Pulling together mine water management across site & business for performance: principles, business role & inclusive governance, strategic & practice framework

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Abstract

A new, benchmark approach for mine water management across a site & business is presented. Developed as a framework style to incorporate governance, strategy & operational guidance, the system identifies key components required for water performance linked across business functions & project stages as an inclusive & encompassing map for effective & influential water management.

The framework is presented as a series of schematics & guidelines, covering:

- Business role of water & activity styles across a project pipeline & mine life cycle;
- Principles of approach for definition, design & outcomes of water in mining;
- Milestone requirements by project stages for water;
- Water management strategy map, where each component outlines core plans, critical information & skills across three key areas, including:
    - Governance: Risk, standards, criteria & metrics;
    - System knowledge & dynamics: Key tools & knowledge;
    - Monitoring & response: Capacity to detect & act.

Implementation of this new style of water management approach for an international resource group achieved impact & success beyond expectations, delivering significant step change water reliability & risk management, cost effectiveness, performance & culture across each business with integration across all sites & studies.

As an innovation potentially significant to an industry working in highly complex environments & settings, the approach is open & transferable to any mine site, commodity or mining method and is shared to promote discussion & action in evolving mine water management across the global extraction industry.

Key words: Mine water management, water performance, water framework, water innovation, water futures

Introduction

Water performance is a growing requirement for the mining industry. Increased expectations for production reliability & safety, environment & social alignment, legacy value & risk management is shifting regulation & operational requirements towards greater controls & more stringent constraints, often in parallel with increased project complexity and resource competition. Water management features as a key risk across the industry currently (BMI 2013; Deloitte 2016; EYGM 2015), and looking to the future, it is likely as trends continue that deep transformation to current practices will be required to enable successful development and operation of mining projects.

Responding to increased pressure, risk & requirements faces challenges at both a structural & functional level with common current practices for water. Water management in mining could be described as often the product of the sum of many parts, where water capacity & responsibility is nested across business functions such as environment, sustainability, mining, technical services, assets and processing, with gaps generally supported with external expertise where detected or required. And whilst water flows between or across multiple domains on a site by nature, management of water across those domains is separated by departments, creating gaps & inconsistencies. There are often mismatches in responsibilities and in-house knowledge, with varying levels of coordination and collaboration between groups across a site or business. And whilst the immediate suggestion may be to hire water specialty in

house for resolution, the challenge is hampered both by the structural differences in various types of water expertise from training (such as surface water, groundwater or infrastructure), and the business model being able to support additional roles.

In recognition and response to changing business needs & operating environment, a new to industry system & service innovation for water management was designed, developed & implemented across an international mining group. Designed as a framework-style for use & adaptation, the approach essentially looks to manage water as an overall system, and provides a roadmap with operating guide for mine water management across the mining cycle from exploration to legacy.

An initial prototype of a holistic approach with an international mining group delivered significant value outcomes in performance, production & risk management – linking across all operations, sustainability, studies (SEIA, Concept/PFS/FS) & infrastructure. A culture of holistic water management was established, with common language & understandings across multi-disciplinary groups, in-house ownership & capacity to deliver against objectives for water performance. Technical & strategic advice integrated groundwater, surface water, dewatering & water diversions, risk, water supply, hydropower/geothermal, regulation & compliance, storm water, drainage, sediment control & AMD, containment & discharge, tailings, water chemistry, closure & community, & water handling infrastructure like dams or river diversions.

Given the originality & benchmark significance of the water management framework for industry & working success (with learnings), an overview of the approach is shared with the mine water community to generate discussion & provide a viable mechanism to assist in strategic water management elsewhere as a broader application. An overview of the design approach, strategy development & prototype mine water management strategy frameworks are presented in the interest of contributing to the evolving practice of mine water & to meet the challenge of change to come.

Strategy development

Design approach

A series of key questions opens up the strategy and critical thinking space for how water management might be configured for greater impact as a core business role. Questions such as:

- What or who defines "good" water management & performance for a site or business?
- What is the direct business role of water management for mining throughout a project life?
- How might we integrate water into a mining business?
- What aspects of mine water are important to have managed & to what level?
- How might mine water management play a greater role in driving resilience & performance across the life of projects?
- How might water play a role in shaping greater outcomes/relationships for communities & environment from exploration through to legacy?

