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# Mine Water Management & Treatment

Mining & Metals



**Water is a critical resource for mining projects. Its management and protection are of paramount importance to every mine. Amec Foster Wheeler offers industry-leading expertise in water resources analysis, including hydrology and hydrogeology, geochemistry, and water management and treatment.**



## Water management

Amec Foster Wheeler has comprehensive expertise in mine water management. This includes the study of groundwater, surface water, mine water and acid rock drainage (ARD) produced by mine wastes. We collect key site-specific data from mines, and integrate and analyze those data using state-of-the-art modeling techniques such as GoldSim™ and the depth of experience of our world-class experts to develop cost-effective mine water management and treatment solutions. Cost-effective solutions often involve smart mine waste handling and water management techniques, such as segregation of mine wastes, isolation of contact water from non-contact water, water recycling, seasonal storage, and conjunctive use of surface water and groundwater supplies. Amec Foster Wheeler's strength is to integrate these disciplines to develop optimal water management strategies.

### Groundwater

Understanding the hydrogeological conditions at mines sites is essential to minimizing the impact on groundwater, and to developing practical and cost-effective management and mitigative solutions. Our hydrogeologists and hydrogeochemists are very experienced in conducting groundwater investigations at mine sites in support of developing water and waste management plans. We have expertise in the study of groundwater-surface water interactions, groundwater movement, contaminant hydrology, and vadose zone hydrology. When required we employ a variety of groundwater modeling techniques, from simple lumped-parameter spreadsheet models to advanced 3D flow and transport models. These models are applied to address key water issues.

### Surface water

Effective surface water management is critical for the successful operation of a mine. Amec Foster Wheeler has decades of experience in surface water analysis and management for mining projects. Our expertise is wide and varied, from baseline studies and basin scale modeling for Environmental Impact Assessment (EIAs), to the development of complex site-wide water balances for operating mines, stormwater management plans, to the design and construction supervision of drainage, diversion and storage facilities.

### Mine waste geochemistry

Estimating the possible outcomes of future water quality at mine sites is a critical component of mine water management. Our experts use a variety of geochemical techniques (e.g. mineralogy, acid-base accounting, total and leachable metals analysis, laboratory and field kinetic testing), an in-depth understanding of the geology and environmental conditions at a site coupled with advanced software applications and predictive methodologies to estimate the future behavior of mine wastes and what impacts these materials will have on site water quality.

### Integrated water resources simulation

To support mine water management, as well as our plant designs, we use dynamic simulation tools (such as GoldSim™) and other leading edge software to build water balances and water quality models. Our use of advanced modeling software, and our knowledge of treatment technologies, result in cost-effective solutions that meet challenging regulatory requirements.



## Water treatment

Amec Foster Wheeler has played a leading role in the development of cost-effective solutions for mine water treatment. We have piloted, designed and reviewed processes for over 200 treatment facilities, including the design, installation and commissioning of more than 20 treatment plants worldwide.

### High-density sludge (HDS)

Our expertise in HDS goes back to the late 1970s, when we provided EPCM services for Canada's first plant. Since then, we have provided services for more than 30 HDS plants for mines and industrial facilities. Our HDS treatment process is a refinement of Simple Lime Neutralization (SLN) that creates a stable sludge of superior density and settling characteristics for more efficient disposal. Our highly automated plants minimize the need for operator attendance.

### Simple lime neutralization (SLN)

Conventional SLN is a proven process for the treatment of acidic metal-bearing solutions. It is the most economical treatment for locations in which the disposal of high volumes of sludge is not an issue.

### Iron co-precipitation of metalloids

We have completed a number of projects to reduce arsenic in mine effluents to meet or exceed discharge requirements. Ferric co-precipitation with a sludge recycle can achieve very low arsenic concentrations, due to the high surface area generated by recycling ferric hydroxide sludge. Amec Foster Wheeler's water treatment specialists are also experienced in using ferric co-precipitation for the removal of molybdenum, antimony, and selenium.

### Cyanide, thiocyanate and ammonia treatment

Our expertise includes cyanide destruction systems using  $\text{SO}_2$  /air technology for primary treatment, as well as the application of biological treatment, hydrogen peroxide oxidation and natural degradation (volatilization) for secondary treatment and final effluent polishing. We also have expertise in biological processes for treatment of cyanide, thiocyanate, ammonia and nitrate from mine effluents to produce non-toxic final effluents in compliance with current regulations.

### Removal of sulphate and other dissolved solids

In many countries, new environmental regulations require reductions in dissolved solids such as sulphate, calcium and sodium. The technology is costly, and its application at mines is relatively new. The optimal solution combines water management, conventional water treatment technologies, and carefully selected advanced treatment processes. Technologies such as reverse osmosis require effective pre-treatment to avoid fouling membranes. Many advanced processes produce large quantities of brine that must be stored or further treated. Amec Foster Wheeler has the experience to select the appropriate combination of technologies to provide our clients with the most cost effective water treatment solutions.

### Pilot plant for mine drainage treatment

Pilot plant studies are used to precisely define the design criteria of a full-scale plant. Treatment on-site is always preferred than off-site treatment because it allows testing to be carried out on representative water unaffected by potential temperature, redox or microbial changes that occur during transport. The operating conditions, effluent quality, reagent dosages and waste production can all be defined with high accuracy. The full-scale system can then be confidently designed without adding significant contingencies and unnecessarily over-sizing equipment. Amec Foster Wheeler's pilot plant was designed to simulate



all kinds of mine drainage treatment processes at a flowrate of two liters per minute. It is fully equipped to operate under various treatment configurations. Thanks to its great flexibility, the pilot plant can simulate neutralisation, coagulation, flocculation, settling of sludge, including sludge recirculation and membrane filtration. Through several available pH controllers, the pilot plant can achieve multi-stage treatment. Alternate or various reagents can be injected in order to meet the client's specific treatment needs.

#### **Total suspended solids control**

Before designing a full-scale plant that achieves TSS removal, Amec Foster Wheeler performs pilot or bench-scale laboratory testing to evaluate different coagulants, alkalis, flocculants, and various types of clarifiers, and sludge recirculation approaches. The results allow the selection of the best process to economically meet the process requirements. Various types of settling options including ponds, open pit lakes, traditional clarifiers, lamella clarifiers, and others.

#### **Passive mine water treatment**

Amec Foster Wheeler has expertise in implementing passive water treatment technologies at coal and hardrock mines worldwide to increase water pH, remove metals, metalloids, and nutrients. Passive treatment systems, when appropriate, can offer several advantages for long-term water treatment over conventional active treatment approaches. We have experience using several passive treatment technologies including various configurations of constructed wetlands, biochemical reactors, reducing and alkalinity producing systems, anoxic limestone drains, open channel limestone reactors, and permeable reactive barriers. Passive treatment systems often incorporate several of these technologies in combination to treat complex waste streams. We have successfully implemented passive treatment system at high altitude sites and those located in cold climates.

**150+**  
year history  
operating in over  
**50 countries**



# Global Mining Solutions


From concept through closure

## Connected excellence

In all we do

For more than 60 years, Amec Foster Wheeler has provided a full range of services for mining projects, from front-end geology and environmental consulting through to design, project and construction management, operations support and mine closure.

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