

At Golder Associates, we have created a company that works with clients from project inception through closure. This issue of *Technically Speaking* focuses on our work that helps mitigate environmental impacts. Typically, the practice of mitigating environmental impacts is done at the end of the useful life of a project – such as what is described in the article on our work with Harland and Wolff, the famed builder of the “unsinkable” RMS *Titanic* luxury cruise liner. However, through more than 46 years of experience, we have learned that it can be more effective to consider potential environmental impacts at the front end of a project when we, on behalf of our clients, have the ability to design for the full productive lifecycle of a project. Hence, several of the projects featured in this issue describe our work at the very front end of a variety of developments including gold, coal and oil sands mines; a roadway; a port; and a chemical plant.

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## "TITANIC" SHIPYARD IN BELFAST TO RECYCLE SHIPS

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**Belfast's historic Harland and Wolff shipyard, perhaps best known for building the fated ocean liner "Titanic," is embarking, with the support of Golder's environmental expertise, on a new venture as an environmentally-sound recycler of ships.**



▲ Simon Davies (left) of the Golder Nottingham office with David McVeigh (right) of H&W on the HMS Fearless, one of the current Royal Navy vessels due to be recycled in the near future.

The work of "breaking" ocean vessels for scrap materials after they have passed their useful life is often done in parts of the world where environmental rules and enforcement are not rigorous. This sometimes releases hazardous materials such as asbestos and heavy metals into the environment and threatens the health of those doing the work.

Now, however, globally agreed and enforceable standards are being developed which mean that ships will need to be dismantled in a way that protects the environment and workers. This opportunity provides a new lease on life for the Northern Ireland shipyard.

To make this possible, the shipyard management has sought Golder's expertise in decommissioning and dismantling, as well as our procedures for environmental control and waste management. This joint venture will be one of the first in the UK to be licensed for dismantling ships and offshore oil rigs. The venture not only helps ship owners meet the new regulations, but helps develop "green" industry in a city that has seen a decline in its industrial capacity over the past few decades.

The result is a win for the shipyard, the area's workforce and the environment.

◀ Cover: The historic Harland and Wolff shipyard has a new future in recycling ships in an environmentally-sound way.

## MODELLING AIR QUALITY IN CANADA

BY MOHAMMED AYOUB, MISSISSAUGA, CANADA  
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The "Golden Horseshoe" area of Canada, centred on Toronto and curving around the northern shore of Lake Ontario, is home to some six million people. However, concerns about air quality are taking some of the shine off the Golden Horseshoe, particularly with projected population growth adding more industry, residences and motor vehicle traffic. Golder has been helping build a better understanding of the sources and composition of the environmental impacts of the existing and planned population, transportation infrastructure and economic base to help find better ways to deal with those impacts.

Working on behalf of the Greater Toronto Area Clean Air Council (GTACAC), Golder has compiled measurements of ambient emissions of carbon monoxide, nitrogen oxides, sulphur dioxide, volatile organic compounds and particulate matter of 2.5 and 10 microns in size from point sources, including factories, mobile sources (vehicles), and area sources such as airports. This information is then fed into dispersion models which calculate the ambient air quality.

The result is information that helps identify potential areas of air quality concern so that the most pressing issues that affect human health can be acted upon first.

As well as analyzing current conditions, the GTACAC and Golder are looking into the future, given projections about population growth and other factors, to see what the air quality in the GTA may be like in the year 2030.

This type of work provides a framework for local leaders to evaluate a variety of air quality control options and their impacts on human health both in the present and in the future. With this information, choices about mitigation measures will be more likely to have the greatest possible effect on air quality.



▶ Air quality is of growing concern in Toronto, Canada's most populous city.

## PLANNING THE RESTORATION OF THE CANADIAN OIL SANDS MINES

BY IAN GILCHRIST, CALGARY, CANADA  
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**“As much oil as there is in Saudi Arabia” is the boast being made about the oil sands of Alberta, Canada, where near-surface deposits of sand mixed with a tar-like oil are being processed into petroleum products. Golder is helping make sure that after the resource is extracted, the landscape is restored to as-close-to-original shape as possible.**

Environmental restoration is nothing new, but the sheer scale of the oil sands developments puts this process into a whole new order. Surface areas of up to 6,000 hectares (44,000 acres) are worked over at a time, so that the resource-bearing material can be efficiently extracted.

