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NORWESTER

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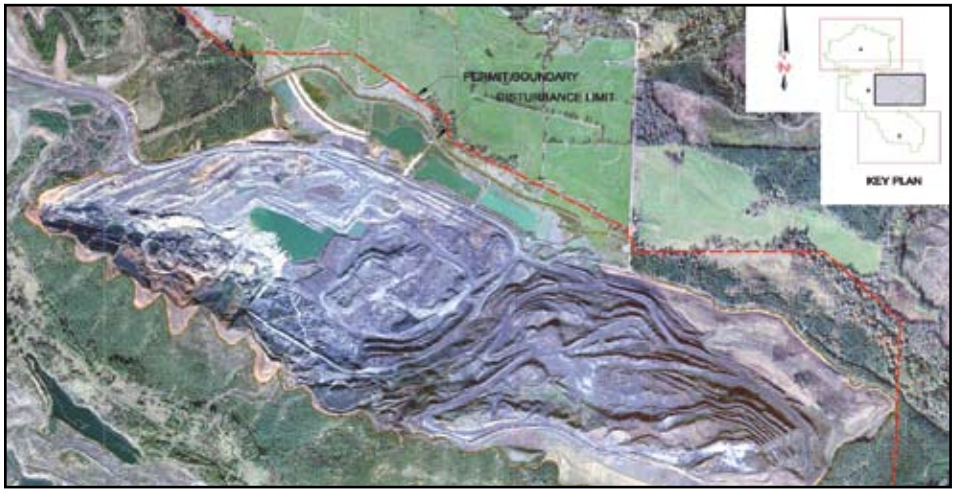
NORWEST CORPORATION

Mine Closure and Reclamation Planning

By Richard Dawson, Karvin Kwan and Calvin Boese

Mine closure and reclamation planning is an integrated exercise that starts with conceptual mine planning and continues through to the end of mining. Building on our surface mine planning capabilities and expanded discipline base, Norwest has been increasingly involved in projects that require leaving behind a productive landscape after mining is completed. These projects require a balanced approach to discipline integration, economically practical solutions and a close working relationship with the project stakeholders. In this article we review two Norwest projects where these principles have been put to the test.



Current aerial view of Central Packwood Pit at Centralia.

Watershed Restoration in the Pacific Northwest

Norwest is currently involved with a large-scale reclamation project for a former open pit coal mine located in Washington State. At its peak, the mine produced approximately 6 million tonnes of coal per year. Since the start of commercial operations in 1971, an estimated 3,800 acres of land have been disturbed due to the mining operations.

The current closure plans involve the development of sustainable landscapes for at least two out of the four main pit areas at the mine. Norwest's role is to provide integrated, practical reclamation solutions which incorporate geochemical, hydrological, geotechnical, and geomorphic considerations into the plan. Combined efforts from personnel in the Salt Lake, Denver, and Vancouver offices were required for project success.

The reclamation plan for the first of the main pits was completed by Norwest in March of this year (final approval from the Office of Surface Mining still pending). The plan included the reclamation of approximately 900 acres of disturbed land, and was intended to provide a diverse ecological habitat with a permanent lake as its main feature. Components were incorporated to ensure a self-sustaining post-mine landscape that met the needs of fish and wildlife populations, as well as recreational objectives.

One of the main components involved the creation of a three-dimensional spoils block model that utilized net neutralization potential from acid-base accounting to identify the location of potential acid-forming materials. This information was then used in the material handling plans so that "hot spots" could be backfilled or handled accordingly (i.e. placed beneath the design water level of the lake, or in lower bench levels). Another key component of the plan was designing for the geotechnical stability of the final pit and associated end-cut lake, as significant geotechnical issues relating to a weak bentonitic seam were present in the highwall, footwall, and west endwall areas.

Key design features in the final plan included the design of toe buttresses to stabilize the post-mining slopes, the creation of a wetland area within the footprint of one of the current settling ponds (to act as a "polishing feature" for the lake water), the design of geomorphic-based alluvial or vegetated waterways and channels, along with gradient terraces, and the incorporation of a variety of final land uses (including upland forests, lowland forest/riparian/wetlands, pastureland and water-related recreation associated with the end-cut lake). The Lake plan provides a diverse aquatic environment that supports fish and other aquatic species and a diverse shoreline that provides habitat for amphibians, waterfowl, shore birds and mammals. The Lake will be recharged from run-off from the reclaimed watershed, and while recreational value is important, the quality of the Lake discharge will be the key element of evaluating success.

