



# Making the most of water — our most valuable resource

MINE WATER SERVICES





## The source of your mine's success

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Water impacts your mine during every stage of its life. Beginning as a drop of rain, the water droplet either soaks into voids to feed groundwater or runs off the surface, filling the rivers and lakes that provide your mine's water supply. Water then becomes an integral part of your operations.

When you close the mine, efforts are made to divert water around and away from the mine, while any remaining contact water is treated. Restored back to its clean and natural state, water flows through the system again as a sustainable resource.

Water. It's one of your mine's most valuable resources.

Carefully managed, meticulously balanced, you use water efficiently through every part of your operation. From securing supply to processing ore, efficient water use is an enabler — it contributes to the social license to operate from beginning to end. As your partner, we help you secure, measure, manage and value every single drop.



According to the ICMM, access to water is one of the biggest global challenges of the 21st Century.

# A (more) resilient way to fill the bucket

Climate change, increasing competition with stakeholders for scarce water supplies, and more stringent water quality regulations are all factors that affect your mine.

Overcoming them smoothly requires an integrated approach with a creative and experienced water management team. Good mine water management is about taking only as much as you need. Not having enough water will stop the mine from operating efficiently and having too much can require costly measures to protect the environment.

It's a detailed process, requiring practical experience to forecast how much water will be available and when. The goal? a resilient water supply for operations with minimal excess contact water for treatment and discharge.

As a team with experience from concept through construction, operation and closure, Stantec can help you manage your mine's water requirements so you have a water supply and water management system you can count on—regardless of environmental conditions—during the entire mine lifecycle and beyond.

Stantec provides water management services at every stage of your mine's life:

- Baseline Studies
- Water Balance & Water Quality Modeling
- Water and Tailings Infrastructure Engineering
- Mine Water Treatment and Water Re-Use
- Lifecycle Planning and Liability Mitigation



Our goal is to  
carry out our work  
with zero harm  
to people and the  
environment.





**The distribution of water on the Earth's surface is extremely uneven. Only 3% of water on the surface is fresh; the remaining 97% resides in the ocean. Of freshwater, 69% resides in glaciers, 30% underground, and less than 1% is located in lakes, rivers and swamps.**



# You have to take out what you put in

## A holistic view of mine water management

At Stantec, we take an integrated approach to mine water management based on a holistic perspective. We see water as a critical element flowing through all phases of the mine from mine planning and design through to operations and post-mine closure, and we understand the connections between this precious resource and the profitability of your overall business.

We also understand that it's about more than just regulatory compliance. As water stewards, we see sustainability in water management as a proactive way to do business in the mining industry.

### **Benefits of efficient mine water management:**

- Minimizes the total water management costs
- Maximizes water security and resiliency
- Minimizes long-term environmental risks
- Reduces conflicts with stakeholders
- Facilitates the social license for a mine to operate

Whether you're looking to explore and develop new sources of water supply for processing, managing risk associated with water management and storage capacity, monitoring and controlling down-gradient water quality, or have a project involving all of this, we can provide you with the ongoing stream of information you need to make crucial and timely decisions.

Highlighted below and throughout is our pool of expertise and comprehensive services from which you can draw.

### **Water Engineering:**

- Hydraulic/hydrologic modeling
- Computational fluid dynamics (CFD) modeling
- Hydraulic structure design (e.g., intake/outfall, culverts, river crossings)
- Dam breach modeling and safety reviews
- Flood modeling and floodplain mapping
- Tailings pond sedimentation modeling
- Water supply and demand analysis

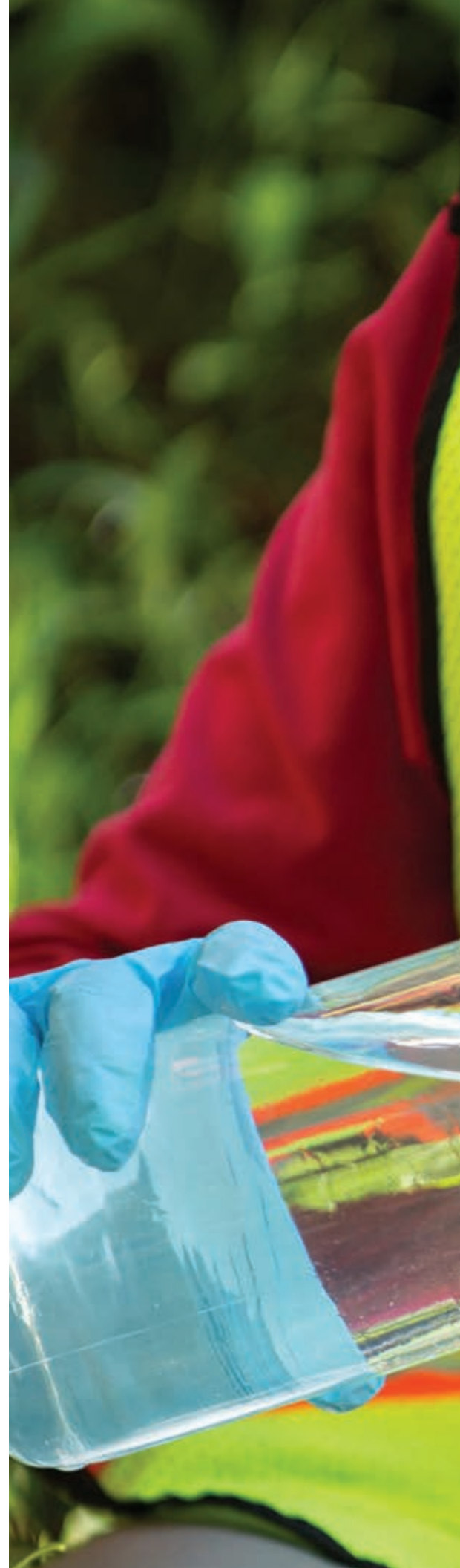
# Do you know what's in your mine water?