Before this work can start, however, Project Applications and supporting Environmental Impact Assessments must be prepared. Golder’s role focuses on preparing detailed baseline studies of the area – the landscape, watercourses, vegetation cover, wildlife presence and other factors. Additionally, there are assessments on how the project impacts the development footprint as well as the cumulative effects of the new project with other regional existing, approved and planned projects. Golder also prepares mitigation plans such as closure and reclamation plans and provides other Project Application assistance. The baseline work requires collecting field data, laboratory samples and mapping the areas.

Once a project is approved and constructed, Golder performs a monitoring function to be sure that the steps laid out in the EIA are being followed.

After the machines move on, Golder will work with the developers to finalize reclamation plans and monitor the reclamation work. The mining operations result in the construction of new landforms and the initiation of new ecosystems and wetlands. Monitoring the progress of these ecosystems, including the re-establishment of wildlife populations, will continue for some time, with the whole process taking decades. The reclamation plans are geared to achieve equivalent land capability, with the target that the reclaimed sites will be close to what was found in the area prior to development.



▲ Developing Canada’s oil sands requires sound environmental measures.

## ACCESSING ENERGY RESOURCES ON NEW ZEALAND'S SOUTH ISLAND AND IN KENTUCKY, USA

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**In many parts of the world, coal is making a comeback. Two projects, from opposite sides of the globe, show how Golder is helping manage the environmental impacts of this energy source.**



▲ Great spotted kiwis, a flightless nocturnal bird native to New Zealand



▲ The site of the coal deposit on New Zealand's South Island



Coal production on federal US lands must meet strict environmental regulations

High worldwide energy prices means that New Zealand has an opportunity to leverage the value of its coal deposits, a vital energy source in a country with few oil and gas reserves.

Thanks to environmental planning by Golder, a coal deposit on the South Island, owned by Francis Mining Company Ltd., can now be developed in a way that safeguards the environment.

The proposed mine site is situated within Government conservation land and a nationally listed Ecological Area that is noted for its bird values and is home to nationally threatened species such as the indigenous Kiwi bird. Golder found that the site has some ecological values, but these are lower than the wider Ecological Area because the site is located in a basin that has already been compromised by heli-logging and a transecting transmission line corridor.

The opencast mine development will remove vegetation habitat and work coal that is considered to be relatively high in sulphur, with the potential for acid rock drainage.

To manage these issues, Golder assessed the environmental values and developed mine plans to handle the site in a sustainable way – designing for mine closure and rehabilitation from the outset. This included specific drainage regimes to reduce mixing and progressive in-pit back filling to minimise the footprint to allow for progressive rehabilitation and control of potential acid rock drainage.

Golder was responsible for the Environmental Impact Assessment, permitting, land access, consultation, geology and mine planning, to allow the development of this resource in an environmentally sustainable way.

Coal is also a major part of the energy picture for the United States of America. However, ever since the National Environment Policy Act (NEPA) of 1969 was passed by the US government, coal production from US federally administered lands has been an onerous proposition. Many coal-mining interests found that the process resulted in requirements too restrictive to make work on federal lands practical.

One result of this occurred in eastern Kentucky where the underground coal workings of the James River Coal Company stopped abruptly at the borders of the US Forest Service administered Daniel Boone National Forest. With a rising demand for energy, however, there has been a new impetus to the quest for resources, particularly from the eastern part of the country. This has sparked greater interest in tapping the resources underlying federal lands.

James River Coal sought to extend its underground coal workings beneath the Daniel Boone National Forest in a way that was environmentally responsible and which satisfied NEPA and the requirements of several US federal agencies including the Bureau of Land Management and the Office of Surface Mining (OSM), as well as the US Forest Service. This included developing measures to protect Threatened and Endangered species including freshwater clams and snails.

To help the company meet environmental regulations, Golder worked through a multi-year process that eventually resulted in acceptable requirements to proceed with sub-surface mining. This energy resource is now helping meet a wide range of needs for James River Coal's customers, which are primarily utilities that supply electricity to homes and businesses.

