



# Engineering and Environmental Services in Northern Canada

A joint venture between Inuvialuit Development Corporation and Klohn Crippen Berger Ltd.

NORTHERN SERVICES



*Oil Sands*

*Oil & Gas*

*Geotechnical*

*Environmental*

*Water Resources  
and Civil*

Down to Earth. Up to the Challenge.

## About Us

# IEG Consultants Ltd. (IEG)

IEG is a joint venture between the Inuvialuit Development Corporation and Klohn Crippen Berger. Dedicated to the communities and people of northern Canada, IEG delivers quality environmental and engineering services to industry, government and aboriginal organizations.

The Inuvialuit Development Corporation (IDC) has invested in business ventures strategically positioned to optimize each other's success and provide return to shareholders. Today, they are a major shareholder for 20 subsidiaries working in complementary industries and realizing complementary visions.



The challenging working conditions of Northern Canada demand exceptional business practice. Business leaders succeed in these conditions only with detailed knowledge of quality control, staff training, work safety, and environmental responsibility. IDC companies, share this knowledge and follow through with superior service.

IDC receives its mandate from the Inuvialuit Land Claim Agreement. The Agreement aims to make the Inuvialuit equal and meaningful participants in the national economy and society. IDC maximizes returns for the Inuvialuit by fostering business development.



**Klohn Crippen Berger**

Klohn Crippen Berger (KCB) is an international engineering and environmental consulting firm with its head office in Vancouver and eight offices in strategic locations in Canada, Peru and Australia. We have a strong reputation for quality service and technical expertise in a range of services including: Mining, Environmental, Water, Power, Transportation, and Oil and Gas. Formed in 1951, we have a long history of participation in local projects, as well as a strong international reputation. We are working on some of the largest, most challenging engineering projects, both nationally and internationally.

From our offices in Calgary, Edmonton, Lloydminster and Inuvik, 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, hydrotechnical, environmental and reclamation services.





## Team leaders

**Brian Rogers** Vice President, has more than 30 years of experience in the design and construction of diverse civil resource development and water resources projects. His experience includes the design and construction of dams, irrigation projects, transportation and infrastructure projects, tailings dams and arctic offshore hydrocarbon development projects.

**Chris Langton** has over 20 years of groundwater project experience in the mining, industrial and commercial infrastructure sectors. Chris has experience in mine water balance studies, mine dewatering, tailings and waste rock dump water budgets and mine closure plans. He has completed contamination assessments, remediation and monitoring of oil and gas facilities, municipal and toxic industrial waste facilities.

**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. His mining experience includes the design, monitoring and construction supervision of large tailings dykes and waste dumps, as well as the design and monitoring of pit

walls. Gregg's pipeline experience includes route selection and design of numerous pipeline river crossings.

**Debra Lamash** has developed socioeconomic, regulatory review, consultation and First Nations programs for clients across a variety of sectors, including hydro for over 20 years.

**Sam Bird** has worked in the northern oil and gas industry for the past five years. He is responsible for the planning and implementation of Phase I, II and III environmental site assessments (ESA) in the Northwest Territories, Yukon, and Alberta. His project responsibilities have required complex logistical and transportation solutions.

**Tom Murray** has over 30 years of experience in geotechnical engineering, including project management, geotechnical design, contract preparation and construction supervision. He has extensive experience in foundation engineering, dam safety, oil sands and water resources projects.

**Warren Vincent-Lambert** has over 15 years of experience in mining, environmental investigations and water management.

**Mark Polet** is a biologist who has worked more than 30 years in the environmental discipline. His experience extends through environmental impact assessments, habitat restoration and reclamation, biological and biophysical assessments, waste managements, environmental ethics and public enrolment.

**Blair Bailey** has seven years of specialized experience in environmental site investigations, remediation and reclamation projects. He has experience managing projects with hydrocarbon, metals, and salinity impacts at facilities throughout Western Canada.

**Ryan Lennie** graduated with a diploma in Water Resources Engineering Technology. This program has equipped him with solid technical skills in a variety of different areas. He is a bright, young Inuvialuit Beneficiary. Through his employment with IEG Nunasi, he is building on his environmental experience, interest, education and training.





# Offshore Geotechnical Services

IEG Consultants Ltd. offers geotechnical design and project management services for a wide range of northern and offshore developments in the Northwest Territories, Canadian Beaufort Sea, and Russian Okhotsk Sea. Our team of engineers and geoscientists has a broad range of northern experience for the development and deployment of seabed and marine resource structures, submarine pipelines and arctic exploration drilling platforms. We apply appropriate technology, ranging from pragmatic experience to sophisticated analytical software to developing practical and efficient design and construction procedures in order to suit our client's needs. We can meet the diverse offshore geotechnical project requirements through the following areas of expertise:

**Submarine Facilities:** Site characterization and investigations of seabed soils from ships, drilling platforms and stable landfast ice. We also provide geotechnical seabed instrumentation and data interpretation, Ice scour identification and pipeline burial/dredging evaluations.

