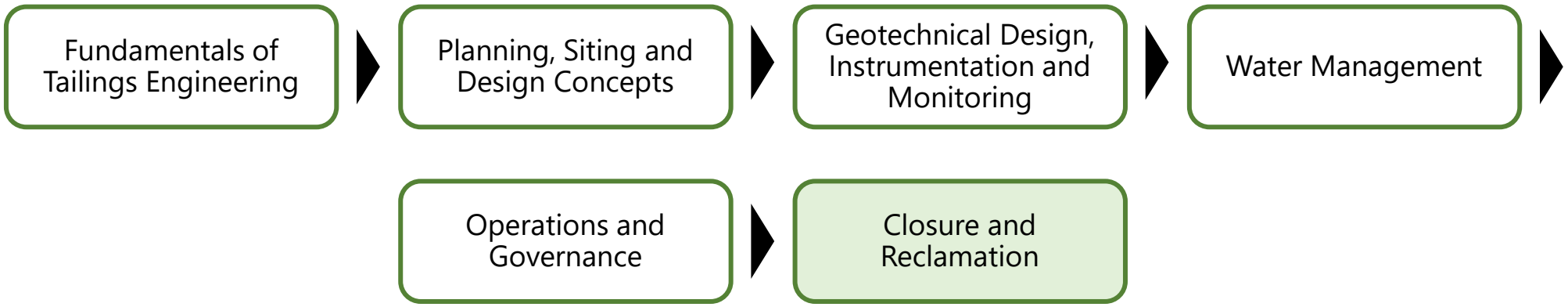
TSF Closure and Reclamation

Terry Braun, M.S., P.E., RM-SME

The Fundamentals Short Course Certification Program



Decommissioning and closure (environmental, social, legal and financial components, life of mine phases)

Tailings Management for closure during operations

Closure Planning (characterization of mine waste, covers and landform design)

Closure Management Plans (baseline data, socio-economic planning, objectives, site trials)

Decommissioning, Closure and Post-Closure Monitoring (planning and management requirements)

Closure cost estimates, environmental liability and financial assurance instruments

Instructor Background

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- 30 years of experience in mining and environmental projects
- Various roles involving ESG, Project Finance and project development and closure
- Licensed Engineer (Civil) in Colorado, Arizona, New Mexico and Texas
- B.S. Civil Engineering, CU-Boulder
- M.S. Environmental Science and Engineering, Colorado School of Mines

Big Ideas
TSF Decommissioning and Closure

Past to Present Framework

GISTM (again)

Mining Life Cycle Perspective

Environmental and Social – industry practice and guidance

Long-game

Past to present framework Mining Operations

Legacy Site – Operated and **Closed** Prior to Modern Era of Mining and Environmental Regulation

e.g., small to large-scale disturbance, limited (to no) engineering controls, NO operating cash flow or financial assurance

Long-Term Producer – Operated **Prior to and During** Modern Era of Mining and Environmental Regulation

e.g., large-scale disturbance, encroachment of surrounding development, old and new engineering controls, operating cash flow, financial assurance

Contemporary Producer – Planned and Operated **During** Modern Era of Mining and Environmental Regulation

e.g., planned for surrounding development, new engineering controls and closure planning, financial assurance

Suggested Reference(s):
Legacy Site - GISTM – Towards Zero Harm, Compendium, Chapter IX Addressing Legacy Sites, Page 126 (https://globaltailingsreview.org/wp-content/uploads/2020/09/GTR-TZH-compendium.pdf)

Working Definitions (as applied to TSFs)

Decommissioning – removal of un-needed infrastructure (e.g., pipelines, pumphouses, powerlines, roads)

Closure – act of transitioning the TSF from the operating condition to a post-operational landform that is physically and chemically stable

Progressive/Concurrent Closure – closure activities that can take place during the operating phase of a mining project

Post-Closure – monitoring, maintenance and reporting activities following implementation of the closure program

Global Industry Standard on Tailings Management (on Closure)

Affected Communities
Topic I

Principle 1
Respect the rights of **Project-Affected People** and **Meaningfully Engage** them at all phases of the **Tailings Facility Lifecycle**, including **closure**

