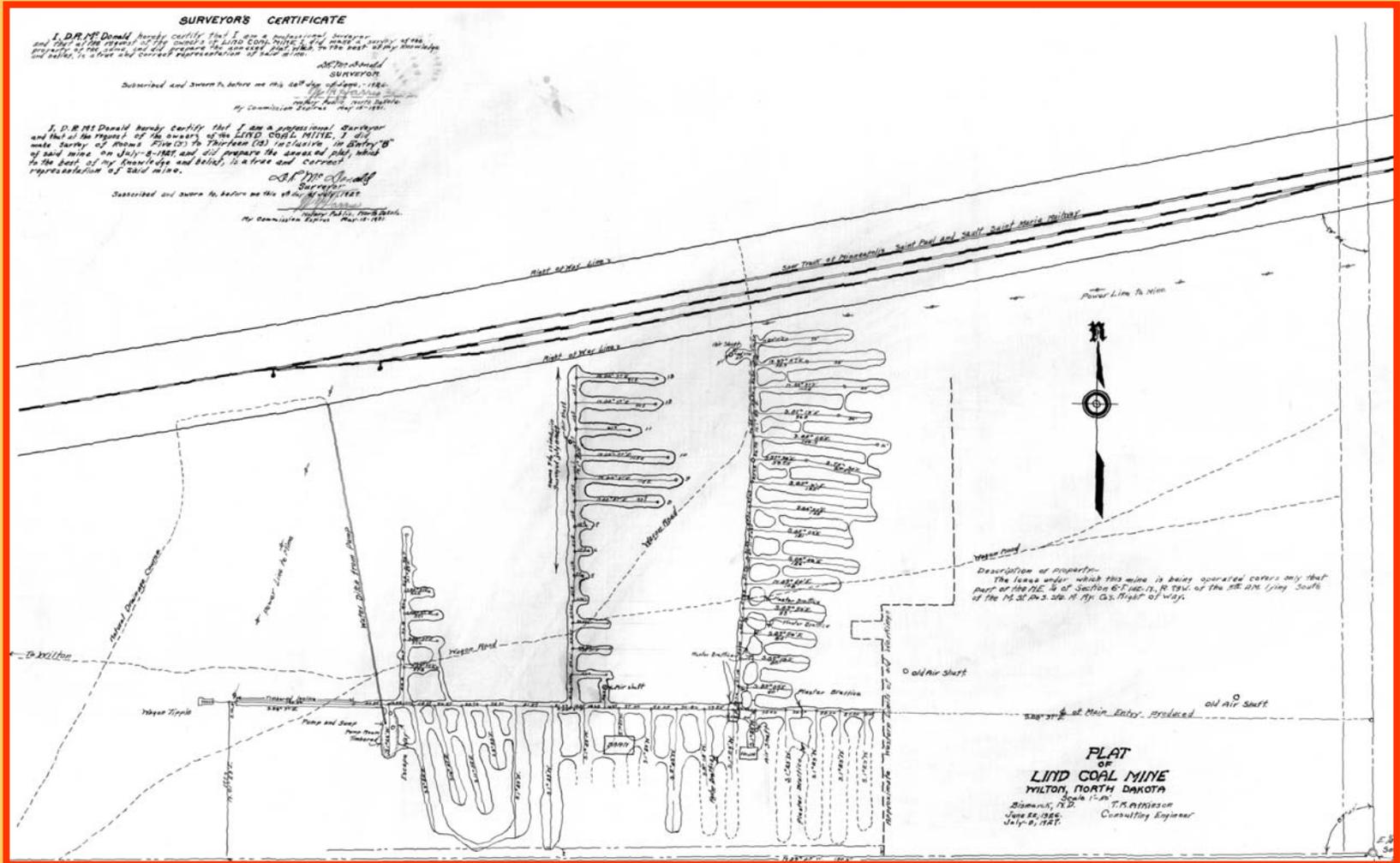


Opportunities for GIS in the North Dakota AML Division

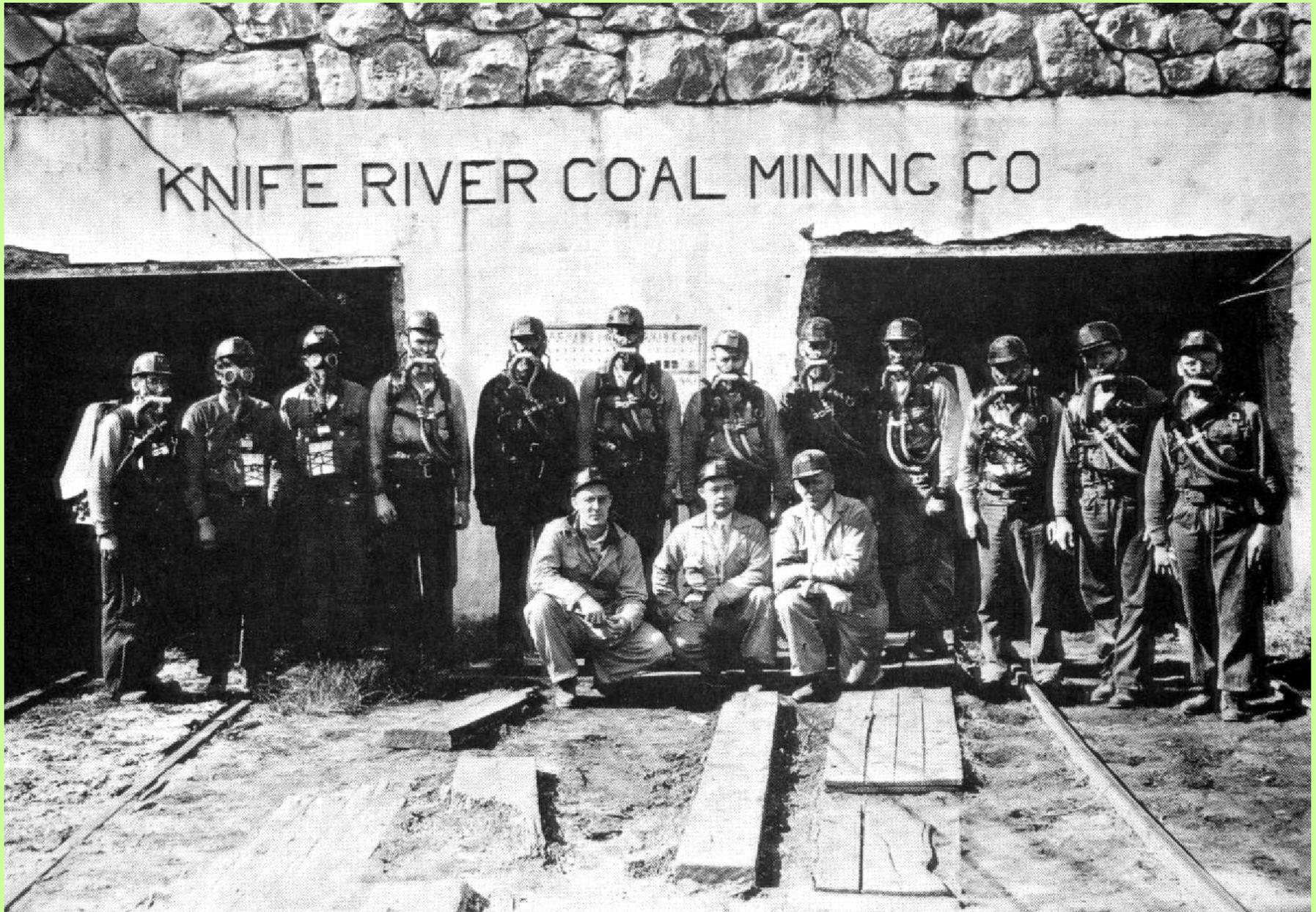


William E. Dodd
North Dakota Public Service Commission
May 2006

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 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 reclamation fee on each ton of lignite coal mined in North Dakota. The state may apply for grants for half the fee, or about \$1.5 million per year.
- ✓ Since AML Program inception in 1981, over \$28 million have been spent to reclaim 13.6 miles of dangerous surface mine highwalls, 1500 acres of mine subsidence, and a variety of other hazardous abandoned mine features in North Dakota. An estimated \$40 million more are needed to reclaim all remaining high priority AML Sites in North Dakota.

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: 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 reclaimed in the mid-1980s. New sinkholes have surfaced several times since, and a road in this area is dangerously undermined. Note the school just across the road from the sinkholes.

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 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 Reclamation: Rotary Drilling



Rotary Drilling is conducted to locate and access the underground mined workings. This shows angled drilling conducted at Beulah in 1999 to intercept mine voids beneath a house.

