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ESG & Mine Water Stewardship: A benchmarking approach to targeted investment and project decision making

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Abstract

Mines and mining companies are challenged to translate corporate water stewardship goals to site-level investment plans that are defensible to stakeholders and realistic to what is practically achievable. A tested quantitative benchmarking methodology has been developed to allow mining companies to use benchmarking to support their planning and investment processes, reporting, and stakeholder engagement. It can be used to guide executives in setting company commitments and to provide the basis for project-level investment decisions. It can support building trust with project stakeholders when reporting on progress and setting future targets, satisfying ESG commitments, and focusing on practical solutions.

Keywords: Water stewardship, benchmarking, ESG, responsible mining, investment

Introduction

Mines and mining companies face two main challenges to translate broad corporate water stewardship goals to meaningful site-level investment plans to manage their water projects and, in turn, to link these site-level actions to wider water resource goals:

1. Firstly, the level of investment needed to bring mining projects to the desired level of maturity, depending on corporate commitments, is challenging given the cost pressures of changing commodity pricing, the requirements of the project and other priorities competing for investment.
2. Secondly, mining companies are challenged to present their position to their stakeholders in a transparent manner that justifies investment decisions and presents a realistic picture of where they are in terms of what is achievable.

Benchmarking can be considered to address these two challenges as a useful tool to both understand what is achievable versus level of investment and to build trust with stakeholders on the current state of maturity of the project portfolio. However, quantitative benchmarking of mine water use within the mining industry has been difficult to achieve given the varying ways this information is measured and reported as opposed to other industry where systems are highly monitored. Also, the number of factors affecting mine water benchmarking is substantial, and it is therefore not meaningful to compare all mines with one another as may happen when standard ESG frameworks are applied. An innovative methodology has been developed to undertake meaningful quantitative benchmarking making use of publicly available information and industry understanding which compares mines of

technical similarity in terms of mine water metrics.

This paper focuses on the use of benchmarking data and the factors to consider in the interpretation of publicly available water data, along with the limitations of such a benchmarking exercise. The tested quantitative benchmarking methodology has been developed to allow mining companies to use benchmarking in a way that is meaningful to their planning and investment processes, reporting, and stakeholder engagement. Relevant examples are provided to demonstrate the value of and potential use of the benchmarking outcomes.

This tested approach can be used to guide project-level investment decisions to execute projects aligned with informed corporate commitments. Finally, the approach can be used to build trust with project stakeholders when reporting on progress, making future commitments, satisfying ESG requirements, and supporting understanding of what is practically achievable.

Approach

The project team worked together with several mining companies to produce a workflow that allows a mine site or a portfolio of sites to evaluate their current position on key water metrics against their peers with similar mines. Factors affecting water benchmarking can be categorized into two key areas: corporate water reporting metrics; and site- or portfolio-level water metrics.

This paper shall focus on the site-level water metrics and the associated quantitative benchmarking process and outcomes. A separate paper is in development on the corporate metrics related to water reporting and company maturity in this space noting that an integrated benchmarking effort incorporating both aspects can be of great value to many mining companies, particularly those committed to the Water Stewardship programmes as defined by the ICMM (2023a) water stewardship maturity framework.

The process developed to undertake the site- or portfolio-level quantitative benchmarking exercise is outlined as follows:

1. Identify appropriate quantitative water metrics for benchmarking;
2. Identify factors affecting water use metrics and site-level performance;
3. Develop benchmarking comparison metrics; and
4. Undertake the benchmarking study and outcomes:
   A. Data gathering and benchmarking library production;
   B. Data review and interpretation; and
   C. Development of site-level action plans.

Each of these steps is discussed further in the following sections.

Step 1: Identify Appropriate Quantitative Water Metrics for Benchmarking

Water metrics considered as part of this process include typical site water use metrics, primarily based on ICMM definitions (ICMM, 2023b). It is important that an understanding of the definition of these terms is used by the data collection teams so that quantitative outputs are comparable. Where possible these data were collected per site and can be compiled into portfolio-level metrics as needed.

Step 2: Identify Factors Affecting Water Use Metrics and Site Level Performance

Key performance factors when considering mine water metrics have been categorized as the following for consideration in a benchmarking study:

- Mine/site-type factors – related to the nature and design of the operation;
- Location-based factors – related to site environment and location; and
- Time-based factors.

These factors are often integrated and overlapping.

The water use metrics of mines vary based on the inherent nature of the mine (e.g. commodity, mine type, etc.) and whether the mine site is water positive or water negative. Factoring in the aspects of mine type and design that account for the greatest water use or loss is necessary to create a meaningful comparison.

Extensive experience of the project team's mine water practitioners in examining mine site water balances has led to the following general understanding of water use and losses

on mine sites. The most common sources of water losses and operational water use on mine sites include:

- Losses to evaporation;
- Losses of water entrained in mine tailings and mine waste facilities; and
- Other water uses for processing activities and other machinery or domestic uses etc.