Defining the frame of designing for water performance is the multiple views of how people see water. From a birds' eye view as shown in Figure 1, for any given site or business there are at least four key perspectives across a water system for a mine with different senses of water value, expectations, power & stakes. Host communities, international markets & investors, regulators & governments & mine operators each hold different perspectives & influence on water performance either as a contributor, or from the external view in judgement. Notably, each group is significant to project & operation viability, and for all except the mine operators, site water management is held to overall performance as a measure of fit and responsibility. The design requirements of incorporating each key perspective extends the frame of who the system is being designed for, and inures the fundamental need for holistic water management to deliver successful mine water performance.

Setting direction

In starting out a reformed water management, the intention was to deliver to four key directives:

- Provide a holistic, system approach to managing water across a site or business;
- Integrate & position water into business processes, & match guidance/service required by stage to support outcomes;
- Link science to application to pragmatic problem solving & decision making;
- Bring leadership & guidance across the water arena (all water/hydro disciplines) to suit business need, increase decision rigour for investment strength & build in-house capacity.

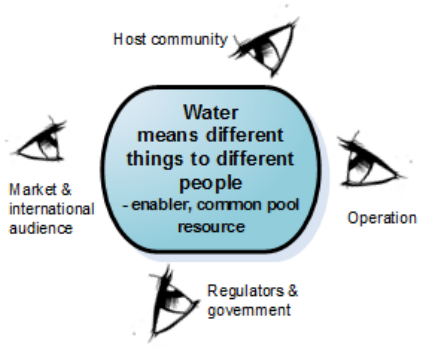

Figure 1 *A representation of the different views of water.*

Mapping the territory

To capture the extents, nature & basis of water as a whole for an overarching view, a generalised global schema map of water in mining was developed as presented in Figure 2. The map lists technical and project development components of water to represent the structure by which project level water knowledge & tools is built (such as a feasibility study), along with interactions and touchpoints with other key disciplines such as closure, community, tailings & geohazards, Linkages between the wide ranging components of water in mining reveal the critical network of overall water performance.

Finding the role

Often it is difficult to place where all of water fits in the traditional structure of organisations – somewhere in & between operations, studies, innovation, environmental & assets. As a means to focus to the role of water without markers & allow a new way of seeing, a map of the practical role of water throughout the life cycle of projects was created as shown in Figure 3. Activity types & level of knowledge are mapped from exploration through studies to operations to legacy, with leadership & strategic management needs across all stages. The business role of mine water is mapped in business function, without department – the role exists as an entity and also between groups.

Establish definition logic & tangible objectives

A working definition of water performance is then adopted as:

1. Suitability of design, investment & operations to surrounding environment & setting across foreseeable life of assets, scales & legacy;
2. Safe operation & water control – inrush/dewatering, drainage, wall stability & potable to sanitary systems;
3. Water security - access to water share/rights as an initial & ongoing enabler of operation;
4. Effective water balance management – particularly rainfall variability & water availability, directly influencing mine production & water supply reliability at wet and dry extremes;
5. Containment of impact sources & any waters contacted – including managed releases or discharge to external environments to agreed targets;
6. Stewardship of water resources & landscapes- respect to existing & future water uses & value to host communities & environments, particularly vulnerability to scarcity or change;
7. Efficiency in the water-power nexus – power demand for water supply, pumping (movement) & treatment technology, dependent to method of power generation for cost & sustainability.