## SUPPORTING THE EXPANSION OF A VITAL INDUSTRY IN SOUTH AFRICA

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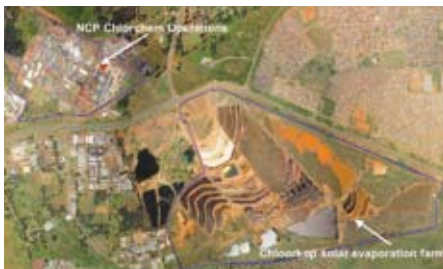
Faced with rising demand for clean drinking water, NCP Chlorchem, Southern Africa's only commercial producer of chlorine used in water treatment, needed to increase production. Finding a way for this expansion to take place, while also ensuring the ongoing health of people and the environment near the plant, was the challenge presented to members of Golder's Johannesburg office.

The site was first used in 1942 by the South African government to produce a range of chemicals. Later, DDT and other chlorinated pesticides were added to the range, but have since been discontinued. NCP Chlorchem currently produces a variety of mainly inorganic products including chlorine for water purification.

The current property owner NCP Chlorchem wanted to expand chlorine production in a responsible and legally compliant manner. Golder was asked to conduct an Environmental Impact Assessment as required by law, as an independent consultant.

Golder's EIA project team ascertained that existing production processes potentially posed risk in the unlikely event of a catastrophic release of chlorine gas. It seemed possible that given this risk, the expansion project may not be permitted – so the EIA team together with NCP Chlorchem technical staff worked on possible mitigations to the operations and design of the existing and future planned plant to reduce the risk profile to an acceptable level. NCP Chlorchem has subsequently received permission to proceed with its expansion.

This expanded facility will help safeguard public health by providing a strategic chemical required for water treatment, and ensuring ongoing operation in an environmentally sustainable way.



## MEASURING ENVIRONMENTAL AND SOCIAL IMPACTS IN TIBET

BY MARSHALL LEE, BRISBANE, AUSTRALIA  
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**Mining activity in Tibet is under close scrutiny by international organizations, so demonstrating sustainable practice is vital. Any possible impacts that the mine may have on the water, soil and other aspects of the environment, as well as any social and financial effects, must be understood so that mitigation measures will be as effective as possible.**

Golder has been working with Continental Minerals Corporation through its subsidiary, Tibet Tian Yuan Minerals Exploration Limited, on its proposed Xiongcu Copper Project in Tibet, to develop a methodology for measuring project effects and tracking results against key environmental, social and financial indicators.

The first objective was to determine the factors that drive sustainability, so Golder's personnel tapped the collective wisdom of their colleagues around the globe to develop a list of project sustainability goals and indicators.

The result is a database that considers factors that include compensation paid for disruption to farming and livelihoods, the success of relocation measures, local employment and business opportunities, educational opportunities for local people, impacts on the availability of health and medical facilities and use of telecommunications facilities.

Golder's partner in the impact assessment of the project is Beijing-based Sinosphere which has a team currently collecting baseline data for the socio-economic indicators. As a result, the mining company can gauge the results of its activities and find ways of improving the quality of life for people affected by the mining project.

This methodology has since been proposed in Indonesia, and with modifications to meet local circumstances it can help determine the sustainability of projects anywhere in the world.



Brian Wrench of Golder Associates meets with members of a family living near a planned copper mine in Tibet

◀ Aerial view shows this chemical plant close to a residential area

## PROMOTING BIODIVERSITY AND SUSTAINABLE DEVELOPMENT IN PERU

BY ANÍBAL DÍAZ, LIMA, PERU  
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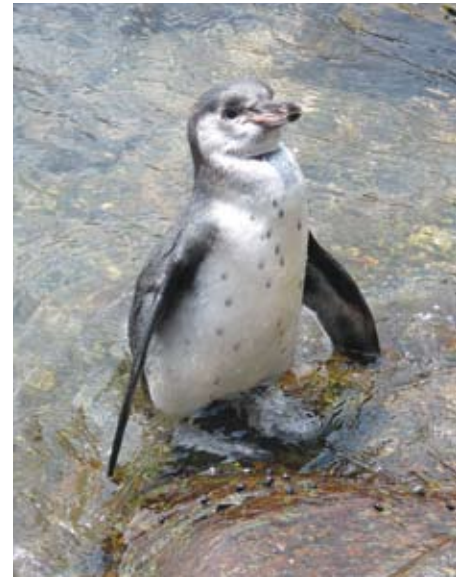
Building greater capacity at the port of Matarani in southern Peru is important to the future growth of the country. The existing port, originally designed for grain and mineral trade, is too small for its expected future role as the terminus of a highway leading from the Amazon region and as the location of a facility for importing chemicals for use in the economically-important mining sector. However, there is also a need to preserve the area's biodiversity – most notably, protecting the habitat of the Humboldt penguin.