## Looking at water through an environmental lens

The availability and quality of water can affect whether your mine operates or not. Related to mine permitting is the potential for impacts to the downgradient environment and ecosystem. With our environmental baseline, permitting and water management assessment services, you can safely define environmental baseline conditions and determine if (or when) you have too little or too much water and what you can do about it.

### **Our experience in baseline studies include the following:**

- Climate station installation and monitoring
- Stream gauging and hydrometric network design
- Spring and seepage surveys
- Surface water and groundwater sampling
- Groundwater characterization and evaluation
- Riparian and aquatic ecosystem environmental surveys
- Water supply evaluations







Stantec can include chemical mass balance calculations in water balance modeling to better understand water quality as well quantity (volume).





# Models that balance the flow

## Dynamic mine water management requires interactive models

Managing mine water is fundamentally a time-dependent process, and at Stantec we use an interactive, time-dependent modelling approach.

We accurately assess your mine's water footprint and the water variability expected over the life of your mine using a suite of modeling platforms. Through numerical modeling, we can replicate, and calibrate to, your surface water and groundwater systems. We also conduct modeling to address the variability of water chemistry over time from geochemical reactions in waste rock, pit wall rock, ore, and tailings. We then put these results into a site-wide water balance model like GoldSim™ to predict water quantity and quality, incorporating natural uncertainty and event-driven risks. These models, through stochastic simulation, are used to determine the potential variability in water volume and quality over the life of your mine.

Once the average and extreme conditions have been defined, our experts develop cost-effective mine water management solutions for your project.

### **Our water balance and quality modeling services include:**

- Hydrologic modeling (HEC-HMS, UBC watershed Model, Mike SHE)
- Groundwater contaminant fate & transport modeling
- Site-wide operational water balance modeling
- Stochastic modeling and sensitivity analysis
- Water quality modeling and impacts to receiving waters
- Integrated groundwater/surface water modeling
- Water quality modeling
- Climate change effects analysis
- Geochemical characterization for waste rock, ore and tailings
- Pit lake geochemical modeling

### **Our environmental geochemistry services include:**

- Aqueous geochemistry of metals and radionuclides
- Tailings and leach facility geochemistry
- Aquatic toxicology and environmental risk assessment

# It's all in how you treat it

## Mine water treatment

Water is a powerful and valuable resource in its natural state, when impacted, less so. At Stantec, we have the experience and technical skills to evaluate, design, and build water treatment systems that are tailored to the unique factors of your mine.


Our team of engineers and process specialists brings state-of-the-art knowledge in treatment technologies such as chemical precipitation, reverse osmosis and other membrane applications, ion exchange, oxidation, and biological treatment. Further, our experts are well versed in potential application of emerging technologies that are needed for challenging treatment requirements. We offer services at every step of the process: in the evaluation, design, construction, and operation of mine water treatment plants.

Over the years, our expertise has expanded by taking an integrated approach to the management and treatment of mine water including mine drainage and mill process water. Cost-effective selenium removal, in particular, is one of our internationally recognized mine water treatment specialties.

As a technology-neutral company, we have no vested interest or bias to any particular water treatment technology or vendor. This allows us to create treatment processes that are appropriate for the site-specific treatment application and in our clients' best interests.

