

A Multi-Disciplinary Design

by Marlene Eisner

Creating a long-term, sustainable lake from scratch takes good communication and a multi-teamed approach

Environmental sustainability is perhaps one of the most important, and most challenging, aspects of the mining industry. From water conservation and innovations in tailings management to the reclamation of land, the goal is to meet the present needs of society without compromising the capacity of future generations to meet their needs.

When Norwest Corporation was hired by Shell Canada to develop and create a lake able to support year-round fish habitat for the Athabasca Oil Sands Project, Norwest knew it was being presented with a unique and exciting challenge. The lake, to be built directly east of the Muskeg River at the confluence of the Muskeg Creek and Muskeg River, will utilize the Muskeg Creek as its primary inlet. Once the lake is constructed and filled, it will begin to balance the habitat lost during mining in portions of the watersheds.

Compensating for lost fish habitat was an essential requirement in the authorization for Shell's Jackpine Mine located about 75 kilometres northwest of Fort McMurray, Alberta. The lake needed to be a sustainable feature of the area and maintain fish passage from the Muskeg River through the lake and upstream along the Muskeg Creek for a minimum of 100 days of the year.

Designing ways

"The design certainly was a unique, multi-disciplinary project," says Adam Bedard, vice-president of water resource engineering at Norwest. "It required civil and mining engineers, hydrologists, geotechnical engineers, fisheries biologists, hydrogeologists and Shell's environmental group. There were a lot of aspects that had to be evaluated, so there was a long design process."

There were regulatory components to consider with agencies such as the Department of Fisheries and Oceans, Alberta Environment, Alberta Sustainable Resources Development and the Energy Resources and Conservation Board. "It was a fairly cutting-edge design – a very customized solution for a very unique set of challenges," says Bedard

Essential features

The lake is designed to be comprised of three main sections—a northern basin, a shallow interconnecting narrow section and a larger deep southern basin. The total surface area is expected to be 47.3 hectares and an erosion control berm has been designed along the lake's west shoreline to manage interaction between the lake and the Muskeg River.

The lake will have a primary inlet as well as a secondary inlet to handle high flood flows. Both inlets will use existing Muskeg Creek channels, which will flow into the northeast portion of the lake. In the south, a primary outlet will connect the lake to Muskeg River. Within the erosion control berm, secondary outlets have been designed at specific elevations to correspond to various flood frequency levels and allow for uninterrupted flow between the lake and river during flood events.

The design of the lake also includes habitat complexing to accommodate various types of fish habitats. Reclamation will be adaptively managed, with natural vegetation monitored to determine further reclamation needs.

Location, location, location

"The biggest challenge to the project was the location," explains Twyla Hutchison, water resource engineer and engineering design team member on the project.

"The lake is in a naturally existing flood plain of the Muskeg River," says Hutchison. "Being in the flood plain, it's a very wet area, and there were a lot of challenges with managing the water."

The first phase was to pre-drain the project site for lake construction purposes, prepare the foundation for the spoil piles and to divert natural waters away from construction activities. The surface drainage system,



Drainage network and beginning of pond excavation, August 2009

constructed between January and March of this year, is lead to two sedimentation ponds that discharge into the Muskeg River.

Timing is everything

Phase 2 of lake construction began in August 2009. "It's been draining since March," says hydrogeologist and project manager Sara McCartney. "Construction will start in the highland areas and move towards the Muskeg River. It will get more and more saturated, so we'll stay in dry areas until winter construction season."

The biggest challenge is completion of the lake in time for spring. Timing is essential, since once the creek is flowing into the lake it could fill in as little as one week. Construction must

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Meeting the Environmental Challenge

by Michael Day

The theme of this edition of the Norwester is "environmental". It is a timely subject as the mining and energy development industries in North America are facing unprecedented challenges to reduce their effects on air, land and water resources.

