worley
DELIVERING SUSTAINABLE CHANGE

Water considerations for copper mining in the Americas

Evaluating how copper miners can manage changing water landscapes in the Americas

Authors: Carola Sepulveda, Hubert Fleming, Michael Bratty

WORLEY.COM

Foreword

Copper miners in the Americas are facing two interrelated challenges: the looming copper supply gap and growing expectations around water stewardship.

Global copper demand is set to double to around 50 million tonnes per year by 2035 (S&P Global). This represents a generational opportunity for copper producers to increase revenue, realize benefits for their stakeholders and deliver a critical metal for the global energy transition. But this dynamic scenario also brings new challenges for miners.

As rapidly as copper demand is increasing, sustainability expectations are increasing for copper producers, too. Particularly when it comes to our planet's most precious resource: water.

Copper mining and processing requires a lot of water. The CSIRO (Commonwealth Scientific and Industrial Research Organisation) estimates that around 1,600 liters of water are required to obtain the amount of copper found in a medium-sized family car (19kg). And electric vehicles need up to four times more copper than conventional internal combustion vehicles, demonstrating the extent of copper demand growth ahead.

In some copper mining regions, water availability is not an issue. But many of the world's largest copper deposits are in some of the driest regions on earth, such as the Atacama Desert in Chile. And just as the scale of copper production needs to expand in these regions, water scarcity is also growing because of climate change.

This scenario amplifies how important it is that water-dependent copper miners improve their water management. In many cases, they'll need to change the way they source water and overhaul some of their most water-intensive processes to reduce their overall water footprint.

In this paper, we examine the future of water in copper mining, what this means for copper producers in the Americas seeking to become better water stewards, and emerging strategies to the trade-offs between water consumption and energy usage.

CAROLA SEPULVEDA
Water Lead LATAM

HU FLEMING
Senior Water Advisor

MICHAEL BRATTY
Process Lead for Minewater Treatment

Contents

Why is water stewardship so important for copper miners?

Earning a social license to operate is among the most important factors for the success of a copper mine. And using water responsibly is crucial to maintaining this social license from stakeholders.

Water stewardship is key to the viability of new and existing copper mines. The United Nations Industrial Development Organization (UNIDO) defines water stewardship as 'The use of water that is socially equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that involves site and catchment-based actions.'

Most global primary copper production depends on a water-intensive process involving the flotation of ores, where mine tailings become a constant sink for water. This increases the water footprint of a mine site over time. In water-scarce areas, the use of filtered tailings and water recycling can reduce water use, but most copper mines still have a large water footprint with existing techniques.

The framework for measuring water stewardship varies from company to company. But the expectation from most stakeholders, is that copper producers continue to take steps to reduce their freshwater usage and limit their overall environmental impact.

