Brian Rogers, Vice President, has more than 35 years of experience in the design and construction of diverse civil resource development and water resources projects.

Bill Chin has over 35 years of experience in geotechnical engineering, including project management, site investigation, design, construction, operations, performance monitoring and safety evaluations of major earthfill dams for both tailings and water storage.

David Mack has over 35 years of experience in the civil, hydraulic, and structural engineering disciplines working on major dams, irrigation and other water infrastructure projects.

Tom Murray has over 35 years of experience in geotechnical engineering, including project management, geotechnical design, contract preparation and construction supervision.

Gregg O’Neil has over 30 years of experience in civil engineering design and project management with a focus on the mining and pipeline industries.

Chuck Slack has more than 25 years of experience in mine surface water management, water supply dams and irrigation canals, river flood protection and erosion control, and fish passage facilities.

Brett Stephens has over 20 years of experience in geotechnical and environmental engineering, including water supply and tailings dams, highway projects, bridges, buildings, landslip remediation and large scale earthworks.

Rob Charron has over 15 years of geotechnical engineering experience with a focus on geotechnical engineering design of tailings facilities, embankments, foundations and retaining structures.

Joel Hilderman has over 10 years of consulting experience in geotechnical and hydrogeological investigations and design including the design of dewatering and depressurization systems, the installation of monitoring and production wells, and development of 3D stratigraphic models for oil sands mines.

Tim Keegan has more than 25 years of experience managing operational risk associated with geotechnical hazards and design, construction and operations in water retention dams, tailings containment, water supply, waste water management, pipelines, and railway operating environments.

Joseph Quinn has over 10 years of experience with slope stability assessment, advanced 2D and 3D numerical modelling, seismic hazard analysis, seepage analysis, site investigation, foundation design and remediation of disused coal workings.

Warren Vincent Lambert has more than 20 years of experience in water management related to mineral resource, infrastructure, water resources, and oil and gas projects. He has extensive operations and consulting experience in groundwater water system characterization and the management of groundwater.
ALBERTA GROUP

From our offices in Calgary, Edmonton and Saskatoon, KCB’s Alberta Group works on challenging projects in the oil sands developments, onshore and offshore oil and gas industry, traditional mining, infrastructure and water resources markets. Our projects include all aspects of tailings management, dam designs, pipelines, offshore drilling islands, plant site foundation engineering, hydrogeology and hydrotechnical, environmental and reclamation services.
Klohn Crippen Berger has provided geotechnical services to the mining, power, energy, water resources and transportation sectors for over 55 years. Our team of engineers and geoscientists have a broad range of analytical, design and construction experience on a variety of projects in Canada and abroad.

**Foundation Engineering**
We have provided foundation engineering for a broad range of projects and soil conditions. KCB has designed foundations for pulp and paper mills, refinery sites, oil sands plants, offshore structures, mine facilities, cogeneration facilities, sewage treatment plants, buildings and industrial structures.

**Embankment Engineering**
We have the capacity to provide for all your embankment needs including: embankment design, slope stability assessments, seepage and settlement analyses, reservoir stability assessments, dam safety studies, construction management and inspections.

**Earthquake Engineering**
KCB has carried out regional assessments of seismic hazards. We can provide designs for slope stabilization works and foundations in high hazard seismic areas taking into consideration dynamic stability and deformation performance.

**Site Investigations, Instrumentation, and Monitoring**
KCB has completed thousands of site investigations for geotechnical and environmental engineering projects involving soil sampling, rock coring and groundwater monitoring. KCB has installed and monitored various types of instruments including slope indicators, geotechnical gauges, pressure sensors, and survey monuments.

**Construction Support**
Our field assignments have involved the construction management and inspection of bridges, pulp mills, dams, canals and hydraulic structures.

**Laboratory Testing**
Our laboratory can perform standard soils testing including moisture content, grain size, permeability, Atterberg limits, specific gravity / relative densities, standard Proctor compaction tests / modified Proctor tests, direct shear tests, triaxial and consolidation tests.