These black-and-white flightless seabirds live only along the Peruvian and Chilean coast and are classified as "Vulnerable" by the World Conservation Union. They grow to between 67 and 72 cm (26 to 28 inches) in height, mate for life and live in highly social colonies. For food, they depend on fish found in the cold but nutrient-rich waters of the Humboldt Current.

In a recently conducted environmental study, Golder staff evaluated the marine resources of the area. Although an evaluation in 2003 found Humboldt penguins on the islands close to the proposed project, this time they were only able to find one penguin during the search because the species is now endangered along the Peruvian coast. Accordingly, Golder recommended that the project footprint not fall within recent penguin habitat.

A risk-based analysis determined that there was a further possible threat to the penguins in the event of a catastrophic release of chemicals into the water. Recommendations were made regarding changes to operations that would help mitigate this potential risk.

The result of Golder's work will be the opportunity for responsible development that meets economic as well as environmental needs for Peru.



▲ Humboldt penguins live in colonies along the coast of Peru and Chile.

## SUPPORTING GOLD DEVELOPMENT IN LAPPLAND

BY ALISTAIR CADDEN, MAIDENHEAD U.K.  
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The developers of the Suurikuusikko gold project, above the Arctic Circle in Finnish Lapland, are working towards regulatory approval, the first application in Finland of European Union regulations on such mines. Golder's work has included tailings dam design and finding ways to manage the mine's impact on both surface and ground water.

For surface water management, Golder helped plan the size and construction of holding ponds using GoldSim®, a proprietary software program that uses risk-based methodologies to determine the impact of variables such as precipitation. This method helps develop recommendations that are based on actual field conditions, rather than being determined by previously-established values.

Probabilistic modelling through Golder's ConSim® program was also used to gain an understanding of the potential for contaminants from the mine to leach into the groundwater, and build ways to manage this risk.

One of the challenges in the work was that for the first time in living memory, the ground did not

freeze to the typical depth during the winter, making transportation and drilling difficult.

There was also the need to demonstrate the mine operator's ability to manage the arsenic and sulphur that are naturally associated with the gold ore, as

well as the cyanide that would be used in the leaching process to extract the gold from the ore.

For this project, Golder brought together a team of people from Finland, the UK, the USA and Canada.



Mining in northern Finland must work within a harsh but fragile ecosystem

# News from Golder

## ACCOLADES

The Geo-Institute of the American Society of Civil Engineers awarded their 2006 "Heroes" recognition to four individuals who have had a profound effect on the geotechnical profession. The "heroes" are Dr. William F. Brumund, a Principal at Golder Associates, Dr. Milton E. Harr, a retired professor from Purdue University, Dr. T. William Lamb and Dr. Robert V. Whitman, both retired professors from the Massachusetts Institute of Technology.



William F. Brumund

Max Ervin

Max Ervin, a Principal in Golder's Melbourne office, is the recipient of the 2006 "Geotechnical Practitioner of the Year" award. This biennial award is made by the Australian Geomechanics Society for "significant contribution to the geotechnical profession and the life blood of the society."

## AFRICA

Pulles Howard & De Lange (PHD), a specialist company founded in 1993 and based in Johannesburg, have agreed to join Golder Associates. The focus of PHD is to deliver high quality services to the mining and industrial sectors and provide ground breaking research for the Water Research Commission and the Department of Water Affairs and Forestry in South Africa. With the addition of PHD, our South African company now employs more than 180 people.

## CANADA

Please join Golder at the International Pipeline Exposition to be held in Calgary, Alberta from September 25 – 29th at the Telus Convention Centre and Hyatt Regency Hotel. Golder will be showcasing our wide ranging experience in the pipeline sector and our unique expertise working in cold regions. If you have any questions regarding Golder's pipeline services please contact Michele Slattery at 403-532-5788 or visit [www.golder.com/pipelines](http://www.golder.com/pipelines).



Tunnel Boring Machines

## ITALY

For the first time in the history of tunneling, two Tunnel Boring Machines (TBMs) broke through their paths simultaneously. Since 2003, Golder has been involved in the geotechnical monitoring for the construction of two high speed rail links between Milan and Naples. The breakthroughs occurred as the TBM's completed the Belogna section.