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Injection Well in Montana

by Seth Okeson and Adam Bedard

Adding a tank to the free product recovery

Pioneer Natural Resources USA, Inc. (PNR) is a long-standing (over 10 years) client of the Denver office of Norwest. Norwest provides a variety of environmental services to PNR including discharge and stormwater permitting support, water management planning, surface and groundwater assessments, and groundwater modeling. PNR recently engaged Norwest to permit a deep injection well with the United States Environmental Protection Agency (EPA). PNR needed the well as part of a pump-back system for remediation of a portion of the shallow Quaternary aquifer located on the Fort Peck Indian Reservation near Poplar, Montana.

The East Poplar field, on the western edge of the Williston Basin, has produced oil and brine by-product since 1952. Historical brine handling practices by multiple operators resulted in an estimated 12 square mile area of contaminated shallow groundwater. The United States Geological Survey performed several investigations, producers were sued, and the EPA pursued enforcement action. Through a merger, PNR had unknowingly inherited the liability for a well improperly plugged and abandoned by a previous operator, which leaked brine into the shallow aquifer. Pioneer was proactive about the site cleanup effort once they became aware of this inherited problem. PNR reworked the well to stop the leakage, performed extensive site characterization, and voluntarily started an aquifer reclamation program. Pioneer recently installed and began operating a free product recovery system and needed the deep injection well to dispose of brine contaminated groundwater.

Norwest proposed an injection well permitting strategy and obtained the regulatory favorable status of a Class V well with reduced permitting requirements and no limit on injection rate or volume from the EPA. The well was permitted for injection below the producing formation into the Mission Canyon and Nisku Formations approximately 6,000 to 7,500 feet below ground surface. The permit approval was expedited as the EPA received no comments during the public comment period. PNR drilled the injection well in December 2007 (centre picture), is completing the shallow groundwater extraction system, and plans to start injecting in the Spring of 2008.

Drilling the PNR-1WD with the town of Poplar in the background

This was very rewarding project for us. Norwest helped a valuable client obtain the crucial, critical path permit for starting up a groundwater remediation system. Our client is voluntarily addressing a legacy environmental problem with commitment at very high levels in PNR. It is not often you see the EH&S manager, Regional Operations Manager, and V.P. General Counsel shoveling dirt (top left picture). The remediation system will mitigate further environmental impacts, reclaim a groundwater resource and remove a major financial, legal, and reputational liability for PNR. This project added to our level of expertise in the area of well injection practice..

Seth Okeson, Water Resources Engineer, Denver, CO
Tel: 303 782 0164 or sokeson@norwestcorp.com
Adam Bedard, Senior Civil Engineer, Denver, CO
Tel: 303 782 0164 or abedard@norwestcorp.com

Winning Team!

I would like to inform you that for the second year running, the University of Alberta Mining Games Team took first place! Even with a minimal amount of sleep, we were able to pull together as a team, work hard, and as a result took home the trophy. Along with this, we were also able to do some great networking with both industry and other students, apply our mining knowledge in a competitive setting and have a lot of fun along the way.

As the team captain, I would like to thank Norwest for your generous support of our team. Without sponsorship by the mining industry, neither the games nor our team could exist. I have attached a team picture with our banner and trophy. Display it proudly as your company played a large role in getting us there.

Travis Wierenga
2008 University of Alberta Mining Games
Team Captain

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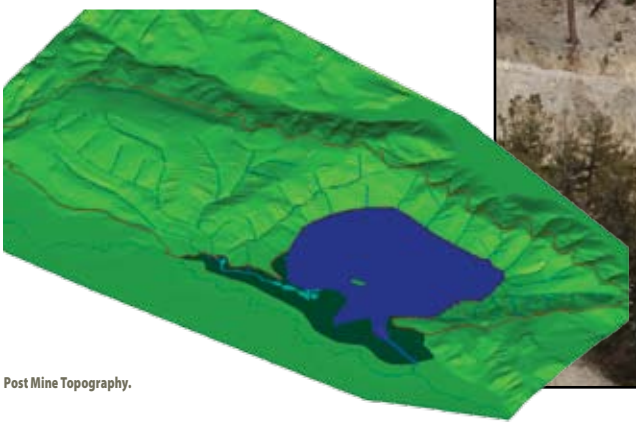
The final result is the generation of a more natural and aesthetically pleasing post-mine topography that satisfies approved post-mining land uses, water quality requirements and geotechnical stability. Implementation of the Plan will result in successful reclamation and will allow the client to meet its reclamation obligations.