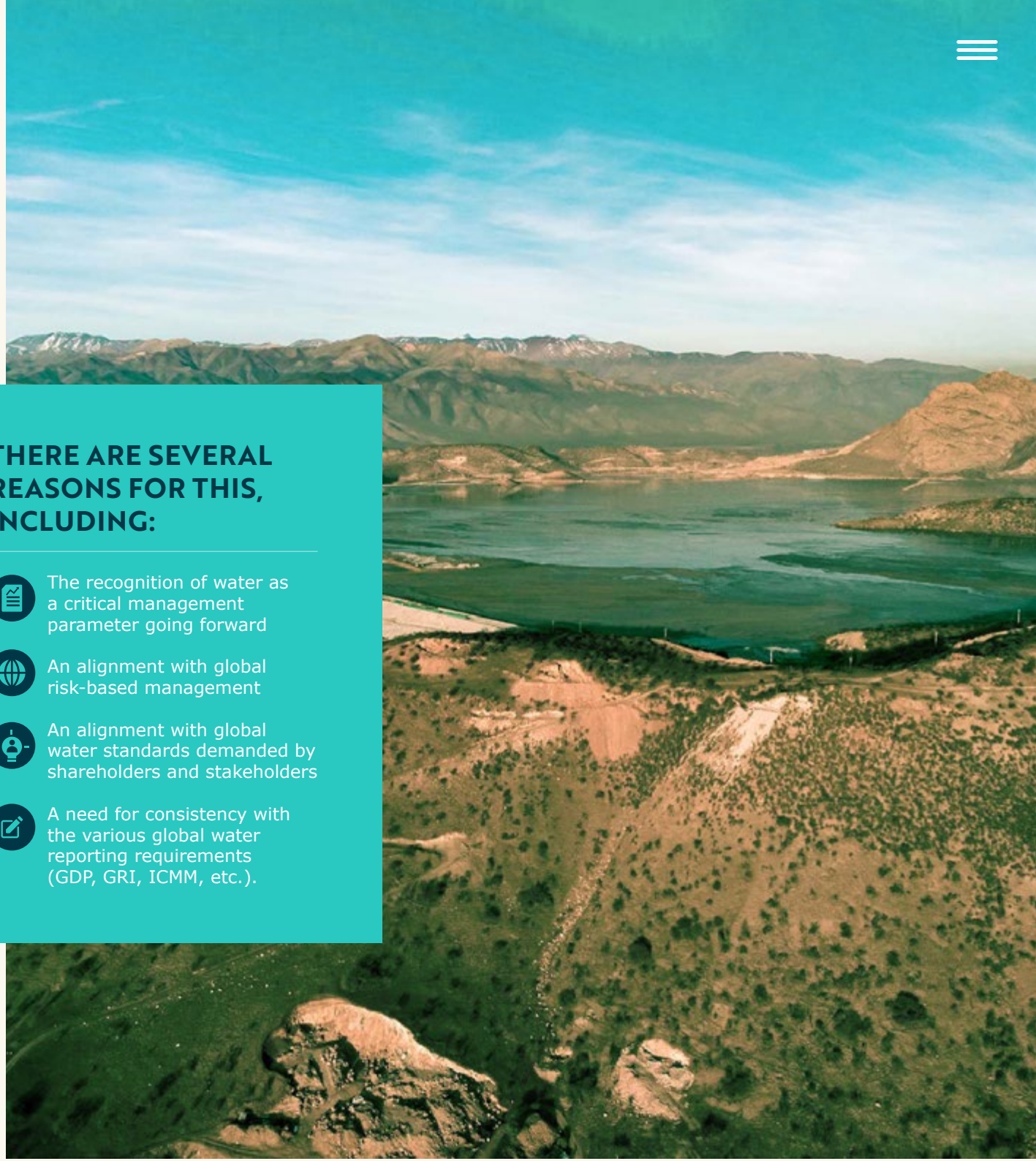
HOW WILL WATER MANAGEMENT CHANGE OVER THE NEXT DECADE?

Mining industry leaders recognize that water is not owned. They appreciate that it's a shared resource. And they also recognize that it's essential to build a common future for water management together with stakeholders.

Those with a water stewardship mindset understand their own water use, how it impacts others in the catchment, and the risks that are shared relating to water quality, water quantity, and water governance.

Furthermore, changing climate patterns are up-ending historic regional and operations-based water balances. This is driving miners to revisit their past water management strategies, as they seek to make their mines more resilient for the future.

Water stewardship, along with the development and implementation of a sustainable water plan, has evolved to become imperative for the copper mining industry.



THERE ARE SEVERAL REASONS FOR THIS, INCLUDING:

- The recognition of water as a critical management parameter going forward
- An alignment with global risk-based management
- An alignment with global water standards demanded by shareholders and stakeholders
- A need for consistency with the various global water reporting requirements (GDP, GRI, ICMM, etc.).

A sustainable water management plan incorporates best practices for miners, so they can meet water resiliency for all their operations. It also provides both management tools for operations and a pathway to meet external reporting requirements.

