suspension of water columns away from tipping points, encapsulating pipes to contain leaks and divert from tip
Elevated tips
Description: Dip and strike tipping points
Annex holes
Description: Drain water annex holes to prevent water entering shaft tipping areas, main tips, in-stope
Cleaning of drains
Description: Loading of drains to prevent fines entering the main ore pass system
Density control of backfilling
Description: Control at backfill plant
Mud press
Description: Collection of mud from return water reticulation system
Mine water management system
Description: Mechanical, process or manual sealing activities
Description: Water reticulation and pumping system by responsible engineer
Description: Studies setting the water balance parameters, controls and monitoring regime
Description: Water balance dashboard (SCADA)
Description: Integral to water reticulation design
Geometry of the excavation
Description: Size, inclination, direction to strata, deterioration of sidewalls
Ore pass design
Description: Mine design and planning
Mine to design
Description: Include the deadmans box, stub
Following the survey notes
Rehabilitation of ore pass
Description: Old and discarded ore passes to be rehabilitated.
Excessive weathering and deterioration, stability of the surrounding ground
Material composition
Description: Large rock, fines, shale, backfill, material (wooden material, elongates, steel objects)
Blast design
Description: Sequence, explosives, drill control fragmentation controls
Stowing and removal of waste material
Description: Elongated support structures, wood, steel (jumpers)
Waste separation ore passes
Description: Split of reef and waste at tipping point
Grizzly size
Description: Managing of rock size entering the ore system and forming arch inside the ore pass
Rate deposition
Description: Changes in volumes during shifts - increase and decrease of volumes over time
Standing time (long weekends, work stoppages), overdraw
Draw planning
Description: Maintain the draw frequency and location as planned
Draw sequence and frequency
Shift configuration
Description: Changes between shift and amount of shifts
Hopper/ train capacity and availability
Description: Planned maintenance schedules to ensure train availability, Resource allocation, Responsibilities between engineering and production
Maintain buffer inside the ore pass
Description: Buffer ensure hydraulic forces are limited to the box front structure and prevent outflow from chute
Dynamic trigger
Description: Seismically induced liquefaction (by blasting or equipment -induced vibration)
Mine design
Description: Regional support, proximity and intersection with active structures
Extraction sequence
Description: Extraction influencing the ore pass (overstoping)
Material mixture
Minerals Council: Formation and release of mud plug inside ore handling system
Mud rush / rapid outflow of material (production area)
Description: Inundation of people below ore pass or people in proximity of excavation such as raise bore loading area
Mud rush / rapid outflow of material (Shaft area)
Description: Material outflow into shaft and loading station
Overfilling and spillage at measuring flask - skip tipping liquefied material into surface bin transferring the risk to shaft bin
Shaft downtime
Spillages into shaft bottom with subsequent risk for cleaning up and loading into spillage skips
Loss of access to workings
Description: Temp closure of cross cut / tunnel
Impact on ventilation
Description: Partial or total closure of tunnel affecting ventilation flow to or from working places
Loss of equipment
Description: Inundation of hoppers, locomotive, dump truck, loader or other mobile equipment
Loss of the ore pass function
Description: Production downtime for duration of clean up and rehabilitation of ore pass and box front

Recommended next steps

Move from a static map to a verified critical-control programme with clear ownership and trigger-based response.

1. Confirm the credible scenarios

Validate water sources, material states, degradation modes and exposure pathways for each relevant ore pass.

2. Select the critical controls

Identify the small set of controls whose absence or failure materially increases mud-rush or outflow risk.

3. Define performance requirements

For each critical control, specify the required condition, verification method, frequency, threshold and escalation action.

4. Assign accountable ownership

Separate control owner, verifier and operational responder responsibilities; resolve engineering and production interfaces.

5. Establish a leading-indicator view

Combine water balance, drainage status, material composition, draw behaviour, inspection findings and alarms.

6. Test readiness and learning

Run scenario drills, review deviations and events, and feed lessons into design standards, TARPs and training.

A practical 90-day mobilisation roadmap

Sequence the work so immediate risk visibility improves while the full assurance system is built.

0–30 DAYS

Stabilise and baseline

- Confirm accountable sponsor and working team
- Screen relevant ore passes and verify immediate controls
- Define stop-work / withdrawal triggers
- Capture current monitoring and inspection data

31–60 DAYS

Standardise and instrument

- Approve critical-control set and performance standards
- Close priority design, drainage and monitoring gaps
- Build the water-balance and leading-indicator view
- Align engineering, production and ventilation response

61–90 DAYS

Assure and embed

- Complete independent field verification
- Run a mud-rush response simulation
- Trend leading indicators and repeated deviations
- Approve sustained assurance and review cadence

Decision required: endorse the control-owner model, initial scope and 90-day mobilisation.

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Thank you

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