Post Mine Topography.

Goat Hill North Regrading.

Landform Grading in Northern New Mexico

Landform grading or geomorphic design is a recent approach to mining reclamation that involves re-shaping mine overburden piles to replicate the surrounding natural landforms. The approach focuses on both the slope forms as well as the overall structure of the topography, while integrating natural hydrologic and vegetative patterns. At the Questa Mine in Northern New Mexico, Norwest is working with an expert in this area, Horst Schor (from H. J. Schor Consulting), to provide oversight and design guidance. The work is being carried out with Norwest engineers from the Vancouver and Denver offices working alongside other consultants with expertise in cover design and revegetation. There is an oversight stake-holder group that provides guidance and review.

Norwest's involvement with the Questa Mine started with the Goathill North Rock Pile slide mitigation project in 2003. The rock pile was constructed in an area characterized by alteration scars and the foundation was underlain by pre-sheared material. Prior to stabilization, slope movements that included the rock pile had been ongoing for some 30 years. The initial re-grading was focused on pile stabilization which was successfully carried out under the watchful eyes of the stake-holder group. Additional re-contouring beyond that required for pile stabilization was undertaken so that the overall slopes of the final landform were compatible with the surrounding topography.

Since the initial grading has been completed, slope monitoring has demonstrated that the Goathill North slide is stabilized and closure planning design has been initiated with a view towards initiating construction in 2009. Features of the design as it is currently envisaged include:

- The final pile shape mimics the natural slopes (slope length versus slope angle) with non-uniform slope gradients; generally steeper at the top and more shallow near the bottom to achieve a concave profile. This form provides a good match with the surrounding terrain and meets long term stability objectives.
- Swales, terraces and channels have been designed as surface water control features but also allow for visual breaks, and in the case of the swales, provide additional shallow areas where vegetation may be established. Design methods incorporate conventional hydrologic techniques combined with geomorphic concepts. The swales are deliberately designed not to run parallel to the slope face but rather to follow diagonal and curvilinear alignments to give the slope surface a less manufactured look while at the same time provide for a more uneven, natural distribution of shrubs and trees across the slope face. The swales are spaced on the slopes to form micro-watersheds and the swale channels are designed to be self cleaning.

Richard Dawson, VP Geotechnical, Vancouver, BC
Tel: 604-631-4101 or rdawson@norwestcorp.com
Karvin Kwan,, Geotechnical Engineer, Vancouver, BC
Tel: 604-631-4107 or kkwan@norwestcorp.com
Calvin Boese, Geotechnical Engineer, Vancouver, BC
Tel: 604-631-4106 or cboese@norwestcorp.com

Artist rendition of Goat Hill North completed landform.

Presidents' Message Over the last 28 years....

International mining consulting affords the opportunity for unique experiences, challenging and rewarding, both professionally and personally. This is my last column for the Norwester and I would like to offer some thoughts on what I have learned over the last 28 years with Norwest.

- Don't go to India and only eat cheese sandwiches
- If you are offered a ride on a camel take it
- Always stay behind a camel's head so as not to get slimed
- Don't complain or make fun of another culture's food (blue cheese and rare red meat are also acquired tastes)
- Don't complain about local beggars-give to a local charity
- Learn and be able to talk about local sports; cricket in India, wrestling in Mongolia and football (American soccer) in almost any country in the world
- Try new foods and if you don't like it don't make a scene (filets of Mongolian marmots are challenging but Mongolian Vodka makes up for them)
- Remember how you feel when a stranger tells you all of the negative aspects of your home town
- Always find good things and compliment your host on them
- Do not be offended when a potential client wants to bargain-it is often part of a negotiating process in many cultures
- Don't assume that everyone around the world wants to move to North America
- Be cautious about joking with US customs agents on the Mexican border
- Learn something from visiting a war ravaged country- I was shown the secret escape tunnels in Sarajevo
- Make sure the guys with the machine guns are on your side when the helicopter lands
- Don't assume that all cultures queue politely or you will miss your plane in India
- Stay away from the person with the bulletproof vest next to you when checking into American Airlines in Barranquilla
- Don't lick your fingers when counting rupees
- We don't think twice about leaving a dollar tip for a Starbucks coffee but worry about giving a porter fifty cents to carry our bags on his head at the train station
- Beware of Chinese translations; "young chicken soup" means partially hatched chick in yellow broth
- Don't underestimate the intelligence of your international client
- Don't exchange currency in dark alleys, no matter how good the exchange rate
- Many times you learn and impress the client more from listening than talking.

