

Engineering and implementing innovative solutions to water inflow and tailings management

# MINING SERVICES

We believe in *innovation*, in *engineering*, in *execution*.

# PSI has been developing innovative new ways - better ways - to address the needs of the mining industry.

With an integrated approach to engineering and construction, PSI manages your needs - from design to implementation - and ensures that the solutions needed are the solutions delivered. PSI Technologies delivers end-to-end customized, innovative solutions to water inflow and tailings management for the global mining industry.

We bring the innovative methods behind civil, geological, and aerospace engineering to underground and surface mining challenges, identifying long-term sustainable solutions to address water inflow, tailings management and other structural needs.

*Our mining services are fully integrated* – from engineering and materials testing to construction and site maintenance – and can help you minimize inflows and environmental impact while optimizing operations.

PSI has experience in a variety of mining operations, including:



Surface Operations | Underground | Open pit | Tailings Management Areas | Aggregate | Oil and Gas



# MOVING IDEAS INTO ACTION

With a fleet of more than 1,000 pieces of equipment and a team of experienced construction specialists, PSI is able to turn engineering innovations into functional on-site performance.

Our turnkey approach to providing mining solutions improves efficiency and execution, ensuring our best plans and ideas are delivered according to our exact specifications. We oversee all earthworks, excavation, demolition and recycling, eliminating the need for multiple contractors to complete projects.

PSI performs all elements of project management, bringing a vertically integrated team that can reduce costs, improve efficiency and increase the effectiveness of our solutions.

## IMPROVING ENVIRONMENTAL MANAGEMENT

PSI owns and operates a constructionand-demolition waste site, allowing for the processing of used mine-site materials including plastics, wood, metals, concrete, asphalt and tailings. PSI is committed to environmental responsibility and provides documentation for LEEDcertified projects.

# ENGINEERING

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PSI

# ENGINEERING THE BEST SOLUTIONS

### Every Mine Is Different. Every Solution Is Unique.

PSI's team of engineers, technicians, and operators work with mining companies to identify specific challenges and conditions unique to their sites and to develop cost-effective, sustainable solutions.

We provide a full suite of engineering services, including geotechnical analysis, materials characterization, and design of effective, appropriate solutions to manage tailings and water inflow.

PSI's engineers also offer project management services, working with our labs and construction teams to ensure the effective delivery of our engineering solutions. We provide quality assurance testing and ongoing maintenance support.

# **PSIMINE3D™** A BETTER APPROACH TO MODELLING

PSI's proprietary PSIMINE3D<sup>™</sup> uses advanced numerical modelling to provide improved analysis of mine field state conditions and the surrounding geological structures. Our system has a demonstrated capacity to predict underground stress and strain states and to help discover new opportunities for tailings management and structural support.



## A TEAM OF INNOVATORS

PSI President and Chief Technical Officer, Dr. Curtis Berthelot (P.Eng.), earned his Doctorate of Civil Engineering with a focus on Aerospace Materials Science. He has built a team of more than 100 engineers, geologists, lab technicians and industrial operators with decades of experience working with mining partners.



L **FESTIN** LAB

# DISCOVERING NEW SOLUTIONS TO MINE MATERIALS MANAGEMENT

# PSI's team of lab specialists works alongside engineers and operators to explore new ways to improve mining operations, tailings management, and structural support.

With a commitment to technical innovation, our labs develop better ways to utilize existing on-site materials to improve mine structural conditions. We design and test customized solutions that can resolve water and tailings issues by exploring the properties of tailings and other locally available materials and testing their behaviour along with various additives.

In addition to our central laboratory, PSI has fully equipped mobile labs to conduct on-site field testing of materials for quality control and quality assurance during delivery.



PSI's central laboratory is certified by the

Canadian Council of Independent Laboratories in several test procedures and is staffed by full-time, certified technicians.





# A BETTER APPROACH TO MODELLING

# PSI solves complex mine problems using advanced 3D continuum mechanics mine modelling with PSIMINE3D™.

PSIMINE3D<sup>™</sup> offers advanced numerical modelling capabilities for predicting the mechanical behavior and performance of mine and rock structures under different stress states and climatic conditions, including drifts, shafts, pillars, berms, rooms, structural support and bulkheads.