North Dakota AML Reclamation: Pressurized Grout Remote Backfilling



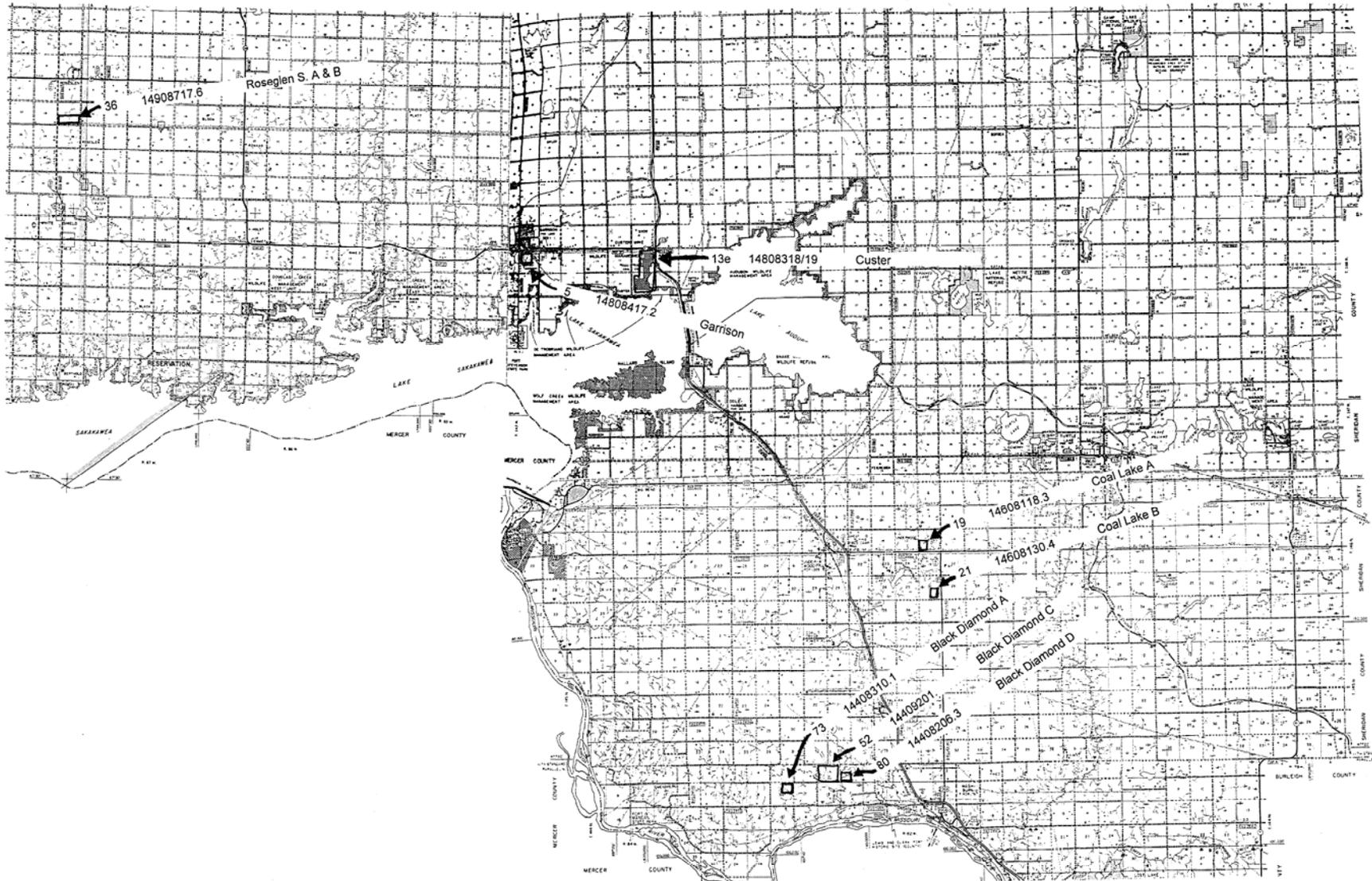
Since 1991, pressurized grout remote backfilling has been used for subsidence control in “high use” areas. Pumping pressure enables the cementitious grout to penetrate partially collapsed mine workings. In this 1994-95 project, grout was pumped under a 3000 foot long segment of a four-lane highway near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

North Dakota AML Reclamation: Surface Mine Backfilling



This shows reclamation at the 2004 Belfield AML Project Site. Approximately 60,000 cubic yards of dirt were moved to reclaim this 15-acre abandoned uraniumiferous coal mine located north of Belfield. Spoil materials at this site were contaminated with uranium, and other heavy metals. These contaminated spoils were identified, stockpiled, encapsulated with a polyethylene liner and covered with non-toxic clay materials.

AML SITES IN McLEAN COUNTY



This is an example of an old database of project locations in Mclean County.

North Dakota AML Reclamation: Project Databases

North Dakota Public Service Commission Abandoned Mine Lands Division Reclamation Project Summary