Competition for water resources between communities, agriculture, industry and energy development continues to intensify in various parts of North America. The rapid increase in shale gas development has prompted concerns about the use of massive quantities of water for hydraulic fracturing, the disposal of produced water, and the potential impacts to overlying ground water resources. In Colorado, produced water is the subject of new regulatory requirements and of water rights litigation. Norwest has been working with clients to respond to these new regulations which are the harbinger of things to come in other states in the western US. In West Virginia, increased focus on water quality improvement has led to the creation of models to establish the maximum allowable loading for impaired water bodies, resulting in competition among companies to become the first operator in a particular watershed. As in the western US, these issues are expected to spread throughout the region.

The practice of mountaintop mining and the associated valley fill construction have been the topics of heated debate in the eastern US. Similarly, numerous press articles detailing the deleterious environmental effects of large scale oil sands development in Alberta have tended to inflate the projections of impacts by using outdated or incorrect information. Only recently have the Oil Sands Developers Group started their own educational campaign to counter the negative press and explain the mitigation measures and

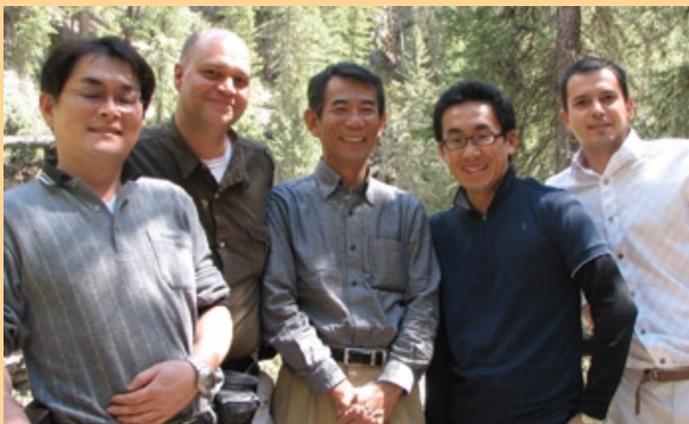
reclamation efforts that are taking place to protect and restore the environment. The creation of new wetland areas to replace those removed during the mining process is but one example of these reclamation measures (see lead article). Norwest is proud to be part of these leading edge reclamation efforts.

The drive towards some form of greenhouse gas (GHG) emissions control, in the form of "Cap and Trade" legislation or EPA regulation, will continue. The implications are enormous for the energy and power generation industries. Carbon capture and sequestration (CCS) will assume a more prominent role. CCS coupled with enhanced oil recovery in the form of CO₂ flooding will become more economically attractive, while sequestration in deep saline aquifers will need to move from the research phase to commercial implementation. Some companies are planning ahead and enacting emission reduction programs to qualify for carbon "credits" should Cap and Trade legislation eventually be passed. Annual inventorying of GHG emissions are mandated to start in 2010 for all US facilities (with the exception of underground mines) that emit more than 25,000 metric tons of carbon dioxide equivalents per year and will set the baseline for future emission reduction goals.



Michael Day,
President - Hydrologic and Environmental Services

The concept of sustainable development is an admirable goal which likely will define the future of energy development. Such a future requires investment in new technologies; greater cooperation between industry, regulatory agencies, and environmental groups; and compromise on the part of all parties. Norwest stands ready to help our clients meet these challenges.



MOECO Looking to Expand Business in Canada and USA

"MOECO (Mitsui Oil Exploration Company) and Norwest personnel enjoy a day in the mountains visiting the town site of Banff, Alberta. MOECO contracted Norwest Corporation to conduct a due diligence study related to some assets in Alberta in the pursuit of expanding MOECO's business in North America. Norwest continues their support to MOECO in the assessment of other assets in the USA and Canada.

left to right: Kobayashi Osamu, MOECO Senior Petroleum Engineer; Oscar Gonzalez, NORWEST Senior Reservoir Engineer; Kato Kanji, MOECO Fellow, E&P Division; Morimoto Jumpei, MOECO-Geologist, E&P; and Carlos Pereira, NORWEST-Senior Reservoir Engineer.