HUBERT FLEMING, PH.D., SC.D. (HON), P.E. SENIOR WATER ADVISOR, WORLEY

Balancing the importance of a life-of-mine water plan with the water-energy nexus

Water sourcing and energy use are closely linked in the copper mining sector, particularly in water-stressed regions of the Americas. This directly impacts the financial and environmental viability of a mine site.

Whether a copper mine has too much water or not enough, it's necessary to have a life-of-mine water plan to meet the objectives of the mine plan. This life-of-mine plan should earn the support of regional neighbors, partners, and stakeholders. Not having sufficient water for the life of a mine, or having too much water, are equally unsustainable.

In drier regions of the Americas, sourcing fresh water directly is more challenging and often energy intensive. For example, miners in the copper-rich Atacama Desert in Chile have limited access to fresh water to run their processing facilities. In these situations, they need to explore other options to make up the water deficit to run their equipment. Trucking the water needed to site may be used for short-term water increases but is not a realistic option. Seawater desalination, wastewater reuse, and tailings filtration are more viable long-term solutions.

Desalinating and pumping seawater to high-altitude mine sites is a capital and energy-intensive exercise. Reducing consumption and increasing the reuse of water can help reduce desalination and pumping requirements. Technologies such has coarse particle flotation and tailings filtration have their own capital and energy requirements. This makes it more important than ever for miners to understand the water-energy nexus and the input variables unique to their operations that will influence it.

It's therefore critical for copper miners to strike the right balance between lowering CO_2 emissions from the energy to source and manage water, while demonstrating water stewardship across their operations. Learn more about the tools and options to achieve this balance, such as water modeling and dry stacking mine tailings, in our recent article on the water-energy nexus.

Regional challenges and regulations

In the Americas, most copper production occurs in Chile. This is followed by Peru, the USA, Mexico, and Canada. Regulatory changes across the Americas are impacting water use by the copper industry and the mining sector. But these specific challenges depend on the region.

But what are the regulatory and operational challenges facing copper miners in key copper mining jurisdictions of the Americas?

CHILE

Water is a significant issue in Chile. The country holds more than 40 percent of the Latin America region's copper projects. And water project capital expenditures for the Chilean mining industry are estimated to reach USD 2.3 billion in 2023 (GWI).

As the largest user of industrial water in Chile, copper mining operations will be heavily impacted by any changes to water regulations. Chileans voted in favor of drafting a new constitution in the fall of 2020. The new constitution would introduce a radical change for the water sector by replacing Chile's tradeable water rights system in favor of non-tradeable water use authorizations granted by a new government agency. The drafted constitution text was rejected in a referendum held in September of 2022, but Chileans continue to favor a new constitution.

USA

The US mining industry will spend an estimated US $ 1.19 billion on water projects in 2023 (GWI). This is due in part to the arid environment of many mines. In western states like Utah, Nevada, New Mexico and Arizona, water can be scarce.

Due to the Inflation Reduction Act funding, copper mines water supply is in competition with rare earth extraction. Rare earth metals often require higher amounts of water than other metals. This has driven up the demand for water reuse technologies. We're seeing a particularly increased investment in water reuse and desalination technologies.

In addition, environmental regulations surrounding the clean-up of mine closures and operating mines, such as strict discharge standards for selenium and sulfates, are driving wastewater treatment spending. A prime example can be found in the state of Arizona where metal mining facilities must now maximize process water reuse.

PERU

Peru is the second largest copper producer in Latin America. And has unique water challenges. The mining industry plays a major role in the Peruvian economy, contributing to 12.1 percent of GDP in 2022. Water project capital expenditures for the Peruvian mining industry are expected to reach an estimated USD 1.06 billion in 2023 (GWI).

The COVID-19 pandemic and civil unrest have caused disruption in recent years, but as of March 2023, key copper mines in Peru have begun to cautiously resume activity. Like many regions, the use of water for industry is contingent on social license.

Acid mine drainage, water reuse, tailings management, and to a lesser extent seawater desalination are the key water challenges faced by copper miners in Peru. Sulphide ore-based mining operations in Peru can create acid mine drainage, particularly during the rainy season.

