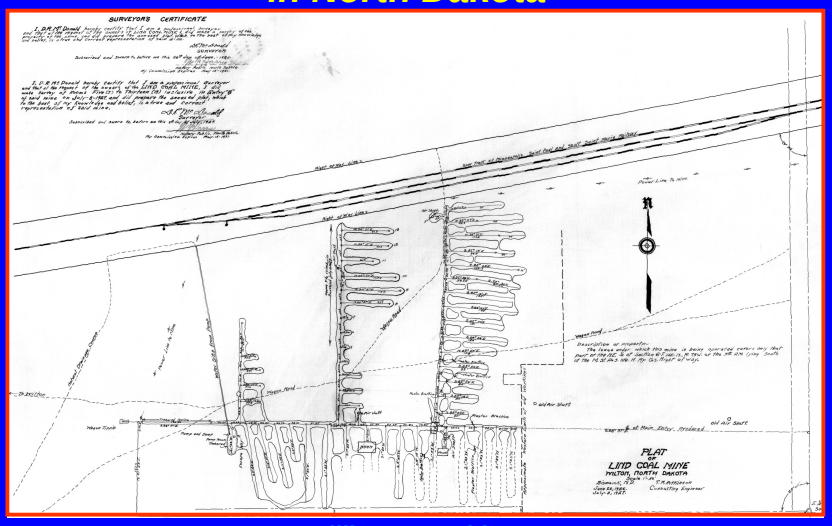
Abandoned Mine Land Problems and Solutions in North Dakota



William E. Dodd
North Dakota Public Service Commission
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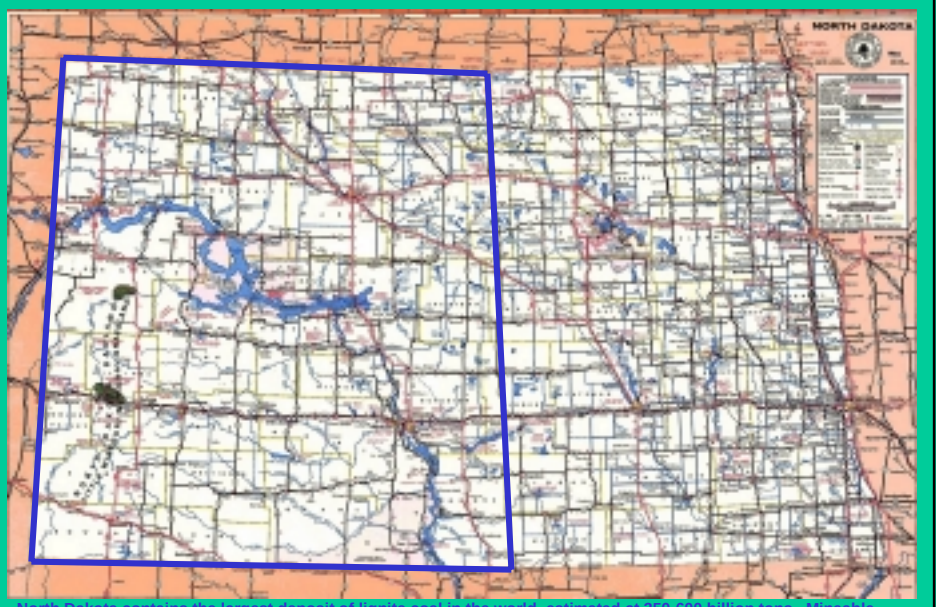
About the North Dakota Public Service Commission and the Abandoned Mine Lands Division