**Offshore Platforms:** Structures foundation design and performance monitoring for earthquake, wave and ice loading.

**Pipelines:** Route selection, regulatory document input, terrain hazard and integrity management/analysis. River engineering and horizontal and directional drill flexibility. Trenching/bedrock rippability, buoyancy control, earthquake engineering and slope remediation and design of drainage/erosion controls.

**Site Investigations, Instrumentation and Monitoring:** Soil sampling and ground water monitoring. Instrumentation installation and monitoring programs.

**Laboratory Testing:** Standard soil testing including moisture content, grain size, permeability, Atterberg limits, specific gravity/relative densities, Proctor testing, direct shear, triaxial and consolidation testing.

**Construction Management:** Field inspection, contract administration, claims negotiation, scheduling and cost estimating.

*Making a difference one project at a time*



## Experience

### **Paktoa, Canadian Beaufort Sea, Devon**

**Corporation:** Provided geotechnical engineering support to Devon Canada for their ongoing exploration program in the Canadian Beaufort Sea. This included several on-ice site investigations and the review of different platforms for year round drilling. KCB completed foundation design for use of the SDC drilling platform at Paktoa C-60, and supported operations staff in the installation and monitoring of piezometers and inclinometers during the winter drilling season. Additional studies were completed to look at development options and the feasibility and cost estimate for a phase development of the Paktoa field, including a pipeline route to the Mackenzie Delta.

### **Granular Resources Inventory of Artificial Islands in the Canadian Beaufort Sea,**

**DIAND:** Approximately 40 million cubic metres of granular material have been dredged from the Canadian Beaufort continental shelf to create artificial

islands or subsea berms for caisson retained islands and drilling barges. These islands were constructed to provide temporary drilling structures for hydrocarbon exploration. After completing drilling and removing the equipment and consumables, these islands were abandoned to natural erosion, or partially scalped and reused in other exploration sites.

A series of reports by KCB for the Department of Indian and Northern Affairs, Canada, have documented these old islands as available sources of good quality granular material that could potentially be used in future developments.

### **Molikpaq Drilling Platform, Sakhalin Energy Investment Company Ltd:**

Sakhalin Energy Investment Company Ltd. purchased the Molikpaq drilling platform for re-deployment near Sakhalin Island in eastern Russia. KCB were the geotechnical

engineers for this re-deployment, which involved design and construction monitoring. The design included a seabed foundation structure stability analyses for the earthquake, ice and wave loading at the site. A major issue in the design was to provide resistance against liquefaction of the internal sand core. KCB identified and provided recommendations for suitable sand borrow material used for infilling of the Molikpaq foundation caisson and provided construction supervision services during dredge operations. KCB has also provided recommendations for the design of water wells within the sand core for the water flood facilitation.



# Onshore Geotechnical Services

IEG Consultants Ltd. delivers geotechnical engineering 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 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):** We provides complete turnkey services to companies and contractors planning HDD crossings. Let us 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:** We can assist you with facility and wellsite related projects-from preliminary site location and investigation stages, through construction and normal operation stages, to abandonment. We 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.

**Project Management:** Excellent project management, addressing scope; quality; time and budget, is essential to the success of your projects. Our strengths are helping clients manage costs and delivering projects on-time.

**Foundation Engineering:** We have provided foundation engineering for a broad range of projects and soil conditions. We have 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.

**Earthquake Engineering:** We have 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:** We have completed thousands of site investigations for geotechnical and environmental engineering projects involving soil sampling, rock coring and groundwater monitoring. We have 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.





## Experience

**Geotechnical Evaluations of Oil and Gas Facility Developments:** We have completed geotechnical evaluations of compressor facilities, pipelines and terminals, and oil batteries for clients such as Encana Corporation, Husky Energy and Access Pipeline.

The scope of geotechnical services included foundation design for pumps and compressor buildings 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, concrete spread footings, mat foundation and site construction inspection and road culvert hydrological assessment.

**Geotechnical Evaluations of Horizontal Directionally Drilled (HDD) Stream**

**Crossings:** Horizontal Directionally Drilled Stream Crossings have been completed in Central and Northern Alberta for Petro-Canada, Enermark Energy, Suncor Energy, Tusk Energy and PennWest amongst others. Trenchless technology was proposed to construct the pipeline stream crossings. The scope of the geotechnical evaluations included: liaison 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 geotechnical data for use in design of the HDD crossing, preparation of construction drawings and technical HDD evaluation reports.