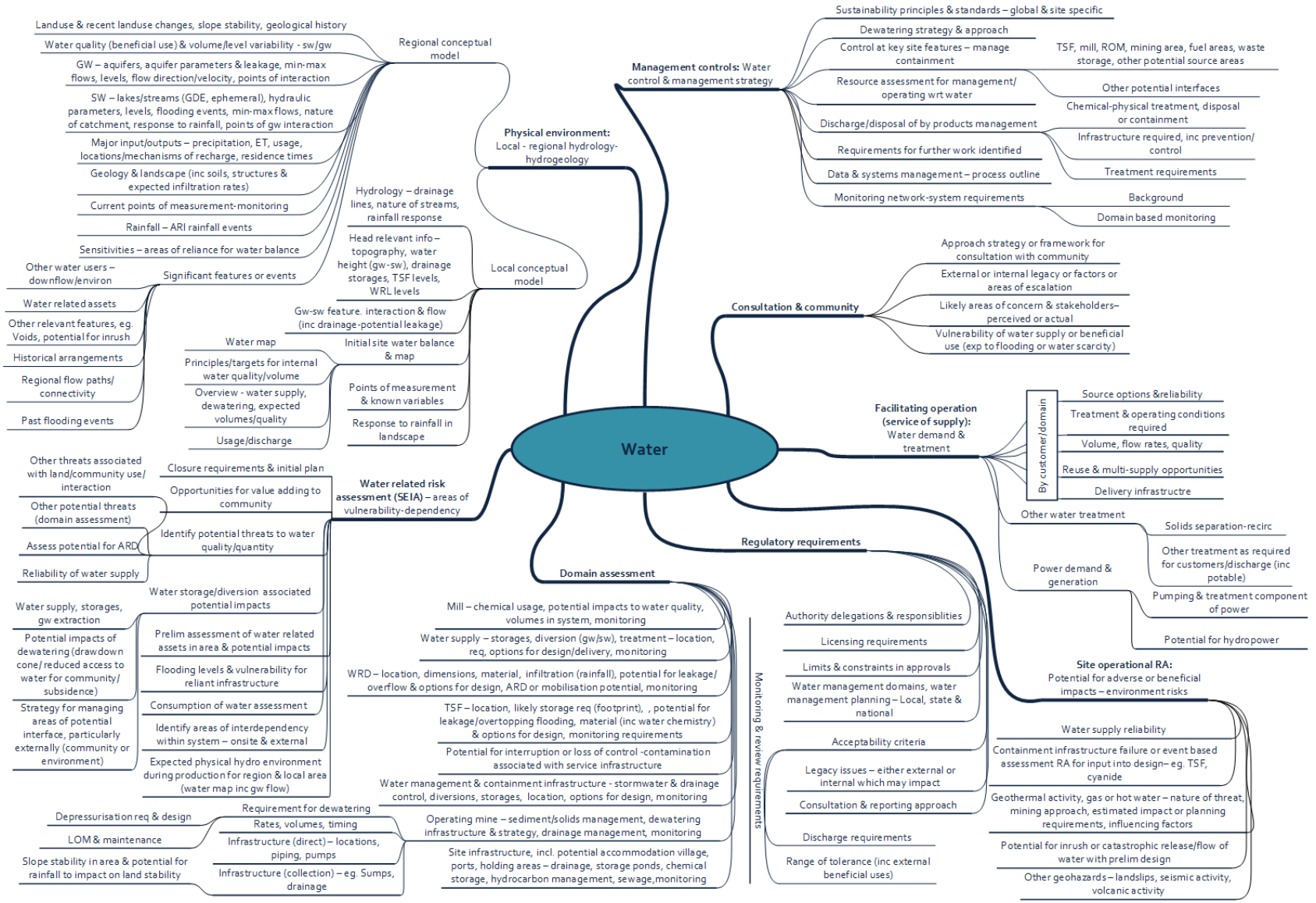

Figure 2 *Schema of water and components across mining activities during feasibility*