I have been fortunate to visit mines and mining people in remote corners or faraway places. My advice is to enjoy the adventures and relish the experiences.

Donovan Symonds, Chairman, Norwest Corporation
John Wright, President, Norwest-Questa Engineering, USA
Mike Day, President, Norwest-Applied Hydrology, USA
Joe Aiello, President, Norwest Corporation, Canada
Bob Evans, President, Norwest Corporation, USA

Environmental Choices for Spring Cleaning

With Spring fresh upon us once again, thoughts invariably turn to cleaning out that cluttered garage or basement where your family has hastily squirreled away a years worth of junk. Typical items include old sports equipment, kids shoes or jackets that don't fit anymore, clothes you no longer wear, or maybe even a piece of furniture or an unused appliance that's been collecting dust.

Instead of carelessly dumping it in the nearest landfill, consider these alternatives. Donate your used clothing to a local organization or charity group, some of which have convenient drop-off bins located in your community. Certain groups may even pick up items at your home. Second-hand stores will often take miscellaneous belongings such as books, CDs and souvenirs. While you're in clean-up mode, go through your pantry and give a few cans of food to the local Food Bank. Recycle what you can, including paper, plastics and even old electronics.

There is such a gratifying sensation to purging this "stuff" we've stashed away throughout the year. This time, choose to contribute to your community instead of the landfill. A little bit of extra effort on your part can also make a world of difference to those on the receiving end of your donations. Of course, the best way to avoid this dreaded seasonal activity is to get organized and deal with it year round.

Gordon Daniel, Mining Engineer, Calgary, AB
Tel: 403-205-5781 or gdaniel@norwestcorp.com

2007-08 Oil Sands Winter Drilling Round-up

by Ian Perry

UTS's Frontier Camp. Photo by Eric Becker

Wolves feeding on a moose carcass near a drilling access road. Photo by Jared McLeod

Bulk Auger Sampling. Photo by Eric Becker

The close of the first quarter corresponds with the end of the 2008 winter drilling season in Northern Alberta, a period which saw the completion of the field portion of four major projects for Norwest clients in the Athabasca oil sands region.

Two of these, namely the UTS Energy Corporation – Teck Cominco Limited joint venture on the Equinox and Frontier oil sands mining projects, and the Value Creation Inc. Terre de Grace in-situ project are managed on a near turn-key basis by the Norwest Field Services group. This group is responsible for the permitting, surveying, contractor acquisition and safe execution of the winter exploration and delineation drilling programs which, on a combined basis in 2008, included the construction of over 470 drilling leases, the building and freezing of 1,100 km of winter access road, and the successful completion of approximately 430 cored exploration wells, as well as an additional 40 geotechnical assessment wells.

Both projects utilized other Norwest areas of expertise, with a major hydrogeological assessment program being undertaken on the Terre de Grace project, and a 1,500 tonne oil sands bulk sampling program on the Equinox and Frontier projects.

In total, from the late November start-up of construction, to the late March completion, in excess of 520,000 person hours were worked by up to 700 people, from as many as 6 remote camps. Safety on these projects is, of course, paramount; not only for our clients, but also for Norwest and all of the contractors on site. The programs were completed with a final Lost Time Injury (LTI) rate of 1.2 (per 200,000 hours worked). The injuries themselves were relatively minor in nature, such that everyone was back on the job within 48 hours. This frequency rate is at the very low end of the scale for this type of front-line industrial work.

Norwest also provided geological and drilling supervision on two other projects, the Imperial Oil Kearl Lake project on which Norwest subcontracted through AMEC , and the Oilsands Quest in-situ project which straddles the Alberta-Saskatchewan border.

These projects utilized an additional 11 coring rigs and up to 35 Norwest (and Norwest sub-contracted) personnel to provide 24 hour supervision of the drilling, coring, logging and abandonment processes.

All told, the 2008 winter programs saw the completion of 757 cored wells, which is a 40% increase over the previous year. This rate of growth could not have been accommodated without the tremendous efforts of our operational partners in these programs, including Mission Geospatial, Boreal Land Services, WADE Construction (supervision) and World Wide Consulting (drilling supervisors and Field Operations Management).