**Wellsite Geotechnical Terrain Assessments**

Were completed for Suncor Energy. These developments were in the Alberta Foothills and Rocky Mountain Front Ranges near Nordegg and Sundre, Alberta

Wellsite Geotechnical Terrain Assessments for Canadian Natural Resources near Grande Cache, Alberta. The geotechnical terrain assessments for wellsite and road developments were conducted to document and evaluate terrain stability in the wellsite vicinity and along access roadways. This assisted with the planning and incorporation of construction logistics for the civil earthworks and drainage measures necessary for the wellsite development.





# Site Assessments & Remediation Services

IEG Consultants Ltd. offers sustainable, cost-effective environmental services to support your arctic project requirements and commitments. Our staff have extensive project experience in Northern and Western Canada. IEG has conducted environmental work for local, territorial, aboriginal and federal government agencies as well as industrial, military and petroleum industries. From our northern office in the western arctic hub of Inuvik, IEG specializes in servicing clients' needs in the Inuvialuit Settlement Region.

As a multi-disciplinary consulting firm, IEG Consultants have the capacity to integrate services from different disciplines to meet unique project requirements. Our staff are familiar with the unique logistical and regulatory requirements involved with remote arctic work.

**Environmental Assessments:** Investigations have been conducted on military, commercial, industrial, agricultural sites as well as up stream oil and gas facilities throughout Alberta, Saskatchewan and the Arctic for divestiture, pre-acquisition, liability or reclamation purposes. We can assess the type and extent of contamination which may exist in the soil, surface water, groundwater, air and sediments using both intrusive and non-intrusive methods.

**Remediation and Monitoring:** Our team has successfully remediated and monitored environmental impacts identified during environmental assessments. Site specific remedial options involving design, modeling, in-situ / ex-situ remediation strategies, excavations and risk assessments may be developed.

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

**Regulatory Compliance:** We work closely with government, aboriginal groups and other communities and industries to develop successful solutions for environmental, social and resource requirements. Our professionals have the capabilities to complete wellsite inspections, right-of-way inspections, liability assessments, monitoring and reporting for environmental approval purposes.

**Project Management:** Addressing scope, quality, time and budget is essential to a successful project. Let us prove to you how we can meet your project goals and objectives through allocation and integration of resources.



## Experience

**Sheep Creek, Yukon:** We conducted an assessment following the release of hydrocarbons at the Sheep Creek Warden Station. We quantified the volume of impacted soils at the site and presented remediation options to Parks Canada. A biocell was determined to be the best available and economic option to conduct soil remediation at the site.

**Unipkat I-22, NWT:** Phase II Environmental Site Assessment of the former Unipkat I-22 well site and drilling sump. Prior to the commencement of onsite activities all required regulatory requirements were completed to access the site. Activities included the logistical and project management aspects of the project including sourcing of heliportable drilling rig, helicopter charter, and subcontractors.

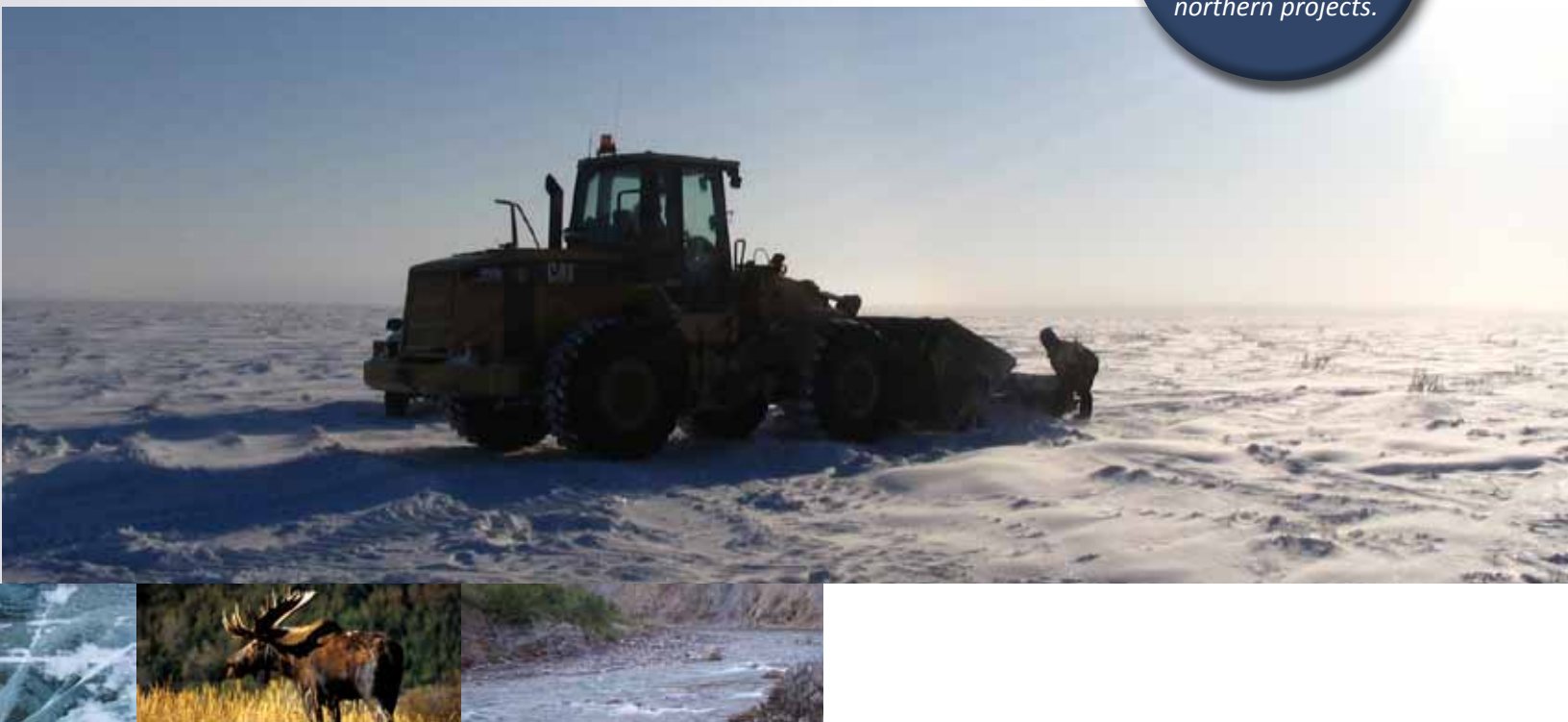
**DEW Line Site Monitoring, NWT:** This project involved the collection of post construction landfill monitoring data from 23 landfills located at 6 former DEW Line