- ✓ The Board of Railroad Commissioners was established by Dakota Territory in 1885. Its name was changed in 1940 to Public Service Commission (PSC)
- ✓ North Dakota has three Public Service Commissioners, each elected to six-year terms.
- ✓ The PSC has jurisdiction over electric and natural gas utilities, telecommunications companies, weights and measures, grain elevators, auctioneers, reclamation of mined lands, siting of energy plants and electric and gas transmission facilities, and railroads.
- ✓ The Commission has 41 full-time employees. The staff is divided into support services and five divisions that provide direct regulatory oversight and consumer assistance.
- ✓ The Abandoned Mine Lands (AML) Division administers a federal program to remove hazards associated with abandoned coal mines. The AML Division has 4.6 FTE's.
- ✓ North Dakota's AML Program was authorized in 1981 under the federal Surface Mining Control and Reclamation Act (SMCRA) of 1977.
- ✓ Program funding comes from a ten cent federal production tax on each ton of lignite coal mined in North Dakota. The state may apply for grants for half the production tax, or about $1.5 million per year.
- ✓ Since AML Program inception in 1981, $26 million have been spent to reclaim 100,000 linear feet of dangerous surface mine highwalls, 1900 acres of mine subsidence, and a variety of other hazardous abandoned mine features in North Dakota. An estimated $44 million more are needed to reclaim all remaining high priority AML Sites in North Dakota.

Coal Mining in North Dakota: Coal Production

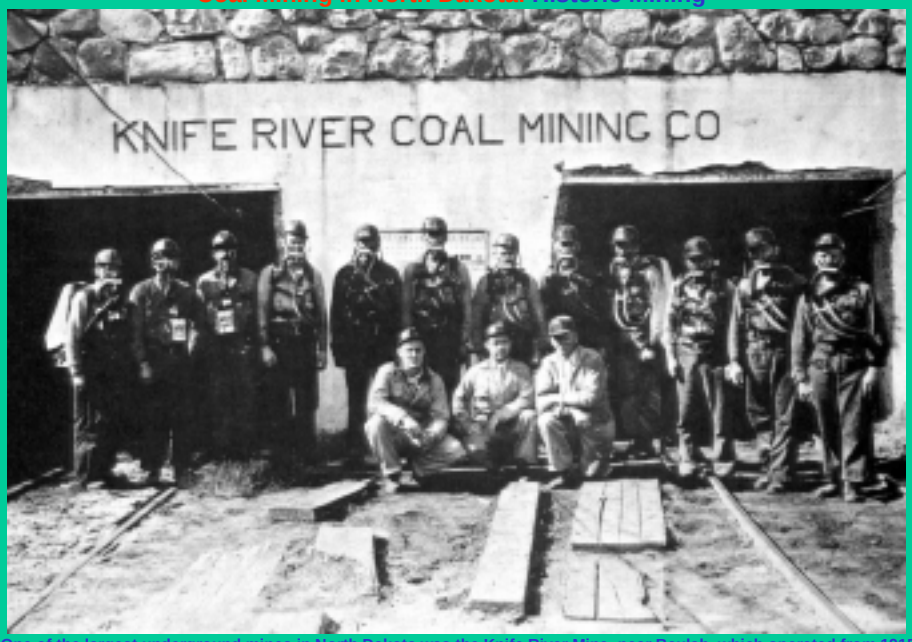


North Dakota contains the largest deposit of lignite coal in the world, estimated at 350-600 billion tons. Mineable reserves cover about 32,000 square miles in the western half of the state. Approximately 30 million tons of lignite are mined annually in North Dakota.

Coal Mining in North Dakota: Historic Mining

The first commercial mine in North Dakota opened in 1873, about 30 miles west of Bismarck. Since then, over 600 lignite mines have operated in North Dakota. This is a picture of the Satterlund Black Diamond Mine, near Washburn, circa 1895.

Coal Mining in North Dakota: Historic Mining



One of the largest underground mines in North Dakota was the Knife River Mine, near Beulah, which operated from 1915-1953 and mined over 10 million tons. This is a picture of the mine rescue crew in front of the main entries, circa 1945.

North Dakota AML Problems: Dangerous Highwalls

This hazardous abandoned surface mine with steeply sloping highwalls was located near Center, ND. It was reclaimed in a 1989 AML Project.