◀ William Pulles and Dr. Fred R. Sutherland, Managing Director of Golder Associates Africa



## IRELAND

Less than one year after we commenced operations in Ireland, Golder Associates has been appointed by the North Tipperary County Council to oversee a 10.5 million Euro plan aimed at rehabilitating six historical mining centres close to the village of Silvermines.

## SRI LANKA

A team with Golder as the lead firm, in association with Lea International (Markham, Ontario) and the Central Engineering Consultancy Bureau (Sri Lanka), has just completed negotiations with the Road Development Authority of Sri Lanka to carry out detail designs for the rehabilitation of 1,500 km of Class A and Class B roads in Sri Lanka. The project will involve environmental and social impact assessments, geotechnical investigations, traffic studies, economic analyses and the preparation of contract documents. The project, which is funded by the Asian Development Bank (ADB), is expected to take about 30 months to complete and the estimated total cost is about US\$ 4.0 million.

## UNITED STATES

The new ASTM Environmental Site Assessment Standard becomes effective November 1st and the U.S. Golder team is now helping clients meet the regulation, which stipulates that property buyers conduct all appropriate inquiries to ensure their transactions qualify for lender liability protection. Golder spent the past year training its Environmental Professionals, developed a report format responsive to the new requirements and began conducting assessments to the 1527-05 Standard across the country.

Golder Associates Inc., our U.S. operating company, has crossed a historical milestone. In June, the U.S. employee ranks rose above 1,000 for the first time. "Although we will continue to grow in the future, our vision of being the most respected firm of our kind hasn't changed," according to Steve Thompson, President of Golder Associates Inc.

We have opened a new office in downtown Seattle to respond to growing opportunities with clients who are based in or near downtown Seattle and on the west side of Lake Washington. For more information contact Grant Bailey at 206-267-1166 or [GBailey@golder.com](mailto:GBailey@golder.com).

## SAFEGUARDING THE ENVIRONMENT IN A NATIONAL PARK IN THE U.K.

BY JOHN MICKLETHWAITE-HOWE, LEEDS, UNITED KINGDOM  
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**Building a new highway in one of the U.K.'s National Parks, which are the most sensitive and well protected landscapes in the country, is a fairly unusual event. Increasingly, highway construction is subject to scrutiny, but in the picturesque Lake District, the level of interest is even greater.**

Working with the main contractor and engineering consultant, Golder Associates staff in Leeds have created in detailed design the initial route plan of a four-kilometre (2.5 mile) bypass around two settlements near Windermere.

Ensuring that this new highway will have minimal effect upon this valued area has entailed careful and coordinated design. A major factor in the current support for the scheme has been the preparation of a 'realtime' 3D flythrough of the scheme. This tool has enabled the project team, in meetings with local politicians, planning officers and the

community, to demonstrate how the proposed scheme will look after it has been built. So far the reaction has been overwhelmingly positive.

In addition, Golder ecologists have undertaken bat surveys and supervised the construction of a bat 'hotel' to accommodate a population that will be displaced from demolished buildings. Mitigation will also include structures to 'guide' flight routes over the construction site. Underpasses to the new road will have lighting controlled to avoid peak periods of bat activity.

Additionally, fencing and crossing points will be provided for the many badgers active around the site – up to 40 setts (burrows).

A Golder archaeologist from Leeds has also undertaken the recording of a building to be demolished, and paleo-environmental sampling of peat areas is planned.

All of this will result in a roadway that meets the needs of the traveling public while also protecting a world-renowned landscape.



BEFORE

"Before" and "After" three-dimensional "fly-through" images help stakeholders understand how a new highway through England's Lake District will look when completed.



AFTER



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### TECHNICALLY SPEAKING

Technically Speaking is published for valued clients and employees of Golder Associates. This quarterly newsletter includes articles showcasing innovative and technically challenging projects that Golder professionals have worked on throughout the world.

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### GOLDER ASSOCIATES

At Golder Associates, we strive to be the most respected global group specializing in ground engineering and environmental services. Employee-owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Our professionals take the time to build an understanding of our clients' needs and of the specific environments in which they operate. Golder has experienced steady growth in the number of people we employ and our technical capabilities. We now employ over 5,000 people who operate from more than 130 offices across Africa, Asia, Australia, Europe, North America and South America.