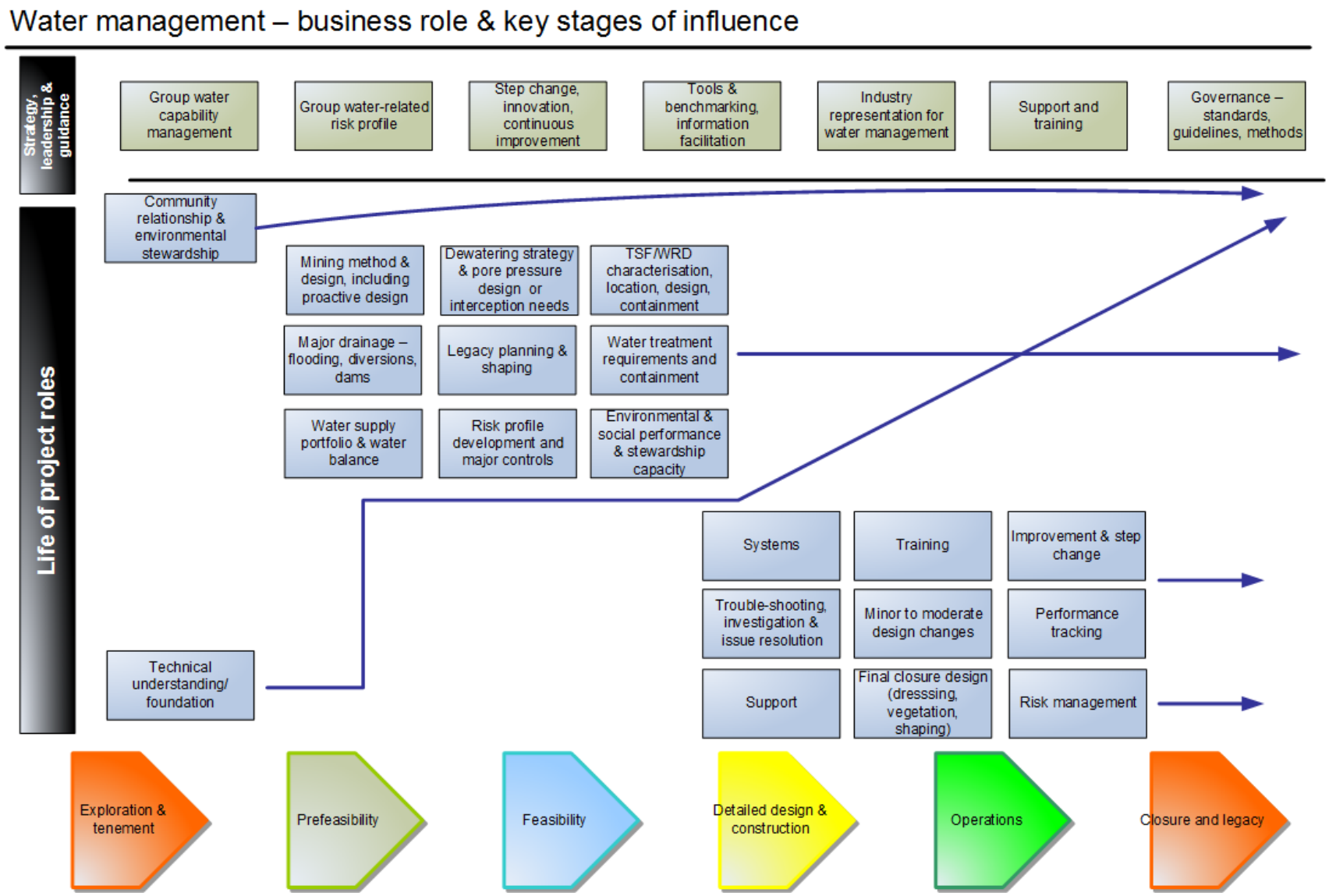

Figure 3 *Map of business role of water and key stages of influence*

Guiding principles of approach

Principles of approach provide strategic guidance of 'how to' mine water management, applicable to feasibility programs, operations and any style of change for water. Developed as a tool for review of options and decision making, the developed key list of principles is as follows:

1. Manage as a system: water, landforms & changes;
2. Design with natural landscape & climate framework;
3. Design with foresight: deploying adaptable or scoped solutions where possible to future needs;
4. Water control: dewatering & mine water for reliability, water movement & handling, safety;
5. Water containment: tailings, impacted water (sediment, metals), discharge program;
6. Water supply resilience: portfolio of sources, including reuse;
7. Stewardship & legacy: landscape design-landform stability, social & environmental outcomes.

Mine water management frameworks

Milestone guidelines by project stage

As a key part of rolling out water management, a series of project guidelines for water were generated for each project stage across the life. Figure 4 shows a guideline template for water at pre-feasibility stage, separating each performance area across the water landscape & listing key information required.

Pre-feasibility is presented as out of analysis of each of the strategy development stages emerges a powerful insight: the most influential, strategic stage underpinning water performance across a mine life is the original design phases, or concept to pre-feasibility. At these stages, economic assumptions and expectations are flagged to Executive and Board level & largely set, major infrastructure such as tailings and pre-feasibility location and design are decided, and mining shapes are determined. Closure fates are also largely governed by major infrastructure decisions. Key work completed at concept to pre-feasibility is fundamental to the success of water performance of the operation.

Mine water management strategy framework

Pulling together mine water management as a cohesive system for operational management is based on forming the strategy & structure of how water functions within a business, how water planning & design is brought together, & what key tools, knowledge/skills & systems are required to deliver strength & adaptability to water performance. As the crux stage, a benchmark framework for holistic mine water management was formed and built as a new way of implementing water for mining and is presented in Figure 5. As a practical and inclusive framework, it works by linking the many together across a shared map of what is required, networking information & planning, and incorporating the diversity of water activity and performance in a common format.

The framework operates under an umbrella of considering acceptable risk, design approaches & potential for change over time. A catchall for overall water performance is reliability, social and environmental outcomes and legacy. As the mechanisms and pragmatics of how, the framework operates across three styles of working:

1. Governance: standards, criteria and metrics - permits & limits, sustainability, risk matrix
2. Core tools and knowledge - mapping technical information needed, plans, core approaches;
3. Capacity to detect and respond - monitoring, training and action response.

