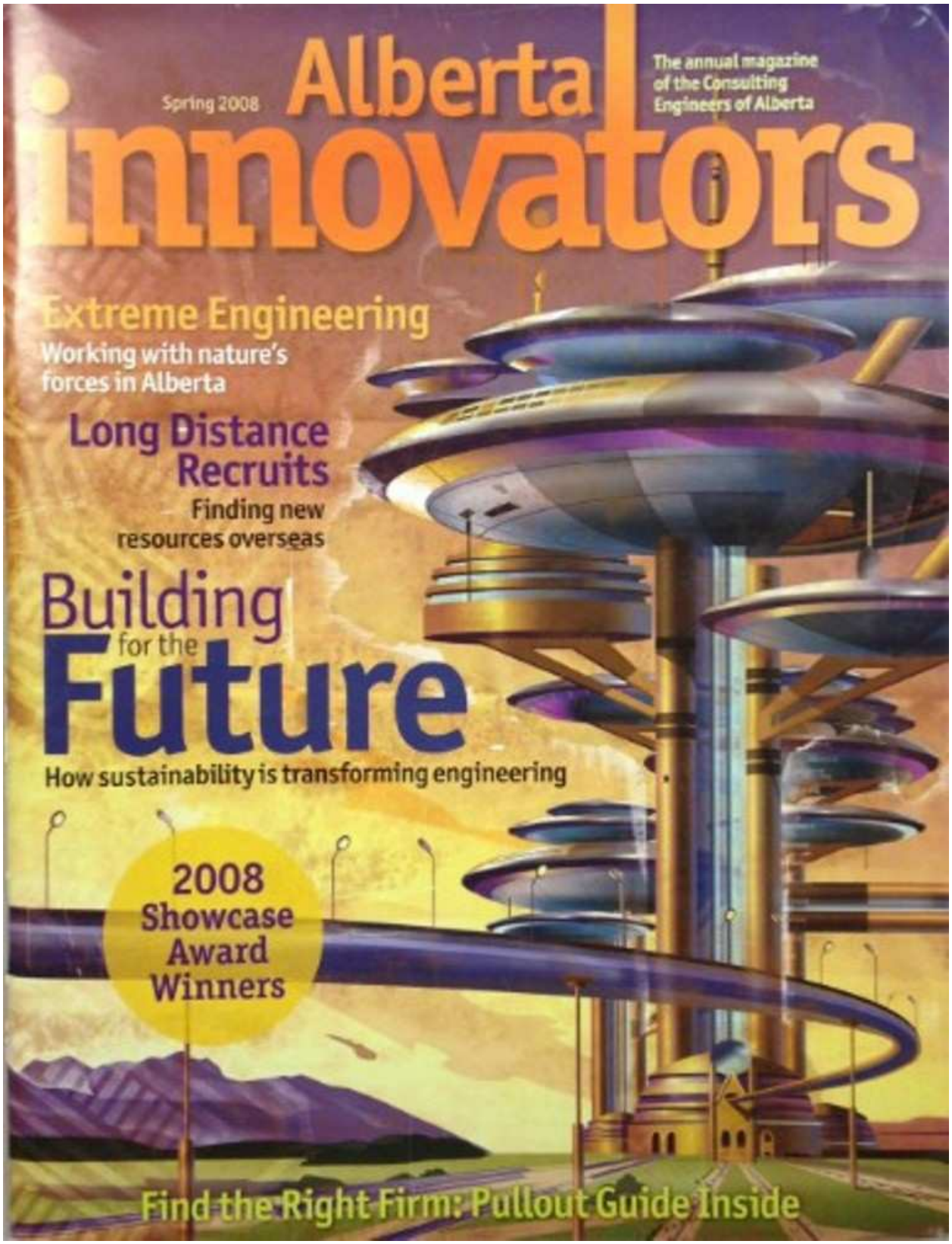
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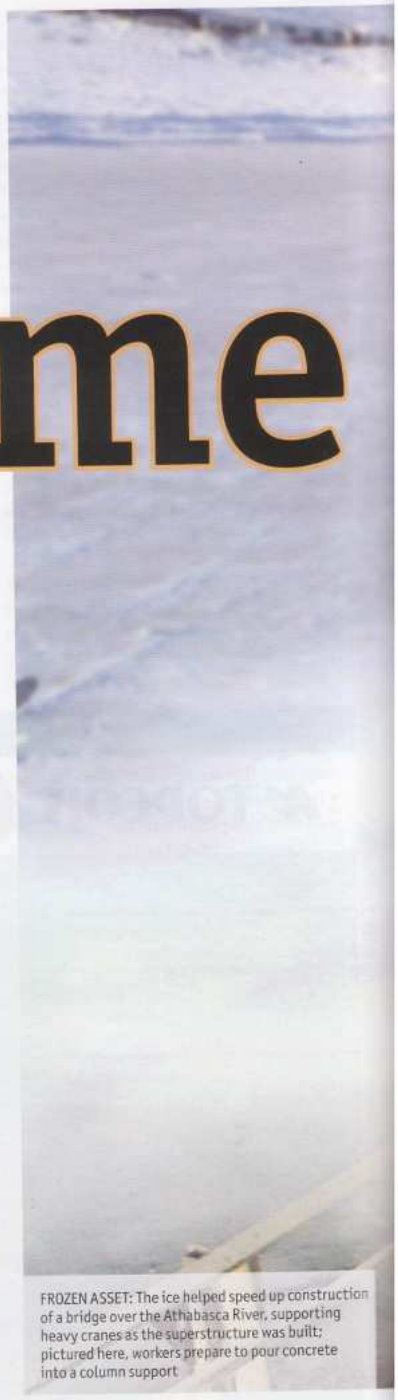
Engineered to the Extreme