sites. The DEW Line sites are located in the Inuvialuit Settlement Region of the Western Canadian Arctic. We were responsible for all project logistics including aircraft charter, remote camp accommodations, data collection, reporting, and project management. At each landfill groundwater and soil samples were collected, thermal data from onsite thermistors were downloaded, and visual inspections of landfill stability were completed.

**Johnson Point Remediation, NWT:** Clean-up of the former logistics base at Johnson Point. We were responsible for the delineation and treatment of petroleum contaminated soil and groundwater. A practical soil and groundwater treatment option was planned including a purpose-built water treatment system, to remediate contaminated groundwater before it was returned to the environment. An soil remediation program is scheduled to decrease hydrocarbon concentrations in contaminated soil.

**Bar-D Atkinson Point Cleanup, Public Works and Government Services Canada:** IEG joined E. Gruben's Transport as environmental consultants for the clean up of the former intermediate DEW Line Site at Atkinson Point, Northwest Territories. The cleanup involved the demolition and disposal of on-site buildings as well as the treatment of hydrocarbon contaminated soil. Hazardous materials were identified and removed for off-site disposal.

*Put us  
to the test to  
meet the technical,  
environmental and social  
challenges of your  
northern projects.*



# Socioeconomics and Consultation

ADDRESSING SOCIAL CONCERNS THROUGH DESIGN - BUILDING A BETTER WORLD

## Services

**Stakeholder and First Nations/Aboriginal Consultation:** Facilitating understanding, involvement, and information exchange during all project stages through use of a variety of tools and techniques such as meetings, communications materials, and open houses.

**Communications and Consultation Plans and Materials:** Developing and implementing project-specific plans and supporting communications materials, including culturally appropriate materials.

**Regulatory Consultation and Advisory Services:** Developing strategies that advance the review and regulatory approval processes. KCB has experience with federal, provincial and territorial processes in Canada and International Finance Corporation standards, World Bank guidelines, Equatorial Principles, and numerous country specific processes worldwide.

**Socioeconomic Baseline and Impact Assessments:** Characterizing pre-project social and economic conditions in the potential area of influence of a project; assessing the potential short, medium and long-term effects on people, communities and economies; and developing mitigation, enhancement and monitoring strategies in concert with stakeholders and First Nations.

**Capacity Building:** Training, skills development and capacity building for local communities and First Nations/Aboriginal groups.

**Traditional Use and Traditional Ecological Knowledge:** Incorporating traditional use and traditional ecological knowledge into socio-economic and environmental baseline and impact assessment studies.

**Corporate Social Responsibility and Sustainability:** Working with clients to integrate social, economic, and environmental considerations into corporate decision making.

**Health and Safety:** Development of Health & Safety programs and integration of safety into project design.





## Experience

**Ruby Creek Mine, Canada:** Baseline studies of socioeconomic conditions in the predominantly First Nation communities around this major proposed molybdenum mine. We documented the lifestyle of the communities, including health, education, and wealth, as well as the condition of infrastructure such as roads, schools, hospitals, and goods and services provided. A series of open houses and community consultations were conducted and a socioeconomic management plan was developed for the project.

