OIL AND GAS SERVICES
AUSTRALASIA

Environmental
Groundwater
Surface Water
Infrastructure

ENGINEERING, GEOSCIENCE
AND ENVIRONMENTAL SERVICES
Klohn Crippen Berger Ltd. (KCB) is an international engineering, geoscience and environmental consulting firm with its head office in Vancouver and nine offices in strategic locations in Australia, Canada, Peru and Brazil. We have a strong reputation for quality service and technical expertise in a range of services including: Oil and Gas, Mining, Environmental, and Water, Power, and Transportation. Since forming 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.

### About Us

Our Australasian operation services a wide variety of clients within Australia and across the Pacific Rim. We are based in two offices, Brisbane and Perth, which operate under an integrated management system consisting of quality, health and safety and environmental procedures. KCB works for some of the largest oil and gas producers and we have ongoing projects with several respected mid-tier operators. Our engineers and scientists have project experience in arid and tropical regions, and are familiar with the engineering design and environmental management requirements for conventional and unconventional oil and gas projects. We pride ourselves on being a high-end technically strong consultancy with mature service delivery practices including inter-office and inter-group project collaboration. This latter element of our business is particularly advantageous as it permits us to efficiently provide multi-disciplinary services including mechanical, electrical and structural engineering from other offices to our local clients.

The Australasian Group provides comprehensive services for environmental management of oil and gas projects with a focus on water and infrastructure engineering and design requirements. This includes project life cycle water management from development of surface water or groundwater supply through wastewater disposal management, monitoring and compliance. We integrate social, environmental and regulatory support in our project design services for project development, operations and reclamation.

Key services include:

**Environmental** - services include community management planning and stakeholder consultation, community surveys, baseline and impact assessment, regulatory stewardship and permitting, operational support and compliance reporting, and closure planning and reclamation.

**Groundwater** - groundwater exploration, advanced numerical modelling of groundwater resources, bore field (water supply) design, installation and commissioning. Other key services include integrated groundwater quality and water balance modelling, wastewater injection assessment, design and permitting, design of groundwater monitoring networks for operational and regulatory compliance monitoring, and groundwater remedial designs. KCB also has experienced hydrogeologists in water policy and access processes.

**Surface Water** - baseline characterisation at regional and site scale, numerical modelling, impact assessment and mitigation design, site drainage and clean water diversions, site water balance and water chemistry modelling, storage impoundment designs and construction management, and operational and compliance performance monitoring.

**Infrastructure** - geotechnical and civil engineering designs for exploration and upstream facilities including site access, well pads, gathering facilities, foundation designs for dams, pipeline route and geohazard assessments and foundation designs for product storage, refining and port facilities, construction management, and earthworks designs for reclamation.

### Our Clients Include:

- Shell
- Conoco-Phillips Canada
- Talisman Energy
- Apache
- Husky Energy
- Origin Energy Resources Limited
- Oil Search Limited
- Linc Energy
- Office of Groundwater Impact Assessment, Queensland
- Department of Natural Resources and Mines, Queensland
- Suncor
- Syncrude
- Access Pipeline
- Pembina Pipeline Corporation
TEAM LEADERS

Chris Langton, General Manager, Australasia, has over 25 years of groundwater and environmental project experience in the mining, industrial and commercial infrastructure sectors.

Chris Dickinson, Principal, Senior Consultant, has over 23 years of experience as a geologist, with almost 20 years as a consulting hydrogeologist working in Australia, Asia, the Pacific and Canada.

Chris Strachotta, Manager, Strategy and Growth, has over 17 years of experience in the field of geosciences in Australia, South America, Asia, Europe and the Pacific.

Brent Usher, Manager, Geosciences, has over 18 years of international experience in the field of hydrogeology and aqueous geochemistry.

Steve Flynn, Manager, Engineering, has over 20 years of international geotechnical engineering experience for mining and construction industries.

Matthew Ind, Senior Civil Engineer, has over 17 years of experience in managing and leading civil design projects in Australia and overseas.

OUR MISSION
To attract, develop, and retain talented staff and quality clients who thrive on challenging projects

OUR VISION
Excellence, teamwork, and innovation building a better world

OUR VALUES
- People First
- Health & Safety
- Sustainability
- A respectful, satisfying and fun workplace
- Professionalism
- Quality
- Innovation
- Technical Excellence
ENVIRONMENTAL Services

Baseline Studies
Characterisation of pre-project environmental conditions in the potential project area of influence. Coordination of multidisciplinary studies relating to the physical, biological and social environment in a diverse range of environmental settings, covering tropical, subtropical and arid zone climates. Conducted for regulatory approval, project financing and corporate governance purposes on both green fields and brown fields project settings. May include the identification of permitting requirements and strategies for the approval process as well as door to door community consultation and data collection.