Conclusions

In response to an emerging need for improved water management and performance, an innovative and reformed approach for mine water management to deliver water performance across a site or business is presented as discussion & review for the international mine water community. Built by design to bolt into any mine site or business, the philosophy and application is developed and demonstrated through a series of maps, guidelines, and practice frameworks. Implementation with an international mining group has achieved substantial success, realising step change in water performance & long term change and it is shared as a useful resource for the industry moving forward.

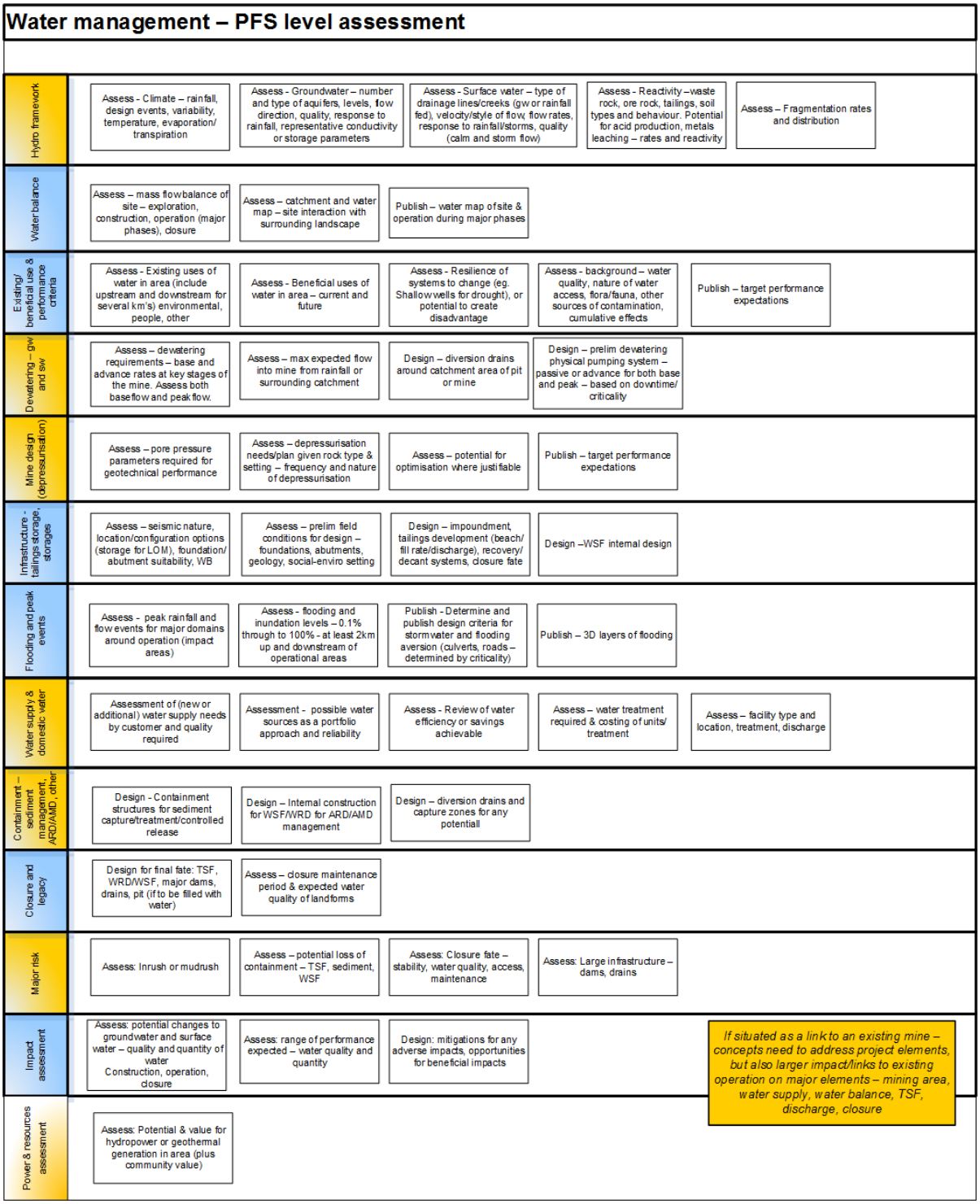

Figure 4 *Pre-feasibility water management milestone guideline*