The trend towards stricter discharge limits will require miners to increase mine water treatment levels. Strict sulphate limits on rivers, 1000 ppm as per the latest 2017 regulation, are driving the need to build treatment plants, especially in brownfield projects, which can treat acid mine drainage and tailings water.

Increased investment in desalination is expected in the medium term as the Peruvian mining industry faces additional water-use restrictions at operations in shared watersheds. This is particularly important in drier regions across southern Peru as miners are pushed to leave stressed, fresh surface water and groundwater resources for communities and agricult.

CANADA

In 2020, Canadian miners produced over 475 thousand tonnes of copper. Most Canadian copper production comes from British Columbia and Ontario. Capital expenditures in copper mining are expected to continue to grow, reaching an estimated US$ 972 million in 2023 (GWI).

Canadian mines often have different water-related challenges than other producers in the Americas because they are often located in areas of water excess. For example, they can experience seasonal excess of water in the spring from snow melt, which needs to be managed and diverted to avoid disruption to the mine site. Even in wet climates, minimizing water use is a priority to demonstrate good governance and water stewardship.

One of the national regulations in place to control effluent discharge for copper mines are the Metal and Diamond Mining Effluent Regulations, which were amended in 2021. These regulations help protect Canada's lakes and rivers by setting strict limits on the quality of effluent that can be discharged. Mine operators must take steps to confirm compliance, and if effluent quality from a mine is non-compliant, mine operators may be required to retrofit or build new water treatment facilities to avoid penalties. These capital expenditures can be significant, so it's best to engage water experts early on.

The Fisheries Act is the overarching regulation governing Canadian water bodies. But the 13 provinces and territories each have their own environmental regulations and regulatory bodies that metals miners must navigate as well.

MEXICO

Tailings management is one of the top concerns for miners in Mexico. And water project capital expenditures in the Mexican mining industry will reach an estimated USD 297 million in 2023 (GWI).

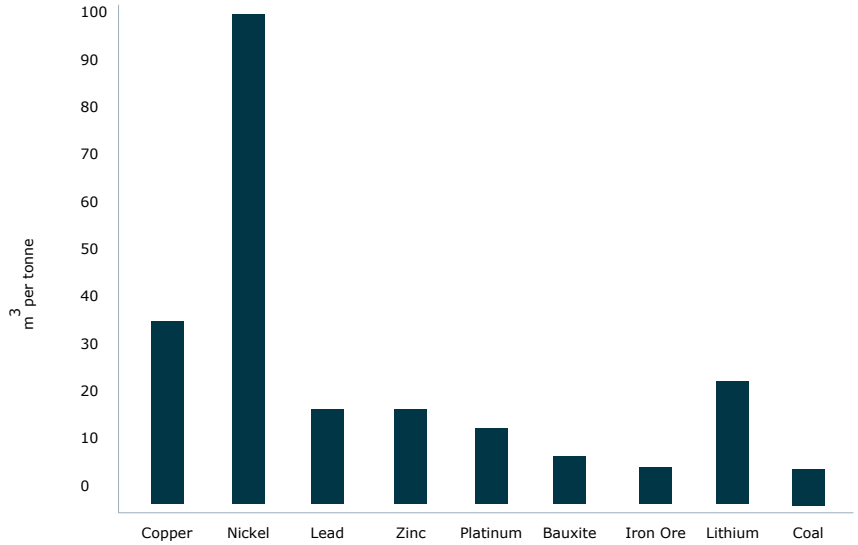
Water scarcity has been a problem for mines in Northern Mexico, as the main supply source for mines – underground aquifers – are being depleted. While desalination is a potential solution, the distance of metal deposits from the sea makes this relatively uneconomical for most. Municipal wastewater reuse is a potential alternative water supply solution.

In Mexico, recent water concession regulation changes have altered the rules of engagement for miners relating to water use and wastewater discharge. These new rules include considerations for Indigenous community consultation and the public. Water concessions for mining are up for public bid and set for a 30-year period. Water rights can be canceled 'due to supervening events or acts of public, general or social interest, or that cause some type of economic, social, environmental or any other type of imbalance'.