Denver Remediation Resumé

By Terry Gulliver

Norwest has a solid resume in environmental remediation. Since the 1980 inception of the Superfund program and growth of remedial activity in the US, Norwest personnel extended their experience in mine permitting and legacy property management into soil and water remediation; this was their primary focus in the 1990s. Norwest became the principal remedial system designer and manager for several Superfund sites, several active chemical plants, many other State managed projects, and a few European projects. They achieved many closures with cutting edge remedies. In situ bioremediation, vapor extraction, sparging, soil heating and containment in place all feature in that applied expertise. When risk-based corrective action became negotiable at EPA and State agencies, Norwest closed other sites by that route. Since remedial activity peaked and matured after 2000, Norwest shifted its focus to booming energy and minerals projects, particularly oil sands, oil shale, coal and coal bed methane. Site assessment and remedial engineering know-how has new aliases, as baseline characterization and reclamation plans.

At the French Superfund site near Houston, polyaromatic and chlorinated chemicals had been dumped in a gravel pit lagoon. A similar site next door had soils incinerated at great cost without any water treatment. Norwest obtained approval for the first in situ bioremediation in EPA's history, and designed and managed a combined aerobic – anaerobic treatment and brought the site to "monitored natural attenuation" status at a third of the neighbor's cost (\$60 million).

The Turtle Bayou Superfund site northeast of Houston had similar chemicals that had been dumped in swampy woods over hundreds of acres. Norwest designed and managed in situ bioremediation systems, and instigated and designed electric soil heating in contaminated clay hot spots. Chemical oxidation and biopiles were also used.

At the Prewitt refinery in New Mexico, vapor extraction coupled with air injection, some water treatment and thermal oxidation was applied to primary remediation of gasoline pools in tight Mesozoic sandstones, followed by biological stimulation leading to natural attenuation.

In an active chemical plant near Pittsburgh, Norwest found a several foot thick benzene pool floating on the water table in gravels adjacent to the Ohio River. They designed, built and operated a sparging system which eliminated the benzene layer without water treatment. Sparging consists of pumping air beneath the water table, breaking up the organic layer. Cycling air injection promoted lifting of volatiles into an oxygenated zone where they were consumed by aerobic respiration (biosparging), without fugitive vapors reaching surface or pumping and treating any groundwater.

In several chemical plants in or near Houston, subsurface contamination was characterized and remediated in a number of ways. At one site, natural microbial attenuation of a tertiary butyl alcohol (TBA) plume by sulfate reducing bacteria was demonstrated by carbon-13 isotope fractionation. This was the first documentation of anaerobic biodegradation.



Norwest's Oil & Gas Group on the Move

Norwest Corporation recently completed a reorganization of its Oil and Gas Services group. Under this reorganization, the Oil and Gas Services group, previously located in Golden, has been consolidated with the Denver office of Norwest. This consolidation provides a more cost effective and efficient organization. While there has been some down-sizing, the new arrangement provides a more sustainable, manageable and integrated unit. The Oil and Gas Services group will be under the leadership of Carlos Pereira who brings 14 years of industry and consulting experience to the group. Carlos will report to Michael Day, president of the Norwest Denver office, who has over 30 years of industry and consulting experience in the energy sector.

The restructuring has not changed Norwest's commitment to serving our Oil and Gas Industry clients for the long-term and to providing the high quality professional petroleum engineering and geologic services that have been synonymous with Norwest's Oil and Gas Services group. Our work in all aspects of traditional reservoir engineering services, property evaluation, geomodeling and simulation, and unconventional resources such as coalbed methane/coal mine methane, tight gas reservoirs, and shale gas will continue. In addition, we bring extensive experience to our clients in the areas of enhanced oil recovery (including CO₂ flooding and sequestration), heavy oils, and oil sands. The integration with the Denver office now allows Norwest to offer additional services to the Oil and Gas Industry at a single location including produced water management, permitting, environmental monitoring and compliance.

While the past year has brought numerous challenges to the oil and gas industry, the current economic climate is now creating opportunities that forward looking companies are able to capitalize on. Norwest's professionals bring the skills and experience to assist your organization in taking advantage of these opportunities.