**Fenix Nickel, Guatemala:** The socioeconomic assessment looked at how the local community would be affected by the reopening of a previous

mining and milling operation. With a current population of less than 10,000, the community is expected to absorb an influx of workers, their families, and new service providers once mine operations are underway. On the baseline studies we collaborated with Guatemalan consultants.

**Molejon Gold Mine, Panama:** We developed consultation protocols for use by our client to gather input from local communities. We also conducted due diligence reviews, presenting data from our socio-environmental studies and incorporating the results into the socioeconomic assessment.

**Mica 5 and 6 Hydroelectric Power Expansion Projects:** KCB has been providing guidance to British Columbia Hydro (Canada) for consultation and the permitting process for these two major expansions of existing hydro-electric facilities.

*Integrating  
community  
needs and  
values.*





# Mine Environment

ENVIRONMENT BY DESIGN: INTEGRATING THE ENVIRONMENT INTO PROJECT PLANNING AND DESIGN TO BUILD SUCCESSFUL PROJECTS

## Services

### **Environmental Baseline Studies:**

Characterize baseline conditions, e.g. climate, aquatic and terrestrial biology, water quality, visual terrain.

### **Environmental Impact Assessment:**

Integrate the project design into the effects assessment to optimize mitigation opportunities. Incorporation of social effects and preparation of Socio-Environmental Impact Assessments (EIA).

**Permitting:** Guidance for permitting throughout the EIA stage, construction, operations and closure.

### **Environmental Management Plans(EMP):**

Preparation of EMP's for operations, including environmental effects monitoring programs.

### **Environmental Audits and Risk Assessment:**

Assessments of existing operations or acquisition targets. Conducting risk assessment workshops and preparing risk management plans.

**Aquatic Biology:** Fisheries and fish habitat assessment including habitat restoration and compensation planning.

**Terrestrial Biology:** Wildlife inventory surveys, terrestrial ecosystem mapping and identification and management of endangered species. Vegetation assessments, monitoring and management plans.

**Closure and Sustainability:** Incorporation of environmental and social factors into the final land use and water use planning for the mine. Design for closure to optimize opportunities and minimize long-term risks.

**Meteorology and Climate:** Air quality assessment, modelling and permitting. Chemical transport and exposure modeling. Greenhouse gas emission inventory, forecasting and reduction strategies.

*Challenge us to take on your toughest projects*



# Experience

**Ruby Creek, Canada:** We have guided this mining project from its conception to the recent award of an Environmental Assessment Certificate from the BC Government.

Design of the socio-economic management plan and incorporation of First Nations interests were an integral part of the design. In addition, the work included engineering for the mine tailings and waste rock facilities to minimize potential effects for operations and closure.

**Suncor – “End of pit” Lakes Research Study:** KCB are part of a team carrying out a full scale pilot program to test the potential for reclamation of oil sand open pit mines with a sustainable lake. The work will include a worldwide research program and construction of a full scale prototype in a completed open pit area.

**Molejon Gold, Panama / Tassawini Gold, Guyana:** KCB conducted socioeconomic and environmental impact studies for gold mines in Panama and Guyana. These ongoing studies include preparing field protocols for baseline data collection by national consultants; due diligence field assessments; and preparation of the Social Environmental Assessment to International Finance Corporation standards.

**Antamina, Peru:** KCB received an award of merit from the BC Consulting Engineers for our innovative work on this poly-metallic mine located high in the Andes. We designed an award-winning wetlands water treatment system of the waste dump waters. We are also carrying out the detailed closure plan.

**Rainy River Gold, Canada:** We are carrying out environmental baseline studies for the proposed open pit gold mine in Ontario. The work also includes preliminary assessment of the geochemistry and design of the tailings facility, waste dump and pit slopes.



# Water Management

MANAGING WATER SAFELY, FROM EXPLORATION TO POST - CLOSURE

## Services

### **Acid Rock Drainage and Metal Leaching:**

Geochemical assessment of mine waste rock and tailings. Water quality predictions for operations and closure. Limiting water quality issues and integration of controls as part of facility engineering design.

### **Water Balance and Water Management:**

Optimizing water recovery in arid climates and improving storage, treatment and release of water in wet climates.

**Mine Dewatering:** Design of mine dewatering systems that manage both quantity and quality of mine water. Design of depressurization systems for pit wall stability.

### **Water Supply and Water Rights:**

Groundwater and surface water supply and storage assessment of mine water supply.

**Hydraulic Structures:** Design and construction of diversion structures, diversion channels, spillways, sediment ponds and decant systems. Assessment of hypothetical “Dam Break” and “Tailings Run-out” effects to support Emergency Preparedness Planning (EPP).

**Environmental Design:** Water quality modelling to integrate facility engineering design with limiting environmental factors in the receiving waters, such as aquatic life or downstream water use.