In addition, there are requirements that mines recycle 60 percent of the water used in the mining processes and the prohibition of mining activities in areas without water. Water rights transfers for use in mining are also prohibited.

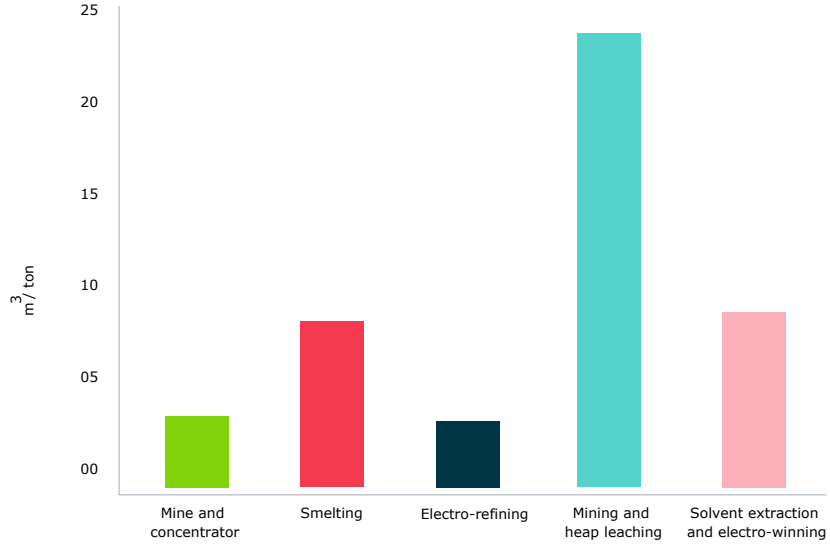
Water consumption across the mining industry

COMPARING WATER USE IN COPPER PRODUCTION WITH WATER USE FOR OTHER METALS.



Cubic meters of water needed to produce a metric ton of ore/commodity.