No.	Project	Location	Cont.#	Contractor	Year	Acres	Cost	Method of Reclamation
94.	Haynes Phase IV	Haynes	AM-443-02	Wilson Construction	2002	85	\$273,552.92	Highwall backfilling, sinkhole filling
95.	Garrison	Garrison	AM-437-02	Thiem Drilling, Inc.	2002	N/A	\$138,250.00	Pressure grouting beneath Hwy. 37, Hwy 15, County ROW, 1,055 yd.
96.	Beulah/Zap VI	Beulah	AM-439-02	Earth Energy and Water Systems	2002	N/A	\$251,860.70	Pressure grouting Hwy. 200, 3,800 yd.
97.	Lehigh Road VII	Dickinson	AM-438-02	Thiem Drilling, Inc.	2002	N/A	\$278,778.35	Pressure grouting beneath Baranko residence, Lehigh Road, 4,632 yd.
98.	Columbus V	Columbus	AM-458-03	Quality Construction, Inc.	2003	42	\$174,469.02	Highwall reduction reclamation, 125,000 cubic yards
99.	Beulah/Zap VII	Beulah	AM-454-03	Thiem Drilling, Inc.	2003	N/A	\$262,111.30	Pressurized grout remote backfilling, Hwy.200, 4650 cubic yards
100.	Beulah/Zap VII	Beulah	AM-455-03	Geoserv, Inc.	2003	N/A	\$14,167.50	Material testing and engineering services
101.	Lehigh Road VIII	Dickinson	AM-459-03	Thiem Drilling, Inc.	2003	N/A	\$211,617.10	Pressurized grout remote backfilling, Lehigh Road, Royal Oak Prop, 3,000 cu.
102.	Lehigh Road VIII	Dickinson	AM-460-03	Geoserv, Inc.	2003	N/A	\$9,026.00	Material testing and engineering services
103.	Buechler/Garrison AML	Sawyer/Garrison	AM-456-03	Thiem Drilling, Inc.	2003	N/A	\$218,913.56	Exploratory drilling at Garrison, pressure grout injection along Hwy. 23, Sawyer
104.	Buechler/Garrison AML	Hwy. 23, Sawyer	AM-457-03	Material Testing Services, LLC	2003	N/A	\$9,325	Material testing and engineering services at Buechler AML site
105.	Snake Road AML	Burlington	AM-487-04	Thiem Drilling, Inc.	2004	N/A	\$231,738.40	Pressurized grout remote backfilling, Snake Road (County Road 10A) 2172 cu
106.	Snake Road AML	Burlington	AM-485-04	Geoserv, Inc.	2004	N/A	\$9,108.00	Material testing and engineering services at Snake Road AML site
107.	Beulah/Zap VIII	Zap	AM-488-04	Thiem Drilling, Inc.	2004	N/A	\$238,519.60	Pressurized grout remote backfilling, Mercer Co. Hwy 13 south of Zap, 3508 cu
108.	Beulah/Zap VIII	Zap	AM-483-04	Geoserv, Inc.	2004	N/A	\$12,059.00	Material testing and engineering services at Zap AML site
109.	Garrison III	Garrison	AM-486-04	Thiem Drilling, Inc.	2004	N/A	\$208,068.45	Pressurized grout remote backfilling, South Garrison,1720 cu.yd., Drilling at St
110.	Garrison III	Garrison	AM-484-04	Material Testing Services, LLC	2004	N/A	\$9,001.25	Material testing and engineering services at Garrison AML sites
111.	Columbus VI	Columbus	AM-490-04	Orrin A. Holen Const.	2004	40	\$162556	Highwall backfilling of surface mine
112.	Belfield	Belfield	AM-489-04	Hlebechuk Const.	2004	20	\$100,822.80	Bury uraniferous material and backfill highwalls
113.	Beulah/Zap IX	Zap	AM-502-05	Thiem Drilling, Inc.	2005	N/A	\$267,618.75	Pressurized grout remote backfilling along County Road 13, Zap-3,824 cu.yd.
114.	Beulah/Zap IX	Zap	AM-503-05	Geoserv, Inc.	2005	N/A	\$14,553.36	Material testing and engineering services at Zap AML site
115.	Garrison IV	Garrison	AM-504-05	Thiem Drilling, Inc.	2005	N/A	\$289,693.50	Pressurized grout remote backfilling, Schempp's Addition and South Garrison-2024 cu.y
116.	Garrison IV	Garrison	AM-505-05	Material Testing Services, LLC	2005	N/A	\$14,530	Material testing and engineering services at Garrison AML sites
117.	Leith	Leith	AM-506-05	Quality Construction, Inc.	2005	45	\$229,783.75	Highwall backfilling of surface mine and sinkhole filling
118.	Williams County Road 9	Williston	AM-520-06	Thiem Drilling, Inc.	2006	N/A	\$354,550 / bid	Pressurized grout remote backfilling along County Road 9, Williston
119.	Williams County Road 9	Williston	AM-522-06	Material Testing Services, LLC	2006	N/A	\$12,050 / bid	Material testing and engineering services at Williams County Road 9
120.	Beulah/Zap X	Zap	AM-521-06	Thiem Drilling, Inc.	2006	N/A	\$286,900 / bid	Pressurized grout remote backfilling along County Road 13, Zap
121.	Beulah/Zap X	Zap	AM-523-06	Geoserv, Inc.	2006	N/A	\$15,000 / bid	Material testing and engineering services at Beulah/Zap Phase X, Zap
122.	Columbus Phase VII	Columbus	AM-519-06	Quality Construction, Inc.	2006	20	\$259,800 / bid	Highwall backfilling of surface mine and sinkhole filling

This is an example of an internal database of AML Projects from 2002-2006. Note that the 2006 costs are bid costs. These will be corrected when the projects are actually completed