From the steep slopes of the Andes to the rocky beaches of the Arctic, engineers are conquering the challenges of extreme conditions

BY **JIM VEENBAAS**



FROZEN ASSET: The ice helped speed up construction of a bridge over the Athabasca River, supporting heavy cranes as the superstructure was built; pictured here, workers prepare to pour concrete into a column support

When the rainy season hits in the Andes mountains and the steep slopes become virtually impassable, Wim Veldman has resorted to the most primitive form of transportation to get the job done – using mules to move men and equipment.

The Edmonton engineer has carved out a career working in some of the most inhospitable places on the planet. One of his most challenging projects was the Oleoducto de Crudos Pesados (OCP), a 500-kilometre heavy crude pipeline that moves 450,000 barrels of oil per day through the jungles of Ecuador, across the Andes to an export terminal on the Pacific Ocean.

"At one point, we had to use mules to haul equipment. We called it the 24-legged fuel truck. If you see some of the pipeline spreads in South America, it's just incredible the slopes they can go up. Ninety per cent of it is just handling the extreme slopes and getting the slopes ready for the pipeline," says Veldman.

"Your excavating equipment can't even sit on the slope. It's cabled to another huge machine on top in order to hold it in place. Workers for the first two or three hours each morning have to restore their safety fences so rocks coming down the slopes don't hit them."

Veldman has battled earthquakes, landslides and elevations of 16,000 feet plus in South America. When he signed on with the OCP project, it had already been beset by a five-month shutdown caused by slope failure and flash floods following 600 millimetres of rain. On that same project, an active volcano threatened to erupt at any time and was a constant threat to the safety of the workers and completion of the project.

"It can be extremely turbulent up in the Andes. On one project in Peru, there was almost no access. In fact, they had camps

every 20 kilometres and almost everything had to be moved by helicopter. There were landslides, volcanic eruptions, even people killed in landslides along the pipeline route," says Veldman, who ran his own firm until it was acquired by Matrix Solutions in 2005.

Veldman carved out an international reputation for working in extreme conditions after spending three years working on the Trans Alaska Pipeline, which stretches 1,300 kilometres from Prudhoe Bay on Alaska's North Slope to Valdez, the northern most ice-free port in North America. The project was completed in 1977 and has since moved more than 15 billion barrels of oil.

Working in the Arctic presents a whole new set of challenges, one that Alberta engineers are more familiar with. In addition to the long, dark and extremely cold winters, builders and designers must grapple with huge swings in temperature and the freezing and melting conditions that accompany seasonal changes.

"You can imagine what it is like surveying in total darkness – and it's totally

EXTREMELY SENSITIVE: In the summer, banks and disturbed areas are restored and re-vegetated after winter pipeline work in Alaska

dark on the north slope of Alaska for three months of the year. You use some laser techniques and lots of lighting, but everything certainly slows down in the cold," says Veldman.

"Some of the rivers up there form incredibly thick sheets of ice in the winter. It's not like river ice you would see on the Peace or the Athabasca, but it's frozen right down to the bottom. The initial spring breakup can happen very quickly and the ice is still frozen on the bottom so all the flow goes over the top of the ice. That can threaten bridges, roads and other structures with flooding."

"There were landslides, volcanic eruptions, even people killed in landslides along the pipeline route."

Steve Stowkowy of UMA Engineering has been dealing with those harsh conditions since 1992 when his firm started dismantling and cleaning up sections of the DEW line, a string of radar stations that used to stretch across the Arctic from Baffin Island to Alaska. With the end of the Cold War, the military base stations were abandoned in 1990, along with all the debris associated with them. Especially damaging were the large quantities of PCBs, chemical contaminants that are difficult to destroy because they don't break down easily.

COOL ADVANTAGE: UMA uses permafrost as a barrier to minimize flow of contaminants into the environment

Complicating the cleanup efforts are the brutal climate and terrain of the north. Some sites are on rocky beaches, while others cling to cliffs. All of them are built on permafrost that changes with the seasons. Temperatures can drop 25°C overnight and the terrible cold means the job can only go ahead a few months of the year.

"Each base included accommodations for anywhere from 100 to 300 people. There's lots of debris associated with that. Of course, the environmental practices back then aren't what they are now. There's a lot of demolition work, there's a lot of cleanup – taking out hazardous material, a lot of contaminated soil that has to be taken off site or buried on site," explains Stowkowy.

"The biggest challenges are the permafrost, remoteness and the short construction season. It usually goes from the end of May until the first week of October. It's offset a little bit because you get a lot of light up there in the summer, but your timelines are very tight."

Occasionally, harsh conditions can be turned around to make projects more manageable. UMA developed a unique design that uses permafrost to contain leachate-producing landfills and aids in the disposal of contaminated soils. Saturated permafrost acts as a barrier and minimizes the flow of contaminants into the surrounding environment. This innovative design has already saved approximately $15 million on the sites that have been cleared to date.