Impact Assessment and Mitigation Plans
Assessment of potential environmental and social impacts as well as cumulative effects that would be expected as a result of the proposed project. This assessment starts with the fundamental environmental and social conditions prevailing in the immediate area of the project and within the surrounding communities and includes the development of mitigation, enhancement, compensation and monitoring plans.

Stakeholder Consultation,
Capacity Building and Social Management Plans
Facilitating understanding, involvement and information exchange during all project stages through a variety of techniques, including the development of social management plans, communication and consultation plans and social impact assessments. Culturally appropriate materials and tools are devised to improve this process.

Training, skills development and facilitation of workshops are undertaken with clients and local communities to build their capacity for working in a manner aligned with corporate social responsibility best practices.

Environmental Management Plans (EMPs)
Developed for regulatory permitting and as part of a Company’s Environmental Management System for both the construction and operational phases of projects. Content and structure are specifically designed to meet the requirements of the project / site and usually include environmental monitoring, emissions control, impact mitigation and procedures for documentation and reporting. Hazard identification and risk assessments can be undertaken during EMP development to understand the pathway from a potential hazard to potential impact and best design the EMP to mitigate potential impacts and provide a better environmental outcome for the project.

Monitoring and Regulatory Compliance Reporting
Establishment and installation of environmental and social monitoring programs during construction, operations and post-closure, including compliance monitoring and reporting for national regulatory agencies and international organisations where required. Monitoring plans designed to follow on from baseline studies and measure levels of impact on the environment resulting from the project in the immediate project footprint and in the vicinity of the project.

Closure Planning
Development of integrated conceptual and detailed closure plans and closure cost estimates, including the development of closure criteria and incorporating environmental and social factors into final land use planning, optimising opportunities and minimising long-term risk.
Experience

Origin APLNG Project, Shallow Monitoring Program, Australia
The Australian Pacific Liquefied Natural Gas (APLNG) Project involves the production of Coal Seam Gas (CSG) in numerous tenements across the Surat Basin in southeast Queensland. The CSG production process requires depressurisation of the coal seam by the removal of groundwater via gas production wells. Current water management strategies for the removed groundwater involve the temporary storage in “ponds” before treatment.

KCB was commissioned by Origin to undertake the biannual regional environmental monitoring program for their upstream production facilities for the past 5 years. A total of 317 monitoring locations, comprising 44 surface water sites and 273 groundwater monitoring bores are included in the current sampling program.

Origin APLNG Project, Eurombah Creek Sampling Program, Australia
KCB were commissioned to undertake surface water quality, zooplankton and stream sediment sampling of Eurombah Creek as part of a preliminary receiving environmental monitoring program for the Spring Gully Reverse Osmosis Treatment Facility discharge. The program involved the establishment of sampling locations, weekly sampling over a period of approximately 8 months, ongoing interpretation of results and reporting.

Undisclosed client, Papua New Guinea
A confidential Oil and Gas client in PNG has engaged KCB to provide technical support services for ongoing environmental monitoring and compliance of site activities.

Oil Sands “end of pit” Lakes Research Study Alberta, Canada
KCB is part of 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 worldwide research program and construction of full scale prototype “End Pit Lake” is a completed open pit.

Ok Tedi Mine Community Relations, Papua New Guinea
The Ok Tedi community relations (CR) team is responsible for gaining and maintaining the company’s license to operate covering a demographic of over 100,000 people. The client team has a current staffing level of 40 with varying levels of qualification and experience. KCB has been commissioned to undertake a CR capacity review, develop a strategic CR management plan and facilitate training programs aimed at updating the present skill base.
Baseline Characterisation
Strategic advice on key groundwater issues relating to project developments. Characterisation of regional and site scale hydrogeology and development of conceptual hydrogeology models. Field investigations to provide site specific aquifer and aquitard properties, confirm lateral and vertical groundwater gradients, groundwater flow directions, and pre-development groundwater qualities.

Baseline groundwater monitoring system designs including remote monitoring instrumentation and telemetry system designs where appropriate.