Integrated Knowledge Base
Topic II

Principle 2
Develop and maintain an interdisciplinary **Knowledge Base** to support safe **Tailings Management** throughout the **Tailings Facility Lifecycle**, including **closure**

Principle 3
Use all elements of the **Knowledge Base** – social, environmental, local economic and technical – to inform decisions throughout the **Tailings Facility Lifecycle**, including **closure**

https://globaltailingsreview.org

Global Industry Standard on Tailings Management (on Closure)

Design, Construction, Operation and Monitoring of the Tailings Facility
Topic III

Principle 6
Plan, build and operate the **Tailings Facility** to manage risk at all phases of the **Tailings Facility Lifecycle**, including **closure** and **post-closure**

Principle 7
Design, implement and operate **monitoring systems** to manage risk at all phases of the facility lifecycle, including **closure**

https://globaltailingsreview.org

Global Industry Standard on Tailings Management (on Closure)

Management and Governance
Topic IV

Principle 8
Establish policies, systems and accountabilities to support the safety and integrity of the Tailings Facility

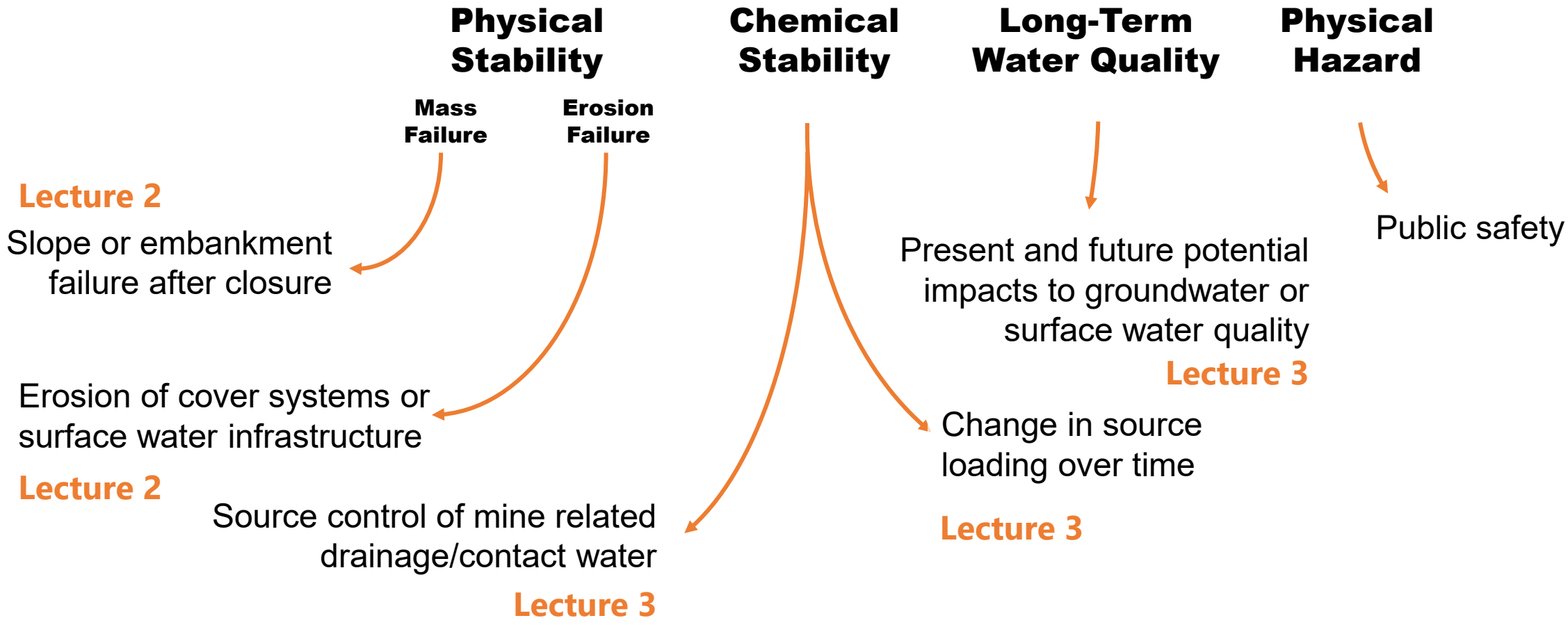
Principle 9
Appoint and empower an **Engineer of Record**