**Groundwater:** Groundwater plume modelling, including dispersion modelling and absorption/attenuation models. Groundwater monitoring programs and the design and construction of groundwater remediation systems.

**Wetlands:** Design and construction of wetlands to mitigate water quality and/or to enhance aquatic habitat.





# Experience

**Antamina Mine, Peru:** Design and construction of an engineered wetland at 4000m elevation and sediment and water treatment ponds for runoff from the mine waste rock dumps.

**Lihir Gold Mine, Papua New Guinea:** Development of a Mine Water, Sediment and Acid Rock Drainage plan for a mine located on an island formed around 5 volcanoes.

**Vale Inco Mine, Sudbury Canada:** Conceptual design, detailed design and construction monitoring of a site wide Water Management System to reduce hydraulic overload at the central Waste Water Treatment Plant. The system services 60 square kilometers of Canadian Shield watershed and features 21 ponds, reservoirs and lakes connected by a fibre optic monitoring and remote control discharge systems.

**Water Balance and Flood Design:** Water management for all of the active tailings projects being carried out by KCB, including design of spillways, decant systems, erosion protection works and diversions.

**Ok Tedi Mine, Papua New Guinea:** Design of pit dewatering system for this 300 m deep pit extension in a high rainfall (10 m/yr) environment.

**Dam Break Assessments:** As part of the new Canadian Dam Safety Guidelines, dam break analyses are carried out for all tailings dams and water supply to assess classification, to formulate design criteria, and to assess downstream flood impacts. KCB has carried this out for the 150m-high Highland Valley Copper tailings dam in British Columbia and other projects.

**Ruby Creek Water Supply:** Hydrological and hydrogeological studies, groundwater field investigations, and detailed design of surface water diversion, groundwater extraction and water conveyance works for the proposed mine.

**Ruby Creek Aquatic Habitat:** Civil and hydrotechnical design for habitat compensation/migration works incorporating bio-engineered structures such as large woody debris, rootwads, boulder clusters, etc.





# Transportation Infrastructure Services

For over 40 years, KCB, its affiliates and predecessor organizations have been active in the planning, design and construction of a wide variety of ports, harbours, and marine terminals. Our experience ranges from economic evaluations, structural assessments and remedial designs, through to site development, wharf design and site services for major new terminals. KCB's background of marine engineering experience is a significant advantage to clients on port projects.

We can meet the diverse project requirements of our port and harbour

clients through the following areas of expertise:

**Port Feasibility & Planning** from pre-investment and feasibility studies to site selection and conceptual design.

**Marine & Structural Engineering** ranging from dredging, reclamation works, loading ramps, piled decks, bulkheads and caisson wharves.

**Geotechnical & Environmental Engineering** including shallow and deep foundations for heavy civil structures and equipment, dynamic loading, seismic design, and ground improvement.

**Coastal & River Engineering** including aquatic construction considerations such as water levels, floods, foundation and flow considerations particular to wet structures and infrastructure.

**Construction Management services** ranging from field inspection, contract administration, claims negotiation to scheduling and cost estimating



## Roads, Bridges and Ports

# Experience

**San Francisco-Oakland Bay Bridge, California, USA:** KCB is providing structural and geotechnical design for the temporary works for the \$1.4B signature span in San Francisco Bay. Once completed, it will be the world's largest self-anchored suspension bridge. Our design component includes: twin 700 m temporary steel trusses, piled marine foundations in the soft soils of San Francisco Bay designed for seismic and ship impact loading, and design of a 163 m tall temporary tower for the erection of the single steel suspension bridge tower.

**Kicking Horse Cantilever Structure, BC:** KCB provided an innovative Value Engineering design to widen a 2.1km section of the Trans Canada Highway. Through careful realignment of the highway in difficult terrain and the use of a unique cantilever structure, two river crossing bridges were eliminated, resulting in savings of approximately \$2.4M.

**Deltaport Container Wharf and Terminal, BC:** KCB is currently leading the design and construction management for the 430m

long Berth 3 expansion of this facility. We led an integrated, multidisciplinary team of engineers to address all aspects of the civil engineering for this important \$200M waterfront development. The original container port facility, built in 1994-1997, was also designed by KCB. Berths 1 and 2 included a two-berth, 670m long caisson wharf for post-Panamax vessels and barges, and development of a 40 hectare container terminal featuring an intermodal rail facility to handle two 2,100m trains, provision for 600 refrigerated containers and up to six wharf cranes.

**Guam Kilo Ammunition Wharf Extension, Guam:** KCB was retained by the US Navy as part of the Moffatt & Nichol team in early 2006 for detailed engineering for the Kilo Ammunition Wharf Extension project on Guam, Marianas Islands. Kilo Wharf, located in the outer Apra Harbour, is the primary and most strategically important ordnance facility within the Pacific fleet area of operations. The wharf extension comprises 6 caissons of varying sizes, designed to resist seismic events plus seismic retrofit of existing caissons.