**Numerical Modelling**
KCB routinely uses numerical modelling capabilities to help find innovative solutions to complex geotechnical engineering problems. In recent years, we used both 2D and 3D stress-deformation analyses to facilitate greater in-depth assessments of the stability of major dams. KCB is also doing pioneering work in applying numerical modelling techniques to evaluate static liquefaction triggering, which is an important component for assessing the liquefaction potential of materials that are considered susceptible to liquefaction.
Experience

Alameda Dam
The Alameda Dam experienced foundation deformations during construction, which continued at a reducing rate after construction was completed in 1995. The project is being carried out in five phases. Phase 1 involved an assessment of the dam's stability to assist in developing near-term reservoir operating criteria for 2012. Phases 2 to 5 involve site investigations, assessments of the foundation deformations and the development of remedial measures that may be required to maintain the long term safe operation of the dam and its appurtenant structures, and evaluating spillway upgrades including incorporation of an auxiliary spillway.

Morrison Dam and Spillway
Morrison Dam is an 1830 m long, 17 m high earthfill dam situated on the East Poplar River approximately 4 km north of the Canada – USA border. The dam creates Cookson Reservoir which stores about 41000 m³ of water and has a surface area of 680 ha at its full supply level. KCB was the prime consultant responsible for performing the annual inspection of the dam, structures and instrumentation, and completing the performance evaluation of the seepage monitoring system.

Boundary Dam Safety Review
The Boundary Dam and service spillway are located adjacent one of the SaskPower thermal power stations that provide much of the base load electricity for Saskatchewan. The dam was widened from a crest width of approximately 12 m to 25 m in 1998 to facilitate coal handling and truck hauling across the dam crest. The reinforced concrete spillway consists of a 42 m wide, gated, ogee-crest control section, parallel walled, 220 m long spillway chute with 5 steel radial gates. A major rehabilitation of the service spillway was carried out in 2008-2010 to replace the majority of service spillway structure with the exception of the headworks and gate system. The initial dam safety review was carried out in 2005 based on the 1999 CDA dam safety guidelines. KCB was contracted in 2010 to carry out the second dam safety review based on the updated 2007 CDA guidelines.

Island Falls Hydro Development
The main dam has a maximum height of 24 m and creates a reservoir with approximately 178.5 million m³ of storage, while the reservoir created by the 10.4 m high Whitesand Dam has 1.7 million m³ of storage. KCB is the prime consultant responsible for performing the dam safety inspection and review of the concrete and earth dams, powerhouse, and spillways, and analyzing of instrumentation data.

Rock Slope / Rock Shed Slide Protection for CN Rail
KCB designed an 80 m long rock shed for CN Rail. KCB's modular rock shed design allows for construction under railway traffic. Our five phase methodology included: i) characterization of rock slope hazards using LiDAR and field mapping, ii) dynamic rock fall and stability analyses for conceptual design, iii) detailed structural design of rock shed, iv) preparing tender package and providing field services for installation of rockfall catchnet to protect work area, and v) QA/QC field services during construction.
OIL SANDS

Services

Klohn Crippen Berger is a market leader in providing multi-disciplinary engineering services to the oil sands industry. Our services support the management, protection and responsible use of our important natural resources throughout the entire facility life cycle of design, construction, operation and closure.

Engineering Design
We have a progressive group of professionals who deliver cost-effective, innovative designs to support oil sands project development and oil sands mining operations. We understand the regulatory process very well and have consistently produced designs approved by regulators with a minimum of conditions.

• Tailings dykes
• Waste dumps
• Open pit slope design
• In-pit dykes
• External tailings structure
• In-pit tailings dykes
• Tailings staging operational planning
• Seepage management and cut-off barriers
• Road and bridge design
• Mine closure
• Dam safety, dam breach and inundation studies
• Control of foundation artesian pressures
• Surface water management design

Mine Environmental Management
Our integrated team of engineers, earth and environmental scientists is well-positioned and committed to help your projects meet regulatory standards for environmental management. Environmental considerations are incorporated into the design, development and operational phases for all projects.

• Environmental impact assessments
• Compliance monitoring and annual reporting
• Regulatory reporting and support
• Groundwater modeling and monitoring
• Mine de-watering and water management
• Baseline environmental assessments
• Closure planning

Waste Management
KCB is a leader in the design and construction management of some of the world’s largest tailings and overburden storage facilities. This has required us to be innovative in helping oil sands developers and producers create waste management programs that are safe, cost-effective and address environmental impact. No project is too large or too complex.

• Waste disposal planning
• Tailings slurry and reclamation systems
• Mine waste management

Mine Water Management
KCB can successfully address mine water management issues during all phases of mine development including operation and closure. Our team realizes how crucial management of surface and groundwater is to maintaining operations and meeting environmental objectives.

Project Management
KCB believes that excellent project management, addressing scope, quality, time and budget is essential to a successful project. Your project goals and objectives can be met through our efficient allocation of resources.