Principle 10
Establish and implement **levels of review** as part of a strong quality and risk management system for all phases of the Tailings Facility Lifecycle, including **closure**

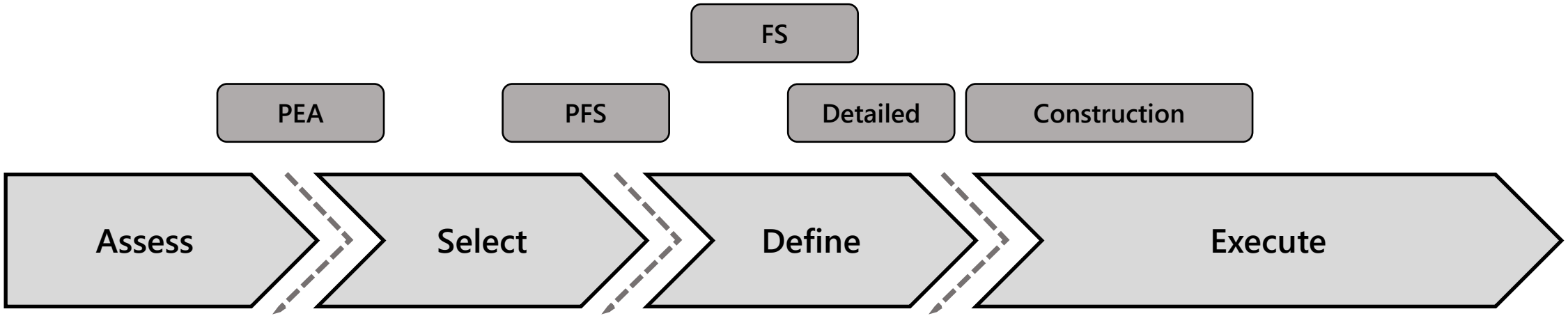
Suggested Reference(s):
GISTM – Towards Zero Harm, Compendium, Chapter VIII Closure and Reclamation, Page 109 (https://globaltailingsreview.org/wp-content/uploads/2020/09/GTR-TZH-compendium.pdf)

https://globaltailingsreview.org

General Risk Areas TSF Closure



Mining Life Cycle
Front End Loading (FEL) framework

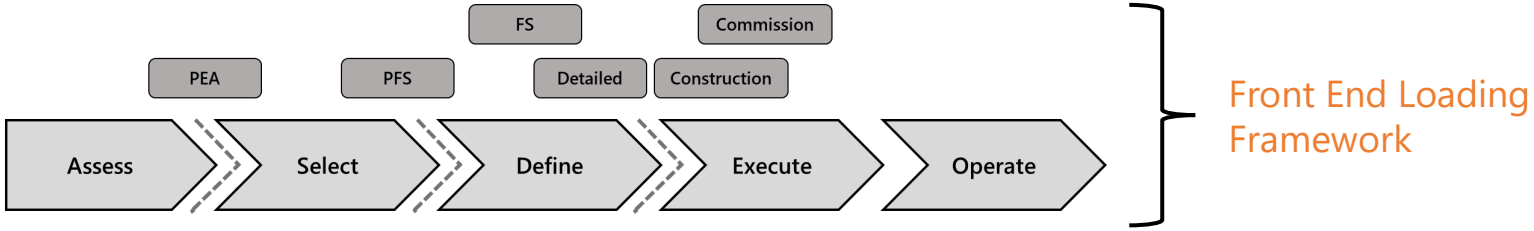


Stage-Gate Project Development and Delivery Process (After Figure 10.1, Merrow (2011))

