



Water Solutions for Sustainable Mining



Effective Water Management Your Success Depends on It

Water is critical to mining, yet it is one of the most challenging resources to secure and manage. Supplies are limited, regulations are strict and increasing, and the pressure for reduced consumption, water quality protection, and responsible water management is high. Today more than ever, mining companies need sustainable and effective water management to succeed.

At Carollo, where water is all we do, we help mining clients solve complex water challenges throughout each stage of the mine life cycle. From water supply production and treatment to wastewater disposal and reuse, we provide interactive and cost-effective water management solutions to help mines thrive.

Our mining clients benefit from our customized approach to complex engineering design and construction management challenges. We tailor each solution to maximize water resources, drive productivity and reliability, and support long-term sustainability practices.

As your engineering partner, we will focus on your water so you can focus on mining.



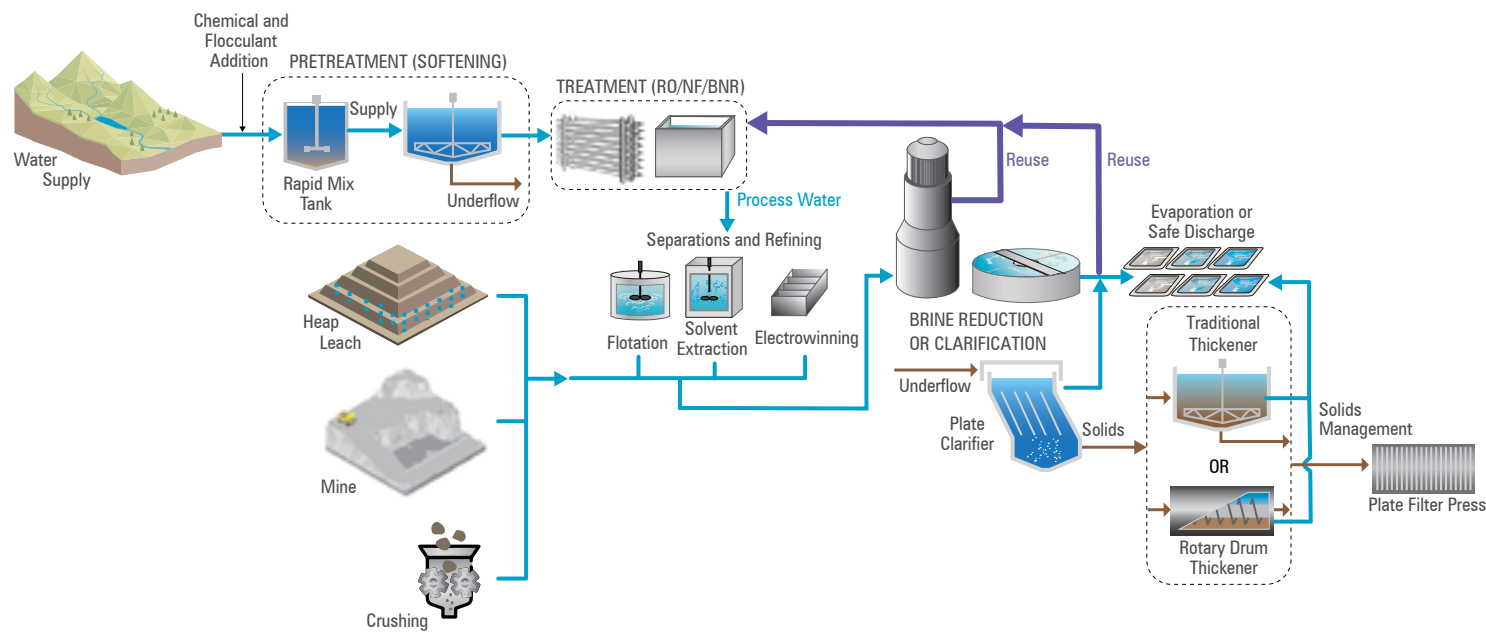
Effective Water Management

Water is essential to your processes and productivity, yet supplies are scarce, competition is fierce, and public scrutiny over water practices is significant. At Carollo, we work with heavy industrial and mining clients to solve complex water challenges through innovative solutions that drive productivity, facility and system reliability, and overall profitability. Our services include:

- **Water supply planning, water use assessments, and facility master plans** to optimize water resources, achieve maximum water value, and reduce risks that could lead to facility outages/shutdowns and cost impacts.
- **Best value solutions** through holistic design, planning, and construction management offerings.
- **Advanced treatment technologies** that meet your specifications for process, wastewater pretreatment, cooling water treatment and beneficial reuse.
- **Creative public-private partnerships** for joint water management, project funding development and ownership, and operational improvement opportunities.
- **Cost-effective initiatives** for water recycling and gray water reuse to minimize your impact on fresh water supplies, reduce your operational costs, and maximize opportunities for growth.
- **Climate resiliency** to assess the vulnerability and risk mitigation of water supplies and assets over the long term.
- **Best management practices and strategies** for reducing water footprints, and managing waste and discharge.
- **Full compliance** with regulatory and safety requirements.
- **Blue Plan-it® Decision Support System** that provides a fully customizable simulation and optimization modeling tool to help you cost-effectively evaluate, optimize, expand, and/or modify your water and wastewater treatment systems and infrastructure.



Water Services Phases of the Mine Cycle



As a full-service water consulting firm, Carollo is equipped to address the varying and multi-faceted aspects of your water supply, treatment, reuse, and sustainability needs. We integrate experts from our specialized practice groups into each project to deliver comprehensive integrated water management solutions.

INTEGRATED PLANNING

- Water Resources Planning and Accounting
- Permitting and Regulatory Assistance
- Water Balance and Hydraulic Modeling
- Master Planning and Reuse Studies
- Stakeholder Consensus Building

WATER & WASTEWATER TREATMENT

- Pilot and Treatability Studies
- Planning/Prefeasibility/Feasibility
- Design/Engineering/CA&I
- Start-up and Commissioning
- Alternative Delivery Expertise

CONVEYANCE/INFRASTRUCTURE

- Pipelines
- Pump Stations
- Infiltration Basins

TREATMENT TECHNOLOGIES

- Arsenic Treatment
- Biological Treatment
- Brine Management and Brine Reduction
- Softening
- Low-Pressure Membranes
- Desalination (RO/EDR)
- Selenium Treatment
- UV Disinfection

WATER REUSE & RECYCLING

- Strategic Planning and Design
- Optimization Strategies for Economic Sustainability
- Permitting and Compliance
- Treatability Analyses

BUSINESS SOLUTIONS

- Financial Planning and Asset Management
- Information Management and Integration
- Energy Conservation

RESEARCH & DEVELOPMENT

- Water Quality and Treatability Evaluation
- Optimization Studies
- Pilot and Bench-Scale Testing