• Construction management & field supervision
• Emergency preparedness & safety
• Preparation of contract documents, drawings & specifications
• Cost estimating
• Budgeting
• Process reporting
• Project cost controls
Experience

**Muskeg River Mine & Jackpine Mine**  
External Tailings Facilities (Shell Canada)  
- Tailings dyke design  
- Liquefaction assessments  
- Seepage monitoring and management  
- Performance monitoring and reporting  
- Site investigations and instrumentation installations  
- Operation, Maintenance & Surveillance (OM&S) Manuals  
- Dam breach and inundation studies  
- Surface water design and management  
- Construction drawing packages  
- Construction monitoring  
- Borrow pit investigations and pit development

**South Tailings Pond (Suncor Energy Inc.)**  
- Tailings dyke design  
- Compensation wetlands design  
- Liquefaction assessments  
- Seepage monitoring and management  
- Groundwater monitoring and compliance reporting  
- Artesian groundwater management  
- Passive and pumping wellfield designs and installation

**North Steepbank Extension Mine**  
(Suncor Energy Inc.)  
- Mine highwall design and infrastructure set-backs  
- Haul road embankment design  
- Waste dump design  
- Mine de-pressurization and groundwater management design  
- Geotechnical and groundwater site investigations  
- Instrumentation installations  
- Performance monitoring and reporting  
- Construction drawing packages  
- Operational support

**Mildred Lake Settling Basin (Syncrude Canada)**  
- Dam safety reviews  
- Liquefaction assessments  
- Surface water drainage assessments  
- Internal drain design

**Hangingstone SAGD Project – Fort McMurray (Japan Canada Oil Sands Inc.)**  
- Site investigations  
- Foundation design  
- Groundwater monitoring and compliance reporting  
- Soil monitoring and management  
- Groundwater management plans  
- Regulatory support

**Base Mine Dam Cut-off Walls**  
(Syncrude Canada)  
- Design of a cement-bentonite slurry cut-off wall  
- Design of a continuous flight auger cut-off wall  
- Cut-off wall mix designs  
- Construction planning support  
- Construction supervision  
- Quality assurance/quality control testing
Klohn Crippen Berger (KCB) offers sustainable, cost-effective environmental services. We have extensive experience in Northern and Western Canada and have successfully completed projects in the oil and gas, mining, infrastructure and water resource industries. As a multi-disciplinary consulting firm, KCB can integrate disciplines to meet your project requirements.

**Environmental Assessments**
Investigations have been conducted on commercial, industrial, mining, agricultural, and oil and gas facilities throughout Alberta, Saskatchewan and the Arctic for development, divestiture, pre-acquisition, liability or reclamation purposes. KCB can assess baseline conditions and impacts to habitat soil, surface water, groundwater, air and sediments using both intrusive and non-intrusive methods.

**Remediation and Monitoring**
We have successfully remediated and monitored environmental impacts identified during environmental assessments. Site specific remedial options involving modelling, design, in-situ/ex-situ remediation strategies and risk assessments may be developed. We are familiar with compliance monitoring designs and monitoring designs for operational performance.

**Reclamation**
We have successfully reclaimed sites utilizing current reclamation methods to achieve the desired end land use. Our team has the capability to complete detailed site assessments, reclamation plans, surface contouring, re-vegetation, weed management and reclamation applications to regulators for site closure.

**Permitting and Regulatory Compliance**
KCB works closely with government, communities and industries to develop successful solutions for environmental, social and resource requirements, and complete regulatory permitting and compliance reporting.

**Environmental Systems Development**
KCB has developed environmental management systems for bedding management, greenhouse gas management, pollution prevention, waste systems development and groundwell geothermal development.
Experience

Phase I, II, III Environmental Site Assessments and Reclamation Projects
Investigated and managed Phase I and II environmental site assessments, remediation, surface reclamation, detailed site assessments and reclamation applications of oil and gas facilities to obtain site closures on private, public and aboriginal lands.

Indian Oil & Gas Environmental Audit and Liability Assessment
Investigated and identified non-compliance issues with federal and provincial legislation, industry guidelines, and good operating practices. Identified potential contaminant sources and receptors, and provided cost estimates associated with environmental liabilities.

Liability Assessments
KCB has completed liability assessments for the oil and gas industry for remediation and/or reclamation of oil and gas facilities.