**Halifax Caisson Jetty "NJ", Halifax, NS:**

In 2002, the Department of National Defence decided to construct a replacement wharf for their existing timber Jetties in Halifax Harbour. This new \$35 M marginal wharf, Jetty "NJ", is to provide full-service berthing for Canadian Patrol Frigates and Advanced Logistic Support Carriers. KCB was selected as caisson designer for conceptual and final engineering phases, tender assistance and field review.

**Esquimalt Graving Dock Evaluation, BC:**

KCB was retained by Public Works Canada to evaluate the structural condition and overall stability of 6 existing timber crib (caisson) structures, which form the North Landing Wharf, and to evaluate the seismic integrity and stability of the Dry Dock Walls and South Jetty structures.

**Rocky Point Jetty Condition Inspection & Structural Evaluation, BC:**

KCB conducted a full inspection of the jetty above and below water, including: all piling, pile wraps, sheet piled, caissons, deck structure and the fender pile system.



# Power Services

KCB offers full engineering and environmental services for hydro projects. Our project design experience ranges from a 7 MW, single-unit project in Canada to a large 1074 MW, multi-unit project in Laos. Our professional staff, comprising environmental scientists and geotechnical, hydrotechnical, civil, structural, mechanical and electrical engineers, delivers total facilities design on small to large hydro projects, both domestically and internationally.

**Engineering, Environmental and Permitting Studies:** Constructing a new hydro facility or rehabilitating an existing hydro facility requires appropriate studies. KCB staff is experienced in hydrological studies (flow determination, flood studies), environmental and permitting studies, energy calculations and power studies, and equipment optimization studies.

**Dams and Intakes:** Whether the project is run-of-river with a low coanda weir and minimal storage or a world class roller-compacted concrete (RCC) dam for flood control, irrigation and power generation, our engineers and environmental scientists understand how to permit, design and build economic structures to store, divert and control a project's water.

**Geotechnical Design:** Geotechnical risk can be one of the most significant risk issues associated with hydro developments. Our extensive geotechnical experience with tunnels (both drill-and-blast and tunnel boring machine, excavated), other underground works and open-cut excavations for powerhouses, tunnel portals, and canals is known throughout the world.

**Water Conveyance System:** KCB's experience will ensure the water conveyance components including canals, tunnels and penstocks are configured in a practical,

economic arrangement based on a sound technical design that provides appropriate hydraulic performance.

**Powerhouses:** KCB has extensive experience with the civil-structural and equipment layout design of powerhouses utilizing Francis, Pelton and Kaplan turbines. Our staff is experienced with the mechanical and electrical equipment layout for the entire water-to-wire equipment package.

**Project Services:** KCB also offers project management and construction supervision services in roles as diverse as Lender's Engineer, Owner's Engineer and Buyer's Due Diligence.





## Experience

**The Nam Theun 2 Hydroelectric Project, Laos:** is the most important project in a long-term collaborative effort between the Lao People's Democratic Republic (Laos) and Thailand to develop hydropower energy in Laos for export to Thailand. We provided bid design, final design and construction engineering services for the two main civil works packages of this 1074 MW project.

**Snoqualmie Falls Redevelopment, Washington, USA:** consists of upgrades of two power plants and a weir to increase the installed capacity from 42 to 52 MW. Our services for this project include preliminary design, detailed design and construction services.

**Brilliant Powerplant Expansion Project, Castlegar, BC:** a 120 MW expansion at the Brilliant Dam on the Kootenay River. KCB provided Owner's Engineer services from the project identification phase through to

commercial operation.

**Arrow Lakes Generating Station, Castlegar, BC:** is a 170 MW project on the Columbia River. KCB was the Owner's Engineer for this project, responsible for conceptual design, reviewing the EPC contractor's design and monitoring the work of the EPC contractor during construction and commissioning. This project received the prestigious Blue Planet prize in 2005.

**Mayo and Wareham Dams, Dam Safety and Seismic Review, Yukon:** KCB performed a dam safety review of Mayo and Wareham Dams for Yukon Energy in 2005. During the safety review a high seismic risk was recognised that was subsequently assessed and evaluated as part of a seismic review that was completed in 2007.

**Zeballos Hydro Project, Vancouver Island, BC:** will add 22 MW of ECOLogo certified green power to the provincial power grid.

KCB designed the tunnel, penstock and powerhouses for this project that will be in service in 2009.

**Irrican Project, Southern Alberta:** is a 7 MW run-of-canal project. Three existing irrigation canal drops were bypassed and the water put through a small generating station that utilized an S-type turbine. KCB designed the powerhouse, intake and all associated mechanical and electrical works.