Superfund site almost ready to be turned back to the alligators.

For the Birds

by Fran Amendola

On behalf of the client, Black & Veatch, who formed a Joint Venture with Kiewit Construction and Henkels and McCoy, (named Populus to Terminal Transmission Partners [PTTP]). Norwest provided support for construction of an approximate 140-mile transmission line project from Salt Lake City, Utah to Southern Idaho. The project included all transmission and distribution line segments, communication lines, new substation construction and demolition work of existing outdated infrastructure, as well as all site access. Prior to installing the towers, which are almost 200 feet tall, access roads had to be built, large diameter foundation holes were drilled, and foundations poured at each tower location. This required dozens of construction and drilling crews working along the entire corridor. The scheduling and logistics involved in this type of project is a bit mind-boggling.

Norwest assisted PTTP in obtaining necessary permits required to construct the project for their client Rocky Mountain Power, a regional entity of PacifiCorp. These permits covered environmental disciplines including storm water, air quality, dewatering, and spill containment.

Norwest developed and implemented a full-time environmental compliance program during the construction phase of the project, assisted PTTP, and provided oversight for environmental programs including protection of air quality, water quality, wetland and wildlife, prevention of noxious weed spread, and management of hazardous materials. Additionally, Norwest completed the plans that are required under these programs, and provided training to project personnel.



Utah Transmission Line Segment, April 2009

including the recently completed Legacy Highway, an area rich in riparian and aquatic habitat used by a variety of wildlife species including raptors and migratory birds. Just north of the Legacy Highway segment, the transmission line dissects portions of Farmington Bay and Willard Bay, areas also rich with abundant wildlife and avian species. A major "challenge" on the project was the abundance of raptors (hawks, falcons, eagles, and owls) since common raptor habitat primarily consists of elevated locations which include transmission line structures.

Environmental protection measures dictated by regulation can include strict avoidance of these areas during critical periods of nesting and brood nurturing until the babies establish the courage to take flight and leave the nest. If approved, some work was allowed if the activities of the birds do not seem to be disturbed, providing an entirely new perspective to the term "bird watching".

One can only imagine how this type of restriction can impact project schedule and budget. However, with diligent monitoring and constant coordination, PTTP was able to maintain an aggressive schedule while the interested raptors kept an eye on progress.

Based on our previous experience with a similar project involving highway construction, Norwest suggested that PTTP go an extra mile for the raptor species in the area. Consistent with our recommendation, PTTP decided to make a respectful and thoughtful gesture to the local community and for the birds.

In July, PTTP offered the Wildlife Rehabilitation Center of Northern Utah (WRC) a generous \$5,000 donation to be used to establish outdoor bird mews (weathering cages) used during the last state of raptor rehabilitation. WRC was excited to receive their "first corporate check" and indicated that it was a great start to program funding since WRC receives no state or federal funding, and can only exist through the generous support of community individuals and organizations like PTTP.

Almost a year after start-up, construction of the transmission lines continue. During the late fall and winter, bird activity is diminished significantly, but will resume again in the spring. Final "tie-in" of the project lines to the grid is anticipated to occur near the end of 2010. Before that tie-in occurs, all disturbed areas will be reclaimed to a condition similar to the pre-construction conditions of the alignment. Beginning early spring 2010, our fine-feathered friends will return for an encore.

Norwest continues to work closely with Black & Veatch and Kiewit Construction pursuing several other transmission line proposals in the Intermountain West. This project represents the first of what is anticipated to be many environmental projects related to the expansion and improvement of the electric energy sector in the Western United States.

This is a prime example of construction "in harmony" with Nature!