Suncor Steepbank Groundwater Monitoring
KCB is conducting groundwater monitoring for Suncor’s Steepbank Mines north of Fort McMurray, Alberta. The plan includes sampling of the current monitoring networks and the development of alternative monitoring strategies.

ISR DEW Line Landfill Monitoring, Defence Construction Canada, Indian And Northern Affairs Canada
KCB conducted geotechnical, soil and groundwater monitoring at 7 remediated former DEW Line Stations in the western arctic.

Killam Abandoned Gas Plant
KCB designed and implemented a groundwater monitoring program, conducted an intrusive soil and groundwater sampling program to delineate on and off-lease soil impacts, developed a comprehensive remediation plan to reduce social and environmental risks to the surrounding area and satisfy terms and conditions of the Environmental Protection and Enhancement Act operating approval. KCB remediated soil on-site using ex-situ remediation strategies.

Sheep Creek Fuel Spill Delineation and Remediation
KCB delineated, excavated and remediated soil on-site in a remote and environmentally sensitive area of Ivvavik National Park, Yukon.

Pipeline Leak of Condensate into Soil and Fractured Rock Impacting Groundwater in a Domestic Use Aquifer
A groundwater remediation and risk management program was implemented. A multi-phase extraction system was designed and installed at site to capture and remove free-phase, dissolved-phase and vapour-phase hydrocarbon constituents from the saturated and unsaturated zones.

Soil Monitoring for Sour Gas Plants
Designed soil monitoring proposals, implemented soil monitoring and management programs at sour gas plants in Alberta as part of ERCB directives.

Former Drilling Sump Assessment
Completed over 50 site assessments in the Mackenzie Delta. These included soil, surface water, permafrost and geophysical data collection.
Klohn Crippen Berger delivers a complete range of engineering services that enable us to take your projects from conception through to operation. These services include feasibility studies, detailed designs, field investigations and monitoring, contracting, construction administration and inspections, commissioning, site impact assessments and regulatory approvals submissions and support.

**Hydrology and Hydrotechnical**
Water balance modelling to evaluate available supply and storage needs. Hydrologic studies for assessing the potential for flooding and the need for flood mitigation works, environmental impacts and viability for hydropower development. Hydraulic and hydrodynamic modelling for designing river crossings, fish passage facilities, streambank stabilization measures and erosion protection works.

**Water Storage and Conveyance (Dams and Hydraulic Structures)**
Rehabilitation and development of new and existing dams, reservoirs and appurtenant structures, river diversion works, irrigation canal and pipeline systems, and water control and conveyance structures.

**Mine Surface Water Management**
Site drainage systems, including stream diversion works, drainage ditches and related structures, haul road crossings, storage and sedimentation ponds, decant structures, pump stations, and level and flow measurement facilities.

**Stormwater Management**
Stormwater modelling and design of pipeline systems, retention and treatment ponds, wet and dry ponds, underground storage facilities and hydraulic structures.

**Flood Inundation and Protection**
Flood routing and dam breach simulations, inundation mapping and emergency preparedness planning, flood protection works, including dykes and flood walls.

**Dam Safety Reviews**
Provide dam safety reviews and related services including hydrologic and flood handling assessments, stability analyses, seismic hazard reviews, condition inspections and instrument data reviews.

**Streamflow and Climate Monitoring**
Designing, installing, monitoring and maintaining streamflow monitoring and weather stations, including real-time communication systems in remote locations, to capture data needed to complete environmental studies and acquire regulatory approvals.
Experience

Glenmore Dam Penstock Rehabilitation Refurbishment of two 3.6 m diameter penstocks and butterfly valves (circa 1930s) at Glenmore Dam. Completed detailed design of new head gates for the penstocks and refurbishment work and provided construction inspection.

McGregor Reservoir Structures The reservoir, created by two earth dams (circa 1914), has a live storage of 358 million m³ and a flooded area of 5300 ha. Rehabilitation work included raising and upgrading dams and spillway facilities to handle the PMF and replacement of the irrigation outlet structure. One significant challenge was to provide cofferdams and control structures which permit adequate water storage while also allowing reservoir lowering for construction.

East Fish Creek Stormwater Quality Retrofit The project included converting an abandoned gravel pit within Fish Creek Provincial Park, Alberta into a wetland system to treat stormwater that was originally released directly into the Bow River. KCB identified areas where significant reductions, versus earlier estimates (by others), in stormwater discharge would result, and developed a new concept that avoided excavations along the existing hillside. This concept was adopted for implementation by the client.