*Klohn  
Crippen Berger  
delivers total  
designs for hydro  
projects*





PO Box 3178, Inuvik, NT, X0E 0T0 CANADA

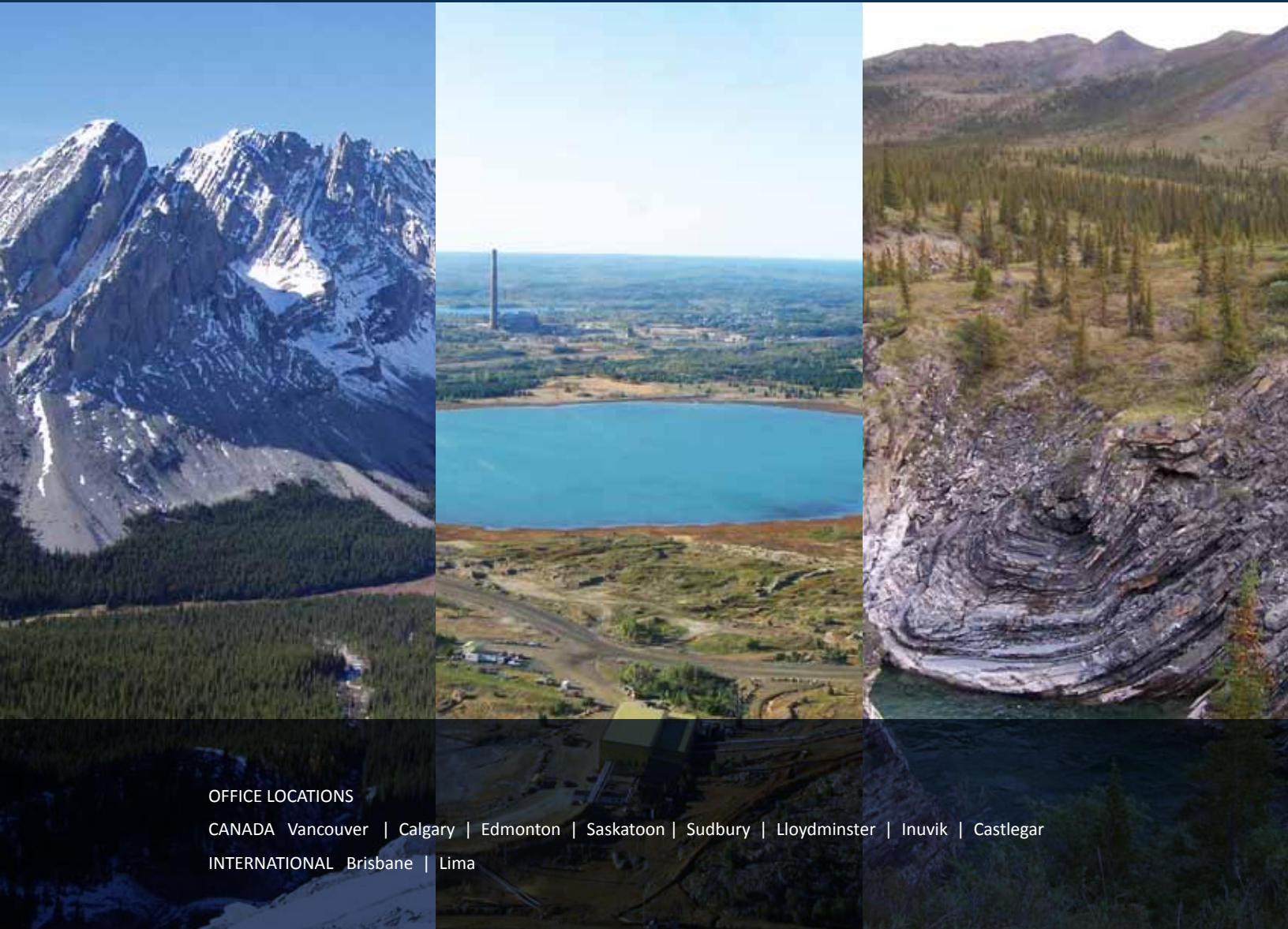
T 867-777-8520 | F 867-777-2747 | E [info@ieg.ca](mailto:info@ieg.ca) | [www.ieg.ca](http://www.ieg.ca)



500-2618 Hopewell Place NE, Calgary, AB, T1Y 7J7 CANADA

T 403-274-3424 | F 403-274-5349 | E [info@klohn.com](mailto:info@klohn.com) | [www.klohn.com](http://www.klohn.com)

Through our association with the Louis Berger Group, Inc., a leading infrastructure engineering, environmental science, and economic development consultant we have access to over 100 offices worldwide, and a breadth of technical expertise.



OFFICE LOCATIONS

CANADA Vancouver | Calgary | Edmonton | Saskatoon | Sudbury | Lloydminster | Inuvik | Castlegar

INTERNATIONAL Brisbane | Lima