Impact Assessment and Mitigation Designs
Refinement of baseline hydrogeological models to include project developments and to reflect potential project impacts on pre-development groundwater conditions. Identification of potential source-pathway-receptor relationships, and potential impacts to groundwater resources, groundwater quality and surface water – groundwater interactions. Development of numerical models to reflect baseline conditions and simulate project development, operations and post-operations scenarios.

Designs for groundwater impact mitigation, including cut-off wall containment technology and interception pump and treat options.

Operational Performance and Compliance Monitoring
Groundwater monitoring designs to monitor system performance and confirm design expectations. Compliance groundwater monitoring designs to meet regulatory approval conditions and to demonstrate impact management to baseline groundwater conditions within and outside the approved project impact footprint area.

Designs for continuous remote data collection and telemetry systems. Groundwater monitoring and laboratory analytical program designs to meet performance and regulatory compliance monitoring objectives. Database and data management design, and data QA / QC design.

Groundwater Source and Supply
Strategic advice on regional groundwater supply based on regulatory requirements for groundwater supply development and directions on policy influences and procedures to access water. Groundwater exploration, aquifer testing and groundwater supply assessment in terms of available supply rate and groundwater quality. Complete bore field supply designs from the production bore to the point of supply or storage; including bore designs, pump specification, mechanical and electrical design, and operations manuals.

Groundwater monitoring system design to monitor system performance and confirm design expectations, and to meet regulatory compliance requirements.

Depressurisation Design
Field investigations to measure in-field aquifer and aquitard properties, and gas solution characteristics. Single and dual phase numerical modelling to determine bore spacing and production bore pumping schedules to achieve design depressurisation conditions for CSG propagation. Production and monitoring bore designs. Reticulation design including mechanical, electrical and telemetry systems.

Injection Design
Strategic advice on injection bore strategy and regulatory process. Field investigations to establish injection properties and determine injection rates, injection capacity, and to identify potentially limiting aquifer boundary effects. Injection and monitoring bore designs, instrumentation and telemetry designs.

Assessment of disposal water chemical compatibility with the groundwater. Identification of requirements for treatment prior to disposal to mitigate against impacts to injection bore efficiencies and/or aquifer impacts due to chemical incompatibilities between the wastewater and the groundwater.

Contamination Assessments and Remedial Designs
Experience

**Origin APLNG Project**
KCB was commissioned by Origin to complete the following works: deep water supply and aquifer injection bore drilling, moderate and shallow monitoring bore drilling, groundwater bore baseline surveying, aquifer injection, sampling research, injection modelling, and developing Health, Safety & Environment (HSE) documentation for hydrogeological fieldwork and Groundwater Management Plans (GMP).

**Department of Natural Resources and Mines (DNRM), Queensland Government**
The Healthy Headwaters Coal Seam Gas (CSG) Water Feasibility Study is analysing the opportunities, risks and practicality of using CSG water to address water sustainability issues in the Queensland section of the Murray-Darling Basin.

KCB was commissioned by DNRM to complete the following works:
- Central Condamine River Alluvium injection study
- Walloon Coal Measures geological modelling
- CSG water production tool

**Queensland Water Commission (QWC), Spring Survey**
KCB was commissioned for the collection of a suite of hydrogeological attributes at selected springs in the Surat Cumulative Management Area (CMA). This work was undertaken in conjunction with parallel surveys of the same identified suite of springs by the Queensland Herbarium and was extended to include detailed assessment of likely source aquifers for each spring.

**Linc Energy**
KCB was commissioned by Linc Energy to complete a desktop investigation of the origin and fate of aquifer gasses at the Linc Chinchilla demonstration site (Project Site). Linc require an investigation into the occurrence of Underground Coal Gasification (UCG) gas in the overlying aquifer at the Project Site. This will further their understanding of the mechanisms in which UCG related gases could potentially migrate through the Macalister A and B coal seams and understand the potential fate of these gases.

**Office of Groundwater Impact Assessment (OGIA), Queensland Government**
KCB was engaged by the Office of Groundwater Impact Assessment (OGIA) to undertake field hydrogeological surveys across the Surat Basin to investigate and assess the potential for connectivity between various aquifers associated with CSG industry.

Included in the survey, was the collection and preservation of water samples for isotopic age dating to further the understanding of the hydrogeological process of the system.
SURFACE WATER

Services

Baseline Characterisation
We carry out baseline surface water quality assessments. We also plan and execute field programs, and design monitoring networks to collect catchment and site scale hydrology and hydrological data.