### Following are some of our water treatment services:

- Treatability testing and process optimization
- Process water treatment engineering
  - Conventional lime neutralization
  - High-density sludge (HDS)
  - Iron co-precipitation of metals and metalloids
  - Sulphide precipitation of heavy metals
- Advanced treatment design
  - Membrane Separation
  - Advanced Oxidative Processes
  - Biological Nutrient Removal
  - Selenium Removal
  - Ion Exchange
  - Passive mine water treatment
- Cyanide, thiocyanate, and ammonia treatment
- Natural and engineered wetland treatment
- Residuals management



The objective of a mine water management system is to generate confidence that the water is managed in a responsible, sustainable and transparent way.



A history of helping mining clients manage water at every state of the mine life.





# Building up for a smooth flow

## Water infrastructure

For water to flow smoothly through your mine, effective water infrastructure is needed. We offer extensive experience in water infrastructure solutions for the supply, conveyance, pumping, and storage of water and tailings. Water infrastructure is collaboratively developed from client needs, the solid foundation of our design experience.

### **Our water infrastructure services include:**

- Pump station design
- Gravity/Pressure main design
- Automated well-field design
- Tailings slurry-pumping and pipeline design
- Water network modeling

A mining community 3,600 people strong  
located in countries around the world.

# One source, two systems well-managed

## Surface and groundwater systems

### Surface water

Water can be found in many forms. In a storm, water falls from the sky as a million drops and lands on the mine. From baseline feasibility evaluations and environmental impact studies to complex site-wide water balance models to stormwater management planning and development, our water experts can work with you to design a pragmatic cost-effective surface water management solution for your mine.

### Groundwater

Flowing under the ground surface in the soil and within the rocks, water takes on the valuable form of groundwater. Our dedicated team of hydrogeologists and hydrogeochemists is ready to help you minimize and mitigate your mine's potential impacts on groundwater.

Using their thorough understanding of mining hydrogeology and their collective experience in hard rock mine environments, our people can conduct groundwater investigations at your mine site to estimate water volume and quality so that efficient water management scenarios can be developed.

Like groundwater and surface water systems, our teams are also closely connected. Our hydrogeologists, hydrologists, biologists (aquatic, terrestrial, wetland), geomorphologists, geochemists, water quality specialists, and engineers collaborate on projects to find the best and most cost efficient solutions.

### Our water modeling services include:

- Aquifer characterization and testing
- Regional and basin-wide modeling
- Integrated surface/groundwater modeling
- Pit and underground dewatering modeling
- Pit lake water and chemical mass balance modeling
- Cover design and infiltration modeling
- Water supply evaluation and permitting
- 3D geological characterization and visualization





Thousands of mining engineering and environmental projects completed for mining clients all around the world.



# Flowing towards the tail end of the mine life

## Tailings and waste management

Water plays a fundamental role in the disposal of mine tailings. And so does the team of scientists and engineers at Stantec. We can help you design water efficient tailings management systems. This system would balance potential socio-economic and environmental considerations while providing a responsible and sustainable way to store tailings. Flowing through it all would be (minimal) water – well managed.

Our team is made up of some of the foremost geotechnical experts in tailings dam design and operation that have designed some of the largest and most water efficient tailings management facilities in the world. Sustainability and adherence to the Global Reporting Initiative (GRI), are significant in our designs for tailings storage facilities. And, we offer creative solutions in addition to conventional tailing disposal such as thickened or paste and filtered tailings disposal methods. We endeavor to minimize water use with each method.

We help decommission tailings storage facilities when a mine is ready for closure through a logical staged sequence of problem-solving activities designed to minimize environmental risks and maximize ecological restoration. This work minimizes impacts from the closed mine on water and often involves treatment of water before its journey back into the natural system.



**Stantec creates lasting connections  
by partnering to manage water at  
mines around the world.**



# Reclaim, remediate, become more resilient:

mine water management  
that leaves a positive  
legacy

The life of your mine will end, and re-integrating the mine system into the natural hydrologic system is the goal. Yet the management of water can continue in perpetuity and no one wants impacted water to be the lasting legacy of their mine. There is also an opportunity to leave a positive legacy. In addition to decommissioned tailings storage facilities that minimize environment risks and maximize ecological restoration, we look to create a long-term, sustainable legacy that carries on long after your mine and centers around protecting the world's most valuable resource: water.

**Our legacy remediation services related to water include work such as:**

- Natural channel design and restoration
- Diversion channel design
- Detention pond and sedimentation basin design
- Erosion control and riverbank protection
- Stormwater management
- Wetland and riparian design

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of place and of belonging. That's why at Stantec, we always design with community in mind.

We care about the communities we serve—because they're our communities too. This allows us to assess what's needed and connect our expertise, to appreciate nuances and envision what's never been considered, to bring together diverse perspectives so we can collaborate toward a shared success.

We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

Stantec trades on the TSX and the NYSE under the symbol STN. Visit us at [stantec.com](http://stantec.com) or find us on social media.

[www.stantec.com/mining](http://www.stantec.com/mining)

Design with community in mind