TOTAL WATER CONSUMPTION ACROSS COPPER MINING PROCESS STAGES (M³ PER TONNE OF MATERIAL) *GWI FEB 2023



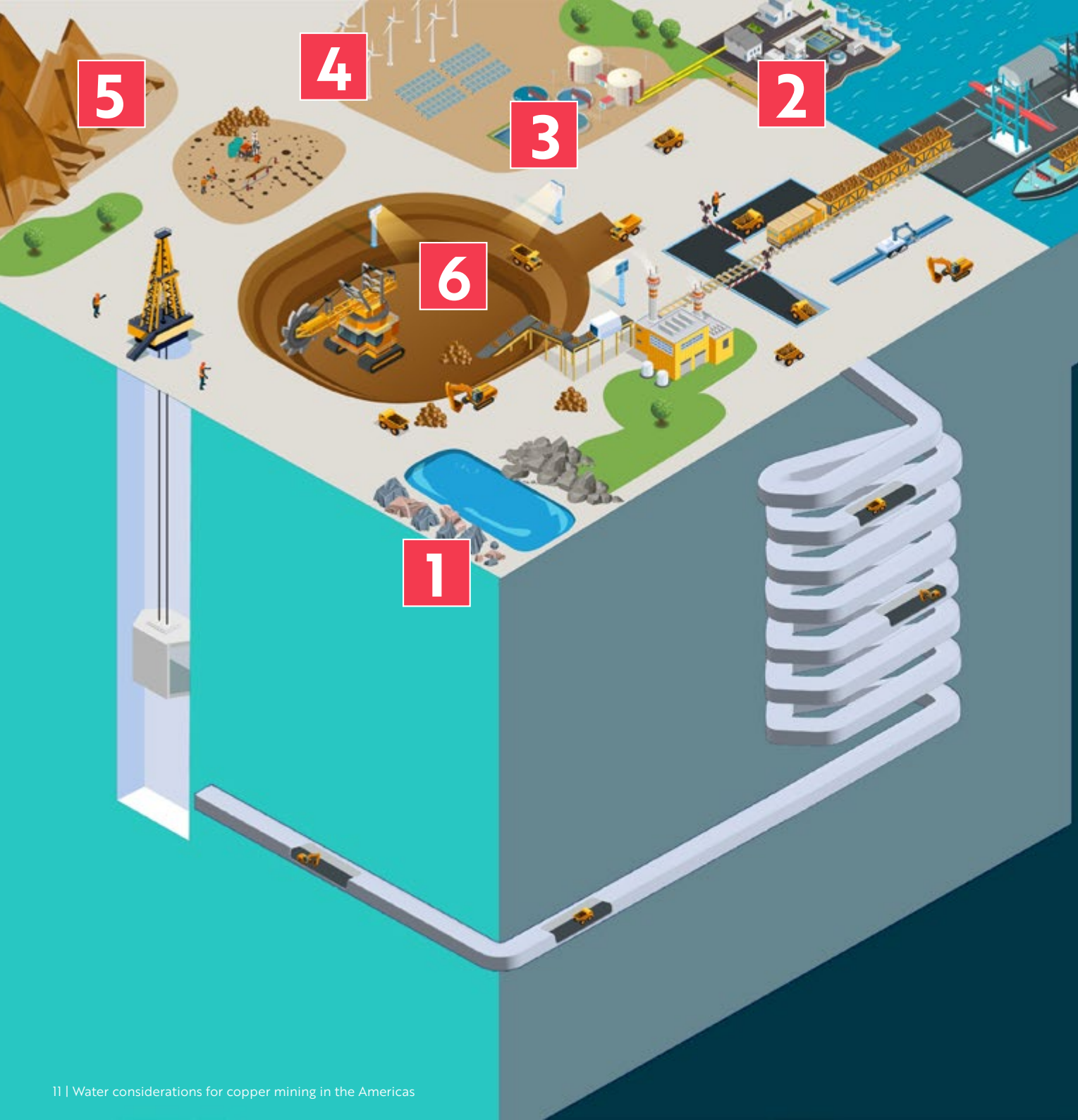
AVERAGED WATER CONSUMPTION ACROSS COMMODITY TYPES BASED ON GWI DATA

The above data indicates broad industry averages however our industry experience spans a wide range of water usage statistics which vary according to our customer's unique mine site conditions. Actual amounts vary from site to site. Also, the amount of water used is largely dependent on the mining processes and technologies used at each site.

It's worth noting that the ICMM standard is to measure 'freshwater abstracted' rather than 'water consumed'.

DID YOU KNOW?

Chile's Ministry of Mining estimates that by 2030, 74 percent of the water volume used at new mining projects in the country will be seawater and triple the total amount consumed today.



Opportunities to improve water management

There are many initiatives copper miners can explore to reduce their water footprint and become better water stewards, from seawater desalination to wastewater treatment to dry stacking tailings.

Explore these opportunities by clicking on the numbered buttons found throughout this interactive infographic.

Water and copper mining projects across the Americas

We understand copper mining and its relationship with water. Less water usage and more water reuse lead to less effluent generated, resulting in better economic and environmental outcomes and greater alignment with surrounding communities.

Across the Americas, we're building partnerships with some of the world's largest copper miners to minimize their mine's impact on local water resources.

45+

years providing water solutions

20,000+

water projects delivered

100+

Senior water experts in the Americas with a combined 1000+ years of experience.

50+

water for mining projects delivered in the Americas

Explore the projects by clicking on the red pins on this interactive infographic map.

Our combination of mining, water and environmental solutions in one company is unmatched. Our experience and capability allow us to provide integrated solutions and services that ensure you achieve your operational, water stewardship and sustainability objectives.

What does a sustainable water management plan look like?

The aim of a water management plan is to design initiatives to use water in more cost-effective and sustainable ways, while supporting increased copper output for the global energy transition.