Safety

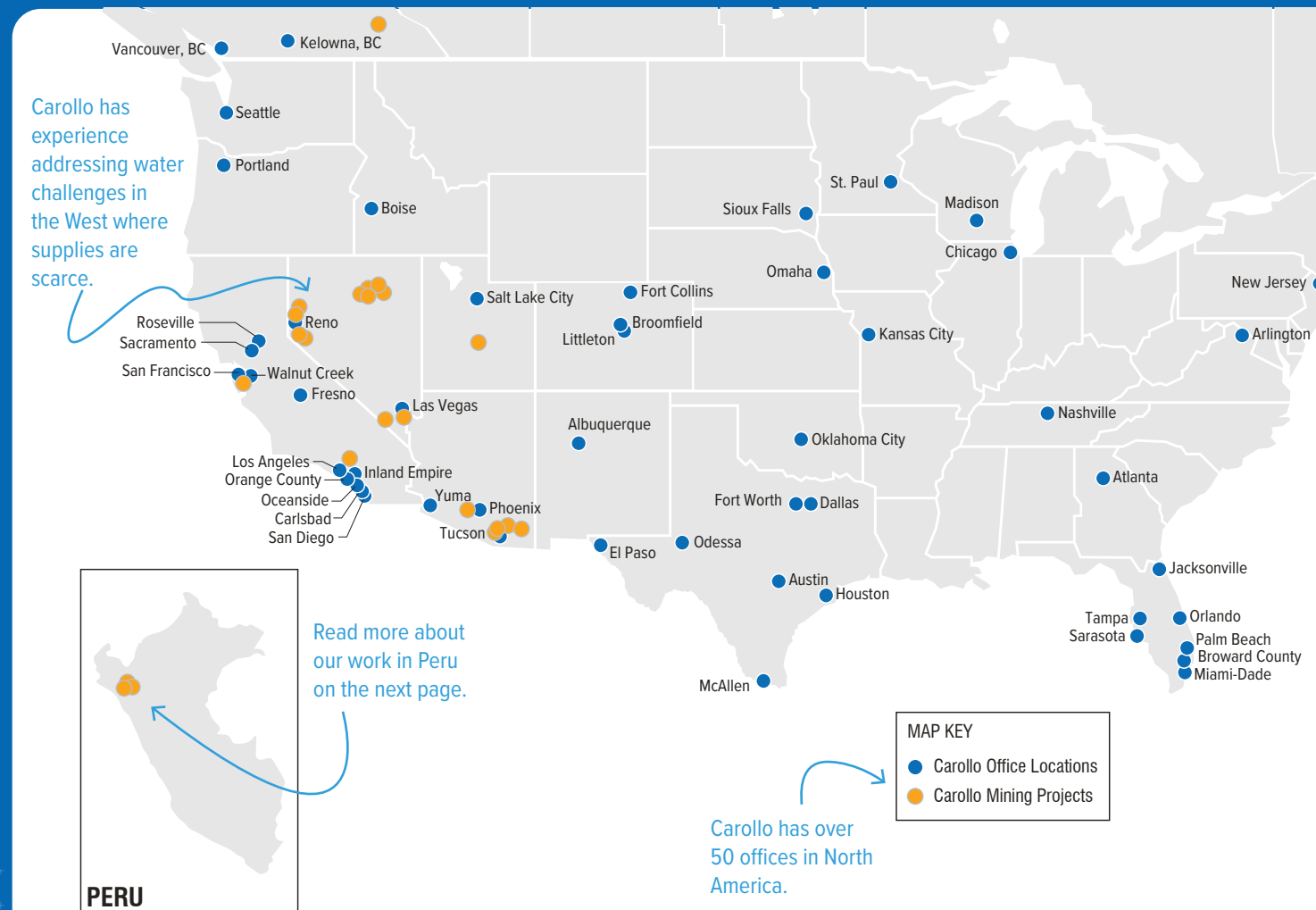


Safety on the Job is Number ONE

Carollo incorporates a safety mind set, not only in our designs but during construction and operations. We fully understand the strong emphasis on safety and the high priority that the mining industry places on it.

Numerous key personnel maintain current MSHA certifications and have completed operator-specific contractor training and site-specific safety training with various mining clients. At Carollo, we strive for continuous improvement of our safety policies, training, and safety culture, not just for the safety of our staff but for everyone on site. Our team adheres to MSHA guidelines and proactively identifies safety issues.

Our Mining Experience at a Glance

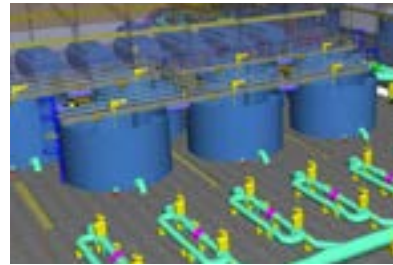


Project Success Stories

Comprehensive Mine Site Water Management Study

Confidential Gold Mining Client | Elko, Nevada

The key elements of the project include effective treatment for Arsenic to below the Nevada Profile 1 standards for the 50 mgd plant. The technology selection for the treatment plant was supported by bench-scale and pilot-scale testing. The Comprehensive Mine Site Water Management Study included scoping, prefeasibility, and feasibility studies to define water treatment, storage, conveyance, and disposal for the mine's approximately 50-mgd flows of dewatering water over the next 15-year planning horizon. The key elements of the project include effective treatment for Arsenic to below the Nevada Profile 1 standards and design flexibility to address the changing water quality and variability in the mine plan. The technology selection for the treatment plant was supported by bench-scale and pilot-scale testing to provide guidance on the optimum infrastructure solution for the life of mine operations. The Arsenic treatment project will be a ferric chloride co-precipitation followed by removal with disc filters. The subsequent thickening processes include plate clarifiers, rotary screen thickeners, and plate and frame filter presses. Two major pump stations are required for the delivery of the treated water to rapid infiltration basins. The pump station design includes horizontal centrifugal pumps and vertical turbine pumps.