PSIMINE3D<sup>™</sup> is a continuum mechanics model that employs non-linear viscoelasticity, plasticity and viscoplasticity, coupled with fracture mechanics. This model is designed to predict stresses, strains, displacements, creep rate and damage at any location in the structure, leading to better geotechnical structural design. Numerical modelling, laboratory and field testing services are linked together to provide the best engineering solution.







# CUSTOMIZED SOLUTIONS FOR MINE GROUTING

# PSI's pursuit of engineering innovation has led to improved grout systems engineered for customized mine applications.

PSI's grouting systems are developed to provide a wide range of material properties not found in traditional mine grouting systems. Utilizing the best of both asphaltic and cementious materials technologies, our engineered grouting systems can be custom blended and modified to obtain properties that meet performance-based specifications for both material delivery and end-product properties unique to your mine environment.

PSI's grout systems are engineered to provide a wide range of viscosity, tenacity, adhesion, fracture toughness and shear stiffness in both dry and submerged mine conditions. PSI uses a full spectrum of chemical additives in its grout system mix designs and supplies all chemical additive materials for surface and underground grout supply and delivery.

### ENGINEERED GROUTING

Our integrated approach allows us to analyze unique mine conditions to customize grouting materials and additive systems to achieve material properties specific for the mine needs. We also have equipment and support personnel to execute the required grout material supply, haul, and placement.





# MANAGING INFLOWS AND OPTIMIZING TAILINGS USE FOR BACKFILL

# PSI's pursuit of engineering innovation has led to improved backfill systems and better use of tailings to manage inflows and provide structural support.

Building on the insights of our PSIMINE3D<sup>™</sup> system and our lab, we develop backfill systems designed to improve structural support while minimizing environmental impact by reusing tailings materials. Our systems are engineered to provide structural stiffness, address creep rates and mitigate water inflows based on the unique needs of the mine and our performance graded specifications.

PSI engineers develop custom backfill solutions that meet necessary standards for fresh and end-product properties such as viscosity, tenacity, adhesion and fracture toughness designed for use in various mining conditions and delivered as a thickened paste or in high-flow systems.

### ENGINEERED BACKFILLING

Our integrated approach allows us to analyze backfill materials, design cost-effective systems for repurposing tailings and execute all required hauling, construction and backfilling services.





# ENGINEERED TAILINGS MANAGEMENT

PSI engineers mine tailings into usable products for backfilling and grouting. Using innovative tailing processing equipment, tailings are engineered and processed to optimize their use in backfill and grout systems.

Reusing materials is at the heart of PSI's corporate commitment to the environment, as is providing our clients with the most economical solution to meet their needs. Engineered processing of tailings satisfies both of these commitments by using tailings waste products as a value added aggregate source, while offsetting the need for costly new backfilling materials. Building on our materials science expertise, PSI has designed, built and commissioned tailing processing equipment for the reuse and processing of mine tailings. Processed tailings are custom tailored to the unique properties of the mine's tailing, and to meet the requirements of the backfill or grout mix design.

PSI mine tailing processing systems are designed to meet the performance and cost-based specifications for individual mine sites. Processed tailings are engineered to provide optimal backfill and grouting systems for diverse mine service applications.





# CORPORATE COMMITMENT

# ENGINEERING A BETTER FUTURE

The most successful mining companies demonstrate an ongoing commitment to safety and environmental responsibility. PSI shares those values and brings a corporate commitment to technical innovation, safe and efficient construction and environmental sustainability - searching for solutions that are socially and economically responsible.

Where possible, we engineer the use of reclaimed and recycled materials – providing off-site crushing, full-depth reclamation of road materials, processing of mine tailings and shredding of wood and plastic recyclables.

# OUR COMMITMENT TO SAFETY

PSI is committed to creating, maintaining and promoting a safe and healthy work environment for our workforce and community. We actively pursue a goal of zero lost-time accidents and have maintained an ISNetworld Rating and a Certificate Of Recognition from the Saskatchewan Construction Safety Association.

**Sharing expertise** is an integral part of developing innovative and sustainable solutions to improve performance in the mining industry. PSI's engineers have published hundreds of scholarly papers on engineering practices, which can be accessed at PSI technologies.ca.



PSI's headquarters are located in Saskatoon, Saskatchewan, Canada – home to world-class engineering and research facilities and a hub of Canada's mining industry. Our clients include mining companies, governments and industrial customers across North America and around the world.



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