ND-000146-SGA JABLONSKY Last Update: 07/26/2005 by: BBEECHIE

Problem Area

Problems

Complete

Existing Problems

Options

P2 Subsidence

Add New Problem

Priority Documentation

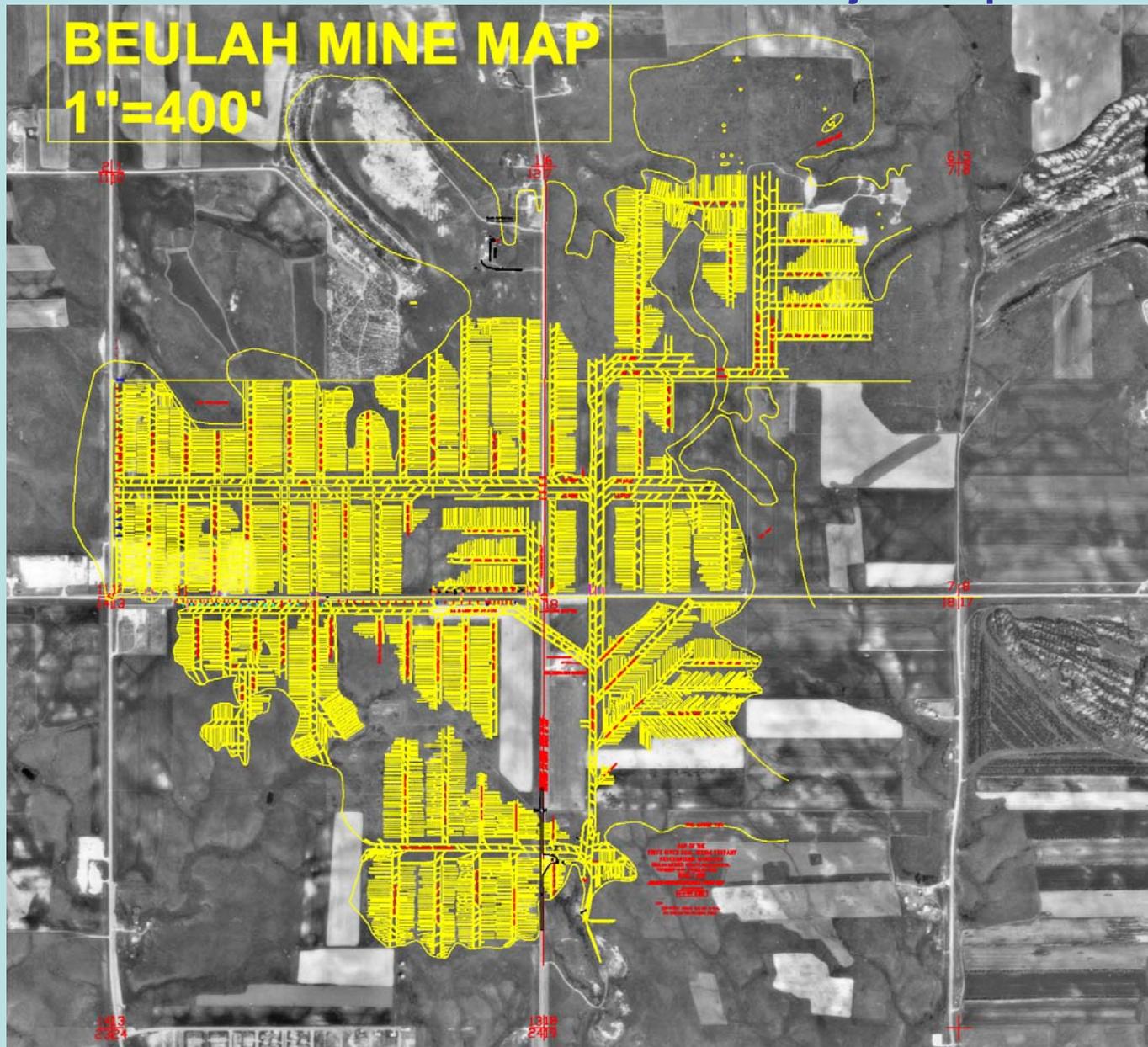
Priority 2 - Subsidence No Alternate Funding

<input checked="" type="radio"/> Cumulative <input type="radio"/> Changes	Enter New Values for:			
	English Units	Metric Units	Cost	GPRA Acres
Unfunded	3	1.21	5000	3
Funded	0	0	0	0
Completed	0	0	0	0
Total	3.0	1.21	5,000	3.0