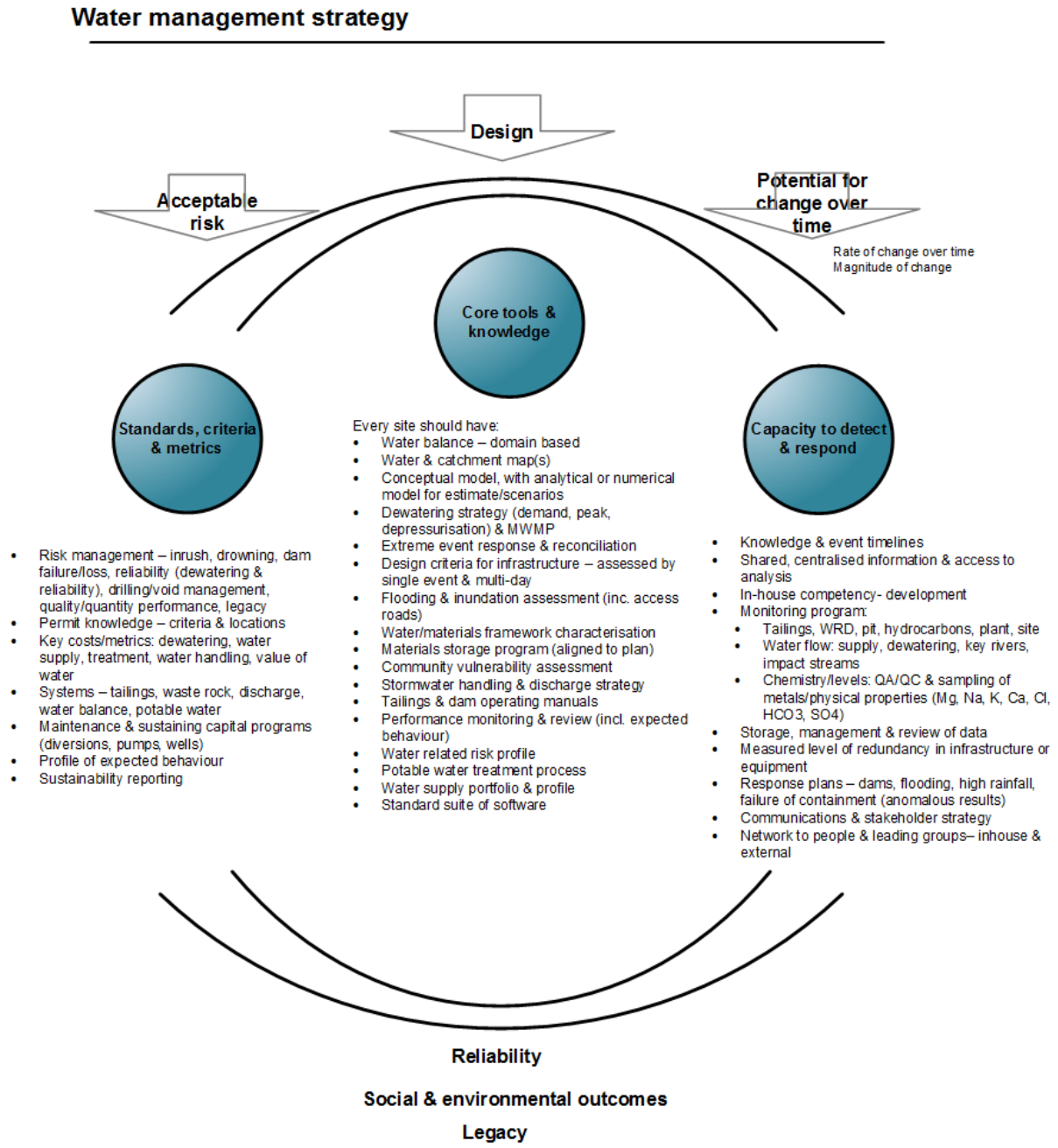

Figure 5 *Mine water management strategy framework*

References

BMI Research (2013) Water scarcity the next big challenge for miners. Viewed at: http://www.bmiresearch.com/news-and-views/water-scarcity-the-next-big-challenge-for-miners

Deloitte (2016) Tracking the trends 2016: The top 10 issues mining companies will face in the coming year viewed at: http://www2.deloitte.com/content/dam/Deloitte/au/Documents/energy-resources/deloitte-au-er-tracking-trends-2016-091215.pdf

EYGM Limited (2015) Business risks facing mining and metals 2014–2015. Company publication, viewed at: http://www.ey.com/Publication/vwLUAssets/EY-business-risks-in-mining-and-metals-2015-2016/$FILE/EY-business-risks-in-mining-and-metals-2015-2016.pdf