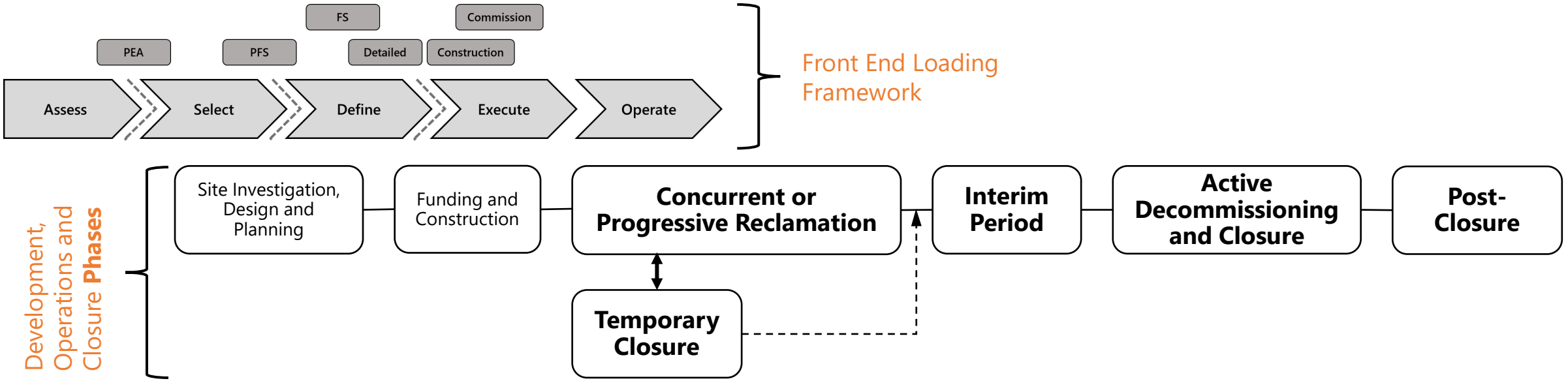
Suggested Reference(s):

Merrow, Edward R. (2011), "Industrial Megaprojects, Concepts, Strategies, and Practices for Success."
Barshop, Paul (2016), "Capital Projects, What Every Executive Needs to Know to Avoid Costly Mistakes and Make Major Investment Decisions Pay Off"
Independent Project Analysis (https://www.ipaglobal.com/)

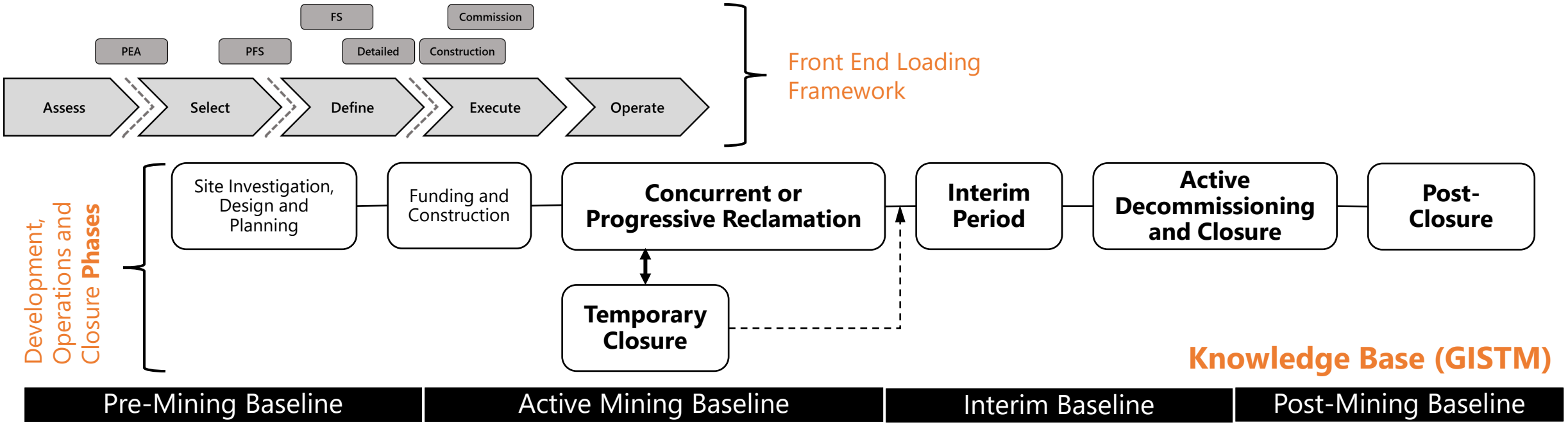
Mining Life Cycle
Development and Closure