Calgary Bow River Weir The Calgary Weir, located just 3 km east of downtown Calgary, is used to divert water from the Bow River into the Western Irrigation District. Flow over the weir creates an extreme drowning hazard that has claimed several lives and inhibits fish passage. The project includes modifying the weir and incorporating a series of drop structures, pools and channels, to enable passage for fish and boats.

52nd Street SE Road Widening As part of The City of Calgary’s 52nd Street Road Widening Project, KCB was responsible for extending and relocating existing utilities, and providing new stormwater drainage systems, including wetland and dry ponds. The nature and complexity of the project meant that the design team had to be ready to adapt to ongoing changes to the road design, actual site conditions and land issues.

Jensen Dam Spillway and Plunge Pool KCB’s responsibilities included assessing the condition and performance of the spillway, determining plunge pool erosion and its implications to the stability of the cliff safety of the dam, and identifying remedial work to facilitate operation of the spillway.

Waterton to St. Mary Main Canal Rehabilitation The conceptual study included developing a comprehensive flood handling strategy, condition assessment of the diversion, conveyance and wasteway structures, identifying rehabilitation requirements along with a construction implementation strategy.
Klohn Crippen Berger delivers geotechnical, hydrological and environmental services to the oil and gas industry throughout Western Canada. Our services incorporate the management, protection and responsible use of our important natural resources throughout the entire facility life cycles of exploration, design, construction, operation and closure.

**Pipeline Design and Maintenance**
We have helped numerous operators and pipeline owners with both geotechnical design and maintenance. We have assisted designers with pipeline routing (including geohazard identification and mitigation), river crossing designs, buoyancy control designs and ROW drainage and erosion control designs. Our maintenance experience includes slope stabilization, drainage control, river crossing stabilization and ROW erosion control measures.

**Horizontal Directional Drilling Design (HDD)**
KCB provides complete turnkey services to companies and contractors planning HDD crossings. Let KCB successfully organize and execute your field programs and provide you with critical advice on the optimal alignments for trenchless pipeline construction.

**Facilities Design and Maintenance**
KCB can assist with facility and wellsite related projects, from preliminary site location and investigation stages, through construction and operation stages, to abandonment. KCB provides civil engineering design for earthworks and foundations involving various types of bearing configurations from lightly loaded slabs to rock-socketed caissons in bedrock. Our projects have involved terrain and maintenance issues such as slope stabilization, site drainage and road rehabilitation.

**River Engineering**
From design, to operations, to abandonment, the river engineering group in KCB supports pipeline owners with outstanding value. We advise on pipeline routing at river crossings with assessments of vertical and lateral scour, to ensure minimum maintenance over the pipeline life. Our river design work spans the range of pipeline sizes and river complexities and provides crossing designs that minimizes future risk at the lowest cost.

Our river engineering services are in high demand in the pipeline operations phase. We specialize in depth of cover surveys and remediation and in bank erosion repair designs. Our clients also call on us for the complete suite of inspection services during construction of stream crossing repairs.
Geotechnical Evaluations of Oil and Gas Facility Developments

- Access Pipeline - Sturgeon Terminal near Red Water, Alberta
- Encana Corporation – Compressor facility near Big Valley, Alberta
- Cadence Energy - Oil battery and compressor facility near Valleyview, Alberta
- Access Pipeline - Trico meter station
- Access Pipeline - Cristina Lake, north of Conklin, Alberta
- Husky Energy - Moose Mountain oil and compressor facility near Calgary, Alberta
- Access Pipeline - Trico lateral pipeline near Fort Saskatchewan, Alberta

The scope of geotechnical services included foundation design of pumps and compressor building foundation, granular oil tank bases, communication towers, site drainage and civil earthwork grading, site reconnaissance / terrain assessment of site condition, planning and execution of geotechnical field drilling programs, provision of foundation design parameters for driven piles, rock-grouted caissons and concrete spread footings, mat foundation and site construction inspection and road culvert hydrological assessment.

Geotechnical Evaluations of Horizontal Directionally Drilled (HDD) Stream Crossings

- Petro-Canada - Prentic Creek near Rocky Mountain House, Alberta
- Enermark Energy - Battle River near Wainwright, Alberta
- Suncor Energy - Pine Creek northwest of Edson, Alberta
- Tusk Energy - Temple Creek northwest of Fort St. John, British Columbia
- Penn West Energy - Souris River, near Melita, Manitoba
- Access Pipeline - Trico lateral pipeline near Fort Saskatchewan, Alberta

Trenchless technology was proposed to construct the pipeline stream crossings. The scope of geotechnical evaluations includes liaising with EPC engineering and construction management teams to assist with the design of the HDD stream crossing, aerial and ground-based site reconnaissance, terrain / slope stability assessment and aerial photo interpretation, planning and execution of geotechnical borehole drilling programs, provision of data for use in design of the HDD crossing, preparation of construction drawings and technical HDD evaluation reports.