Water Management Portfolio Pump Station and Pipelines Design

Confidential Gold Mining Client | Elko, Nevada

Detailed design of two high flow pump stations, pipelines, and rapid infiltration basins for dewatering water disposal. Each pump station was designed for N + 1 redundancy, which resulted in three 300 HP pumps and four 400 HP pumps to accommodate flowrates of 12,800 gpm and 4,800 gpm, respectively. The design included about 12 miles of HDPE and steel pipe ranging in size from 24-inch to 40-inch. Design challenges included an elevation gain and drop of 700 feet over 4 miles and an installation of surge mitigation measures. Responsible for cost and schedule control as well as interdisciplinary coordination throughout the design process.



Water Treatment Plant Expansion

Morenci Water and Electric | Morenci, Arizona

Carollo provided engineering design services and construction support for the expansion of the Morenci WTP. The water system serves Morenci, Clifton, and the Morenci Mine Facility. Carollo developed a cost-effective solution to the area's challenge of limited water supply to support the growing community through an extensive Value Engineering and Cost Estimation process. The completed expansion increased the plant capacity to 6-mgd, providing a much-needed increase to the clean water supply for this mining town. The project scope included obtaining the Approval to Construct permits from the Arizona Department of Environmental Quality. The key challenges of this project included: streamlining the water system to benefit not only the Morenci Mine Facility but also the surrounding communities and resolving increased water needs with a cost-efficient expansion.



Mine Study of Bubbles Destruction in SO₂

Minera Yanacocha SRL | Peru

This project was Carollo's third project for Yanacocha who owns the largest gold mine in South America. Yanacocha treats up to 700 m³/hr of barren wastewater for cyanide using the SO₂/Air process. Treated water from this process decants to a feed tank and is pumped to an Ultrafiltration (UF) membrane system for further treatment. High levels of dissolved gas / "microbubbles" have been identified as a cause of an observed cavitation issue in the UF feed pumps. This 2017 study was carried out to identify the root cause and potential solutions for an apparent gas evolution (microbubble/cavitation issue affecting Ultrafiltration (UF) Feed Pumps in the modified SO₂/Air cyanide treatment process at the La Quinoa CIC Excess WTP (EWTP). The study included a site visit for problem analysis and direct measurements of total gas pressure. Several potential solutions were identified and evaluated and two degassing methods were recommended for further consideration and implementation. This work follows earlier assignments to perform hydrodynamic modeling of the SO₂/Air reactors and third party review of the downstream membrane separation facility.



Pumpkin Hollow Mine Water and Wastewater Scoping Study

Nevada Copper | Yerington, Nevada

Carollo provided a scoping study for the water and wastewater systems at Nevada Copper's Pumpkin Hollow mine. This study was a direct result of the significant growth of the mine's workforce from 25 to more than 400 people requiring an increased capacity of both the water and wastewater systems. Carollo evaluated the trade-offs of each potential water and wastewater system. This potable water and wastewater scoping study enabled Nevada Copper to make an informed selection about which treatment systems are viable for the mine's future operations. A direct adsorption consumable media was recommended based on the lifecycle cost.



Rock Disposal Area Water Operations and Maintenance Review

Previously Owned by Jerritt Canyon Gold | Elko, Nevada

Carollo used their expertise in water treatment plant design to provide Jerritt Canyon Gold, LLC (JCG) with projected Operations and Maintenance (O&M) costs for operation of an existing water treatment plant (WTP) in the event that the facility is re-purposed in the future for treatment of Rock Disposal Area (RDA) water. The study accounted for future chemical consumption, electricity, labor, and maintenance costs to develop an estimate of future O&M costs. The existing JCG Tailings Water Treatment Plant (WTP) currently treats an average design flowrate of 836 gpm and a maximum daily average flowrate of 1,000 gpm of tailings water for discharge to injection wells. In the future, the WTP may treat seasonal flows of approximately 60 - 200 gpm from the Rock Disposal Area (RDA) to meet Nevada Profile 1 standards. The water from the RDA contains different constituents of concern than the current plant influent and the desire is to re-use as many process units as possible.





carollo.com



Carollo's commitment to the water industry has been a hallmark of the company since our inception in 1933. This single-minded focus allows us to deliver innovative water solutions, a collaborative environment, and exceptional client service. Our passion about ALL water systems means we strive to sustainably maximize the use and benefits of this precious resource.