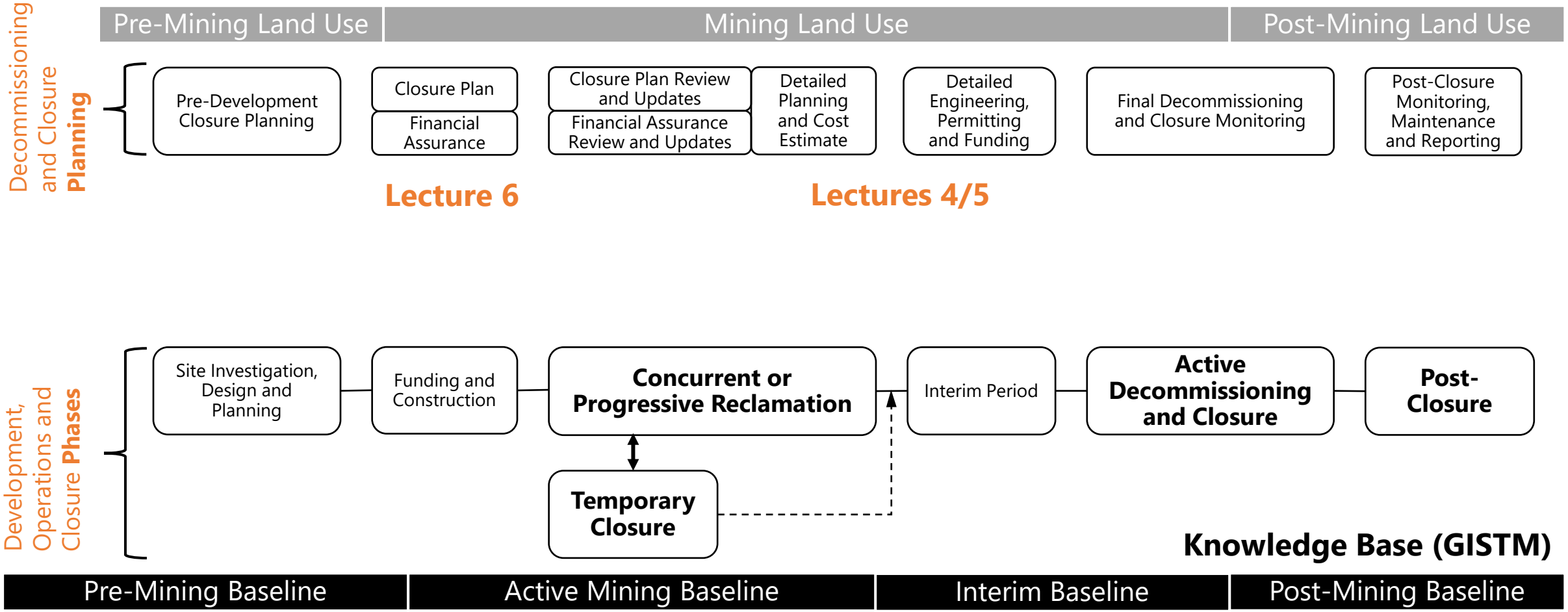
Mining Life Cycle Development and Closure