Peregrine Falcon chicks

The project alignment includes several sensitive areas along the Great Salt Lake

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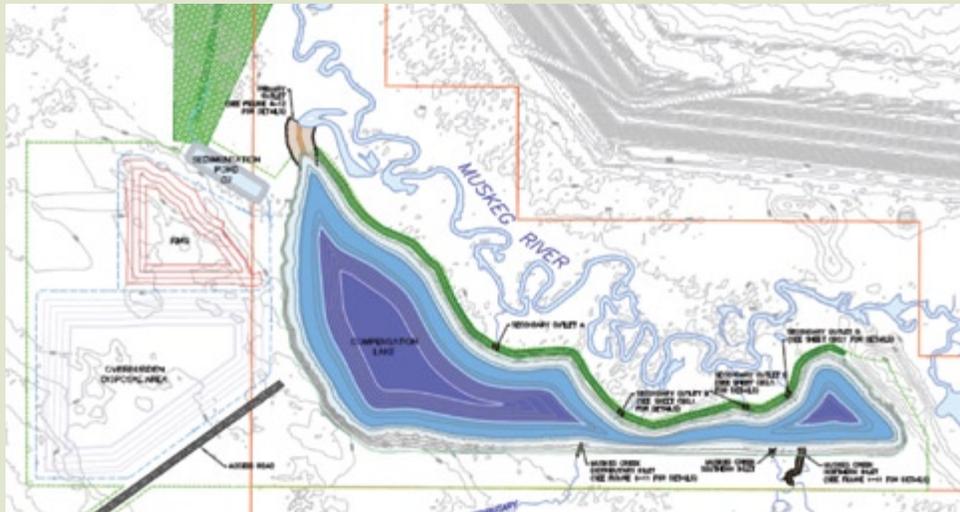
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be completed by mid-March 2010 to ensure everything is in place prior to spring flows.

Current priorities surrounding construction include the handling of all the materials that are being excavated. "There are numerous materials that are being managed during construction," explains McCartney. "The first step involves stripping suitable reclamation material and stockpiling it for use when the lake is completed. Remaining materials depending on character-

istics such as construction suitability will be segregated." A total of five distinct on-site stockpiles will be utilized.

Scheduling late during the fall and winter months was essential to meet the spring deadline. "It does get quite cold in the winter, but that facilitates the construction," explains Keith Wilson, Norwest vice-president of mining and mine development.



Final design drawing for the Compensation Lake

Communication is key

It was essential to have a team that worked closely together, with consistent, ongoing communication, in order for everyone to understand how their portion of the design affected the other design components.

"The key word is communication," says Tim Fitzgerald, Vice-President of Oil Sands. "There is recognition that this work is a joint effort between Norwest, Shell and its contractors.

A rewarding experience

Although it has been a long process, it will be three years from the initial work on site to the completion in March, and a technically challenging one at that, Bedard says the experience has been especially rewarding.

"We've learned a lot and developed significant experience with regard to habitat construction," he says. "It's an integrated project and will leave a lasting legacy for Shell and the surrounding community. It's very rewarding and exciting and we're looking forward to building it and getting to see it happen in real time."

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Tunnel Vision

by Richard Wright

The Atlas Coal Mine National Historic Site, located at East Coulee in the badlands of Alberta, contains a unique coal mining heritage; the only remaining timber coal tippie in Canada. The tippie is a remnant of the days when coal was King but could have become a dinosaur, just like the bones found down the road at the Royal Tyrell Museum in Drumheller, had the Historical Society not stepped in to save this Canadian heritage.

In 1936, a 210' long conveyor tunnel was constructed to transport coal from the mine portal to the tippie. Support timbers having rotted, the tunnel had deteriorated to the point where it was unsafe to access. Thankfully it has been

saved by the "Tunnel Vision" project. The nine month refurbishment work in 2008 by Devrial Resources Inc. included hand mucking of over 260 tons from tunnel collapse zones and replacement of over 160 timber square sets to original specification. Public access required safety certification and Norwest assisted by donating professional time and resources, with Dick Wright providing the vital certificate in 2009.

The visitor experience includes donning cap lamp and hard hat to get a small flavour of what underground mining might have felt like in the days when acetylene lamps were the only source of light. The vision and hard work of Linda Digby (Executive Director) and Robin Digby (Building Conservator), seen in the tunnel photo top right, have been instrumental in saving this national resource; as have the rest of the Historical Society members and other kind donors. The photo also proves that old miners never die; they just fade into the background; where Tony Strickland, a retired Norwest mining



Linda Digby and Robin Digby, Atlas Coal Mine National Historical Site and Tony Strickland, Norwest Corporation-Retired

engineer, can be seen in the tunnel. Tony donated significant time to the project.