North Dakota AML Problems: Dangerous Highwalls/Hazardous Water Bodies

This is the edge of a surface mine highwall near Noonan, ND, that extended approximately 3 1/2 miles in length. The highwall dropped about 60 feet to a hazardous water body that was up to 30 feet deep. It took several years and millions of dollars to reclaim this site.

North Dakota AML Problems: Dangerous Piles & Embankments/Polluted Water

Uraniferous, or uranium bearing, coal was mined from this site near Amidon, ND, in the early 1960s under contract to the Atomic Energy Commission. Coal was burned in the pit and the ash was shipped to processing plants. When the mine was abandoned, uranium-rich ash polluted the water and the soil. This site was reclaimed in 1992.

North Dakota AML Problems: Coal Fires

Coal refuse fires, like this one burning in Beulah, ND, January 2002, are difficult to extinguish. Coal screenings had been deposited at this site, near the former location of a power plant, for many years and were several feet deep. Emergency reclamation included excavating the burning materials, dousing with water and burying them in a pit.

North Dakota AML Problems: Subsidence

This picture, taken near Scranton, ND, in the early 1980s, provides an example of the hazards associated with abandoned underground mines. A portion of this site was "daylighted" or completely excavated and reclaimed in the mid- 1980s.

North Dakota AML Problems: Subsidence

Underground mine subsidence can be especially dangerous when near residential/commercial areas or public roads. This sinkhole collapsed suddenly beneath the Black Diamond Lounge in Beulah in 1993. It damaged the foundation, severed water lines and ruined air conditioning units. Luckily no one was injured and the sinkhole was repaired.

North Dakota AML Problems: Subsidence

This sinkhole collapsed suddenly in a machine shed near Beulah "swallowing" a tractor. It was repaired in an emergency project conducted in 2001.

North Dakota AML Reclamation: Sinkhole Filling

The easiest and cheapest way to remedy underground subsidence is to excavate and fill the sinkholes with dirt. However, these sinkholes can be extremely hazardous to the public. This 10 foot deep sinkhole appeared suddenly on the driving surface of Lehigh Road near Dickinson, ND, in the mid 1980s.

North Dakota AML Reclamation: Slurry Fill Remote Backfilling

Subsidence control projects have been conducted in North Dakota since 1982. In this 1983 project near Beulah, a slurry of sand and water was "poured" into the mine workings through large diameter drill holes. This method was adequate when the mine was intact and open but was less effective when the mine had already begun to collapse.

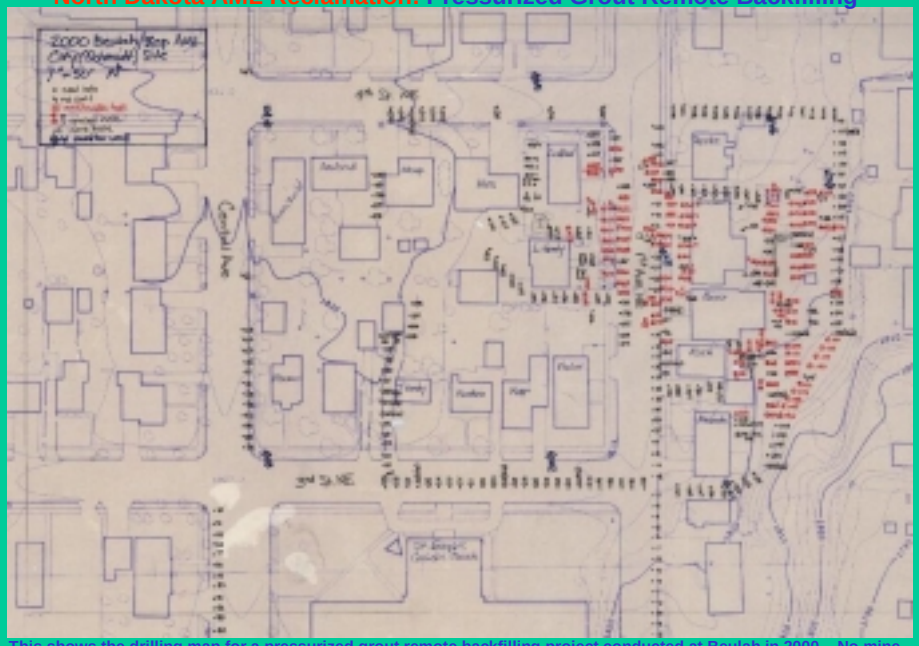
North Dakota AML Reclamation: Pressurized Grout Remote Backfilling