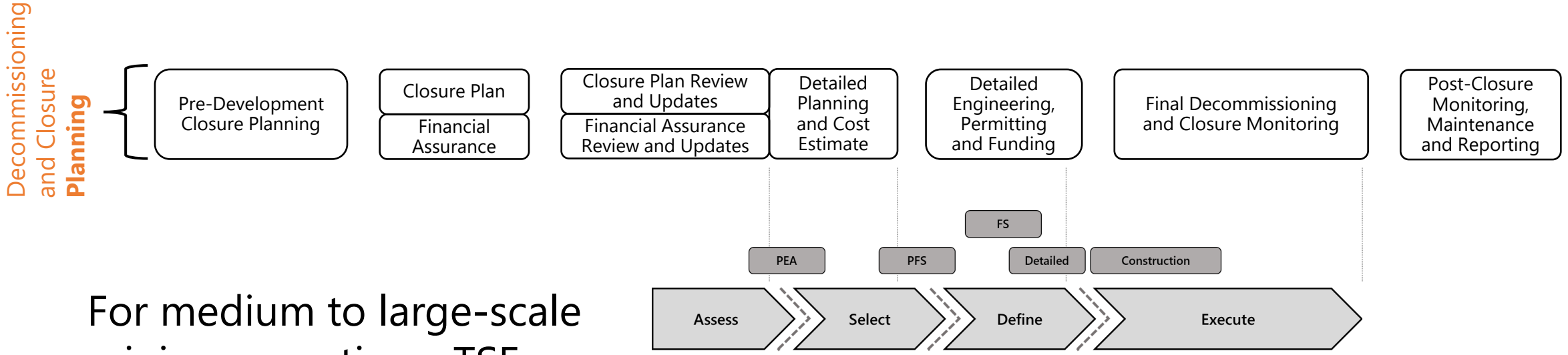
Mining Life Cycle Development and Closure