Prior PAD
Next PAD
Delete Problem
Submit
Search
Print
Map

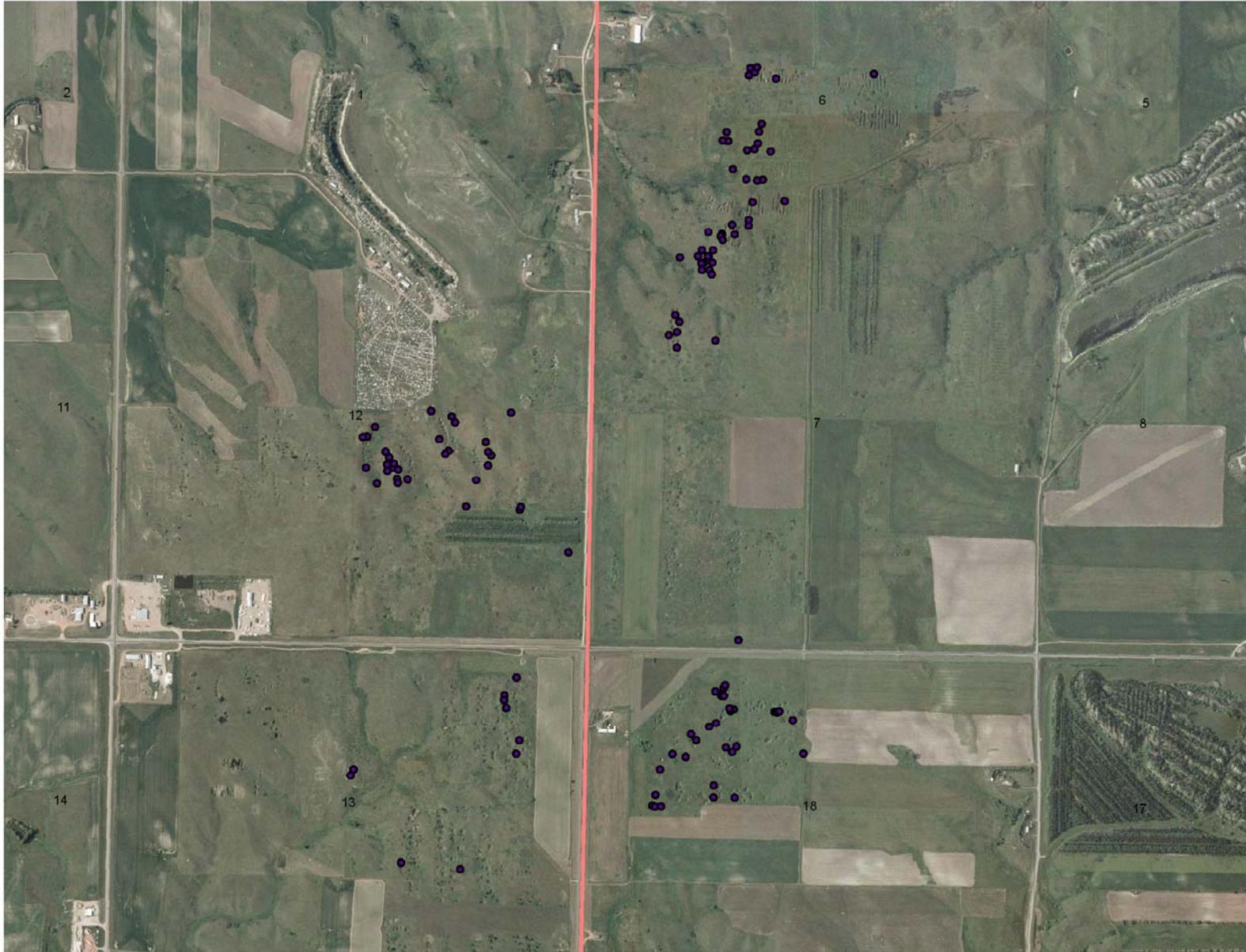
Exit

North Dakota AML Reclamation: Project Maps



This a project map for a portion of the Beulah/Zap Mine Area. The Knife River underground mine encompassed portions of six square miles but this is only one of approximately 50 mines within a 20 mile radius of Beulah and Zap. A tenth phase of a project series intended to address highest priority AML problems.

North Dakota AML Reclamation: GPS Data



The North Dakota Game & Fish Department reported approximately 120 sinkholes located on the North Beulah Mine WMA in October 2005. This report was sent via e-mail with an attached shapefile containing GPS coordinates. The coordinates were transposed to an aerial photo using ArcGIS.

North Dakota AML Reclamation: Field Verification



This is a photograph of one of the sinkholes that was reported. It was about 20'X15' with an average depth of 15' and a maximum depth of 27'. It was excavated and filled with dirt in a May 2006 AML project. Due to budgetary constraints, only the worst 15 of 120 sinkholes reported at this site were repaired.

North Dakota AML Reclamation: Mine Map and Inventory Database

Adobe Reader - [PSC VB.pdf]

File Edit View Document Tools Window Help

Save a Copy Search 83% Help Search Web Embed video and audio in Adobe PDF

Options x

Bookmarks

- Appendix III
 - Volume A
 - Volume B
 - McLean
 - Index 1
 - Index 2
 - Mercer
 - Index 1
 - Index 2
 - Index 3
 - Morton
 - Index 1
 - Index 2
 - Index 3
 - Mountrail
 - Index
 - Oliver
 - Index 1
 - Index 2
 - Volume C
 - Map Inventory
 - Missing Maps List

Pages

Attachments

Comments

McLEAN COUNTY

Planning Unit Number	AML Print-out Number	Legal Description*				Page
		T---N ₂	R---W ₂	Section ₂	Part-Section	
070	186	144	81	2	NW	1
070	188	144	81	10	S1/2	2
068	173	144	82	6	SW	3
068	174	144	82	6	SW	3
068	171	144	83	10	NE	6
068	170	144	83	11	NW	12
070	185	145	80	20	NW	15
070	187	145	80	20	E1/2	16
070	189	145	80	32		17
067	168	145	82	5	NW	18
068	181	145	83	36	N1/2	19
068	182	145	84	26	SW	20
068	183	145	84	35	NW	21
070	190	146	81	13	NW	26
067	164	146	81	18	SW	27
067	165	146	81	30	SE	34
067	161	146	82	12	NE, NW	38
067	162	146	82	13	SE	43
067	169	146	82	23	SE	46
067	615	146	62	26	NE	49
067	584	146	82	32	SW	50
067	167	146	82	34	SW, NE	53
067	163	146	82	35	NW, NW	54
064†	581	146	86	34		56
087	252	147	82	20	NE	57
087	592	147	82	27		58
087	593	147	84	27	SW	59
087	251	148	83	17	NW	60
087	594	148	83	18		60
087	595	148	83	19		74
087	250	148	84	7	SW	77
087	253	148	84	17	NW	78
087	249	148	84	18		81
087	596	148	84	30	ER	93
087	597	148	84	31	SC	96
086	258	148	85	30	NW	97
087	591	148	85	35	N1/2	100
086	255	148	86	16	E1/2	101
086	256	148	86	19	SW	103
086	257	149	85	12	NE	104
086	254	149	87	17	S1/2	107