Since 1991, pressurized grout remote backfilling has been used for subsidence control in "high use" areas. Pumping pressure enables the cementitious grout to penetrate partially collapsed mine workings. In this 1994-95 project, grout was pumped under a 3000 foot long segment of a four-lane highway near Burlington, North Dakota.

North Dakota AML Reclamation: Pressurized Grout Remote Backfilling

Grout injection along US Highway 200 near Beulah in 2001. Grout was composed of cement, flyash, aggregate, superplasticizer and water. The material tester in the background is testing the slump of the grout. Grout used at this location was about 10-inch slump. The grout must achieve unconfined compressive strength of 150 PSI at 28 days.

North Dakota AML Reclamation: Pressurized Grout Remote Backfilling



This shows the drilling map for a pressurized grout remote backfilling project conducted at Beulah in 2000. No mine maps were available for this site. About 115 of 430 holes drilled at this site (marked in red) intercepted mined workings. Seven homes and one city street were threatened by this collapsing underground mine.

North Dakota AML Reclamation: Pressurized Grout Remote Backfilling

Angled drilling was used during the 2000 Beulah project in order to intercept mine workings directly underneath homes and other structures.

North Dakota AML Reclamation: Pressurized Grout Remote Backfilling

This angled drilling was conducted during a 1997 project to stabilize a bar, restaurant, and gas station near Beulah.

North Dakota AML Reclamation: Pressurized Grout Remote Backfilling

This slide shows drilling directly through the floor of a restaurant in order to fill the mine voids beneath it.

North Dakota AML Reclamation: Pressurized Grout Remote Backfilling

This shows the casing of a drilled hole with 3 inch ID Schedule 40 PVC Pipe. The casing was used as a conduit to pump grout into the underground mine beneath a gas station in Beulah.

North Dakota AML Reclamation: Pressurized Grout Remote Backfilling

Confirmation drilling and coring are conducted to make sure the underground mine workings have been stabilized and that the grout has set properly. Note the groundwater monitoring well to the right of the core barrel.

North Dakota AML Reclamation: Surface Lifting

Pressurized grout remote backfilling caused this lifting feature and blowout on 1st Street in Beulah. The "bulge" was about 20 feet long, 15 feet wide, and 1 foot high. It was leveled by the contractor and the City of Beulah repaved the street. Injection pressure was only about 10 PSI when this occurred.

North Dakota AML Reclamation: Structural Monitoring

Because pressurized grout remote backfilling poses some risk of surface lifting and resultant damage to structures, specialized surveys and monitoring techniques are used. Pre- and post-construction elevation surveys, visual inspections, continuous laser level monitoring, and crack monitors are some of these techniques.

North Dakota AML Reclamation: Groundwater Monitoring

Pressurized grout remote backfilling can affect groundwater levels and quality in the mine or adjacent unmined coal seam. The AML Division works closely with the North Dakota Department of Health to ensure that groundwater resources are not adversely affected.

North Dakota AML Reclamation: Partnering

Public participation can be a key to project success. In this 1999 Beulah Project, the contractor was required to hold two informational workshops with property owners, city government and any other affected parties to discuss timetables, goals, objectives and concerns, and to establish a framework for dispute resolution.

North Dakota AML Reclamation: Geophysical Void Detection

Geophysical methods for locating underground mined workings have been attempted in North Dakota with limited success. This shows Dr. Richard Faflak conducting a ground penetrating radar survey along Snake Road near Burlington, ND, in 1994. Wet clays in the glacial till overburden attenuated the signal and caused poor results.