Mining Life Cycle Development and Closure

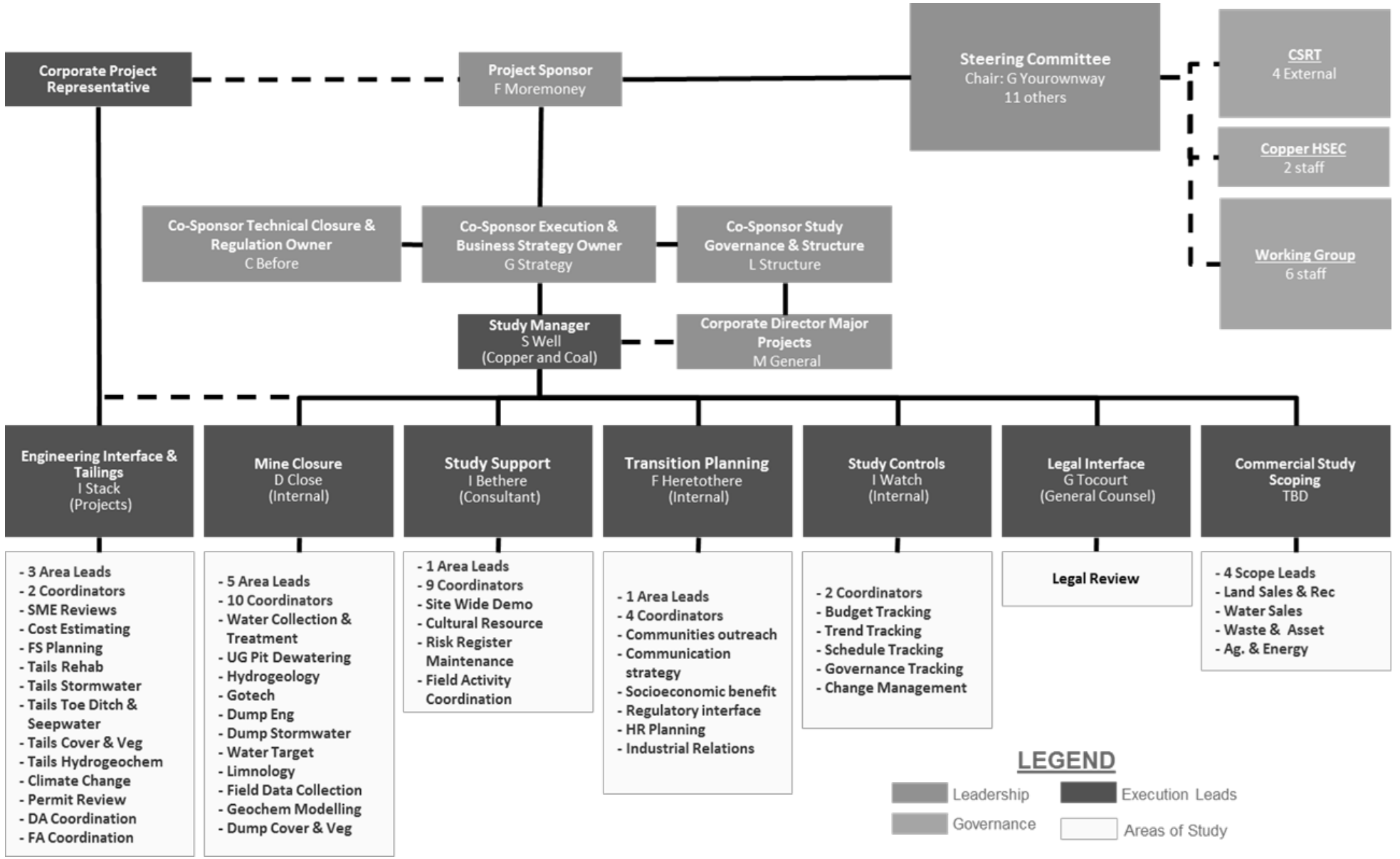


Mining Life Cycle Development and Closure



For medium to large-scale mining operations, TSF Closure can be part of a **Major Capital project**

Conceptual designs when closure > 5 years in future
PFS designs when closure >2 and < 5 years in future
FS/Detail designs when closure < 2 years in future


Corporate Project Representative
Project Sponsor
F Moremoney
Steering Committee
Chair: G Yourownway
11 others
CSRT
4 External
Copper HSEC
2 staff
Working Group
6 staff
Co-Sponsor Technical Closure & Regulation Owner
C Before
Co-Sponsor Execution & Business Strategy Owner
G Strategy
Co-Sponsor Study Governance & Structure
L Structure
Study Manager
S Well
(Copper and Coal)
Corporate Director Major Projects
M General
Engineering Interface & Tailings
I Stack
(Projects)
Mine Closure
D Close
(Internal)
Study Support
I Bethere
(Consultant)
Transition Planning
F Heretothere
(Internal)
Study Controls
I Watch
(Internal)
Legal Interface
G Tocourt
(General Counsel)
Commercial Study Scoping
TBD
- 3 Area Leads
- 2 Coordinators
- SME Reviews
- Cost Estimating
- FS Planning
- Tails Rehab
- Tails Stormwater
- Tails Toe Ditch & Seepwater
- Tails Cover & Veg
- Tails Hydrogeochem
- Climate Change
- Permit Review
- DA Coordination
- FA Coordination
- 5 Area Leads
- 10 Coordinators
- Water Collection & Treatment
- UG Pit Dewatering
- Hydrogeology
- Gotech
- Dump Eng
- Dump Stormwater
- Water Target
- Limnology
- Field Data Collection
- Geochem Modelling
- Dump Cover & Veg
- 1 Area Leads
- 9 Coordinators
- Site Wide Demo
- Cultural Resource
- Risk Register Maintenance
- Field Activity Coordination
- 1 Area Leads
- 4 Coordinators
- Communities outreach
- Communication strategy
- Socioeconomic benefit
- Regulatory interface
- HR Planning
- Industrial Relations
- 2 Coordinators
- Budget Tracking
- Trend Tracking
- Schedule Tracking
- Governance Tracking
- Change Management
Legal Review
- 4 Scope Leads
- Land Sales & Rec
- Water Sales
- Waste & Asset
- Ag. & Energy
LEGEND
Leadership
Execution Leads
Governance
Areas of Study

Environmental and Social Industry Practice and Guidance

Environmental performance standards trending toward global applicability, driven in part by Environmental, Social and Governance:

- Responsible Business
- Responsible Sourcing
- Responsible Finance

Broad stakeholder engagement under GISTM

Keyword Search: IFC Performance Standards, Sustainable Supply Chains, ICMM Mining Principles, Towards Sustainable Mining