Water management includes setting goals for how water is used and returned to the environment, monitoring those goals, and developing and implementing programs to meet them.

For a copper mine, a water management plan will usually aim to minimize freshwater abstraction, maximize water efficiency and reuse, efficiently manage any water discharge, and create beneficial reuse for local communities. The net effect being the lowest operational cost of water, while improving the environmental sustainability of mining operations.

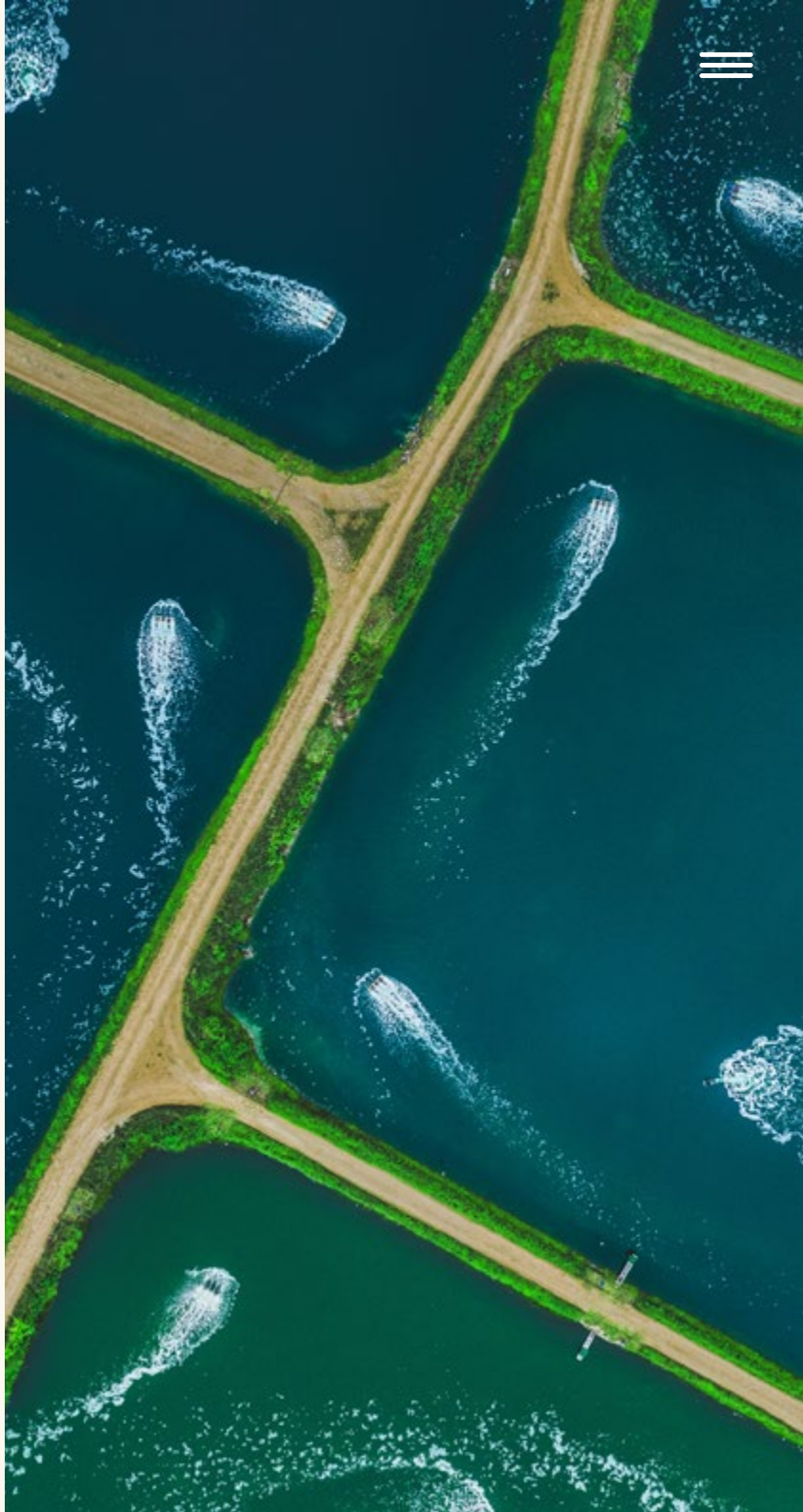
Historically, miners have only needed to do this at individual sites. But today, it's not only important to meet water management goals set and managed at the corporate level, it's also important to communicate those goals and status to a larger community of stakeholders. These include shareholders, governments, and local communities near mines.