Comparison metrics that allow for evaluation of these factors must therefore be considered in the benchmarking exercise.

When considering location-based factors the site's environment can affect the integrated or catchment-based water balance affecting overall water metrics. Additionally, resource availability at the site location, often influenced by geopolitics, can also affect a mining operation's performance. Factors including the availability of and access to energy; capital; supporting resources such as chemicals or technology supply within the local supply chain; and access to skilled talent etc. are also aspects to factor in when considering the performance of mining operations. These aspects are considered location-based factors.

Time-based factors are also important to consider given the rate of change of climate predictions and also the ongoing development of new technologies.

A quantitative benchmarking assessment must aim to compare similar operations in relation to these key performance factors. Additionally, these factors will affect the type and number of opportunities for improvement and therefore the maximum performance metrics possible by an operation.

Step 3: Development of Benchmarking Comparison Metrics

To address the factors set out in Step 2, the benchmarking comparison metrics were developed and collected for individual operations. The development of benchmarking comparison metrics builds on experience from several projects and the work originally published in Yungwirth *et al.* (2023) as follows:

- Mining operation type – open-pit mine, underground mine, mineral processing facility, or a combination of these;
- Stage of operation and age – design, construction, operation or closure;
- Climate – arid, equatorial, warm, temperate, arctic;
- Climate projections;
- Project location – delineated by continent and country;
- Commodity and production – primary and secondary commodity produced and production method; and
- Type of tailings – conventional (slurry), thickened, filtered, mixed (if known).

Additionally, the following corporate factors were also considered related to the ownership of the sites as a mechanism to compare some of the factors identified in Step 2:

- Company size (by market capitalisation) and number of operations; and
- Maturity assessed through membership of ICMM or other relevant industry associations committed to responsible mining and water stewardship practices.

Changes in comparison metrics over time were noted where possible.

Step 4: Undertaking the Benchmarking Study and Outcomes

The benchmarking study was progressed through sub-steps A through C as described below.

A. Data Gathering and Benchmarking Library Development

Publicly available data from sustainability reporting was the primary source of information used to undertake the benchmarking exercise and form the basis of a benchmarking library. Data was also obtained from other published sources including government and other publicly available reporting frameworks such as South Africa's Department of Water and Sanitation (DWS) Water Conservation and Water Demand Management Guide (WCWDM) (2016), Minerals Council of Australia's Water Accounting Framework (WAF) (2022) and the Chilean Copper Commission's (COCHILCO) Best Practices and Efficient Use of Water in the Mining Industry Guide (2008). The aim was to collect a dataset that contained at least 10 years of data for each site (if possible) so that trends over time could be tracked.

The following factors were considered challenges and limitations of the benchmarking exercise:

- Water reporting methodologies differ in terminology and metric definition. Two of the primary reporting standards are ICMM and WAF, however others also exist. An understanding of water reporting metrics is required to interpret the reported results and to translate the metrics so that metrics of equal definition are being compared.
- Reporting formats vary and not all companies report based on ICMM or WAF requirements which may differ or may not require site-level detail.
- Some companies' data are self-reported and not externally verified which can cause some challenges when using it as a comparison point.
- In practice, data from public sources often do not contain an appropriate level of detail to allow site level comparisons. Technical understanding by the data gathering team interpreting this information and applying experience to estimate key parameters is essential to produce useful information for comparison.

B. Data Review and Interpretation

Information from the benchmarking library was presented in a graphical format allowing comparison of sites against other similar operations globally. The graphical format allows selection of comparison metrics relevant to the site or portfolio of sites to allow useful comparisons to be made. **The selection of appropriate comparison metrics and the context around this selection is a critical component of the interpretation.**

A temporal assessment of metric changes over time coupled with future predictions is also a useful aspect of the interpretation of the results.

The benchmarking assessment was then used to further prioritise the focus of the study within the selected portfolio. Comparison of priorities across the site or portfolio of sites aligned with material ESG and project considerations. Presentation of the results via a graphical output aided interaction with project stakeholders in setting priorities or criteria based on the benchmarking exercise. Some ways that water benchmarking can add value:

- To support informed setting of reasonable and actionable water savings targets aligned with corporate goals;
- To transparently understand and present the performance of a site or portfolio of sites against similar mines. This can be used to communicate both performance and technical realities to project stakeholders;
- To further investigate water savings options and understand maximum possible performance (based on current technologies); and
- To target investment in sites or projects that will add the largest value. Opportunities can be prioritised based on water savings versus cost or other relevant metrics (as described below).