Useful References

https://gecamin.com/planningforclosure/

https://tailingsandminewaste.com/

APRIL 2018 MMSA MINE SUMMIT

April 2018 MMSA Mine Summit Flyer

April 2018 MMSA Mine Summit Proceedings

2017 MINE SUMMIT

2017 Mine Summit Flyer

2017 Mine Summit Agenda

2017 Mine Summit Speaker Bios

2017 Mine Summit Facilitator Bios

2017 Mine Summit Attendees

2017 Mine Summit Summary

2017 Mine Summit Interactive Agenda

2016 MINE SUMMIT

2016 Mine Summit Info

2016 Mine Summit Flyer

2016 Mine Summit Agenda

2016 Mine Summit Bios

2016 Mine Summit Attendees

August 17-19 2021 Ulaanbaatar, Mongolia

https://mineclosure2021.com/

NOVEMBER 7TH 2018 MINE SUMMIT

November 2018 Mine Summit Flyer

November 2018 Mine Summit Agenda

November 2018 Mines Summit Speaker Bios

November 2018 Mine Summit Presentations

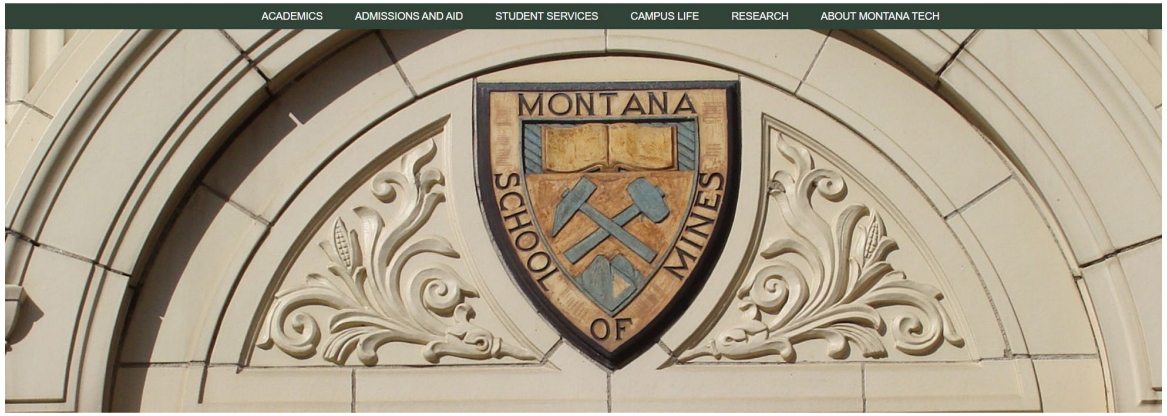
November 2018 Summit Photos

November 2018 Summit Attendees

https://www.smenet.org/

onemine.org

MONTANA TECHNOLOGICAL UNIVERSITY https://www.mtech.edu/mwtp/index.html



https://mining.mines.edu/mine-summit/

Mine Design, Operations and Closure Conference

Mine Design, Operations & Closure Conference
August 22nd - August 26th 2021

THE TAILINGS CENTER

COLORADO SCHOOL OF MINES
EARTH • ENERGY • ENVIRONMENT

THE UNIVERSITY OF ARIZONA

Colorado State University

Course 6 – Lecture Series

Lecture 1 → Tailings Facility Decommissioning and Closure

Lecture 2 → TSF Closure Planning

Lecture 3 → Geochemical Aspects of Tailings Facility Closure

Panel/Round Table 1 → Designing for Closure

Lecture 4 → TSF Closure Management Plans

Lecture 5 → TSF Decommissioning, Closure, and Post Closure Monitoring

Lecture 6 → Closure Cost Estimates, Environmental Liability, and Financial Assurance Instruments

Panel/Round Table 2 → Financial Assurance for Closure

Takeaways

GISTM contemplates closure (e.g., integrated knowledge base)

Engineering TSF risks persist in Closure (keep your notes from Courses 1 through 5)

Mining Life Cycle from a FEL perspective

- TSF Closure can be part of larger scope and considered a Major Capital Project

ESG trends extend to closure

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Reputation.

Didn’t close your last mine “right”?

Prepare for an uphill battle for your next new mine…