More recently, nongovernmental professional organizations focused on ESG metrics have emerged as key stakeholders.

The result has been the advent of multiple regional and global professional standards for water management and reporting. These include GRI 303, the Water Disclosure Project (WDP), United Nations SDGs,CEO Water Mandate reporting guidelines, the Initiative for Responsible Mining Assurance (IRMA) certification and Australia's Water Accounting Framework

As a result, ICMM (International Council on Mining and Metals) has developed a water stewardship framework, for implementing, monitoring, and reporting a rigorous water stewardship plan. Adhering to this framework is becoming increasingly important to meet the needs of a mine's stakeholders. The ICMM framework has become a de facto standard for miners, with various governments, including Chile, Australia, and other major mining countries, included in developing requests for permits, and reporting to government entities.

At the individual operations level, embracing ICMM protocols results in much more streamlined monitoring and reporting of water management, allowing a single set of data and metrics, in a unified format useful for operations management, corporate management, as well as reporting to external stakeholders. It increases transparency to external stakeholders, helping to facilitate investment, insurance, and government permitting. It also allows miners to inculcate water management into the overall mine and corporate sustainability program.



Water solutions are well worth the investment

The future of copper production needs to be socially equitable, environmentally sustainable, and economically beneficial. And responsible water usage sits at the core of the viability of any copper mine, whether it's facing a water shortage or a water surplus.

The most effective water management strategies are built on a stakeholder-inclusive processes that considers cross-site and catchment-based actions. Success in water management is not possible without this collaboration.

Technology is also key to environmentally responsible copper mine development. New water treatment technologies and more sophisticated data collection and modeling are increasingly indispensable tools to better manage water at mine sites.

The world depends on copper miners to supply higher volumes of this critical metal to enable the decarbonization of global economies. And with a balanced and inclusive approach to water management, they are perfectly positioned to participate in the energy transition, sustainably grow revenues, and lead the mining industry in water stewardship.

Interested in developing water management plans to meet your water stewardship goals? Complete our water stewardship self-assessment.

WATER STEWARDSHIP SELF-ASSESSMENT

How is your copper mine tracking on its journey to water stewardship?

	Metric	Yes/No
1	Does your company have stated water management metrics, which are quantifiable, measurable, and reportable?	
2	Is your company using KPIs to track progress against water goals and commitments at both the site and corporate-wide level?	
3	Are you demonstrating your water management performance to investors, customers, or other stakeholders and are you confident in your ability to respond to these inquiries?	
4	Does your mining operation have process infrastructure in place to reuse XX percent of water abstracted?	
5	Is the water consumption at your sites increasing at a rate less than 5 percent annually?	
6	Is your water management capital spending less than 10 percent of your total mining spend?	
7	Have interactions with local stakeholders remained positive in the past 2 years?	
8	Is your business in good standing with regulatory bodies, receiving no warnings or legal action in the past year?	
9	Are you confident in the availability of water in the future will not constrain your ability to reach your production and market potential?	
10	Is your operational water balance model up to date and does it consider: • The full catchment and other users in the catchment • Your full mine life • Seasonal variability • Climate and geochemistry trends over time	

If you scored less than you would have liked, we can help.

Get in touch with an expert

Special acknowledgements to Adrianne Yang, Bruce Thomas-Benke and others across our wider water for mining team who provided valuable insight, and to Global Water Intelligence for providing valuable references.

WORLEY.COM