Ian Perry, Manager, Field Services, Calgary, AB
Tel: 403-232-4148 or iperry@norwestcorp.com

Donovan Symonds Retires after 28 Years with Norwest

Donovan Symonds, Chairman of Norwest Corporation, announced his retirement from Norwest effective February 29, 2008. Donovan is an original founder of the company and served in a variety of capacities during his 28 year tenure, including Chairman and President. He has been instrumental in growing Norwest from an initial partnership of five professionals in 1979 to a full-service international energy, mining, and environmental consulting practice with nearly 250 full-time employees.

During his professional career Donovan has been active in several professional societies. He is currently President of the Coal Preparation Society of America and a past member of the Board of Directors of the National Mining Association. He was awarded the 2006 Erskine Ramsey medal by the American Institute of Mining, Metallurgical and Petroleum Engineers to recognize distinguished achievements in the coal mining industry.

To many of us at Norwest, Donovan is Norwest and Norwest is Donovan. By this we mean that Donovan was instrumental in creating the Norwest as we know it – a friendly and enjoyable place to work. He cultivated teamwork within an open and creative working environment where he was "first among equals", meaning we all worked with Donovan as members of the Norwest team. Thank you for giving us the opportunity of getting to know you over these past 28 years, both professionally and personally. We'll miss you... keep in touch!

Donovan and his wife Kathy will continue to reside at their home in Park City, Utah where he intends to finally improve his skiing and fly fishing, and spend more time at soccer matches cheering on his grandchildren.

Stefanko Best Paper Award

Norwesters Steve Hennings and Scott Thomson, along with client Jim Sandford (Xstrata Coal NSW), have been selected to receive the prestigious Stefanko Best Paper Award for 2007 for their paper entitled "A PETROLEUM INDUSTRY APPROACH TO COAL MINE GAS DRAINAGE." The award-winning paper describes an innovative approach to draining methane from coal mines ahead of the longwall; thereby increasing safety, mining efficiency, and the ability to capture greenhouse gases. The Norwest authors received their award during the Coal & Energy Division Luncheon on Tuesday, February 26, 2008 at the SME Annual Meeting and Exhibit in Salt Lake City, Utah.

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NORWEST CORPORATION

EDITOR

Theresa Murphy

Tel: 403 237 7763

Email: tmurphy@norwestcorp.com

visit us on the internet @ www.norwestcorp.com

contact us:

NORWEST CORPORATION

www.norwestcorp.com

CANADA

Calgary, Alberta
Tel: 403 237 7763 Fax: 403 263 4086
Email: calgary@norwestcorp.com

Vancouver, British Columbia
Tel: 604 602 8992 Fax: 604 602 8951
Email: vancouver@norwestcorp.com

USA

Charleston, W. Virginia
Tel: 304 414 4500 Fax: 304 414 4505
Email: charleston@norwestcorp.com

Denver, Colorado
Norwest-Applied Hydrology
Tel: 303 782 0164
Email: appliedhydrology@norwestcorp.com

Gillette, Wyoming
Tel: 307 685 3044 Fax: 307 686 0880
Email: gillette@norwestcorp.com

Golden, Colorado
Norwest-Questa Engineering
Tel: 303 277 1629 Fax: 303 277 0119
Email: questa@norwestcorp.com

Grand Junction, Colorado
Tel: 970 245 6552
Email: grandjunction@norwestcorp.com

Houston, Texas
Tel: 281 333 2241 Fax: 281 333 1192
Email: houston@norwestcorp.com

Pittsburgh, Pennsylvania
Tel: 724 255 9905 Fax: 724 225 9903
Email: pittsburgh@norwestcorp.com

Salt Lake City, Utah
Tel: 801 539 0044 Fax: 801 539 0055
Email: slc@norwestcorp.com

Trinidad, Colorado
Email: trinidad@norwestcorp.com

Yerington, Nevada
Tel: 775 463 9388 Fax: 775 463 9488
Email: yerington@norwestcorp.com

INTERNATIONAL

Beijing, China
Tel: +86 10 6466 4848Fax: +86 10 6466 7489
Email: guojiuhong@norwestcorp.com.cn

Newcastle, NSW
Tel: + 61 02 4975 5228 Fax: + 61 02 4975 5220
Email: australia@norwestcorp.com

Kolkata, India
Tel: 91 33 2474 7618 Fax: 91 33 2474 6440
Mobile: 91 98300 42074
Email: mahesh_k@dataone.in