*NOTE: Legal descriptions are "read" from right to left.
 †The legal description identified by this Planning Unit and AML printout number is situated in Mercer County, not McLean County. Information about this Planning Unit and AML printout number, however, is included with McLean County mine specific information.

5 of 487

start | Inboxes - Micro... | Underground Mi... | What Is GIS? - ... | 2006 OSM Prop... | Books | Microsoft Power... | PSC VB.pdf | 9:19 AM

The PSC contracted with Fireside Technology Group, Bismarck, ND, to scan available abandoned mine maps from state historical archives and the AML inventory of mine specific information. Maps were linked to the textual information and arranged by bookmarks. This is one of two indexes for McLean County.

North Dakota AML Reclamation: Mine Map and Inventory Database

Adobe Reader - [PSC VB.pdf]

File Edit View Document Tools Window Help

Save a Copy Search Select 83% Help Search Web Try Acrobat 7 Professional for free

Options X

Bookmarks

- Appendix III
 - Volume A
 - Volume B
 - McLean
 - Index 1
 - page 1
 - page 2
 - page 3
 - page 6
 - page 12
 - page 15
 - page 16
 - page 17
 - page 18
 - page 19
 - page 20
 - page 21
 - page 26
 - page 27
 - page 34
 - page 38
 - page 43
 - page 46
 - page 49
 - page 50
 - page 53
 - page 54
 - page 56
 - page 57
 - page 58
 - page 59
 - page 60
 - page 74
 - page 77
 - page 78
 - page 81
 - page 93
 - page 96

Signatures

Pages

Attachments

Comments

McLEAN COUNTY

Planning Unit 068: AML Printout #170: T144N, R83W, Section 11, NW

Additional Legal Location: None

Name: Pfister Coal Mine Owner: Fred Pfister (1916-1917)
No data (remaining years)

Category: Commercial/Local

Type: Underground, drift, single entry (1916-1917); Underground, drift (1923-1930); Underground, slope (1931-1935, 1940-1942, 1949); Strip (surface) (1945-1950)

Overburden:	Coal Seam:	Thickness Mined:	Source:
30 ft.	8 ft.	7 ft.	SEBR:1918
47 ft.	7 1/2 ft.	6 ft.	CHID:1926

Cultural Resource Site Numbers: Not formally recorded

Basic Data (excerpted from primary sources):

This mine is not listed as a new mine in 1916, and it may have been in operation prior to that time. The mine is reported continuously from 1916 through 1935, when it is listed as closed. A mine named the Pfister Coal Mine is reported as a new mine in 1940; but, it is not known if this mine is at the same location as the earlier Pfister Mine. This mine is reported in 1940, 1941, and 1942, when it is listed as not operating. The mine again is listed from 1945 through 1950; it is not listed as closed or not operating in 1950, and it is not known if the mine ceased operations about that time or if it continued to be operated but was not reported following 1950. It should be noted that Brant (1953) does mention a Pfister Mine in T144N, R83W, Section 11 (no part section provided), and indicates that this mine was a slope (underground) mine.

Descriptive information pertaining to this mine is included in:

[source:year(pages)]

CHID:1926 (33)	WCB Map:1921
SEBR:1918 (148-149)	WCB Map:1922

Notes:

It is not known if the Pfister Mine reported from 1916 through 1935 and the Pfister Mine reported from 1940 through 1950 were operated in the same portion of Section 11. Therefore, it is not known if