C. Development of Site-Level Action Plans

Typical objectives of the benchmarking exercise are to plan future programmes, prioritise investment, and to understand target setting. It's therefore important to follow the benchmarking exercise with workshop-based opportunity development to produce a prioritised site level action plan. The action plan should set clear goals for each site or portfolio that are aligned with business and stakeholder needs. To promote transparency, it is important to document the evaluation and selection process to allow acceptance of the proposed solutions by the project stakeholders.

Building on the previous work (Yungwirth *et al.*, 2023) the following process was developed to support investment decisions and target setting:

1. Identification of priority sites/portfolio. Consideration of sites in water-stressed regions or those underperforming are typical criteria.
2. Interrogation of site water balance and water management plans alongside workshops with multi-disciplinary site stakeholders to identify opportunities.
3. Selection of a short list of potentially applicable opportunities for improvements using a ranking exercise. Appropriate

implementation of technology should be considered in the assessment. A list of water savings technologies typically applicable to mining and smelting sites can be found in Yungwirth *et al.* (2023).

4. Development of concept-level engineering (to support cost estimation) and estimates of timeline and potential water savings using predictive modelling.
5. Cost estimation (CAPEX, OPEX, and standardised Net Present Value (NPV)) and evaluation of results based on cost per water Megalitre (ML) saved, timeline, or other project requirements (see below).
6. Presentation of results through transparent engagement with relevant stakeholders.

Dependent on the site or portfolio, considering other material ESG concerns such as energy requirements (e.g. NetZero commitments) alongside potential water savings may be valuable.

Results of the study were presented in a graphical format which allowed evaluation of options individually or as a combination of portfolio metrics. The following were critical to the success of the evaluation and development of site-level action plans:

- Appropriate interpretation of the benchmarking exercise;
- Setting a common baseline year for comparison of water metrics;
- Understanding corporate level priorities;
- Understanding that solutions are inherently site-specific;
- Standardising cost estimation criteria and predictive modelling over a timeline of interest;
- Engagement with relevant stakeholders; and
- Transparent and graphical presentation of results.

I**t may be useful to consider the maximum possible metrics at some of the sites based on practical limitations of technology, mining method etc. so that the water use metrics are viewed in this context.** However, this type of assessment requires significant site monitoring data and understanding to undertake successfully.

Case Studies

A selection of case studies is presented here to illustrate the value the benchmarking approach provided to several different mining companies.

Case Study 1: The benchmarking approach (and subsequent action plan) was used by the mining company to set realistic operational site-level actions which then were combined to set corporate targets. The benchmarking approach was also used to transparently present the company's position to stakeholders to justify investment decisions, mid-term operational targets and to feed into corporate reporting.

Case Study 2: Benchmarking was used to support the mining company's decision to focus on recycle-reuse efficiency at their sites as they were in the process of designing updated water treatment solutions which then could be optimised while achieving significant improvement in efficiency metrics aligning with their corporate goals.

This action plan was aided by implementation of the Mine Water Pinch process at site level (after Dama-Fakir *et al.*, 2024). The Mine Water Pinch process is a tool that can be applied to optimise water reuse/recycling by identifying water users where high quality water may not be needed and aligning these uses with existing lower quality water streams on the site, allowing direct reuse with limited or no treatment, limiting costs and energy use associated with water treatment and optimising water intakes.

Conclusions

Mines and mining companies face increasing challenges to translate broad corporate water stewardship goals to meaningful site level investment plans and practical targets. A quantitative benchmarking approach has been developed to assist companies in targeting investment to the most impactful projects amongst competing priorities for investment in their portfolio. Presentation of interpreted benchmarking results has also been shown to support transparent interaction with project stakeholders to justify both investment decisions and realistic targets.

This paper presents a methodology to undertake meaningful quantitative benchmarking making use of publicly available information and industry understanding which compares mines of technical similarity in terms of mine water metrics. Context and technical interpretation of the public data is essential to allow meaningful comparisons to be made between similar projects. The factors essential to these benchmarking comparisons have been presented.

The benchmarking approach outlined in this paper has been shown to transparently support the integration of corporate water stewardship targets with prioritised site-level action plans, proactively supporting investment decisions. The approach also supports the evaluation of opportunities to improve water metrics demonstrating that solutions are highly site-specific and must be evaluated on a per site basis.

Key success factors in the development of aligned site-level action plans were: appropriate interpretation of the quantitative benchmarking exercise; setting a common baseline; understanding corporate level priorities; understanding that solutions are inherently site-specific; standardising cost estimation criteria and predictive modelling over a timeline of interest; engagement with relevant stakeholders; and transparent and graphical presentation of the results.

This paper presents a tested and defensible methodology to produce and use water metric benchmarking to guide practical site-level action plans and investment decisions. The process has been demonstrated to be meaningful and defensible to the mine site- and portfolio-level planning and investment processes, reporting, and stakeholder engagement at mine sites aligning corporate ESG and water stewardship goals with practical site-level actions.

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