Wellsite Geotechnical Terrain Assessments

- Suncor Energy - Wellsite developments in the Alberta Foothills and Rocky Mountain Front Ranges.
- CNRL - Geotechnical terrain assessments for wellsite and road developments.

Salmo Gas Pipeline, Erosion Protection, Salmo, BC

KCB’s scope of work included preliminary design, regulatory permitting, detailed design and construction monitoring of the erosion protection works.

River Engineering

- Nordegg River Diversion and Crossing Replacement
- Site Investigations for crossing designs of the South Saskatchewan and Red Deer Rivers on the Express Pipeline Project
- Site inspections, EM pipe scoping, flood analyses and channel stability assessments for numerous major rivers in Western Canada
- Battle River Erosion Protection Measures
- Pipeline Scour Database Development and Maintenance
- Pipeline Rupture Investigations

Experience
Klohn Crippen Berger has a strong groundwater team. Our groundwater staff has strong practical, field-based experience and numerical modelling skills required to analyze complex geological and hydrogeological environments, and provide sound groundwater engineering designs.

**Baseline Studies**
A representative groundwater baseline is fundamental to project development as groundwater is frequently a pathway for contamination. KCB has completed several baseline groundwater studies for major resource development projects.

**Groundwater Assessments**
Our recent groundwater assessments have ranged from multi-million dollar site investigations for large mining developments, to detailed assessments for dewatering designs for infrastructure developments in complex hydrogeological environments. Groundwater contamination assessments are routinely completed for oil and gas and other facilities.

**Groundwater Flow Modelling**
KCB is recognized by clients as a leader in groundwater modelling. Industry standard groundwater modelling software platforms FEFLOW and MODFLOW are used, and our modellers have developed tools that streamline the modelling process and improve model predictive functionality.

**Groundwater Engineering**
Some recent solutions delivered by our team include: seepage mitigation designs for tailings facilities, mine depressurization and dewatering designs and interception designs to engineer aquifer flow for seepage management.

**Regulatory Compliance**
KCB has a proven track record of working closely with government, First Nations, communities and industries to develop and implement successful groundwater solutions and monitoring plans for system performance monitoring and compliance reporting.
Experience

**Travers Inlet Structures, Alberta Infrastructure**
A dewatering system was designed for construction of a new canal inlet into the Travers Reservoir in Southern Alberta. To construct the inlet, an excavation immediately adjacent to the Travers Reservoir was successfully dewatered using two stages of wellpoints. Construction was completed on schedule.

**Mine Dewatering Ekati Fox Pit**
A mine dewatering design was provided for the Koala underground mine in the Northwest Territories. The design was based on hydraulic testing of faults and fractures using inclined piezometer completions installed from underground mine openings. Fracture flow groundwater modelling provided inflow predictions for mine development and operating scenarios.

**Site C Hydroelectric Impact Assessment**
We constructed 3D geological and groundwater models for BC Hydro to assess the likely extent and impact of increased groundwater levels that may result from construction of a dam.

**Muskeg River Mine**
Aquifer depressurization is required in advance of mining to provide safe, dry working conditions in the open-pit mine near Fort McMurray, Alberta. The existing system was assessed and a revised design was approved to improve depressurization of future mining areas.

**Jackpine External Tailings Facility**
A seepage mitigation design was completed for a tailings facility to manage seepage for environmental compliance and to achieve geotechnical foundation depressurization criteria for stability.

**Suncor Millennium Mine Operations Support**
Since 1992, we have provided groundwater support to Suncor Energy. Services have included annual monitoring compliance reports, baseline groundwater studies, design and installation of compliance and performance monitoring well systems, depressurization assessments and well designs, and coordination of geophysical assessments for hydrogeological interpretations. We have also designed and supervised the installation and commissioning of a 10,000 m³/day seepage control wellfield for the South Tailings Pond.

**Hangingstone SAGD Groundwater Support**
Groundwater services at the Japan Canada Oil Sands Limited (JACOS) trial SAGD facility have included annual groundwater sampling and reporting, compliance site assessment services and monitoring well installations.