McLean-12

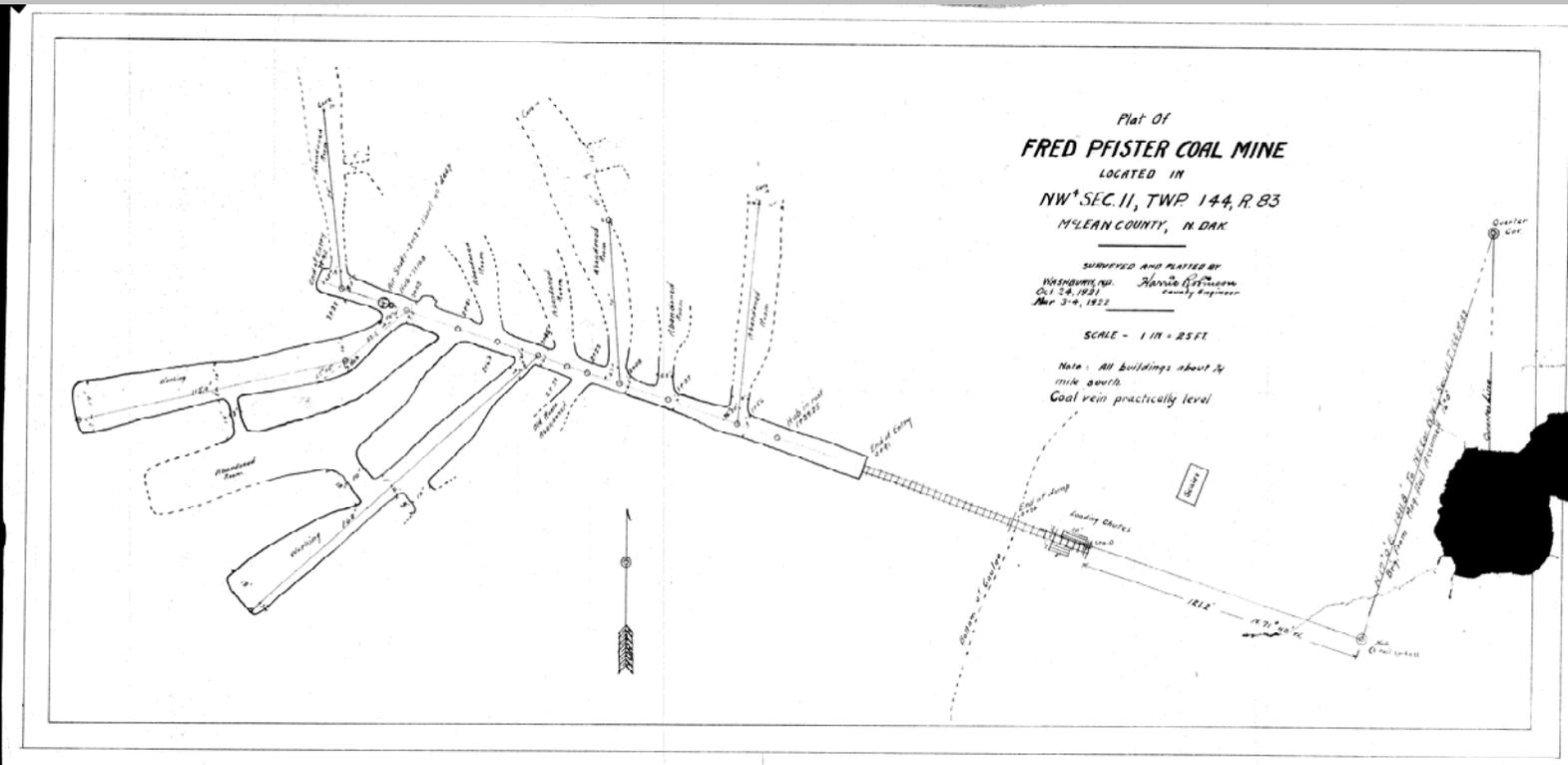
21 of 487

start 3 Windows EX... Microsoft Powe... Mercer_co - Arc... Inbox - Microso... Adobe Reader - ... Windows Print S... Document4 - Mi... 11:25 AM

This shows a specific text entry for the Pfister Coal Mine, located in Section 11, T144N, R83W, McLean County. It provides data on the type of mine, mine operator, overburden and coal thickness, production by year, and information sources including a reference for any available maps. Approximately 1500 pages of text were scanned into the database.

North Dakota AML Reclamation: Mine Map and Inventory Database

MCLAREN COUNTY
144 83 11 NW
144 83 11 NW E1/2 CENTER



By clicking on the map link on the text, the mine map for that entry can be retrieved. This is a 1922 map of the Pfister Mine. Approximately 420 mine maps were scanned into the database.

North Dakota AML Reclamation: Mine Map and Inventory Database – Future Plans

Underground Mine Mapping Project Proposal

Title of Project: *North Dakota Abandoned Mine Map and Information GIS Database*

Submitted to OSM: March 29,2006

- **Phase 1:** Scan or photograph all remaining maps (some were too large or fragile to be scanned initially) and mine inventory source materials, have all text encoded using OCR software to enable a database to be searchable by text. Estimated cost \$6000
- **Phase 2:** Georeference all mine maps using Arc and CAD software to rotate, scale and fit the mine maps to established reference points on base maps. Estimated cost \$32,000
- **Phase 3:** Assemble all data into a GIS Database that allows maps and data to be searched using the original database, text search or interactive map with some or all information available on the PSC website. Estimated cost \$44,000

Total Estimated Cost: \$82,000

This work is proposed to be conducted cooperatively by PSC employees and contract scanning and engineering firms between October 2006 and December 2008.

Potential Benefits

1. **A combined and consolidated database of available historic mine maps and information.**
2. **Will aid PSC staff in identifying, prioritizing and reclaiming hazardous abandoned mine features.**
3. **Will allow property owners, mining companies, realtors, public planners, researchers and others rapid access to locations, maps and data for abandoned coal mines in North Dakota.**