Impact Assessment and Mitigation
Potential impacts on surface water resources, surface water quality, and surface water / groundwater interactions can be incorporated into hydrological models. Development of numerical models for water balances and site water quality management incorporating project development, operations and post-operations scenarios. This data is used to provide strategic advice on surface water issues.

Performance and Compliance
The development of surface water monitoring systems is integral to the approach to monitor the designs against design expectations and for regulatory compliance. Designs for continuous remote data collection and telemetry systems and for groundwater monitoring and laboratory analysis.

Site Drainage and Clean Water Diversions
Catchment modelling to estimate baseline and peak flood catchment flows. Design of clean water diversions, site drainage and storage facilities for site runoff. Reticulation designs including civil mechanical and electrical systems. Construction supervision and construction capacity building.

Water Chemistry
Water balance studies to quantify regional and site water management fluxes and expected water quality for release to the environment or disposal by injection.
Experience

**Koniambo Nickel, New Caledonia**
Detailed design for sediment control dams, including sedimentation studies, hydrology, and construction design in a high rainfall environment. Construction QA / QC monitoring.

**Wafi-Golpu Project, Papua New Guinea**
Concept to feasibility level design of the site-wide water management structures, and development of sediment and erosion control plans. On-site capacity building for Papua New Guinea construction crews. Site surveys of water courses, identification of fresh water intake locations and pipeline alignments. Catchment impact studies.

**Collingwood Tin, Australia**
Return water dam and spillway design for a tailings storage dam.

**Lihir, Papua New Guinea**
Carried out town water supply studies and reliability studies for the mine’s water supply. Designed the drainage system for Kapit Pit and the Low Grade ore stockpile. Construction supervision.

**Lady Annie, Australia**
Carried out water reliability studies and provided concept to construction level designs for raw water dam, site-wide storm water management systems, road drainage and culverts.

**Ok Tedi, Papua New Guinea**
Provided the detailed designs for surface water systems at the Bige Lower Ok Tedi Dredge site. Included the Kobom Creek and local diversion channels and the hydraulic design of waste stockpile and water management structures for operations and closure.
INFRASTRUCTURE Services

Access and Exploration
Concept and detailed design for all aspects of access and exploration including: foundation / pad design, water supply and water storage, reticulation, instrumentation and controls.

Well Site and Gathering Facilities
Water pipeline reticulation systems, including electrical and mechanical design and pump specification. Plant civil, geotechnical, electrical and mechanical design. Plant foundation designs. Surface water, sediment and erosion control. Geotechnical and civil design for water storage dams and evaporation ponds.

Linear Infrastructure
Geotechnical and civil design for surfaced and unsealed roads. Surface water drainage and erosion management. River crossings, bridges and culverts. Pipeline route selections, geohazard assessments and routine performance inspections.

Refining, Product Storage and Shipping
Civil and geotechnical designs for ports, railways, roads and associated infrastructure.

Rehabilitation
Design services associated with brine management, drill pad rehabilitation and remediation and site risk assessments.

Other Engineering Services
Construction supervision and monitoring, geohazard assessment, tunnels, water management and hydroelectric power.
Experience

**Ok Tedi, Papua New Guinea**
Performed a geotechnical stability assessment along an existing pipeline corridor, the mine site and river port, covering a distance of over 160 km. The assessment identified slope instability risks to the pipeline, and recommended action for risk management.

**Browns Range, WA, Australia**
Design of water supply reticulation system, including equipment selection, control philosophy, quality estimates and CAPEX / OPEX cost build-ups.

**Nam Theun 2 Hydroelectric Project, Laos**
Provided bid design, final design and construction engineering services for the two main civil works packages for this 1074 MW project.

**Antamina Water Pump-back System, Peru**
Designed a new pump-back system to accommodate the low-grade ore stockpile. The surface water management plan comprised a system of lined ponds, ditches, pump-back stations and sodium-hydroxide dosing to control the quality of surface water released to the environment.

**Vale Inco, Canada**
Pre-feasibility study to assess options to improve reliability of the reclaim pumping system that supplies water to the Upper Pond.

**Votorantim Metals Goethite Pumping System, Peru**
Design for the replacement of a goethite pumping system at the Votorantim zinc refinery in Peru. Upgrade of pumps and associated piped infrastructure.

**Ok Tedi, Papua New Guinea**
Mechanical and Electrical design of cyclone systems. Retrofit of valve chambers and capacity upgrade at hydro-electric plant.