The Historical Society continues to restore the remaining mine structures and has ambitious plans for creating an underground resource area, where visitors, especially children, can learn more about how pioneers to Alberta helped lay groundwork for its rich heritage. More information can be found on their website: www.atlascoalmine.ab.ca.



Atlas Coal Mine National Historic Site, East Coulee, Alberta, Canada.

Third time's the charm...?

by Helene Wieting and James Sorenson

'If you wish to really know people, travel with them.' ...and travel we did. Twelve Norwesters and family members from the Salt Lake City, Calgary, Vancouver, Grand Junction, and Denver offices, were divided into two vans and ran over 1879 miles from Logan to Park City, Utah on a hilly running course in the Wasatch Back mountains. We were together for 27 hours and 40 minutes.

One might think that after running the Wasatch Back Ragnar Relay two years straight, a runner might start to question their sanity. Why would anyone want to run a 188 mile relay race with 11 of their co-workers in roughly 27 hours; eating little and sleeping even less? The only answers that come to mind are competition, the challenge, and insanity.

This year the "Miners not Whiners" team members included six veterans who ran the last two years: Bob Evans, Kirk Weber, Greg Gillian, James Sorensen (Salt Lake City), Helene Wieting (Denver), and Sean Ennis (Vancouver). Also, five first timers: Chris Campbell, Melanie Woytiuk, Gordon Daniel (Calgary), Joe Cain (Grand Junction) and Andrew Nuttall (Salt Lake City) and a runner coming out of retirement, Doug Moore (Salt Lake City), who ran the Wasatch Back in 2007.

The team was relieved and excited to have lower than average temperatures and a little rain, especially after two years of record highs during the race.

Fun started early as Van #1 reached the starting line and was greeted by music, runners in costumes, and other decorated vans. Kirk warmed up with a vertical climb Stairmaster challenge at a vendor booth, and then got the team off to a strong start.

Bob, in engineer fashion, manned the GPS enabled laptop to maneuver the course and map out the cheer stations. Melanie and Chris (the Canadians) remarked how meals are "super-sized" in the states, but throughout the course felt like the hills were "super-sized" too.

Doug's competitive spirit showed through by not letting an old injury slow him down. He said he was only going to speed walk – right. Once a runner always a runner, especially in the heat of competition.

After a short rest, Helene got the team going early in the morning by depriving them of coffee (everyone's true colors showed then) until their next legs were done. She kept everyone on schedule and all ran strong.

Fun continued on into Van 2 with lead off runner Andrew, who will tell you that the five hour energy drink didn't even last long enough for a 40 minute run at 2:00 am. Sean felt right at home with the light rain and below average temperatures during his third leg of the race.

Joe flew across 9.6 miles. He mentioned early on that he liked running hills, so his last leg was 3.6 miles of greater than 7% grade and he conquered it like it was flat, dry ground.

James, similar to Joe, enjoyed four miles at 8% grade. There's nothing like adding rain and mud to the course to make it a little more challenging. He must be a sucker for punishment, volunteering to run the Ragnar leg.

Greg running fifth, carried the team up and over the pass and cruised down the punishing path into Park City. First timer Gord had the privilege of crossing the finish line, savoring a well run race and finishing before the monsoon-like rain began.

The greatest part was joining the other van and supporters to relax and share stories. Thanks to all of the volunteers, family, supporters, and runners for making this yet again another fun and memorable event!



**Team Miners Not Whiners: front row (l to r) James Sorensen, Andrew Nuttall, Bob Evans, Sean Ennis, Gordon Daniel
Top row (l to r) Doug Moore, Greg Gillian, Melanie Woytiuk, Chris Campbell, Kirk Weber, Helene Wieting, Joe Cain**

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